Using Design Patterns and Layers to Support the

Early-Stage Design and Prototyping of

Cross-Device User Interfaces

by

James Lin

B.S. (California Institute of Technology) 1997
M.S. (University of California, Berkeley) 2000

A dissertation submitted in partial satisfaction of the
requirements for the degree of

Doctor of Philosophy

in

Computer Science

in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA, BERKELEY

Committee in charge:
    Professor James Anthony Landay, Co-chair
    Professor John Canny, Co-chair
    Professor Jennifer Mankoff
    Professor Marti Hearst

Fall 2005

The dissertation of James Lin is approved:

_____

Co-chair   Date

_____

Co-chair   Date

_____

Date

_____

Date

University of California, Berkeley

Fall 2005

Using Design Patterns and Layers to Support the

Early-Stage Design and Prototyping of

Cross-Device User Interfaces

Copyright Fall 2005

by

James Lin

ABSTRACT

Using Design Patterns and Layers to Support the

Early-Stage Design and Prototyping of

Cross-Device User Interfaces

by

James Lin

Doctor of Philosophy in Computer Science

University of California, Berkeley

Professor James Anthony Landay, Co-chair

Professor John Canny, Co-chair

People often use a variety of computing devices, such as PCS, PDAS, and cell phones, to access the same information. The user interface to this information needs to be different for each device, due to the different input and output constraints of each device. Currently designers designing such cross-device user interfaces either have to design a UI separately for each device, which is time consuming, or use a program to automatically generate interfaces, which often result in interfaces that are awkward. Each method also discourages iterative design, considered critical for creating good user interfaces.

I have created a system called Damask to support the early-stage design of user interfaces targeted at multiple devices. Within Damask, designers use *layers* to specify which parts of a user interface is common across all devices and which are specific to one device. They use *design patterns* to specify higher-level concepts within a user interface. Design patterns in Damask include pre-built UI fragments that are already optimized for each device. Designers

can instantiate patterns in their designs and then customize the instances to fit their particular requirements.

Through a study performed with twelve professional web designers, we have found that, in the early stages of design, designers using patterns and layers in Damask create cross-device user interfaces that are as good as or better than those created without patterns and layers, in less time.

_____

Professor James Anthony Landay
Dissertation Committee Co-chair

_____

Professor John Canny
Dissertation Committee Co-chair

To my parents, Alice and Bob Lin

Table of Contents

List of Figures

List of Tables

Acknowledgments

No one, including me, could have written a dissertation like this without the help, support, and encouragement of a veritable army of colleagues, family, and friends.

First of all, thanks to all of those who participated in my interviews and usability studies (preserving anonymity prevents me for naming them personally): the nine user interface designers whom I interviewed at the beginning of this project, the six user interface designers who used HopiSketch, the seventeen user interface designers who used Damask, and the thirty-four user interface designers who *evaluated* the designs made with Damask by the previous group.

Thanks to the undergrads that worked with me on Damask: Wei (Michelle) Xue and Qing Li on the coding, and Madhu Prabaker on the evaluation. DENIM was an important predecessor to Damask, so I would also like to extend my thanks to the researchers who worked with Jason Hong, Mark Newman, and me on that project—Yang Li, Marc Ringuette, and Michael Thomsen—as well as the throngs of undergrads: Liane Beckman, Michael Bina, Lisa Chan, Eric Chung, Andrew Cuneo, Carol Hu, Peter Khooshabeh, John Brian Kirby, Jenny Lee, Robert Lee, William Lee, Boxin Li, Benson Limketkai, Nahush Mahajan, Michael Pow, Lifeng Shelley Shen, Quinn Solomon, Orna Tarshish, Eric Tse, and Juan Valencia.

The design patterns in the book *The Design of Sites* were a crucial part of Damask. Thanks to Doug van Duyne who, along with James Landay and Jason Hong, cataloged the patterns and wrote the book.

The PIMA and Hopi projects at IBM Watson Research Center scared me at first, because I thought I had been scooped. But once it was clear that hadn't quite happened, I realized what a great opportunity it would be to work with those researchers. Thanks to Lawrence

the Great Scott Troika, Scott Carter and Scott Lederer. It has been a privilege, and a lot of fun, working with all of you. I look forward to seeing you again at conferences, seminars, and reunions.

Of course, life at Berkeley wasn't just about GUIR. Andy Begel and David Oppenheimer joined me in wondering whether we would ever graduate from Berkeley—we made it! Rich Vuduc and Ben Horowitz accompanied me on all sorts of wacky adventures, like the Silicon Valley Tour (Classic, .com, and Redux Editions), Rail Around the Bay, and a tour of the Jelly Belly Factory. And I can't forget my fellow Caltech undergrad/Berkeley grad friends, including Vito Dai (who also went to my high school!), Frank Ling, Michael Ru, and Chinh Doan, my roommate for 7½ years.

Thanks to the members of my quals and dissertation committees, Jennifer Mankoff, Marti Hearst, John Canny, and Warren Sack, both for their research insights and in helping me navigate the Ph.D. process. My advisor, James Landay, was instrumental in shaping my research career. He showed me by example how to be a successful researcher, he was not afraid to challenge my half-baked ideas in private, but he always defended and promoted my research in public. Thank you very much.

And finally, thanks to Mom and Dad, who saw the potential of computers for me at an early age, and helped plant the crazy idea in my head to pursue a Ph.D. in the first place. I appreciate your love, support, and encouragement.

1 **Introduction**

"Using a computer" is no longer limited to using a personal computer. Interacting with a PC in a home or office is now augmented with a variety of devices, such as handheld personal digital assistants (PDAs), mobile phones, pagers, and even telematics systems in cars. Companies as varied as Amazon [1], the BBC [28], and Yahoo [32] are starting to allow their customers to access their services through such a variety of devices. For example, you can find out which theaters are playing a particular movie and at what time through a voice-based phone interface, a PDA web site, or a desktop web site. However, due to the attributes and limitations of each device, the interfaces across devices are often drastically different. This makes the task of designing a user interface (UI) for a service that targets several devices difficult, because you essentially need a distinct UI for each device.

If UI designers want to target several devices for an application, they generally face two alternatives. One option is to design a user interface for each targeted device. This process results in interfaces that are optimized for each device, but it has several drawbacks. Designing several user interfaces is very time consuming, and the more devices the designer targets, the more time and effort the designer must spend. It is also hard for designers to keep the designs coordinated across devices. A designer could add a feature to one device-specific UI, and then easily forget to at least

investigate the possibility of adding that feature to another device-specific UI. Also, a different person often designs each device-specific UI, exacerbating this problem.

The other option is to design an interface for only one device and let special-purpose programs automatically generate the interfaces for other devices. This cuts down development time but leads to interfaces that are awkward to use. Consequently, they are only used as a last resort by end-users who have no other way to access the information or perform the task provided by that UI.

The difficulty of designing for multiple devices discourages designers from iteratively refining and prototyping their designs. One of the best ways to create a good user interface is to continually design, test, and analyze a user interface idea [60, 103]. If creating a design in the first place is difficult, designers will not want to try multiple designs or drastically change their initial design, which may impact the quality of the final design. Tools that make early-stage design, prototyping, and testing of cross-device user interfaces easier could dramatically improve the usability and usefulness of those interfaces.

There is a way that allows designers to design and prototype cross-device UIs that are appropriate for each device, yet takes much less time than designing each design-specific UI separately. Specifically, my thesis is:

> **A tool that uses design patterns to bridge the gap between device-specific UIs will enable designers to create cross-device UIs with at least the same functionality as if the designer designed each device-specific UI separately, but in less time.**

To show this, we have created a tool called Damask aimed at designers who want to design and prototype a UI targeted at three types of interfaces: the web accessed through a desktop, mobile phone displays, and prompt-and-response style voice

interfaces (see Figure 1-1). We have picked these three because they represent the "extremes" of the range of devices that are widely used. For example, simply shrinking a screen designed for a desktop PC will not result in a good mobile phone interface.
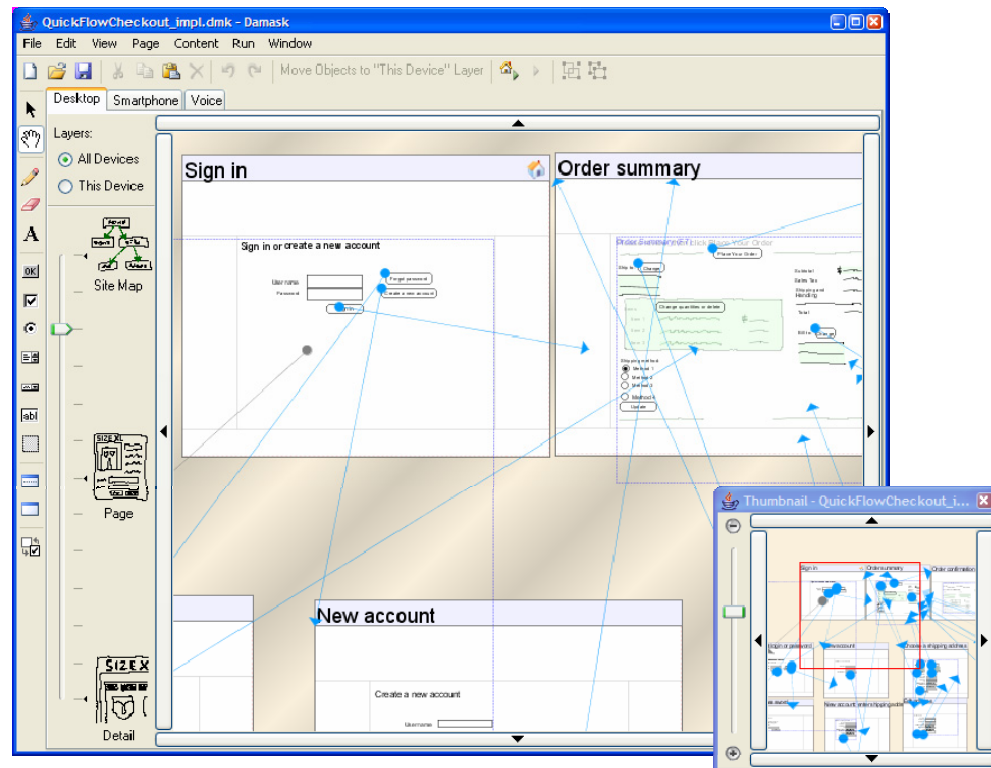
FIGURE 1-1   Damask's user interface

With Damask, the designer designs a user interface for one device, by sketching the design and by specifying which *design patterns* [4, 188] the interface uses. As the designer sketches an interface, Damask constructs an *abstract model* [49], which captures aspects of the UI design at a high level of abstraction. Damask uses the abstract model and the patterns to generate the other device-specific interfaces in real time, which the designer can refine if he or she wishes. The generated interfaces are good enough so that it is more convenient to use the tool than to design each of the other interfaces separately.

Damask also provides a Run mode in which designers interact with their design sketches in a browser that roughly simulates the devices they are targeting. This allows designers to get quick feedback about their design from other team members or even their target users, which will inform any modifications they want to make to their design.

1.1 Creating Cross-device Interfaces

Here is an example of a designer using Damask to design a UI, for example, an e-commerce web site for the PC, mobile phone, and voice. The designer decides to first target the PC, so he sketches out some web pages for the PC version of the web site in the main canvas area of Damask. As he is sketching his site, Damask creates mobile phone and voice versions of the site. Figure 1-2 shows one such page, along with the smartphone and voice versions.
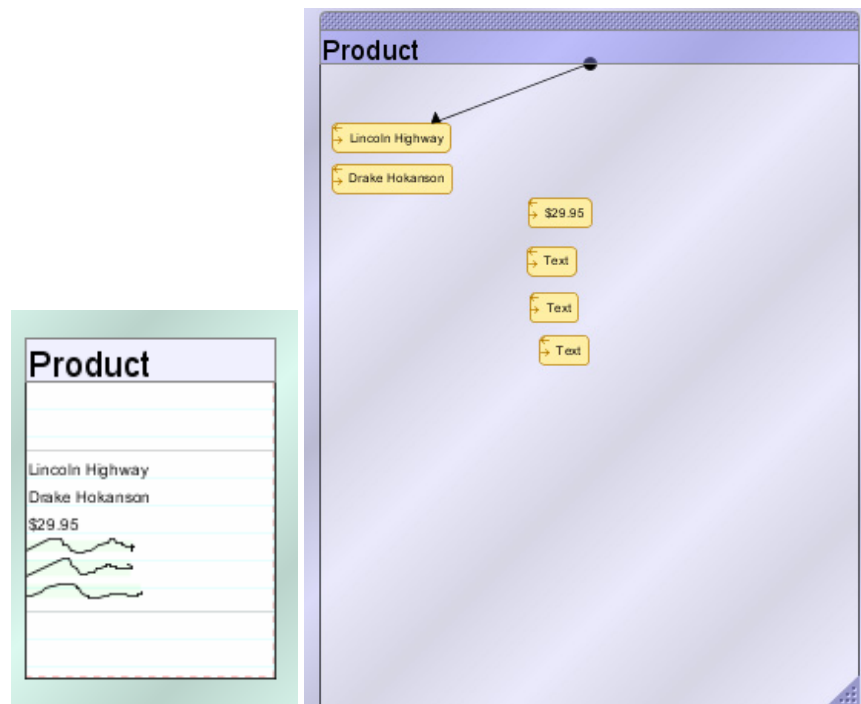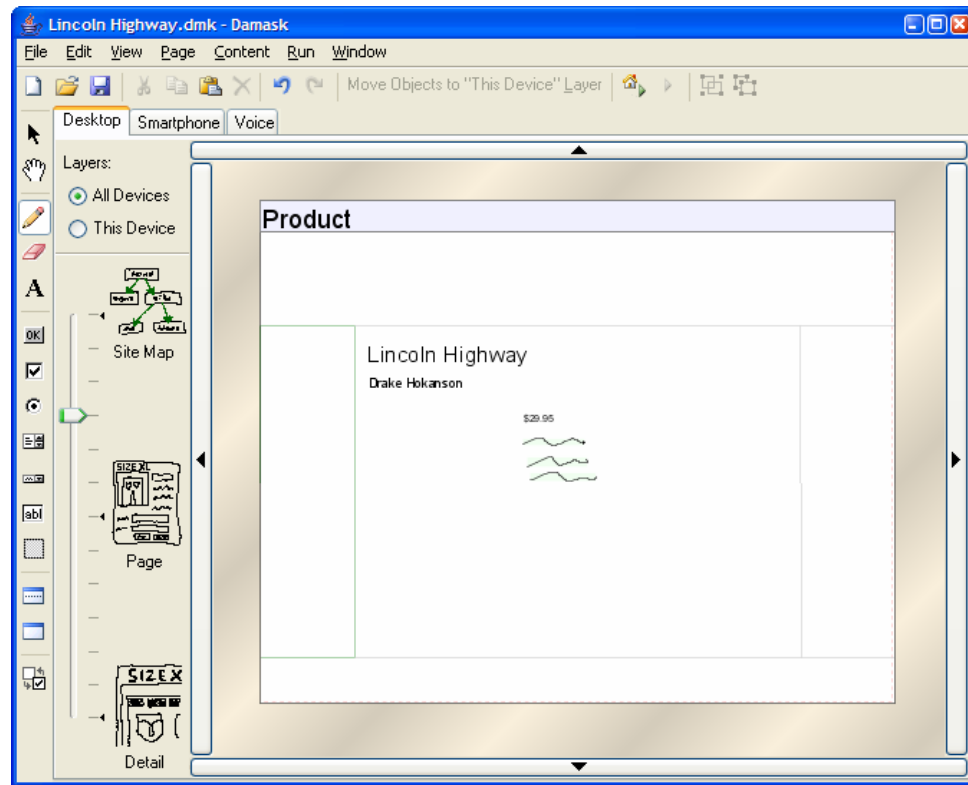
FIGURE 1-2 *Top* A desktop web page sketched by a designer in Damask. *Bottom* The smartphone (left) and voice (right) versions of that page generated by Damask.

When the designer creates, edits, or deletes an object in the *Desktop* view, the same action is performed in the *Smartphone* and *Voice* views. However, moving or resizing an object in one view does not affect the other views, since the displays of mobile phones are so limited that the designer would most likely have to move the object again.

While he is sketching, he knows that he does not want the product image and the "Related Products" section of the desktop page to also be in the other two versions. So he switches from the *All Devices* layer to the *This Device* layer, and then sketches those items (see Figure 1-3).
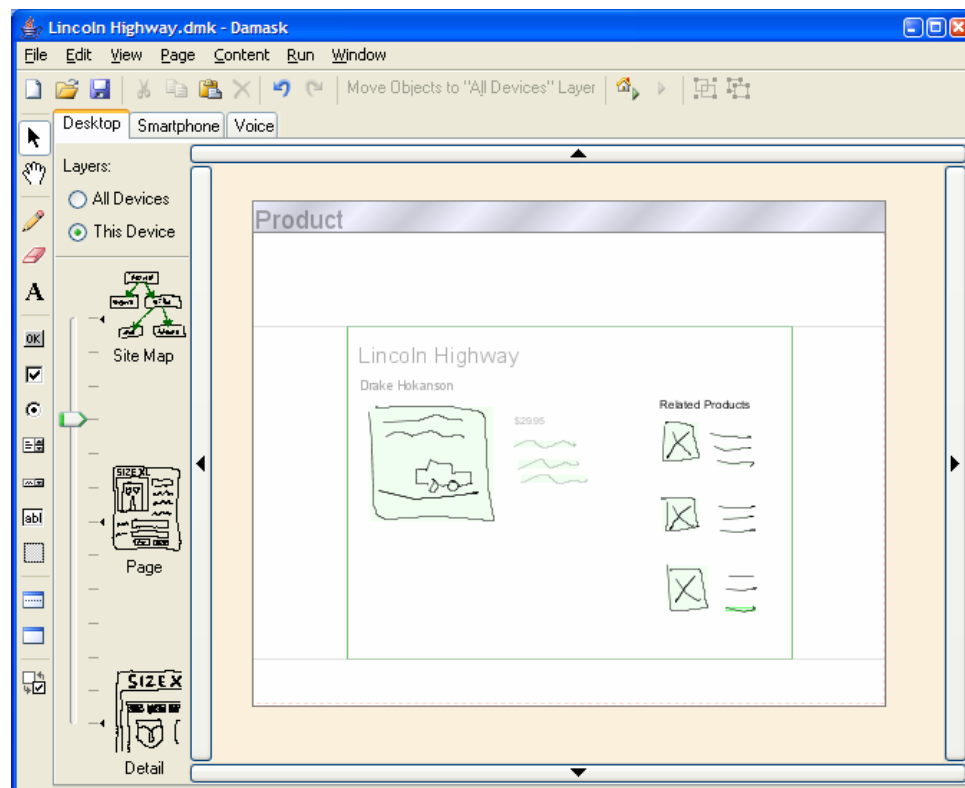
FIGURE 1-3   Adding objects to the *This Device* layer in Desktop view, which does not affect the Smartphone and Voice views. The objects previously drawn in the *All Devices* layer are grayed out, since the *This Device* layer is the current layer.

The designer also goes to the *Voice* view, switches to the *This Device* layer, and adds connecting phrases between the disconnected bits of text to make a smooth sentence. He also changes the prompts labeled "Text," which were generated from the squiggly lines he drew in *Desktop* view, into actual text (see Figure 1-4). This allows the designer to create an interface that is tailored to voice while still synchronized with the other devices. For example, if the designer changed the name of the product in *Smartphone* view, it would also be changed in *Voice* view.
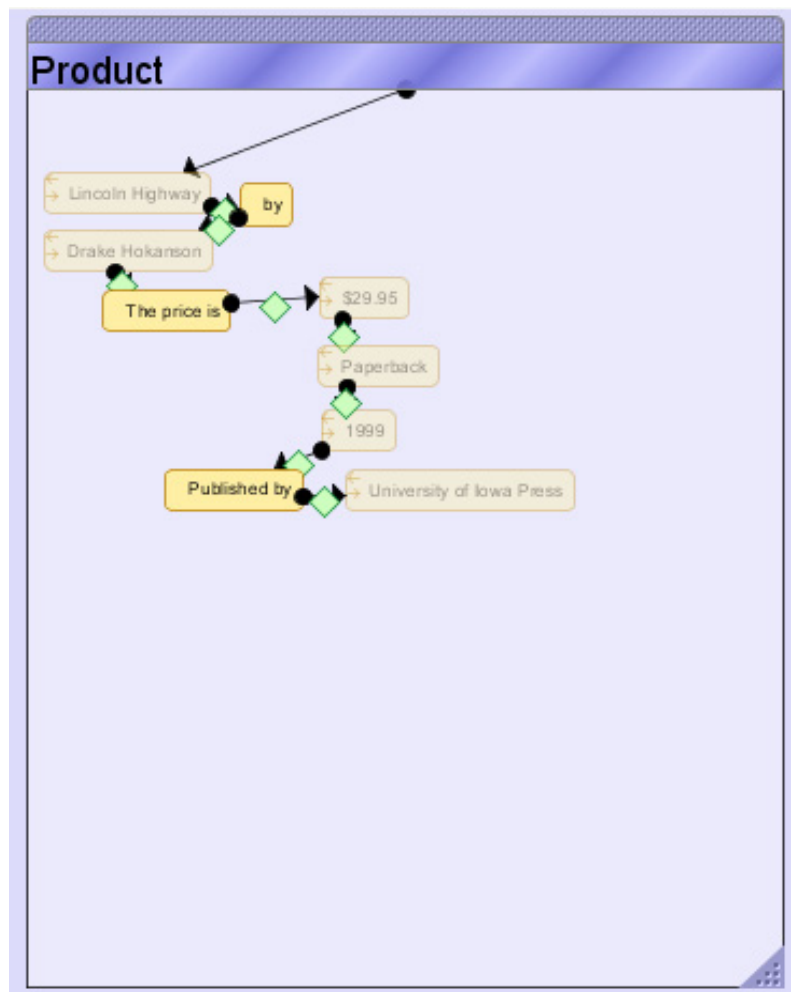
FIGURE 1-4   Smoothing out the voice interface.

Later, the designer decides to add a shopping cart to the site. Instead of sketching it out from scratch, the designer takes advantage of the patterns built into Damask. He brings up the Pattern Explorer to browse through the patterns, and comes across the SHOPPING CART pattern (see Figure 1-5).
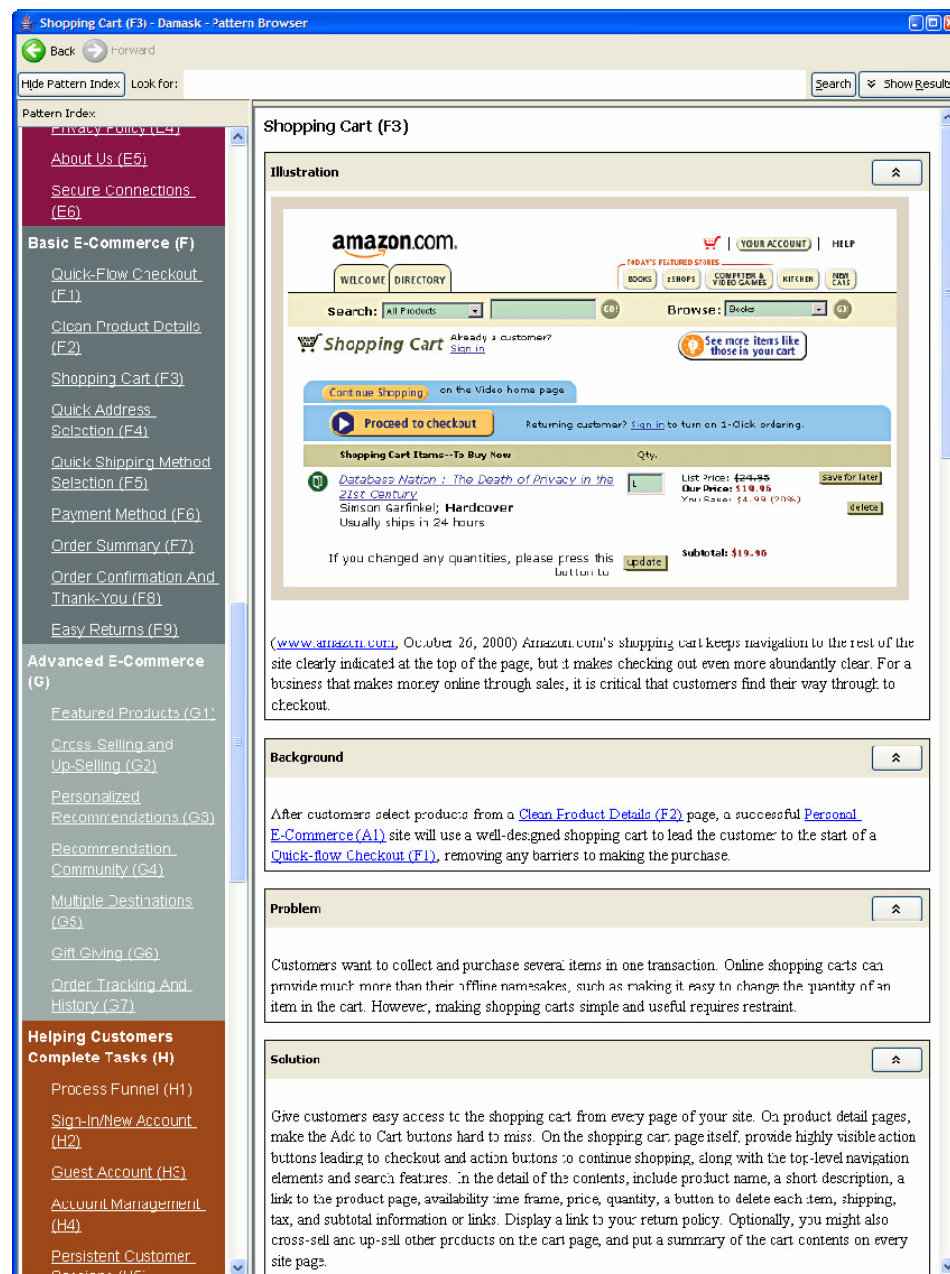
FIGURE 1-5   The Pattern Explorer with the SHOPPING CART pattern selected.

He sees that there are three generalized solutions for SHOPPING CART—for desktop, smartphone, and voice (see Figure 1-6).
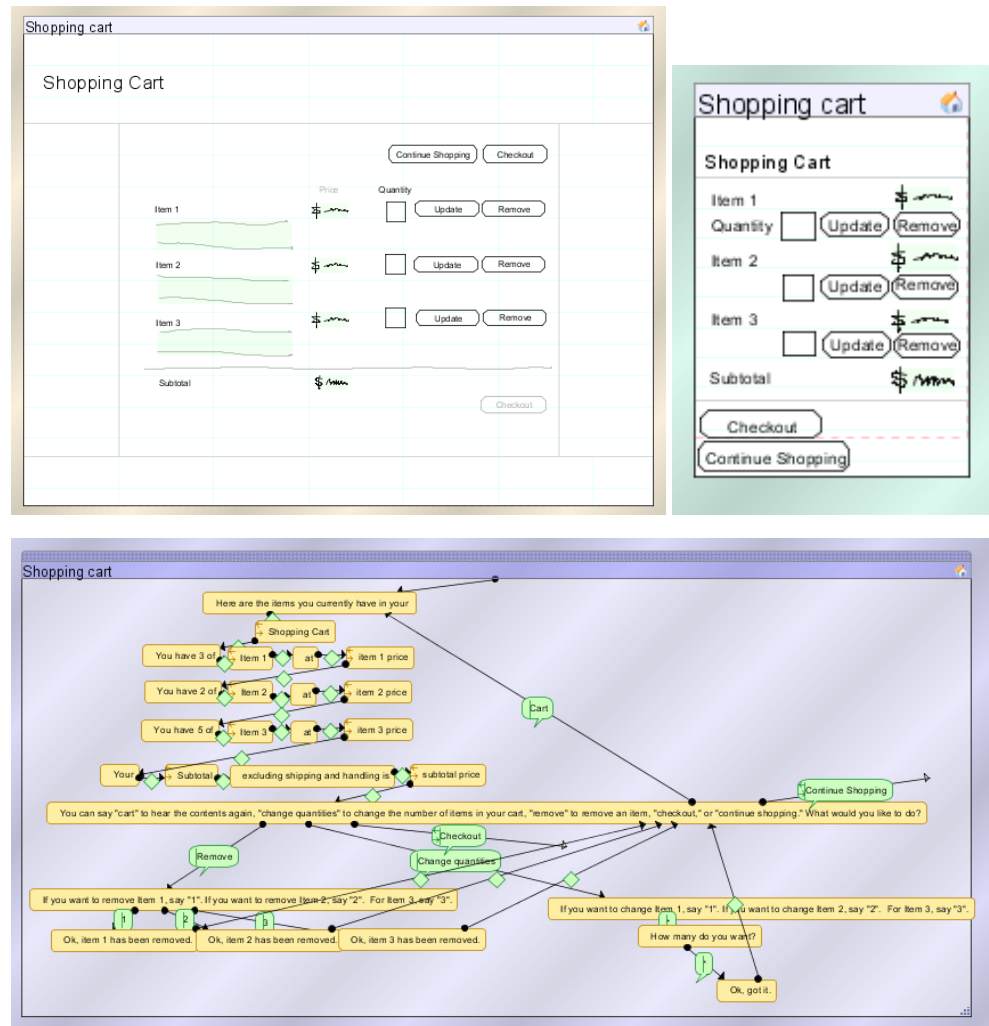
FIGURE 1-6   The generalized solutions for SHOPPING CART. *Top* The desktop and smartphone versions. *Bottom* The voice version.

The designer drags the solution of the SHOPPING CART into the canvas. This adds an *instance* of the pattern to the desktop, mobile phone, and voice versions of the designer's design (see Figure 1-7). The instance is surrounded by a light blue dotted box and the name of the instance's pattern.
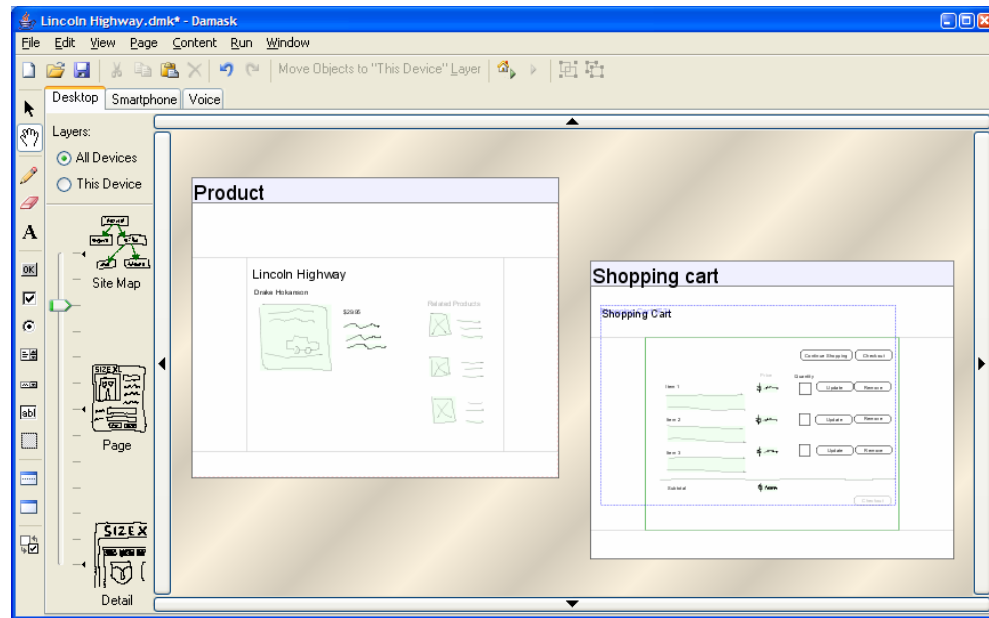
FIGURE 1-7   The shopping cart added to the main design.

The pattern that the designer has just instantiated is very generic, for example, having mostly text placeholders instead of actual text. The designer now customizes the pattern instance to fit his own project. He replaces the text placeholders with actual text, moves widgets around, and adds his own images. He could even add pages and arrows if he decides that is appropriate (see Figure 1-8).
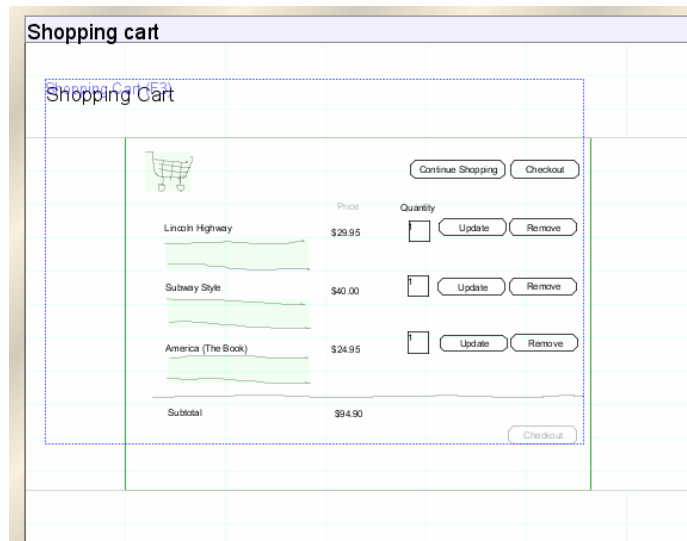
FIGURE 1-8 The desktop version of the shopping cart, with the contents, prices, and quantities changed by the designer.

As the designer edits the pattern instance, Damask applies some of the edits to the designs for the other devices, according the same rules as when the designer edited his own design: adding, removing, and editing an object in the All Devices layer apply across all devices, while moving and resizing it do not (see Figure 1-9).
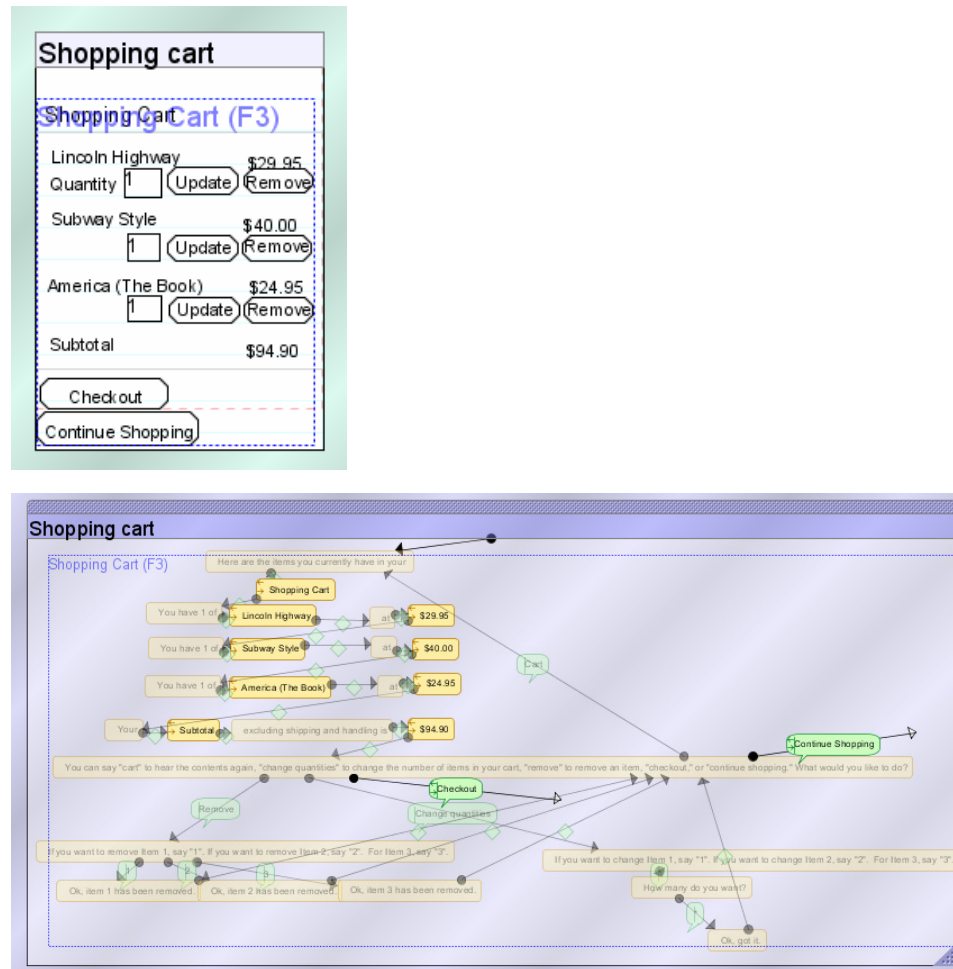
FIGURE 1-9   The smartphone (top) and voice (bottom) versions of the shopping cart, customized by Damask. Note that the contents of the cart have changed.

The designer now adds an Add to Cart button to the Product page in Desktop view and links the button to the Shopping Cart page. This creates and links a button in the Smartphone view (see Figure 1-10).
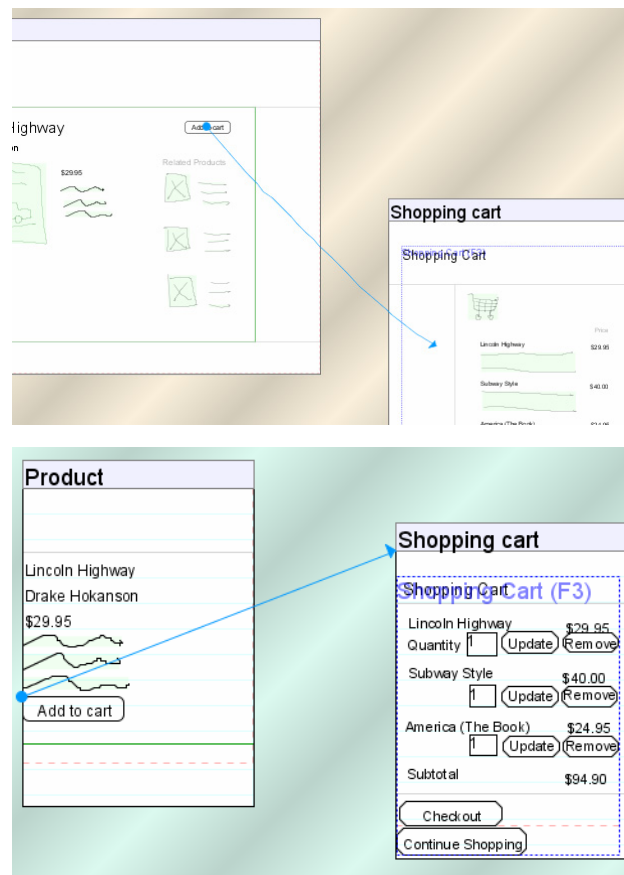
FIGURE 1-10 *Top* A designer adding an "Add to Cart" button with a link to the "Shopping Cart" page in *Desktop* view. *Bottom* An "Add to Cart" button linked to the Shopping Cart page in *Smartphone* view that was automatically created by Damask.

This also results in a voice response labeled "Add to Cart" in the *Voice* view, pointing to the first prompt in the "Shopping Cart" form. The response represents the end-user saying "Add to Cart," which results in the "Shopping Cart" form being read to the user. However, the source of the response is not quite right; as designed, the voice interface will pause after saying "University of Iowa Press," waiting for the user to say, "Add to Cart" (see Figure 1-11).
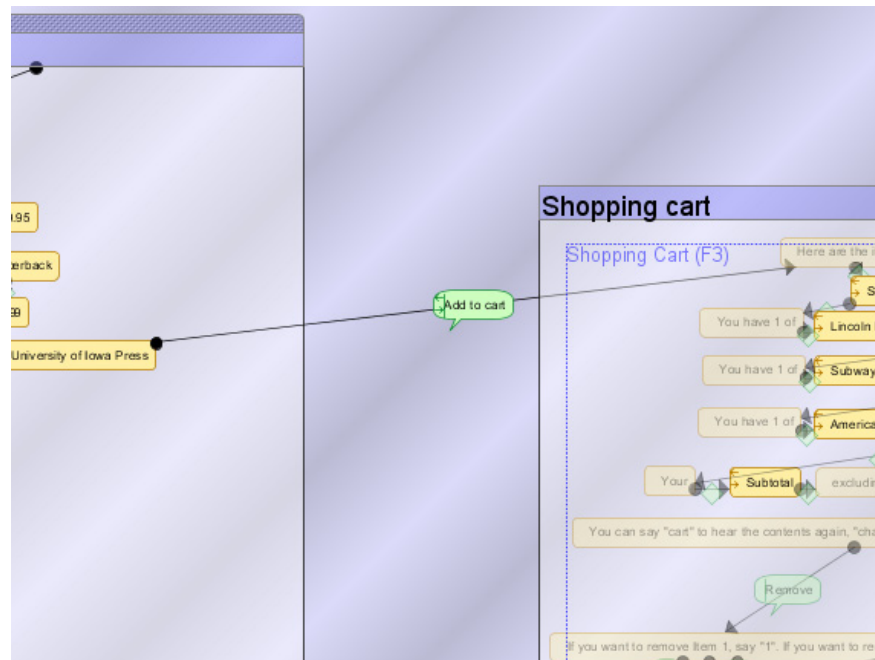
FIGURE 1-11   An Add to Cart response linked to the Shopping Cart form that was automatically created by Damask.

To fix this, the designer adds a prompt in the This Device layer that says, "What would you like to do now?" A better prompt would include what choices the user could make at this stage, but since the designer has not yet decided what the choices will be, he decides this is good enough for now, and will refine it later. Then the designer re-anchors the response so that it originates from the new prompt (see Figure 1-12).
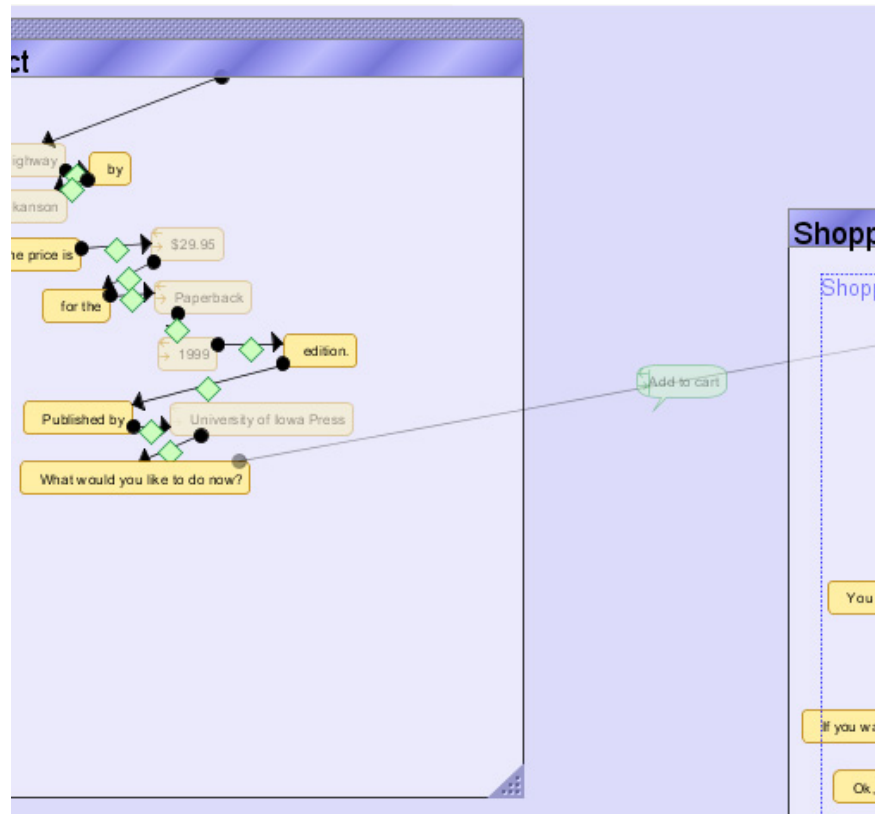
FIGURE 1-12 The Add to Cart response after it was fixed up by the designer.

1.2 Dissertation Contributions

This dissertation makes the following research contributions:

- An understanding of current work practices for cross-device user interface design, achieved through field interviews and surveys

- The novel application of the following techniques to cross-device user interface design:

    1 *Design patterns* allow designers to describe their designs at a high level of abstraction and, by capturing interaction semantics, make it easier for a design tool to create interfaces appropriate for different devices.

  2 *Layers* can provide a clean conceptual model for designers to keep track of
     which UI elements are consistent across devices and which are device-specific.

- A data model to represent cross-device UIs that incorporates design patterns and
  layers and links corresponding elements across devices

- A user interface design tool called Damask that improves the design of cross-
  device UIs by implementing the above concepts

- An understanding of how cross-device user interface design is influenced by
  design patterns and layers, achieved through laboratory studies

Damask uses concepts from the areas of design patterns and model-based user
interfaces, which we describe in more detail below.

1.3 Design Patterns

Patterns were first introduced by Christopher Alexander and his colleagues in the
field of architecture. He states, "Each pattern describes a problem which occurs over
and over again in our environment, and then describes the core of the solution to that
problem, in such a way that you can use this solution a million times over, without
ever doing it the same way twice." [4] This basic definition has become popular in the
software engineering (e.g., [56]) and human-computer interaction (HCI) fields [27, 182,
188, 189].

We believe that there are patterns in user interfaces for multiple devices, and that
the structure of these pattern solutions can be dramatically different, depending on
the devices' characteristics. For example, the desktop version of an ADD TO SHOPPING
CART pattern could show the new contents of the shopping cart or show other
products that the shopper is interested in. On the other hand, the voice version of the

pattern could simply say, "ok, it has been added," to avoid overwhelming the shopper with information.

Since patterns describe interactions at a higher level than widgets, a tool that supports patterns can generate device-specific interfaces that are better optimized than a simple widget-by-widget transformation that many research systems do today. Also, simply documenting these patterns may help designers think more clearly about uis on multiple devices, since they could see how the interfaces relate to each other using patterns as a vocabulary.

1.4 Model-Based User Interfaces

Damask's underlying representation of ui designs and patterns is based on the concept of *model-based user interfaces* [178]. Model-based ui research has been going on for about two decades, and its basic premise is the idea of designing user interfaces based not just on visual appearance but also on an abstract model of the interface. The model describes the interface at a higher level of abstraction than the actual widgets. For example, instead of describing a dialog box as having three radio buttons and two check boxes, an abstract model would describe it has having one part where the user can select one of three items, and two other on-off selections. This level of abstraction allows the possibility of rendering the user interface in other ways, such as using a drop-down list or presenting a voice menu instead of radio buttons. Using patterns for describing interfaces further increases the level of abstraction and allows even bigger differences in interfaces across devices.

While model-based user interfaces have the promise of creating flexible interfaces that can adapt to their environment, they have not been widely adopted in the commercial software development world, which has instead gravitated towards visual

interface builders. We believe one reason for the lack of acceptance is the fact that many model-based UI tools do not match or augment the work practices of designers. They often force designers to think at a high level of abstraction too early in the design process. Designers are accustomed to thinking about concrete interfaces at the beginning of this process. In addition, specifying models often requires the designer to deal with preconditions, postconditions, and conditionals, which starts to look like programming. Most designers are not skilled at programming, so specifying models impedes their main task of designing UIs.

Damask's approach allows UI designers to specify their designs at a more abstract level, i.e., create an abstract model for the interface, but with a vocabulary that designers understand, via sketches and design patterns. Design patterns also enable Damask to generate interfaces that are more appropriate for the targeted device.

1.5 Outline

The rest of the dissertation is organized as follows. We describe our interviews with cross-device UI designers in Chapter 2 and our experience with an early prototype of a cross-device UI tool in Chapter 3. In Chapter 4, we describe the user interface of Damask, including how a designer will use it to design cross-device interfaces, and we describe how we implemented Damask in Chapter 5. The evaluation of Damask and its results are in Chapter 6. In Chapter 7, we first discuss two of the main concepts that Damask embodies, design patterns and model-based user interfaces, and related work in more detail. We discuss future work in Chapter 8, and conclude in Chapter 9.

2 Study of Current Practices in Cross-Device UI Design

To get a better understanding of how designers currently design cross-device UIs, we interviewed nine UI designers across eight companies who worked on cross-device UI projects. The seven men and two women were recruited through electronic mailing lists for UI designers. We interviewed six of the designers in their offices, two over the phone, and one by e-mail. All of these projects targeted desktop PCs and mobile phones, and all but one also targeted PDAs. None of them targeted voice. Table 2.1 lists the type of companies for which our participants worked and the devices for which they designed.

TABLE 2.1   The participants for our study, their companies, and the platforms they designed for.

Designer	Type of company	Desktop	Palm	Pocket PC	WAP phone	Hi-end phone
A1	Web portal	✓	✓	✓	✓	
A2	Enterprise software	✓	✓	✓	✓	
A3	Mobile access to corporate data	✓	✓	✓	✓	
A4	Corporate portal	✓		✓	✓	
A5	UI design firm	✓	✓	✓	✓	
A6		✓	✓	✓	✓	
A7	Startup incubator	✓		✓		✓
A8	Mobile phone carrier					
A9	Mobile phone carrier	✓	✓		✓	

We focused our questions on how the designers addressed the issue of handling multiple devices (see Appendix A). We wanted to know whether their companies grouped designers by device (e.g., PDA vs. phone designers) or by application (e.g., e-mail vs. calendar). We asked how they maintained consistency across designs, whether the desktop and mobile versions were developed at the same time, whether the same team worked on both versions, and if not, whether the two teams discussed their designs with each other. We also asked them whether they observed recurring interaction design patterns [188] in their designs and whether they documented them.

Finally, we discussed our ideas for a cross-device UI design tool and asked them for their reactions and to speculate on how useful such a tool would be. While it is hard for someone to predict how they would use a tool, the questions were designed to learn more about the designers' concerns about such a tool, not to learn about specific features.

We will discuss our findings along the following themes: responsibilities of the designers; scope of cross-device projects; organization of project teams; managing UI consistency; tools and documentation, and patterns; and the need for real-time change across devices.

2.1 Roles and Responsibilities of the Designers

All of the designers were responsible for overall information and interaction design, and some also handled graphic design [140]. None of them were developers. Seven of the designers did detailed UI design work. The others, Designers A2 and A9, guided the people doing the detailed design work and made sure they followed good usability principles and adhered to the companies' mobile UI style guides. Table 2.2 lists the participants along with their job roles, educational background, and design experience.

TABLE 2.2 The job role, educational background, and design experience of our participants.

Designer	Job role	Educational background	Years of UI design experience
A1	UI designer	BFA Industrial design	6
A2	Usability engineer	PhD Human factors	3
A3	UI designer	BS Kinesiology	4
A4	Info. architect/ UI designer	BS Cognitive science	4
A5	Senior info. designer	BS Graphic design	>5
A6	Human sciences director/senior interaction designer	BS Computer science	>5
A7	VP R&D	PhD HCI	>5
A8	HCI team member	BS Physics	1½
A9	User experience design manager	BA English and fine arts	6

2.2 Scope of Cross-Device Projects

For most of the cross-device projects, the mobile UI offered a subset of the desktop UI's functionality. For Designers A5 and A6, mobile access and desktop access were thought of as two aspects of their projects as a whole; neither was considered a subset or superset of the other. Designer A9's projects were focused on phone interaction; the desktop was used mostly for managing aspects of the mobile experience, like storing pictures that the user took with the phone's digital camera.

2.3 Organization of Project Teams

At all but one of the companies, there were at most three UI designers in charge of the UI design for a project. At the UI design firm, a project typically had two to six designers.

For six of the designers, the cross-device projects were targeted at multiple devices from the beginning. The designers worked on both the desktop and mobile versions at the same time.

Designers A1, A2, and A4 only worked on the mobile UIs. These applications were originally written for the desktop and were later ported to mobile devices. These designers did not consult the desktop UI designers or their design documents; they simply looked at the desktop UI directly.

When asked how the tool should support multiple designers, the designers did not suggest any elaborate features. Designer A9 said that he never saw other designers actually use collaboration features in other tools and stressed that the overall learning curve of a new tool has to be low for a designer to consider using it.

We were particularly interested in finding out how a team of designers typically split up responsibility for designing a cross-device UI project. There are several possibilities:

1 *Device added later:* A UI for a device is designed long after the UI for another device is done

2 *Group by feature:* One designer designs a large part of the UI for all devices, at the same time other designers work on other parts of the UI

3 *Group by device:* One designer designs the UI for only one device, at the same time other designers work on other devices

The process makes a big impact on the design of a cross-device design tool. For example, Process 3 is not a good fit for a tool that takes a UI designed by a designer, and presents a generated UI for another device to that same designer.

We found that Processes 1 and 2 were the most common. Only Designer A2 said that they followed Process 3, which was a mistake, because he and his colleagues had

trouble maintaining consistency among the various device-specific UIs. For example, one application would say "e-mail" and another would say "message." Consequently, they switched to Process 2 for their next revision.

2.4 Managing UI Consistency Across Devices

All of the designers said that maintaining consistency across devices was a major issue. While the interaction obviously cannot be the same across all devices, the designers said that parts of the UI should be, such as menu order, terminology, colors and graphics. Designer A2 said that it was easier to keep device-specific UIs consistent if designers grouped themselves by application rather than device, as mentioned above.

The most common way that the designers achieved consistency was simply to check their designs manually to make sure they were being consistent, which was tedious. They did not have any specialized tools for this purpose.

Designers A5 and A6 typically created an information architecture diagram first, and then designed the user interface off of that. Making sure their UI designs were consistent with the information architecture typically kept the designs consistent with each other.

2.5 Tools, Documentation, and Patterns

The tools that the designers used were similar to those used by other web and interaction designers. The most commonly mentioned tool was Microsoft Visio [122], which was used not only for conceptual diagramming, but also for laying out mobile phone UIs. Other tools included paper, whiteboards, Adobe Illustrator [2], and Microsoft FrontPage [121]. None of the designers used computer tools specialized for handling multiple devices.

Three companies (A1, A2, and A9) developed style guides for mobile UIs. Since Designer A2's company also makes software development tools, the company's long-term goal is to incorporate the style guide standards directly into a development tool for mobile UIs.

Designer A2 and his co-workers also tried to tackle the cross-device UI design problem by developing their own cross-device application flow language. However, they found it hard to design a language that could encompass both high-level application flow and device-specific interaction. They eventually abandoned the project due to lack of time and manpower.

All of the designers said they observed recurring interaction design patterns in their work. Designers A1, A2 and A9 documented their patterns, incorporating them into their companies' mobile UI style guides. The others did not document their patterns because they did not have enough time or did not think they were useful enough to document.

When we told the designers about our idea of making design patterns a cornerstone of a cross-device design tool, all but one of the designers were enthusiastic; Designer A8 was not sure whether designers would be able to recognize patterns in their work often enough to be useful. The designers also thought that enabling designers to create their own patterns and add them to the tool's pattern library was very important, and many thought it was crucial.

2.6 Need for Synchronized Changes Across Devices

The designers' reactions varied on whether it was important to see the mobile phone UI change while they edited the desktop UI, and vice versa. Four of the designers did not think it was important; they were concerned that the transformation process

simply would not be good enough to warrant real-time change. Two designers would like to have the option. The others did not know.

2.7 Implications for Cross-Device UI Design Tools

From the above findings, we came up with the following implications for cross-device UI design tools.

Presenting retargeting results for one designer is useful. All of the designers designed the user interface for several features across multiple devices (as opposed to working on a particular set of features for only one device). Therefore, a tool that takes a designer's UI for one device and presents that designer with UIs for other devices fits within current design practices.

Support for synchronous collaboration is not a high priority. According to our interviewees, explicit support for multiple designers in a tool is not a high priority, since detailed design work for a particular feature is usually done by one designer.

Designers need help maintaining consistency of content across devices. Consistency was identified as a major burden of cross-device designers. The challenge is to keep the appropriate content consistent across devices, while letting the layout and navigation flow between screens change to fit the target device.

Support for design patterns. Using design patterns as the foundation of a cross-device UI design tool is a sound idea, but allowing designers to create their own patterns is essential for the long-term usefulness of this feature.

3 Prototype of Cross-Device Design Tool

While our interviews allowed us to discover general aspects of the design process that we needed to support, we wanted to get more detailed feedback about how an early-stage cross-device design tool should behave and what features it should have. It is hard for people to speculate about what such a tool should be like without interacting with one. Since there are no early-stage cross-design tools, we quickly designed and evaluated a prototype of one. The prototype, called *HopiSketch*, was built using DENIM [105] for the user interface and Hopi [17] for the retargeting process. Due to time constraints, this was done before the interviews in the previous section were completed; consequently, we were not able to incorporate all of the findings of those interviews into HopiSketch.

3.1 User Interface

We decided to use a sketch-based interface for the user interface of HopiSketch because designers usually sketch on paper during the early stages of design [140]. The user interface is based on DENIM, an existing sketch-based tool for early-stage web

design.

DENIM has one window (see Figure 3-1) with three main areas. The center area is a canvas where the designer creates web pages, sketches the contents of those pages, and draws arrows between pages to demonstrate the behavior of hyperlinks (see Figure 3-2). On the left is a slider that is used to set the current zoom level. The bottom area is a toolbox that holds tools for drawing, panning, erasing, and creating and inserting reusable components.
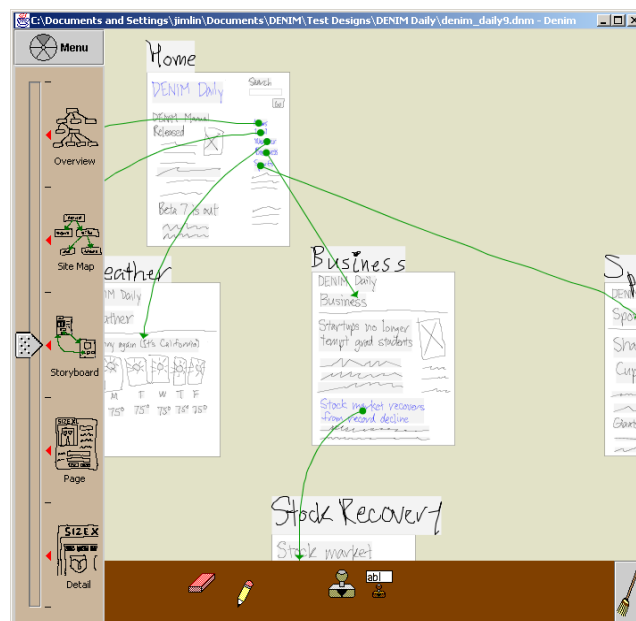
FIGURE 3-1   DENIM showing a typical design.
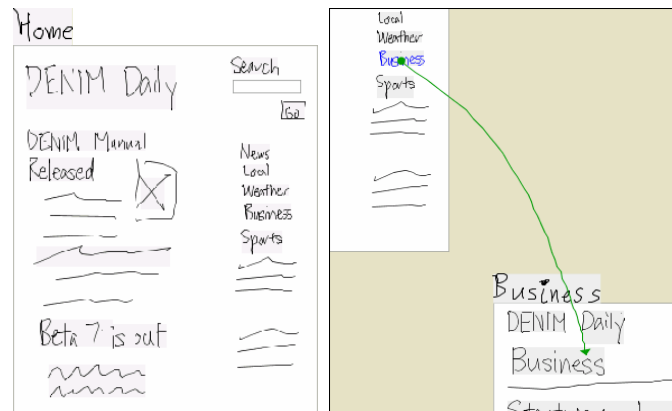
FIGURE 3-2 a) A page with the label "Home" b) An arrow, whose source is a blue hyperlink, "Business."

Designers test the interaction of their designs in Run mode. Opening a pie menu over a page and selecting File→Run launches a separate browser window with the page loaded. The designer can navigate through the site design exactly like in a web browser, clicking on hyperlinks and using the Back and Forward buttons.

To create HopiSketch, we augmented DENIM to allow designers to insert radio
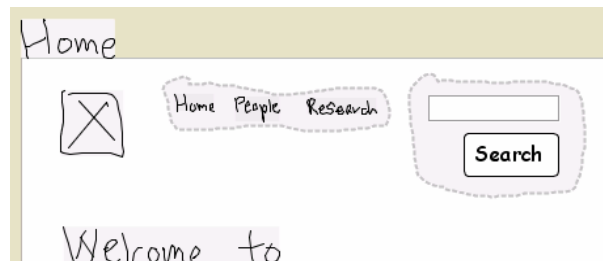
FIGURE 3-3 a) *Top:* Web form widgets within a page.
b) *Bottom:* Two groups within a page: one containing *Home*, *People*, and *Research*; and the other containing a text box and a *Search* button.

buttons, check boxes, buttons, and drop-down boxes, which are commonly used in web applications, directly into their designs (see Figure 3-3a).

In addition, we added the ability for designers to group elements together to indicate that the elements are related. For example, a designer can group a text box and a Search button together to show that they should be treated as one unit (see Figure 3-3b). Groups also affect the behavior of radio buttons: within a group, only one radio button may be selected at a time.

HopiSketch focused on design for PCs and for Palm handheld devices. To retarget a PC design to the Palm, the designer presses a Retarget button. The tool takes the design, resizes the pages to fit the Palm's screen, and if needed, splits pages to minimize scrolling on the Palm. Elements within a retargeted page, such as handwriting and sketched images, are not resized or otherwise altered. Figure 3-4 shows a design for the PC and the results of retargeting the design to a Palm handheld.

3.2 Architecture

Figure 3-5 shows the overall architecture of HopiSketch. When designers press the
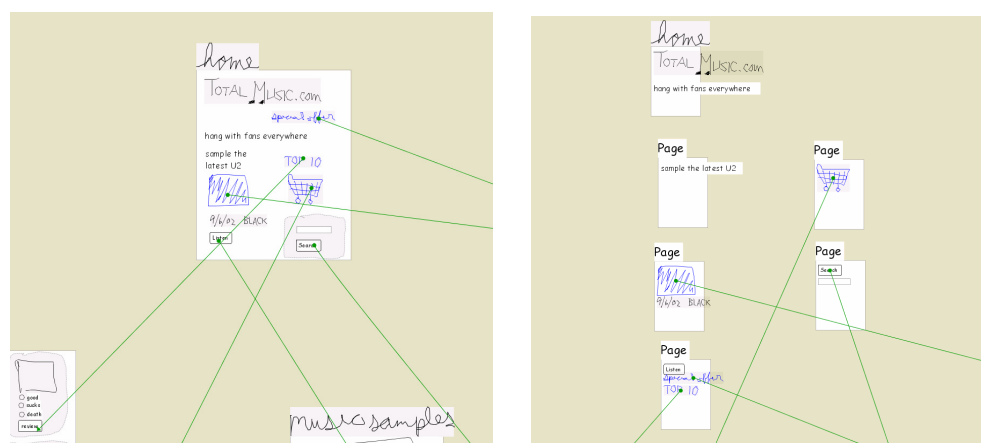
FIGURE 3-4   *Left:* A UI design for the PC. *Right:* The design retargeted for the Palm handheld.
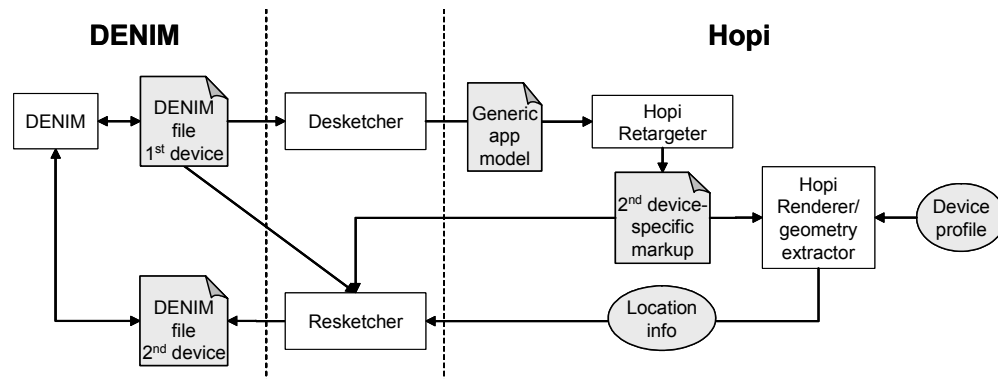
FIGURE 3-5   The architecture of HopiSketch.

Retarget button, the system takes the design file and feeds it to a *de-sketcher*, which translates (or *de-sketches*) it into a generic model [49]. The model is based on xhtml [192] for general content elements and XForms [194] for form elements such as radio buttons and check boxes. One xhtml+XForms page in the model represents one page in the original denim file.

The model is then fed through Hopi, a system for designing cross-device web applications based on a generic model. The model first goes to Hopi's *retargeter*, which transforms it into a markup language for a target device. This process can result in one xhtml+XForms page being split up into several pages, depending on the characteristics of the target device. The retargeter creates pages that fit within a target device's screen, or are a little longer, allowing a bit of scrolling. The retargeter tries to keep elements that have been grouped together on the same page, although this is not always possible.

The resulting markup pages are then fed into Hopi's *renderer/geometry extractor*, which renders the markup using the predefined characteristics of the target device and determines the positions of elements in the markup.

Finally, a *re-sketcher* takes the markup, the extracted geometry, and handwritten elements from the original DENIM file, and creates a sketch-based version of the markup to be presented to the designer.

3.3 Evaluation of HopiSketch

To evaluate HopiSketch, we performed an informal task-based, usability test. The participants were introduced to our tool and then asked to create elements of a simple e-commerce site.

3.3.1 *Participants*

Six designers participated in the usability study, four men and two women. All six designers were employed at user interface design or information architecture firms, had experience designing for the desktop web, and had at least some experience designing for mobile devices. Four of the designers have worked on cross-device user interfaces, although such interfaces are not the focus of their current work. Table 3.1 summarizes the characteristics of the participants.

3.3.2 *Methodology*

The usability tests were performed on an IBM ThinkPad laptop with a Wacom Graphire tablet. First, we gave the designers a warm-up task to get used to the tablet. Next, we demonstrated HopiSketch and had the designers do some basic tasks, such as creating pages, adding elements to pages, and running the designs. Then, we asked the designers to create an online music store application for a desktop browser. We retargeted these desktop applications to Palm devices; the designers were then able to modify the generated results. About 60 minutes were available for the complete design task, including creating the desktop application and editing the Palm version.

TABLE 3.1 Summary of participants of our prototype evaluation.

Participant	Characteristics
B1	UI designer Graphic design background Uses Photoshop and Illustrator Has worked on > 20 cross-device projects
B2	Interaction designer Liberal arts background Uses Photoshop, Fireworks, and Dreamweaver Has worked on < 5 cross-device projects
B3	Information architect Programming and business background Uses Photoshop, Visio, and Flash Has not worked on any cross-device projects
B4	Information architect Media (TV, photography) background Uses Visio and Photoshop Has worked on < 5 cross-device projects
B5	UI designer and usability engineer Computer science background Uses Illustrator and Dreamweaver Has not worked on any cross-device projects
B6	UI designer Graphic design background Uses Fireworks and Visio Has worked on < 5 cross-device projects

Finally, we debriefed the designers and had them fill out a questionnaire (Appendix B). We were looking for comments addressing two general themes:

- Were the tool and the generated user interfaces useful? Would the answer change depending on the number of devices being targeted?

- How can the tool be enhanced to better support the design of cross-device applications?

3.3.3 *Results*

We found that HopiSketch had implementation flaws that made it difficult for designers to perform some tasks. In particular, the de-sketching process was not

sufficiently robust and mature to handle all the designers' sketches, which led to pages being split and elements within the pages being laid out in unexpected ways.

We also found that because the designers only had about 30–40 minutes to design for the desktop, their desktop designs were not very large. Consequently, some designers said that it would have been easier to simply re-sketch their small designs from scratch instead of starting from our generated user interfaces. Some of them were also slowed down by their lack of familiarity with the Wacom tablet.

Given the maturity of our prototype and the time constraints of the evaluation, most designers concluded that using HopiSketch was no faster than using paper and pencil for retargeting the designs that they had created. On the other hand, five of the six designers saw potential benefits of the tool within a broader context:

- Two of the designers, Designers B4 and B5, thought that for large designs, a design tool that can retarget could potentially save them a lot of time.

- Three of the designers also found value in the generated sketches, even though they were not ideal. Two of the designers, Designers B1 and B2, thought that the generated sketches still provided a useful starting point to design for the second device. Designer B2 said that by starting from the generated sketches, he would not forget to implement features in the PC version for the Palm version. Thus, if a feature was not present in the Palm version, it was because he explicitly deleted it from the generated design, not because he forgot to copy it from the pc version.

- Designer B1 said that the generated sketches were useful to show to clients, to demonstrate to them how unwieldy a Palm web site would be if it had all of the functionality of the PC web site.

- Another designer, Designer B6, said that he could imagine that a more robust version of the tool would generate sketches that would help him "see potential pitfalls (or opportunities)" in the design for the target device.

When we asked the designers the minimum number of target devices that would be required for a retargeting tool such as HopiSketch to be useful, all but one of the designers said two devices. One of them said that the tool would probably be most useful if the two devices were the same general type, such as from one mobile phone to another, as opposed to from desktop PC to mobile phone.

However, when we asked the designers how likely they were to use a commercial-strength retargeting tool for early-stage design, the reaction was more mixed. Three designers were likely to use one, one designer was neutral, and two said they were unlikely. One of the designers who was likely to use a retargeting tool said he would do so only if it were not sketch-based. This is because he would only use sketch-based tools for conceptual design, not for designing layouts for specific devices.

Finally, the designers gave us several suggestions that would make a retargeting tool more useful to them, which we describe in the next section.

3.4 Implications for Cross-Device UI Design Tools

The designers described a number of ways in which they believe a tool for retargeting designs could be more useful. Most of the suggestions are related to the theme of letting designers better understand, guide, and control the retargeting process. Each of the following suggestions was made by at least one designer. While these suggestions are not necessarily representative of the design community as a whole, we believe each suggestion has merit. We also discuss how Damask addresses these concerns.

Control over retargeting. Four of the designers mentioned that they would like to guide the retargeting process directly. They would like to be able to explicitly tag which sections of a page should be carried over to the target-device design, and which sections should be omitted, before the retargeting process takes place. One designer said he would like to make the tags conditional on what the target device is. Damask addresses this concern through the concept of *layers:* the layer in which an object is determines the devices in which it exists.

Another designer said that, when targeting the Palm, the tool should not split pages automatically, since the Palm handheld has scroll buttons. Instead, the tool should create pages that would scroll and then allow designers to split the pages themselves. This shows that information about the devices' characteristics must be taken into account throughout the retargeting tool for the tool to be effective. In Damask, the designer splits and merges pages manually.

Iterative design. Many designers wanted to better understand the retargeting process. For example, some said they would prefer a more iterative approach than the study permitted. Due to time and tool constraints, all of the designers went through the retargeting process only once. These designers would rather design a little bit for one device, retarget, look at the results, design a bit more for the first device, and so on. One designer specifically mentioned that he would like to see the design for the target device modified in real time while he worked on the design for the initial device. In Damask, retargeting occurs in real time.

There should also be a tighter relationship between designs of the same user interface on different devices. With HopiSketch, a retargeted design has no relationship to the original design once it has been generated. Ideally, the tool should be able to propagate changes made in a generated device-specific design back to the

original. However, not all changes should be propagated. A designer may want to remove an element in a mobile phone version because it is unnecessary, but keep it in the desktop version because it aids navigation. Damask addresses this concern through the concept of *layers*.

Templates and content replication. Another theme was the ability to intelligently replicate content. For example, several designers mentioned that if they wanted a search box in the upper right-hand corner of every page, they would like to create a template that contains the search box, and apply that template to all of the pages in the site.

They also mentioned that if a page is split during retargeting, some elements in the original page, such as search or navigation aids, should be replicated on each of the resulting pages. Designers would need a way to specify which elements should be replicated, since it would be difficult to make such decisions automatically. Damask provides *templates* to support these concepts.

Support for alternative design processes. A cross-device tool should be flexible enough to support a variety of design practices, especially since cross-device design is a new discipline and design practices are still evolving. For example, our tool was designed to take a user interface for a large display, like a desktop PC, and retarget it to a device with a smaller display, like a Palm handheld. One designer said it was easier for him to add to a design than subtract from a design, so he would prefer to do the opposite of our tool: take a Palm user interface and merge its pages to form a desktop PC version. Damask lets designers start with any device they want.

Improved page splitting. All of the designers said that the algorithms for rearranging and splitting up content could be improved. One designer said that any handwriting and images should be shrunk to fit the dimensions of the handheld.

Damask does exactly this. Similarly, one designer mentioned that since Palm handhelds can scroll, groups should never be split between two or more pages. Instead, the tool should create a scrolling page that would keep all of the items of a group together. Damask lets designers manually split pages instead of automatically doing so.

Sketch-based interface. Some designers found the sketch-based interface appealing. Designer B1 said it took "napkin sketching to a new experiential level without making it beautiful," and that it allows him to focus on whether his ideas are valid. Designer B2 simply said that "it's a good way to work."

Others did not find it as compelling. Designer B4 wanted additional shape and alignment capabilities, such as provided by Visio or other diagramming tools. Designer B2 liked sketching, but said he uses sketching only for conceptual design. For layout design, he would prefer to use a more structured interface. Since opinion was split and we wanted to push the limits of user interface design, we decided to stick with a sketch-based interface for Damask.

Designer B1 suggested that the contents of the pages could contain a coarse grid similar to graph paper. This would help, but not force, designers to draw neater sketches, and would indirectly help the retargeting algorithms, since they work better when elements are aligned. Damask employs a grid for this purpose.

Familiar interaction. Some designers expressed reluctance to learn a new tool interface, and would have liked HopiSketch's user interface to have been more similar to the tools they already use. The most commonly mentioned tools were Adobe Photoshop and Microsoft Visio. Damask uses more familiar UI elements, such as standard toolbars and keyboard shortcuts.

Handling different classes of devices. There was some skepticism that our tool would be really useful for designing user interfaces to be run on different classes of devices, such as pcs and mobile phones. Designers B1, B2, and B3 said that the interaction flow is very different among different classes of devices, and that there is insufficient support in our tool to handle those differences.

A cross-device design tool should be able to support the design of applications whose user interfaces have very different interaction flows depending on the device. HopiSketch does not handle such design activities because it only transforms at the page and widget level. Higher levels of abstraction within the design are needed to support disparate interaction flows. Design patterns may be one such abstraction [104], and we will discuss how Damask uses them for this purpose in the next chapter.

4 Damask's User Interface

Damask is a design tool for the early-stage design and prototyping of cross-device UIs. It includes a catalog of design patterns for use in designing desktop-based web sites. Some of these patterns are also useful for designing mobile phone and voice UIs. These patterns include several generalized *solutions* capturing the essence of how to solve the problem stated in the pattern, one solution for web-style interaction on a PC, one for mobile phone displays, and one for prompt-and-response voice UIs.

With Damask, designers create their UI designs by sketching and by adding design pattern solutions to their design for one device. As they are creating their designs, Damask generates corresponding UI design sketches for the other two devices, which the designers can modify if desired. Finally, designers can use Damask to run their designs in a Run mode, or in the case of voice UIs, also export them to VoiceXML, so that they can test and interact with their design sketches.

First, we will describe Damask's user interface. Then we will walk through an example of how designers would create and run their UI designs, including how they would use design patterns and layers within their designs. In the next chapter, we will describe Damask's architecture and implementation.
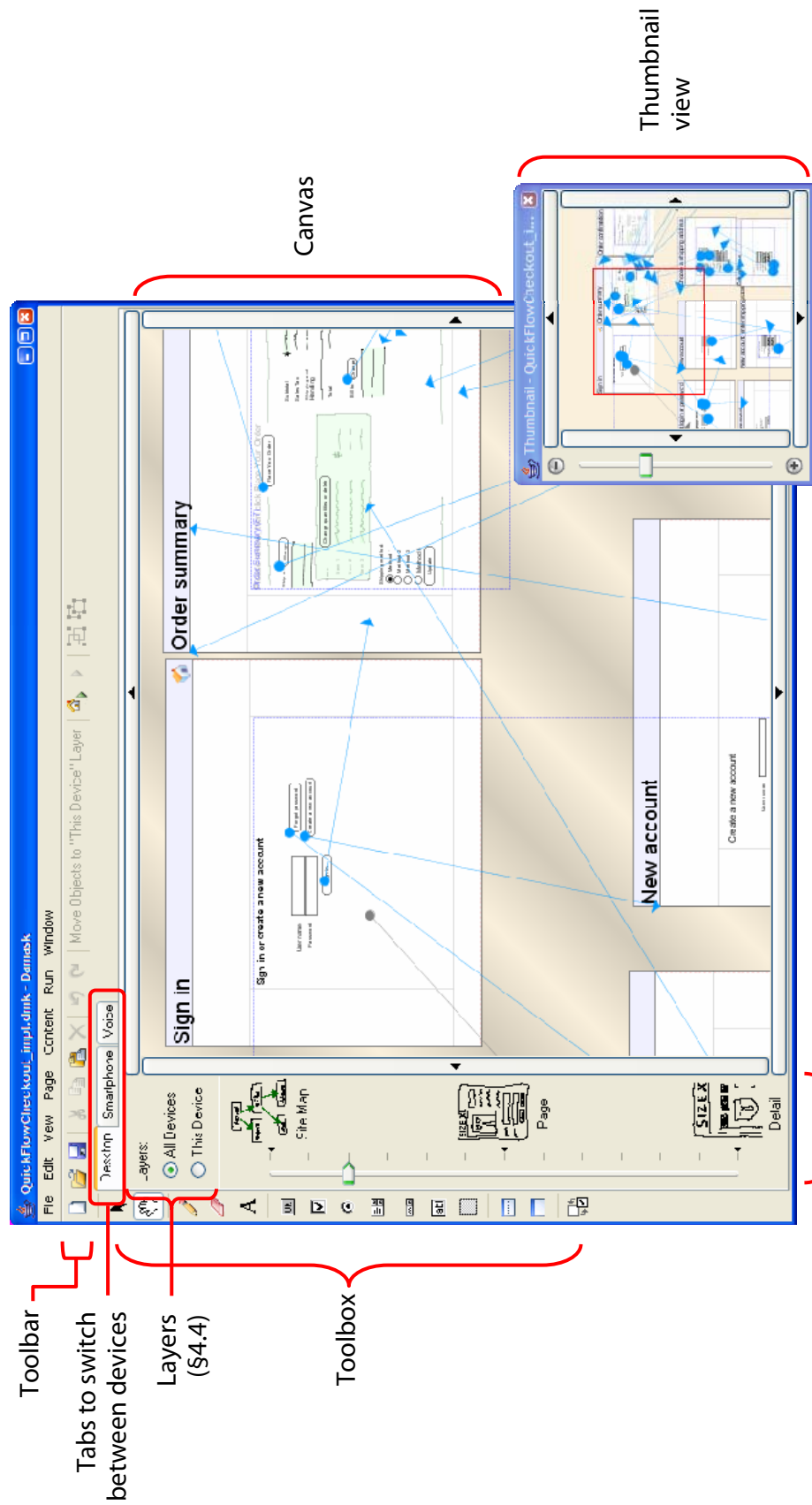
FIGURE 4-1   Damask's user interface.

4.1 Damask's User Interface

Damask's user interface is similar to other design tools that our research group has developed, such as DENIM [105, 141] and SUEDE [91, 168] (see Figure 4-1).

The canvas contains the actual user interface design. The design includes which patterns it is using, as denoted by a blue outline and the name of the pattern. For example, in Figure 4-1, there is an instance of the ORDER SUMMARY pattern in the "Order summary" page. There are tabs above the canvas where designers can choose which target device they are viewing: desktop, smartphone, or voice. To view the different device-specific UIs at the same time, the designer can view the design in multiple windows.

To pan around the canvas, the designer can use the scroll buttons along the edges of the canvas, or use the hand tool in the toolbox and drag it over the canvas. The designer uses the zoom slider, just to the left of the canvas, to zoom in and out.

Damask also includes a Thumbnail view, which is a miniature view of the canvas that is similar to the Navigator palette in Adobe Photoshop [3]. The red rectangle within the thumbnail shows the current view of the canvas in the main window. The designer can move or resize the rectangle, which pans and zooms the main canvas appropriately.

Damask also has a Pattern Browser window (see Figure 4-2), where designers can browse for patterns to be instantiated in their designs, find the details about a particular pattern, and instantiate a pattern.
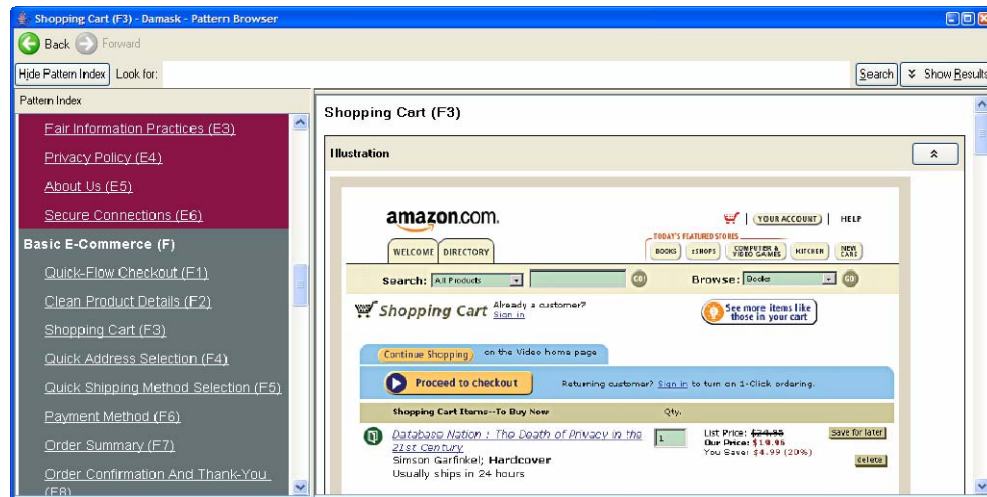
FIGURE 4-2   Damask's pattern browser.

4.2 Designing Desktop and Mobile Phone UIs

A graphical desktop or mobile phone UI design consists of pages of content, linked together with transition arrows that define behavior, in the spirit of DENIM.

4.2.1 Pages

To create a page, the designer uses the pencil tool 🖊 and drags out a rectangle on the canvas indicating the size of the new page (see Figure 4-3). By default, Damask will create a page of a default size if the designer draws a rectangle smaller than that size. The default size depends on the device (1024×768 for desktop, 180×220 for smartphones).
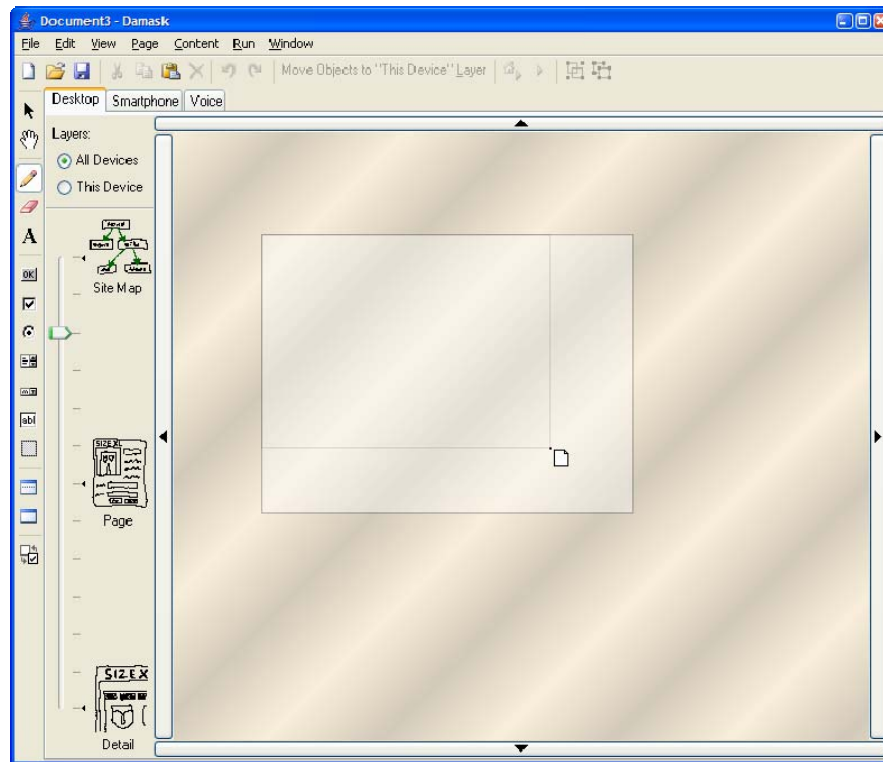
FIGURE 4-3   Creating a page.

The designer can set the focus to a page by tapping in the page. Damask then adds a drag bar to the top of the page so that it can be moved, and a grip in the lower right-hand corner so that it can be resized. If the designer makes the page larger than the default size, Damask will draw a red dotted "fold" line to indicate that an end-user would have to scroll to see any content below or to the right of the fold (see Figure 4-4).
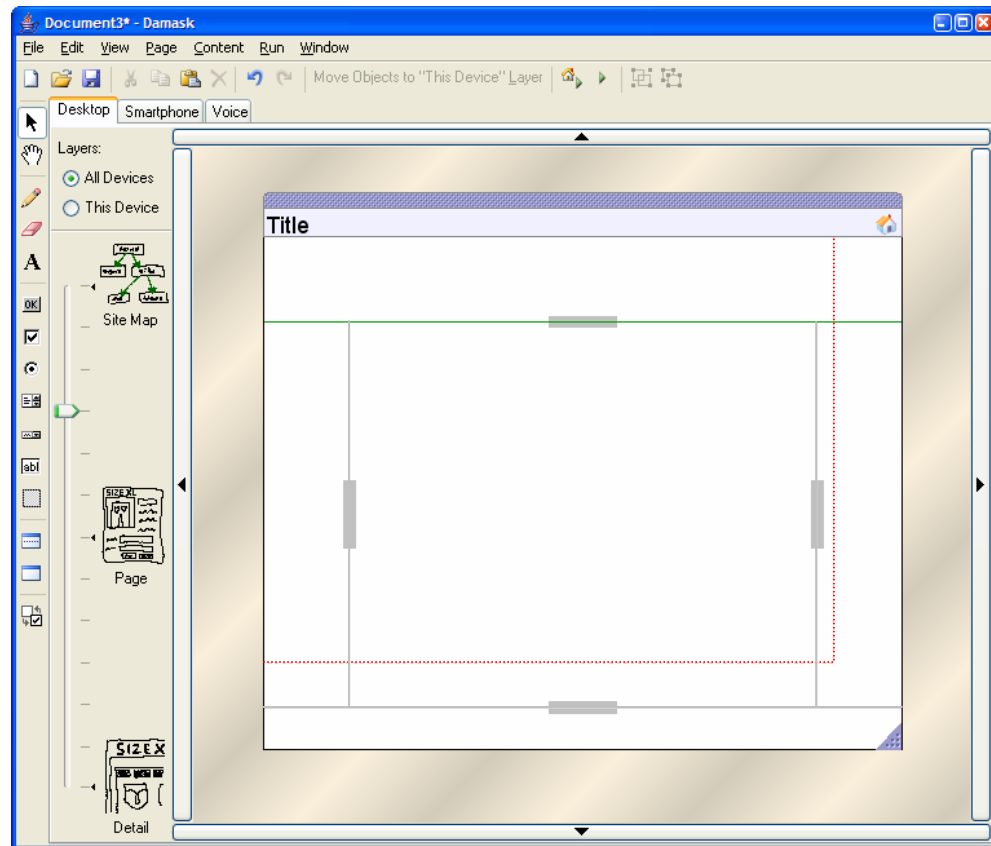
FIGURE 4-4   A page, with gray bars for dragging and resizing regions and a red dotted "fold" line.

Each page is made up of several page regions: north, south, east, west, and center. These regions reflect the sections into which a page is typically split up, for example, north for the navigation bar, east for related items, and center for the main content. In desktop pages, all five page regions are visible. In smartphone pages, only the north, south, and center regions are visible, since a smartphone's screen typically isn't wide enough to have content along the sides. A designer can resize a region by dragging the gray bars in the center of a region boundary (see Figure 4-4).

When Damask's zoom level is near the Page level or lower (as indicated by the zoom slider to the left of the canvas), a light blue grid is drawn in the background of the page, as a subtle guide to help designers lay out elements within the page.

Damask has no alignment tools, because we want to maintain a lo-fi feel for the user interface [99], and not tempt designers into spending too much time fiddling with details, during the early phases of the design process [200].

A designer can cut, copy, and paste pages through the Page menu on the main menu bar, or by right-clicking on a page. The designer can also set the home page of the UI through that menu. By default, the page that is first created is the home page. The home page is denoted by a home icon in the upper right-hand corner of the page (see Figure 4-4).

Damask includes tools to split and merge pages (see Figure 4-5). To split a page, designers select the split tool from the toolbox and then click at the location in the page where they want it to be split horizontally (see Figure 4-6). They can merge two pages they had previously split by clicking on the merge tool and then clicking on one of the two pages.

FIGURE 4-5   The tools for splitting a page (above) and merging pages (below).
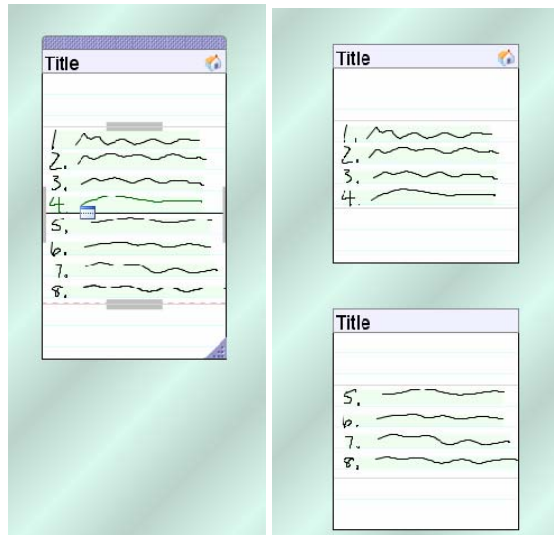
FIGURE 4-6   *Left* Using the split tool to split a page. *Right* The result of splitting a page.

4.2.2 Adding user interface controls to pages
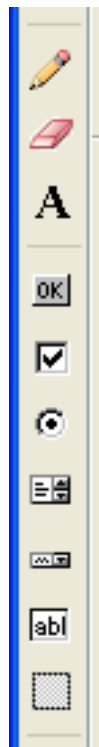
To add content and interaction to a page, a designer adds *controls* to the page. There are eight types of controls: labels, buttons, check boxes, radio buttons, list boxes, drop-down boxes, text boxes, and panels (see Figure 4-7).

A label has three modes: ink, typed text, and an image. To add ink, the designer selects the pencil tool and draws inside the page. Damask adds ink strokes that are spatially close to the most recently created label, which has a green border, to that label (Figure 4-8). Each label has a light-green background to indicate to the designer how Damask has grouped together the strokes.

FIGURE 4-7   The toolbox buttons used for creating and erasing controls.
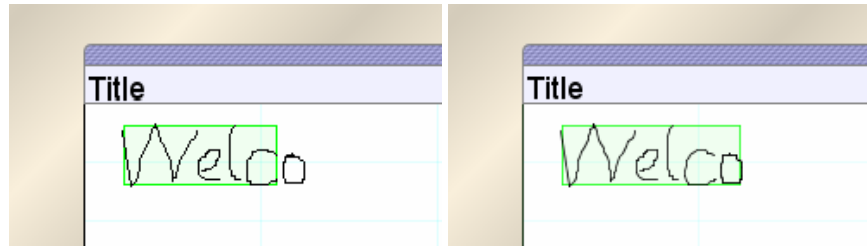
FIGURE 4-8   Adding an ink stroke to a page.

If designers want to group ink strokes in a different way, they can select the labels which they want to be merged into one label, and then click the group tool ⊞ in the top toolbar. Damask ungroups the selected labels into individual ink strokes, and then regroups them into one label (see Figure 4-9). Clicking the ungroup tool ⊟ simply ungroups the selected labels into separate strokes without regrouping them.
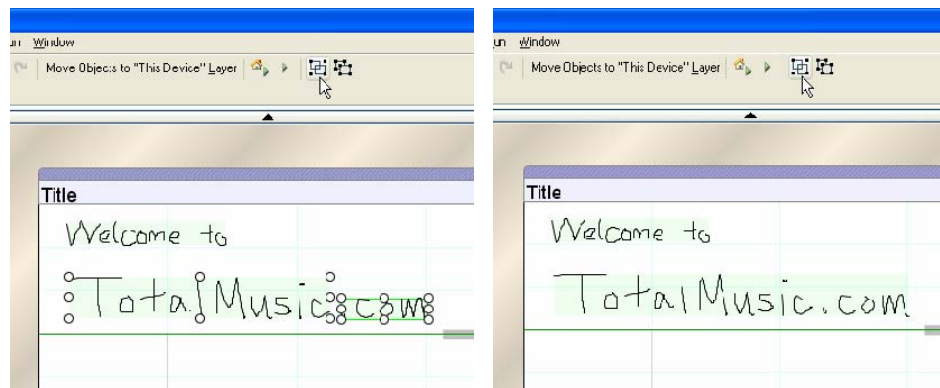
FIGURE 4-9   Grouping labels together into one label, by clicking the Group button in the toolbar.

To add typed text, the designer selects the text tool **A**, clicks on the canvas, and types in a label. To edit the text, the designer selects the text tool, clicks on the label, and types.

A designer can also change the display mode of a label, e.g., from ink to text, by right-clicking on the piece of content, and choosing the new type from the menu (see Figure 4-10). This allows the maintenance of different modes of the same label in parallel. This is useful for when designers want to show a more finished version of a

design to a client, but then want to go back to a more informal representation so they are not unnecessarily distracted by details while they change their design.
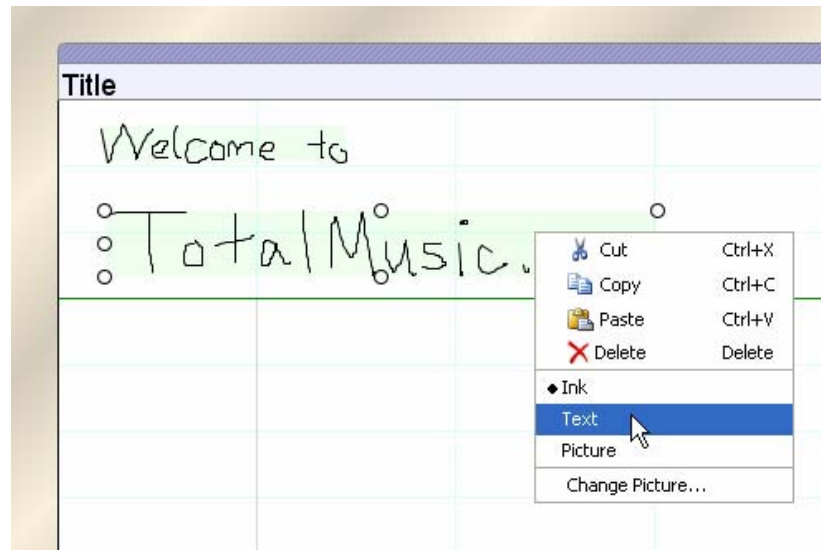
FIGURE 4-10   Changing the display mode of a label.

This is also the mechanism to add an image; the designer first creates a label by either sketching or typing, then right-clicks on the label, selects Change Picture… from the resulting pop-up menu, and then selects an image from the file chooser.

To add another type of control, the designer selects the corresponding tool in the toolbox (UK ☑ ☉ ⊟ ⊡ abl), and then clicks within the page. To modify the textual content of a control, the designer selects the *text* tool **A** and then clicks on the control (similar to how Microsoft PowerPoint behaves). The caption's text is then edited in place, or in the case of a list box or drop-down box, a dialog box pops up allowing the designer to edit the control's list of text.

To change the default state of a control, like making a particular check box checked by default, the designer selects the change control state tool ⊞ at the bottom of the toolbox. The designer can then interact with the design as if the design were

live, for example, clicking on a radio button to change which one is selected (see Figure 4-11).
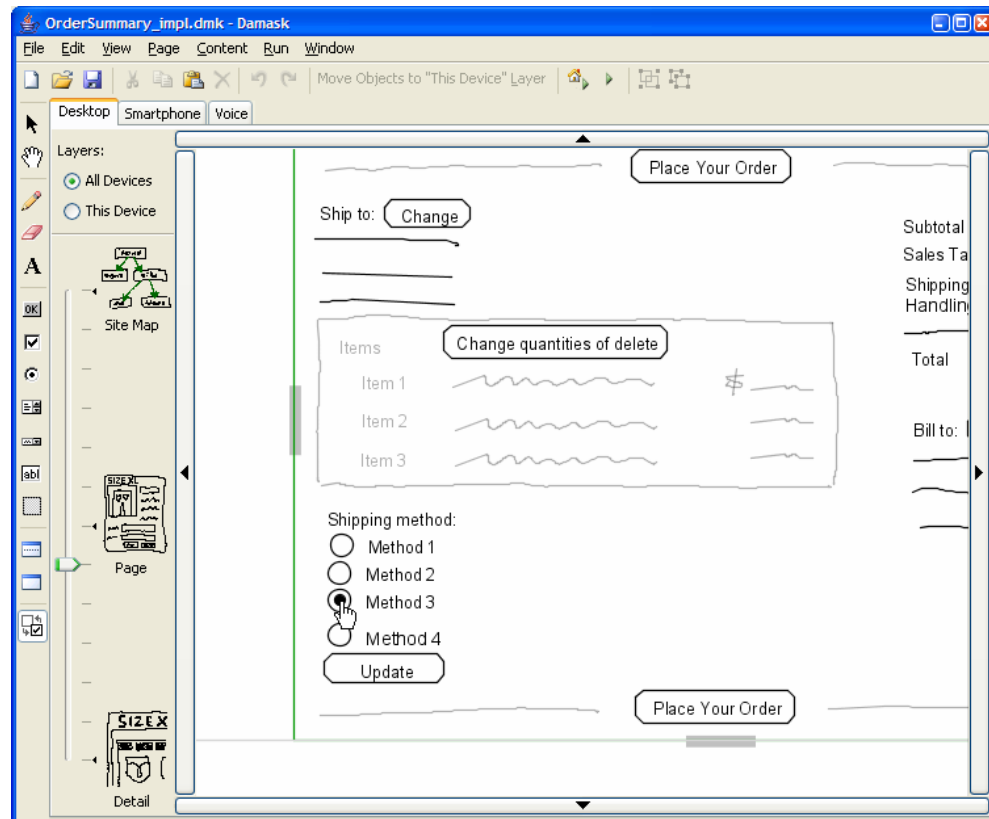
FIGURE 4-11   Changing the state of a radio button.

Panels are used to logically group related sets of controls manually. They are not meant to be visible in the final user interface. They are also used to separate groups of radio buttons; for any set of radio buttons within a panel, only one can be active at any time. Also, for all of the radio buttons outside of every panel, only one radio button can be active. To use a panel, the designer selects the panel tool from the toolbox ▢ and drags out a rectangle, and then adds or pastes the desired controls within the panel (see Figure 4-12).
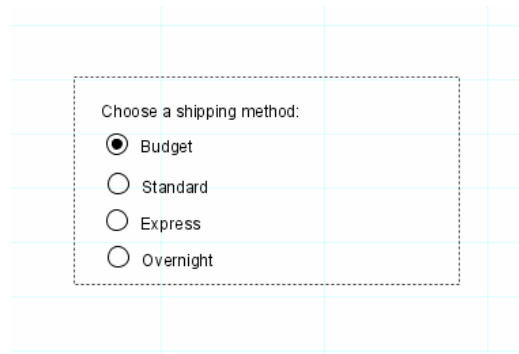
FIGURE 4-12 A panel containing a label and radio buttons in the canvas. The dotted border is invisible at run time.

4.2.3 *Specifying behavior with arrows*

An arrow between two pages represents a relationship between those pages. Like DENIM, Damask provides organizational and navigational arrows (see Figure 4-13).

Organizational arrows are used to represent a relationship between two pages. For example, the designer may want to show that the concepts between two pages are related, or that the end-user tends to go from one particular page to another, but the designer does not want to fill in the details on how at this time. These arrows are generally created early in the design process, during the information architecture phase [140, 141].

A *navigational* arrow specifies a transition from one page to another in the interface. Such an arrow from an item on one page, such as a word, image, or button, to another page means that, in Run mode, the user can click on the item to transition to the other page. More specifically, if a navigational arrow starts from a word, the word behaves like a hyperlink on a web page in Run mode.
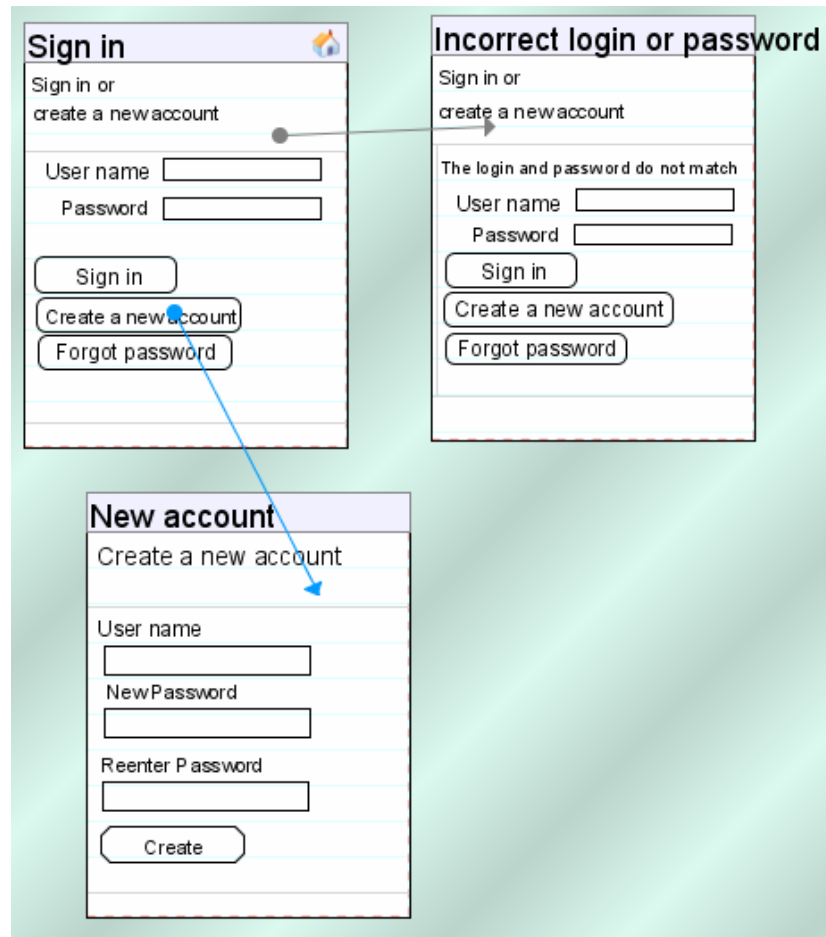
FIGURE 4-13   An organizational arrow (gray) between the "Sign in" and "Incorrect login or password" pages, and a navigational arrow (blue) between the "Create a new account" button and the "New account" page.

To create an arrow, the designer draws a stroke using the pencil tool ✏ between two pages. The system checks if the stroke is an arrow. Organizational arrows start on one page and end in another. This creates a gray arrow from the source to the destination. Navigational arrows start on a specific object in one page and end in another page. This creates a green arrow from the source to the destination. When creating a navigational arrow, any organizational arrows from the source page to the destination page are removed, since the navigational arrow now has at least the same information as the organizational arrow did. As additional feedback, if the arrow

originates from a text or ink object, that object becomes blue, like a hyperlink in a web page.

4.2.4   *Manipulating objects within a page*
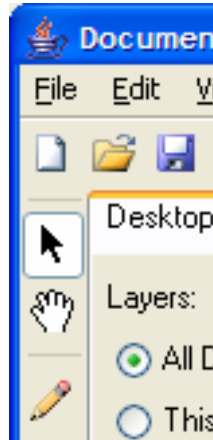
FIGURE 4-14   The pointer tool.

A designer can select an object by choosing the pointer tool ► in the toolbox (see Figure 4-14), and then either clicking on an object, or shift-clicking on or drawing a selection rectangle around multiple objects. The designer can then move the object (or objects) by dragging, resize by dragging one of the resize handles, or cut, copy, and paste through a right-click context menu, the Edit menu, or the standard keyboard shortcuts.

4.2.5   *Templates*

Web sites often have common elements across many pages. Damask includes a templates feature so that designers do not have to create the same elements on every page. To see the templates associated with the design, the designer chooses View→Templates. The Templates pane slides in from the right (see Figure 4-15).

Check box to apply template to selected page

Removes the template
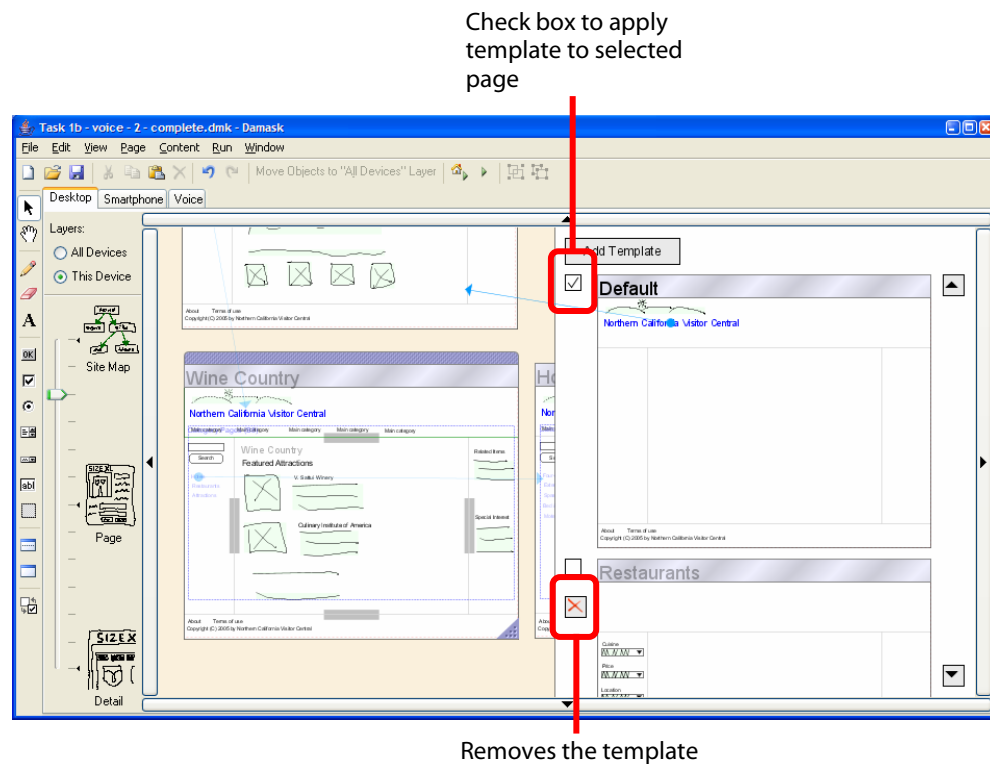
FIGURE 4-15 The template pane. Clearing the check box next to the default template would remove it from the currently selected page, in this case, the Wine Country page.

When the designer adds elements to a page in the Template pane, all of those elements are added to every page that uses that template. To apply a template to a particular page, the designer first clicks in that page to give it focus if necessary, then clicks the check box to the left of the desired template page. By default, the template pane includes a page titled "Default" that is applied to every page in the design, although it can be removed on a page-by-page basis. Designers can add more templates by clicking on the Add Template button at the top of the pane, and remove a template by clicking the button with a red X next to that template. Templates added by the designer are *not* applied to every page by default. More than one template can be applied to a page; the elements are simply composed together.

4.2.6 Run window

Damask allows designers to interact with their design sketches in a Run window, where designers can test out the interaction of their designs. Selecting Run→Run from Selected Page displays the page with the focus in the Run window; Run→Run from Home Page displays the home page. There are also two toolbar buttons corresponding to the two menu items (see Figure 4-16).
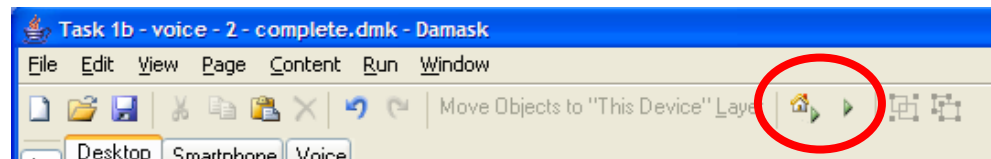
FIGURE 4-16   The toolbar buttons for *Run from Home Page* and *Run from Selected Page*.

Inside the Run window, the designer can navigate through the design as if it were running in a web browser. If the Run window is displaying a desktop page, back and forward buttons are provided to simulate a web environment. Any changes made to the page in the main Damask window are automatically reflected in the Run window. If it is displaying a smartphone UI, then a telephone keypad is put beneath the displayed UI, although currently only the Back button is active (see Figure 4-17).
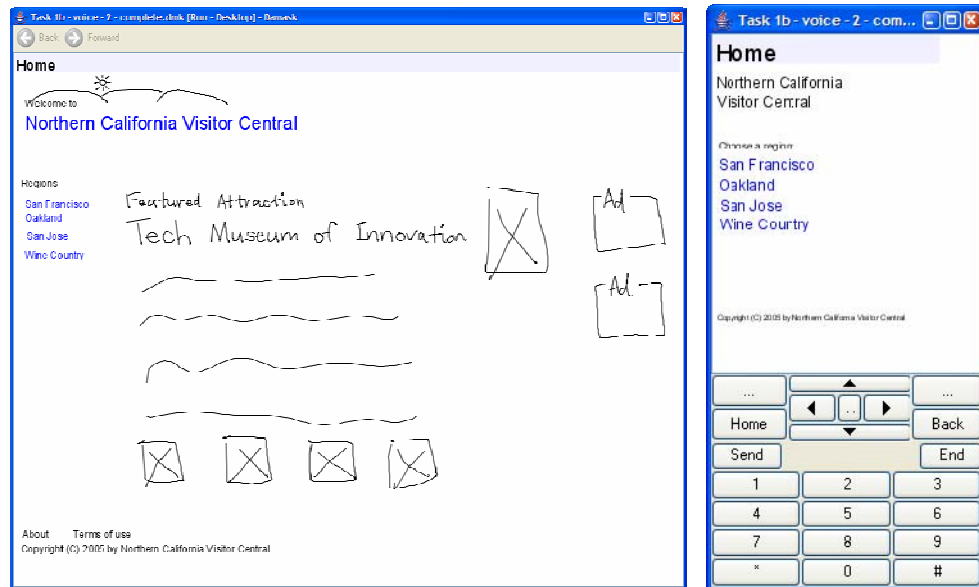
FIGURE 4-17 Run windows for desktop (left) and smartphone (right) designs.

4.3 Designing Voice UIs

Designing a voice user interface in Damask is quite different than designing a web or smartphone UI. Damask's voice mode is similar to SUEDE's design graph area [91]. A voice user interface is represented by computer *prompts*, connected by possible human *responses*. Related prompts and responses are grouped together into *forms*. There are only four tools available in voice mode: selecting and moving objects ⬉ , panning the canvas ✋, creating objects ✏, and removing objects ⬰ (see Figure 4-18).
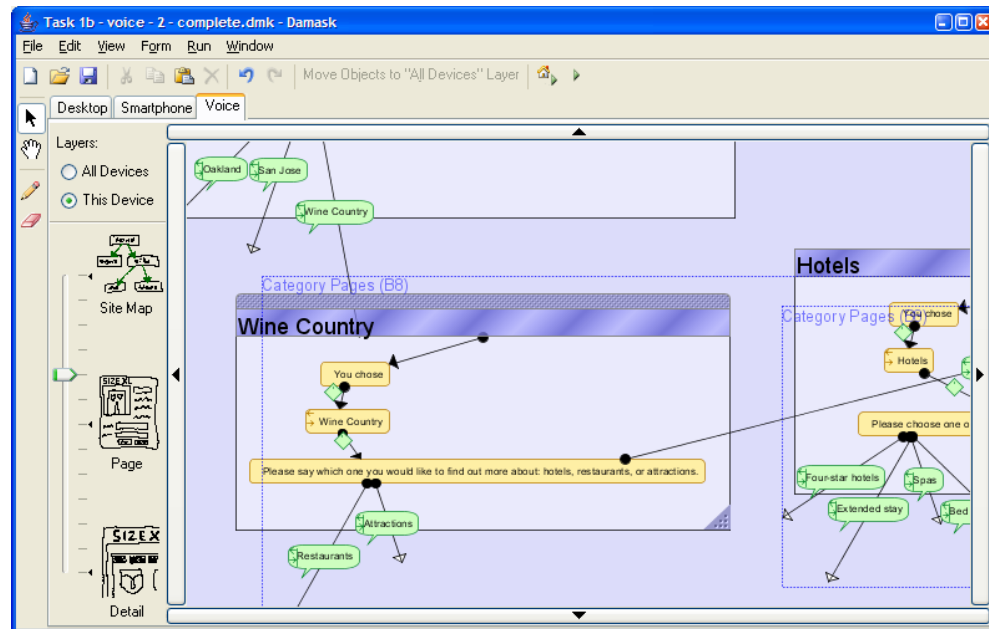
FIGURE 4-18   A voice UI design, including a form titled "Wine Country," orange computer prompts and green user responses.

4.3.1 Forms

Forms are similar in concept to forms in Voicexml interfaces and analogous to pages in web sites. They group together related prompts and responses into a single entity. Creating and manipulating forms is the same as interacting with pages (Section 4.2.1).

4.3.2 Prompts

Prompts represent phrases that the computer speaks. To create a prompt, the designer uses the pencil tool 🖉, taps within a form, and types the prompt (see Figure 4-19). To edit the text in a prompt, the designer uses the pencil tool and taps within the prompt. To move the prompt, the designer uses the selection tool 🡔.

FIGURE 4-19   Inserting a prompt.

4.3.3 *Responses*

Responses represent the phrases that people say in response to prompts. To create a response, the designer uses the pencil tool 🖊, and drags a line from the prompt to which the response is responding, to another prompt which the computer will say in reply to the response. The line becomes an arrow; a voice balloon with the response text appears along the arrow (see Figure 4-20). It is possible to create a response which does *not* end at a prompt; it is simply a dead end until it is hooked up to another prompt.
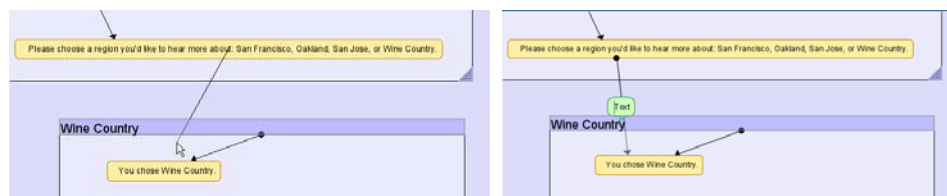
FIGURE 4-20   Creating a response.

The designer can drag the endpoints of the arrow to other prompts. To edit the response text, the designer taps on the text with the pencil tool 🖊. If designers want more than one phrase to go between the same prompts, they can separate the possible response phrases with carriage returns (see Figure 4-21).
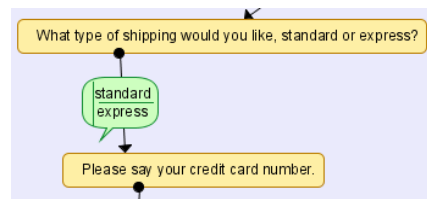
FIGURE 4-21 A response with more than one possible phrase.

There are two special cases for response text:

- An asterisk (*) will match any response that is not matched by any other response. If there are no other responses, then * matches anything.

- No text in a response from Prompt A to Prompt B means that the computer says Prompt B immediately after Prompt A. In this case, the voice balloon becomes a diamond shape, which the designer can click on to add text back into the response.

A designer can create a response that goes from a prompt directly to another form, as opposed to another prompt. In this case, the destination prompt of the response is assumed to be the *initial prompt* of the form, indicated by a special empty response which is anchored at the top of the form and points to the initial prompt. In Figure 4-22, "What is your favorite vegetable?" is the initial prompt. Designers can change the initial prompt by moving the endpoint of the special response.
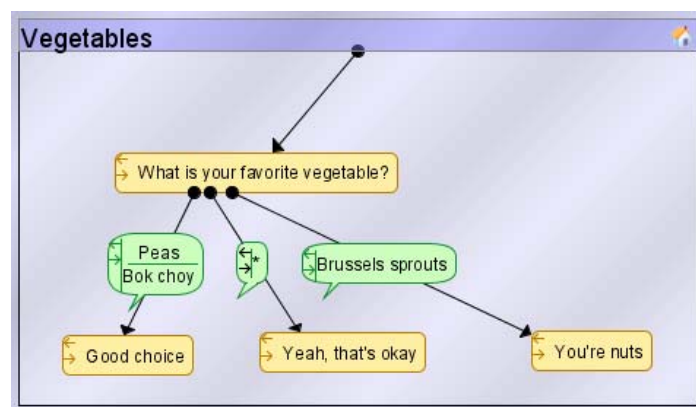
FIGURE 4-22 The prompt *What is your favorite vegetable?* is the initial prompt in this form.

4.3.4 Universals

Universals are commands that a user can say at any time to perform a global action. Designers create universals in the Templates pane, which contains a default form with a blank prompt that is used solely for anchoring the start of universal responses. To create a universal, the designer creates a response from that prompt to the prompt that should be played when an end-user says the universal (see Figure 4-23).
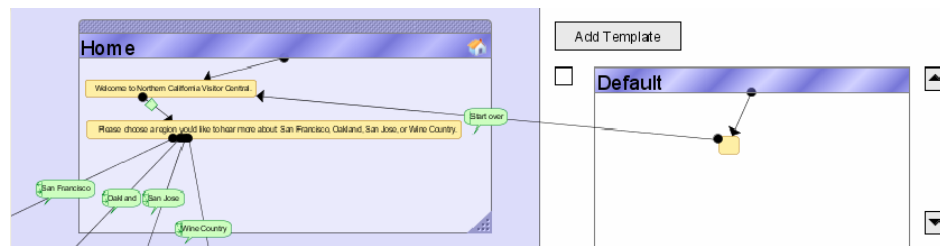
FIGURE 4-23   A universal which goes to the Home form whenever a user says "Start Over."

4.3.5 Run window

When the designer chooses Run from Home Form or Run from Selected Form from the Run menu, a dialog box pops up with the first prompt in the form as the message of the dialog box. If there is an empty response (i.e., a response with no text) that starts from this prompt, then the dialog box also shows the prompt at the other end of the empty response, and repeats this process until it reaches a prompt that has no empty responses.

A user types in his or her response in the text box below the computer's prompt and clicks OK (see Figure 4-24). A text box is used in the window so that the designer can test whether the display prompt contains enough information so that a user knows what to say in response. This technique has been used in other voice development tools such as the VoiceXML terminal in Tellme Studio [181]. The user

can click Cancel to end early. If a prompt has no responses, then only an OK button is displayed, without a text box.
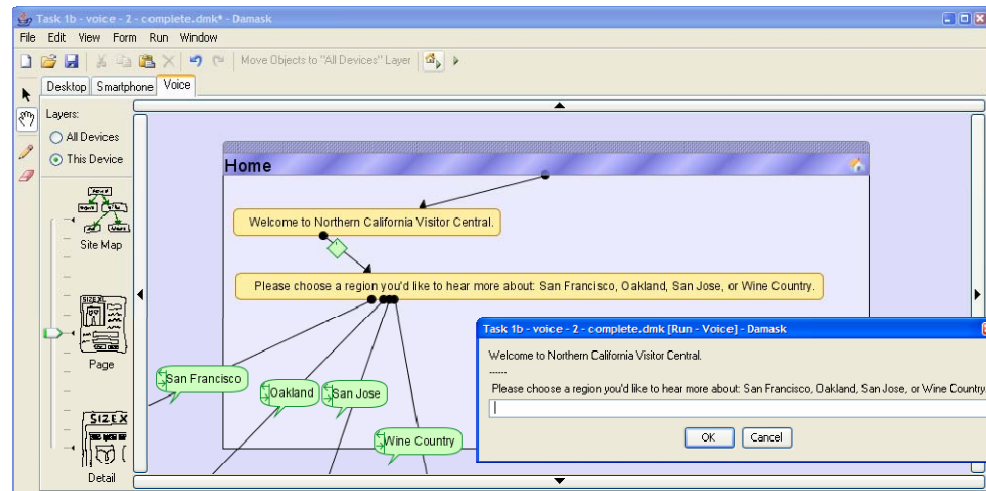
FIGURE 4-24   Run mode for voice user interfaces, with the same form in design mode in the background.

If the response matches one of the designer's responses, then the appropriate prompt or prompts are displayed in the dialog box. If the user types in nothing, then the dialog box says, "Sorry, I didn't hear you," and redisplays the prompt. If the user's response does not match one of the responses that the designer defined, then the dialog box says, "Sorry, I didn't catch that," and redisplays the prompt.

The Run window is intended for the designer to do a quick sanity check of the voice UI design. Nonetheless, reading a prompt is not the same as listening to a prompt. For this, there is an option to export the design to VoiceXML, which is described next.

4.3.6 Exporting to VoiceXML

To verbally interact with the voice UI, Damask allows designers to export their voice UI to a VoiceXML [193] file, which they can then upload to a web site such as Tellme Studio or BeVocal Café [24], or Voxeo Evolution [191], and interact with their

VoiceXML file over the phone. The generated file is not meant to be used for final deployment of a voice UI; it is solely for prototyping purposes. To generate the file, the designer chooses Export to VoiceXML from the File menu.

The generated file behaves in the following way. The computer first says the first prompt in the home form. If there is an empty response that starts from this prompt, then the computer also says the prompt at the other end of the empty response, and repeats this process until it reaches a prompt that has no empty responses.

A user says something in her response. If the response matches one of the designer's responses, then the computer says the appropriate prompt or prompts. If the user says nothing after a period of time, then the computer says, "Sorry, I didn't hear you," and repeats the prompt. If the user's response does not match one of the responses that the designer defined, then the computer says, "Sorry, I didn't catch that," and repeats the prompt.

You may notice that the VoiceXML file is the audio equivalent of the Run window discussed in the previous section. In fact, the Run window was first created to test the VoiceXML generation feature.

4.3.7 *Limitations of the VoiceXML export feature and the Run window*

While the Run window and the VoiceXML export feature are useful for quick tests of voice UIs, they are not ideal for doing extensive usability tests with potential users. The biggest drawback is that if the user does not say one of the choices that the designer had chosen beforehand, then the Run window or the VoiceXML file does not recognize the user's response and gets stuck. Also, text-to-speech (TTS) systems still sometimes have problems saying natural-sounding speech, and Damask does not

have a facility for recording human speech for either prompts or responses. For this, a Wizard-of-Oz interface, like the one in SUEDE [91], would be more suitable.

4.4 Layers

Layers are used as the basic concept for determining whether a page/form or a control appears on every device or just one device. For each device, there are two layers: All Devices and This Device. An object in the All Devices layer exists in every device, although the location of that object can vary across devices, and moving an object in one device does not affect the corresponding object in the other devices. An object in the This Device layer exists only for the device that is currently being viewed.

The designer switches between the two layers by choosing the appropriate radio button next to the top left-hand corner of the canvas (see Figure 4-25). If designers select an object that is not in the current layer, Damask pops up a dialog box asking if they would like to switch to the other layer so that they can select the object.
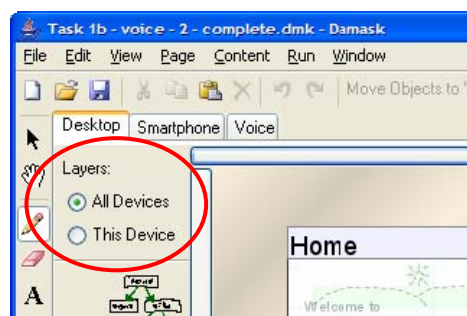
FIGURE 4-25   The radio buttons used for changing the active layer.

Controls in the active layer are shown normally, while those in the inactive layer are grayed out. A page or form in the All Devices layer has a striped title bar when the This Device layer is active (see Figure 4-26). However, a page or form in the This Device layer is grayed out when the All Devices layer is active, for reasons explained later.
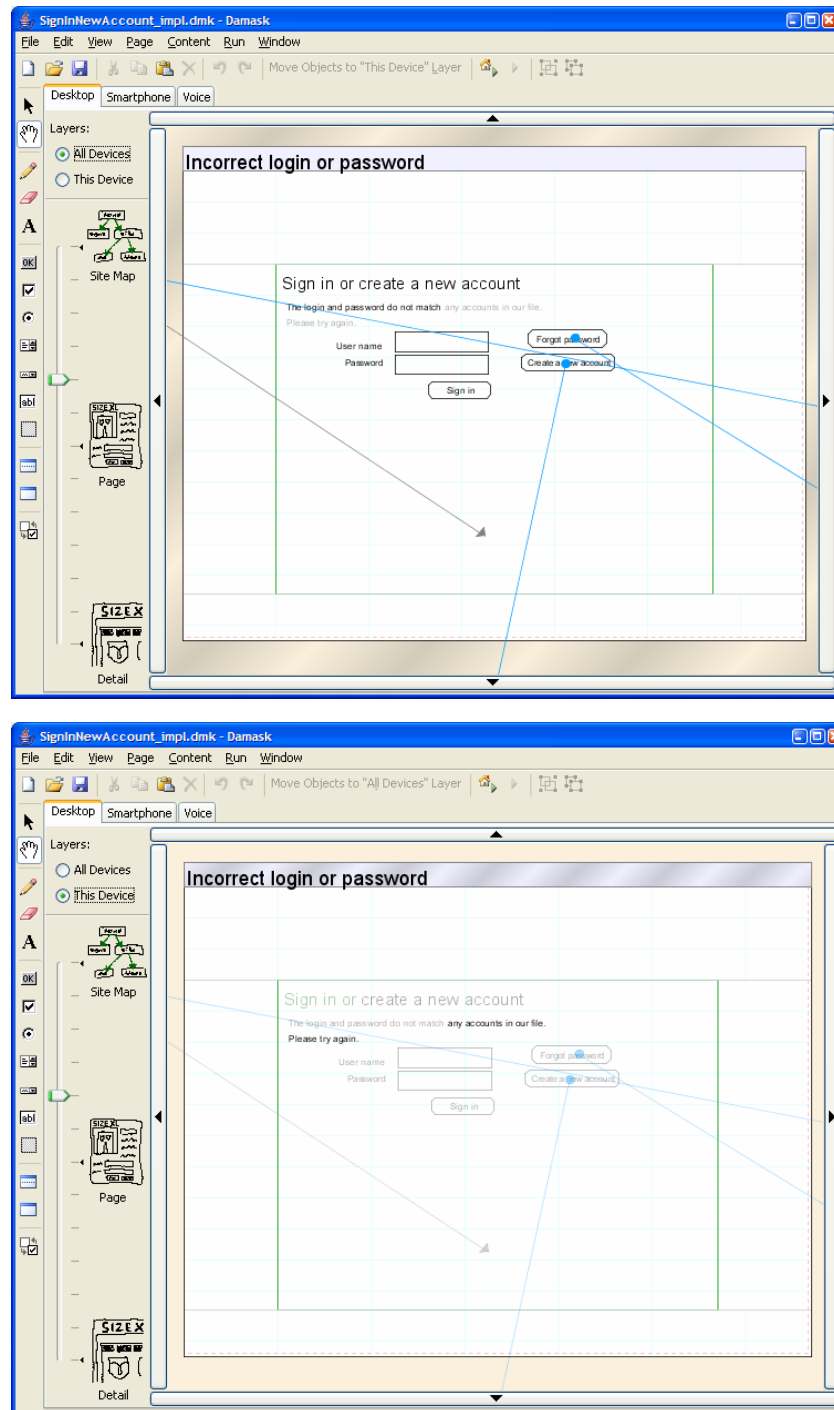
FIGURE 4-26 The same page with *All Devices* as the current layer (above) and *This Device* as the current layer (below). The phrase "any accounts in our file. Please try again" is in the *This Device* layer, and all of the other objects are in the *All Devices* layer.

The background of the canvas is striped in the All Devices layer but plain in the This Device layer. The purpose is to be a more obvious visual indicator to designers of which layer they are currently viewing (see Figure 4-26).

There are some restrictions on placing a control in a page, depending on what the layer the control and the page are in:

- If a control is being created when the All Devices layer is active, it cannot be placed in a page on the This Device layer, since there is no corresponding page in the other devices in which the new control could be placed. This is why such a page is grayed out in this situation.

- If an arrow is being created in the All Devices layer, it cannot start from or end at a page on the This Device layer, for similar reasons.

Currently, Damask does not give feedback if the designer tries to do either of these actions, although future versions should.

Damask includes a button on the toolbar that allows the designer to change the layer of an object. When the designer selects objects in the All Devices layer, and presses the toolbar button labeled Move Object to This Device Layer, the selected objects are removed from the All Devices layer and placed in the This Device layer for the currently selected device. This also removes the objects from the other devices (see Figure 4-27). Conversely, when the designer selects objects in the This Device layer, and presses the toolbar button labeled Move Object to All Devices Layer, the selected objects are removed from the This Device layer and placed in the All Devices layer.
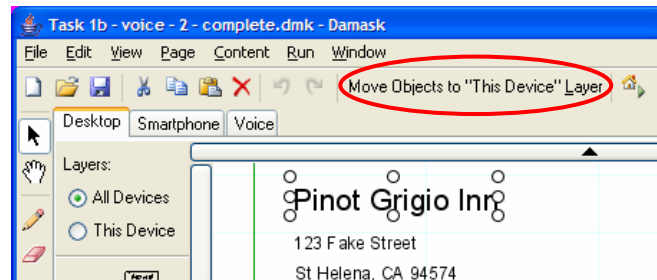
FIGURE 4-27 The "Move Object to This Device" button in the toolbar.

These buttons interact with template objects in the same way as normal objects. For example, if the designer selects an object in the template pane in the All Devices layer and presses Move Object to This Device Layer, the selected objects are removed from the All Devices layer and placed in the This Device layer for the currently selected device in the template. This has the effect of removing the template object from the other devices.

4.4.1 Relationship between desktop/smartphone and voice UI elements
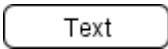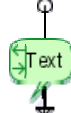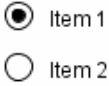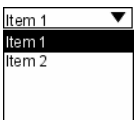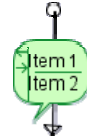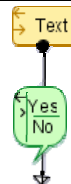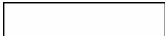
When an element is placed in the All Devices layer, Damask needs to handle how to map desktop/smartphone elements to voice elements. In the case of pages and forms, it is straightforward. Creating a page in the desktop or smartphone view also creates a form in voice view, and vice versa. However, if a designer splits a page in, say, the smartphone view, *both* pages still correspond to the one desktop page and one voice form. This is because splitting a page is done typically for display purposes only; the logical grouping of the elements within the page or pages still remain the same.

It gets more complicated with controls. Adding a control in one device adds the control below all of the other controls in the other devices. In other words, the controls are simply laid out vertically in the order the designer added them. While this is a simple and predictable policy, it is not particularly smart. A more complete version of Damask would incorporate an inferencing algorithm to figure out which

controls are grouped together, using techniques such as those in ScanScribe [161]. This would be coupled with a more robust layout algorithm, such as that in supple [55] or gadget [48].

Also, Damask has a particular mapping between desktop/smartphone controls and voice controls. Table 4.1 lists the control that is created in the voice view when a control in the desktop or smartphone view is added.

TABLE 4.1   Visual controls and their corresponding voice controls.

Visual controls	Corresponding voice controls
Button	Response
Radio buttons List box Drop-down box	Response
Check box	Prompt + Response
Label	Prompt
Text box	Response

In addition, if there is a button immediately after a set of radio buttons, a list box, a drop-down box, a check box, or a text box, and there is an arrow starting from that

button, then the corresponding voice response points to the same control as the arrow.
Otherwise, it points to nothing (see Figure 4-28).
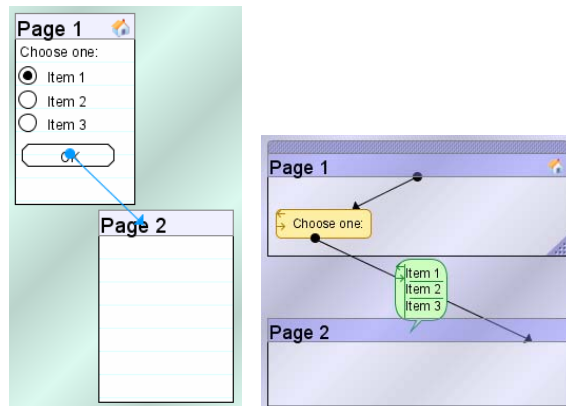
FIGURE 4-28   A set of radio buttons and a button that links to another page, and the equivalent voice design. Note that the text of the radio buttons is the same as the text of the response, while the destination of the arrow from the OK button is the same as the destination of the response.

One might think that a check box, list box, drop-down box, or set of radio buttons would more naturally map to several responses, one response per choice. We did not choose this for the following reason. Suppose you create a desktop page with a list box followed by a label, and that inserting the list box results in several separate responses inserted in the voice view. That would result in the following design:
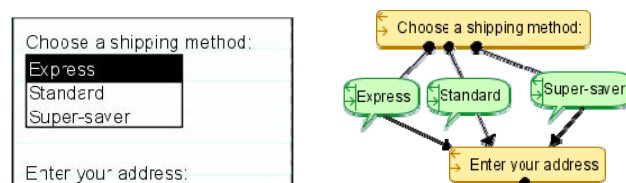
Now, suppose we take the "Express" response and point it to a different prompt. This results in the voice UI saying "Enter your address" if the user says "Standard" or "Super-saver," but the UI saying something else if the user says "Express." But this causes a dilemma for the desktop page: to remain consistent, the "Enter your address" label should be visible if "Standard" or "Super-saver" is selected but invisible when
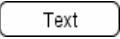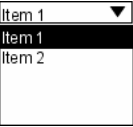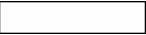
"Express" is selected. However, we do not want to complicate Damask's visual language to accommodate such a special condition, and it is doubtful that the designer would want such behavior.

Is there another way for Damask to keep the desktop page equivalent to the changed voice UI? Damask could split the page between the list box and the "Enter your address" label, add a "Next" button after the list box, and then create an arrow from the button, whose endpoint depends on the item selected in the list box. However, designers would not see all of these changes until they switched from the Voice view to the Desktop view. The drastic nature of these changes would almost certainly result in total confusion for the designers, who would be wondering what they did to cause that page to be split.

All of this is a consequence of the fact that we have one common model backing up desktop, smartphone, and voice designs.

Table 4.2 lists the control that is created in the desktop and smartphone views when a control in the voice view is added.

TABLE 4.2 Voice controls and their corresponding visual controls.

Voice control		Corresponding visual control	
Response with no text (to connect two prompts without user input)		Nothing	
Response with one line of text		Button	
Response with two or more lines of text		Drop-down box	
Response with *		Text box	
Prompt		Label	

Furthermore, if the response points to another form or a control in another form, then an OK button will be added right after the corresponding desktop/smartphone control (unless that control is already a button or hyperlink). This is because voice responses encapsulate both receiving user input and acting on that input, whereas in a desktop/smartphone design, one control receives user input, while a button allows that input to be acted upon.

4.4.2 Synchronizing text between desktop/smartphone UIs and voice UIs

Often, the text between a desktop or smartphone UI and a voice UI is different, even if the general meaning is the same. For example, a desktop UI might have a check box labeled "Send Me a Copy," whereas a voice UI would ask the user, "Would you also like me to send a copy to you?" expecting a yes or no response. A designer could move the voice control to the This Device layer, but this would remove the check box

from the other views. The designer then would have to create new check boxes in the This Device layers in the desktop and smartphone views, and these new check boxes would not be synchronized.

Instead, we have another mechanism for controlling the synchronization of text between voice and desktop/smartphone UI designs (see Figure 4-29). On the left side of each prompt and response, there is a two-arrow icon. The designer clicks on the icon to toggle between keeping the text for that prompt synchronized and unsynchronized. When the text is not synchronized, the icon is dimmed.
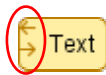
FIGURE 4-29   The "synchronize text" indicator, circled on this prompt, is dimmed to indicate the prompt's text is not to be synchronized with other devices.

4.5 Patterns

Damask comes with a catalog of 90 patterns, from the book *The Design of Sites* [188]. To view the patterns, the designer goes to the View menu and chooses Pattern Browser. The Pattern Browser window consists of three areas (see Figure 4-30). An index of all patterns runs along the left-hand side. The top part includes a toolbar, a search text box, and a pane that contains search results. The main part of the window is the description of the pattern that the designer has selected from the index, as well as links to other patterns that are related.

Toolbar

Toggles index

Search

Toggles search results

Search results

Expands or collapses section

Pattern description

Index of patterns

Shopping Cart (F3) - Damask - Pattern Browser

Back   Forward

Hide Pattern Index   Look for: shopping cart

Pattern Index

Site Branding (E1)

E-Mail Subscriptions (E2)

Fair Information Practices (E3)

Privacy Policy (E4)

About Us (E5)

Secure Connections (E6)

Basic E-commerce (F)

Quick-Flow Checkout (F1)

Clean Product Details (F2)

Shopping Cart (F3)

Quick Address Selection (F4)

Quick Shipping Method Selection (F5)

Payment Method (F6)

Order Summary (F7)

Order Confirmation And Thank-You (F8)

Easy Returns (F9)

Advanced E-Commerce (G)

Featured Products (G1)

Cross-Selling and Up-Selling (G2)

Personalized Recommendations (G3)

Recommendation Community (G4)

Search   « Hide Results

Search Results - shopping cart - 20 matches found

Quick Address Selection (F4) - Background
Quick-Flow Checkout (F1) - Background
Quick Shipping Method Selection (F5) - Background
Shopping Cart (F3) - Name

Shopping Cart (F3)

Illustration

amazon.com.

WELCOME   DIRECTORY

Search: All Products   GO

Already a customer?
Sign In

Shopping Cart Items—To Buy Now

Continue Shopping   on the Video home page

Proceed to checkout

Database Nation : The Death of Privacy in the 21st Century
Simson Garfinkel; **Hardcover**
Usually ships in 24 hours

TODAY'S FEATURED STORES

BOOKS   SHOPS   COMPUTER & VIDEO GAMES   KITCHEN

| YOUR ACCOUNT |

Browse :   Books

See more items like those in your cart

Returning customer? Sign In to turn on 1-Click ordering.

Qty:

1   update

List Price: $24.95
Our Price: $19.96
You Save: $4.99 (20%)

Subtotal: $19.96

If you changed any quantities, please press this
button to

(www.amazon.com, October 26, 2000) Amazon.com's shopping cart keeps navigation
to the rest of the site clearly indicated at the top of the page, but it makes checking out

FIGURE 4-30 The pattern browser.

Each pattern has five parts, which is similar to the structure of patterns found in several publications such as *A Pattern Language* [4] and *The Design of Sites* [188]:

- name

- background and sensitizing image

- problem

- solution

- related patterns

Each section can be expanded or collapsed by clicking on the associated button with a chevron (see Figure 4-31).
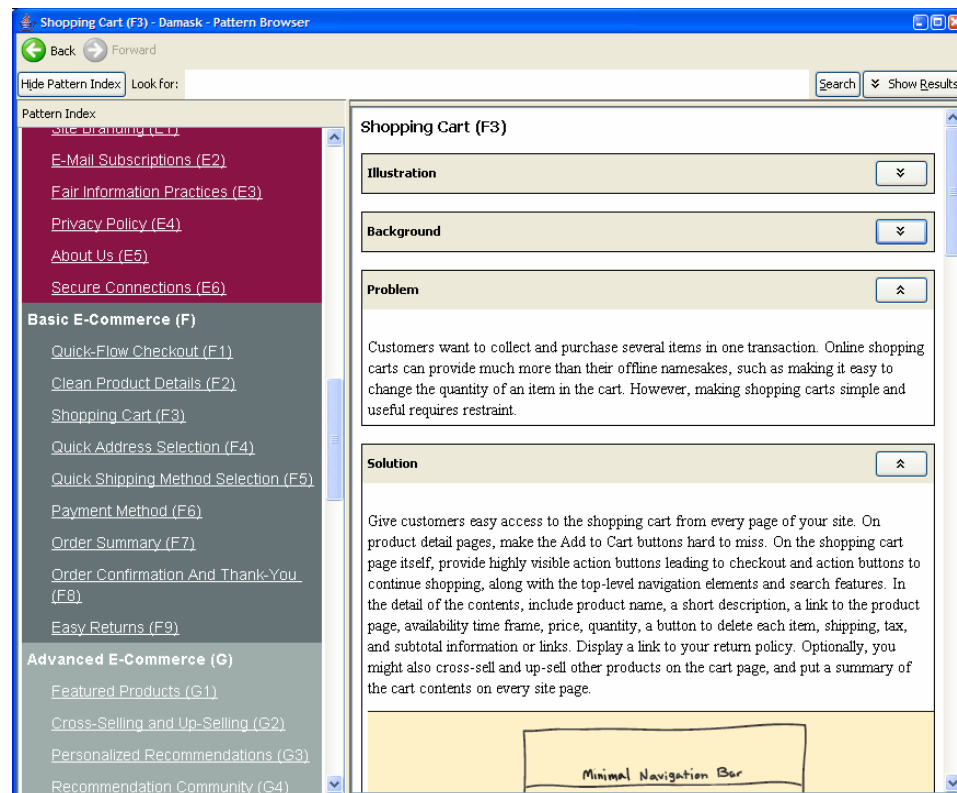
FIGURE 4-31 The pattern browser with the Illustration and Background sections collapsed.

For eleven of the patterns, the Solution section contains generalized solutions for that pattern, with one solution for each device supported by Damask (see Table 4.3).

The patterns that were implemented were low level enough to have a meaningful set of pages and controls (as opposed to a pattern such as SITE ACCESSIBILITY, which is more conceptual). Each solution is simply a Damask design, with the same structure as a UI design that a designer created in Damask (see Figure 4-32). Since the pattern already takes care of issues such as putting pages and controls in the appropriate layer, designers using it could potentially save a lot of time, if it fit their needs.

We picked the patterns listed in Table 4.3 to implement, primarily because they formed a cohesive group around which we could create an experiment for evaluation, which is described in Chapter 0. Damask-based solutions would be suitable for more than the eleven implemented, but they were not done due to time constraints.

TABLE 4.3   The patterns for which Damask solutions were implemented.

B8	Category Pages
C1	Homepage Portal
F1	Quick Flow Checkout
F2	Clean Product Details
F3	Shopping Cart
F4	Quick Address Selection
F5	Quick Shipping Method Selection
F6	Payment Method
F7	Order Summary
F8	Order Confirmation and Thank You
H2	Sign In/New Account
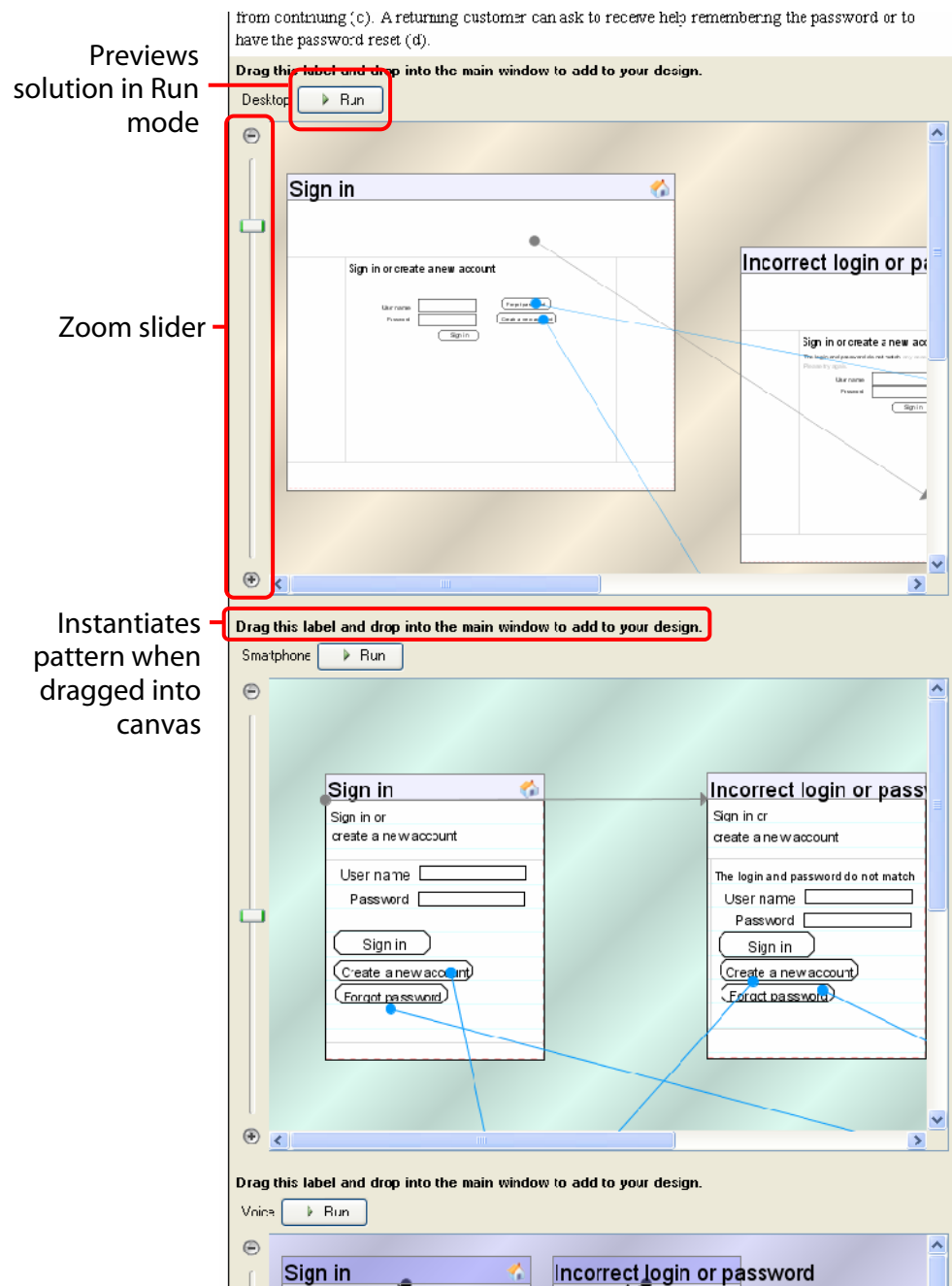
FIGURE 4-32 The pattern browser showing solutions of the SIGN-IN/NEW ACCOUNT pattern for the desktop and smartphone, which can be added to a Damask design.

For each device-specific solution, designers can zoom in and out using the zoom slider, and preview the solution in Run mode by clicking the Run button. To add a pattern instance to a Damask design, the designer drags the label that starts with

Drag this label and drop into… directly onto the canvas in the main window. Damask instantiates the pattern and adds the instance to all devices, regardless of the current layer in the main window. This means that it does not matter which device solution the designer drags and drops.

A designer can also merge a new pattern instance with an existing page, by dragging the aforementioned label on top of an existing page. This merges that existing page with the "home page" of the pattern, denoted with a home icon in the Pattern Browser. Only one existing page can be merged with a pattern page.

The pattern instance is surrounded by a blue dotted box plus the name of the pattern in transparent blue text (see Figure 4-33). It automatically resizes itself if the elements that make up the pattern instance are moved or deleted.
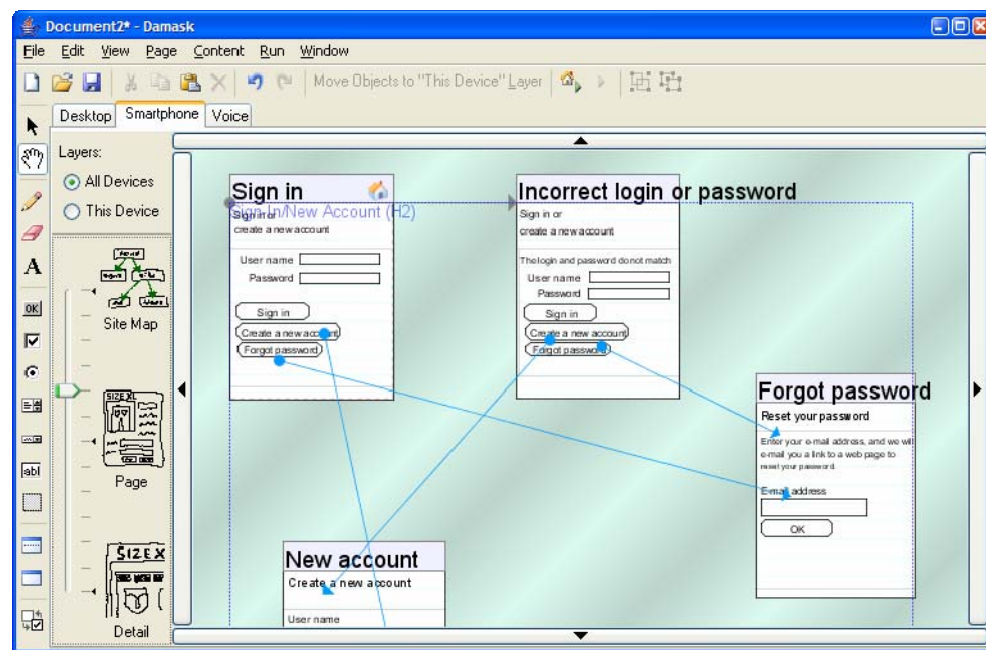
FIGURE 4-33 An instance of the SIGN-IN/NEW ACCOUNT pattern in a UI design.

Designers can now change the pattern instance in any way they want, including adding, deleting, and moving around controls, arrows, or pages. The original pattern

is unaffected. The relationship between a pattern solution and a pattern instance is similar to a prototype-instance relationship in prototype-based object-oriented languages such as Self [172] and JavaScript [44], and user interface management systems (UIMSs) like Garnet and Amulet [136].

4.6 Summary

Damask's design reflects the concerns that cross-device user interface designers had expressed in our interviews and an evaluation of our initial cross-device UI design tool. Its use of model-based UI principles and layers allow designers quickly see how changes they make to one device UI manifest themselves in the other device UIs. Layers let designers control which parts of their design get retargeted to other devices and which do not. Designers can create common elements in their UI designs using Damask's templates feature. Finally, design patterns include prebuilt UI design fragments that can have very different interaction flows depending on the device, which facilitates the creation of cross-device user interface designs that are optimized for each target device.

5 Architecture and Implementation of Damask

Damask is written in Java 2 Standard Edition version 1.4. Besides the standard Java libraries, it uses two other libraries. SATIN [71] is a library for pen-based applications. Damask uses it specifically for recognizing whether ink strokes should be grouped. Piccolo [21] is a 2D graphics library for Java, which Damask uses for the canvas area.

The architecture of Damask is based on the model-view-controller (MVC) pattern [93]. MVC decouples the data model from the user interface, allowing multiple views and types of user interaction to manipulate the same data model. In Damask's case, the view is the UI of Damask that was described in Chapter 4, while the model is the abstract model of the user interface being designed by the designer. When the user interface receives an event from the designer, such as a key press or a mouse move, the UI calls a method in the controller, which modifies the model. When the model is changed, it fires events. The view objects listens for events and adjusts the user interface appropriately.

We will first discuss the model and the basic architecture, and then talk in more detail about how the model relates to the Desktop and Smartphone views and the Voice view.

5.1 Implementation of Model Objects

In this section we will talk about how the model backing the user interface is implemented.

5.1.1 *Interaction graph and interaction elements*

`InteractionElement` is the base class for every element within a model, including dialogs, components within dialogs, and connections (see Figure 5-1). (Actually, for implementation purposes, `InteractionElement` is an interface which only one class implements, `AbstractInteractionElement`. But to simplify this discussion, we will consider `InteractionElement` and `AbstractInteractionElement` to be equivalent.) Instances of `InteractionElement` are organized within a scenegraph. The root of the scenegraph is an instance of the `InteractionGraph` class, which contains three lists, `Dialogs`, `Connections`, and `PatternInstances`, all of which are subclasses of `InteractionElement` (see Figure 5-2).

Devices are represented by instances of `DeviceType`. A `DeviceType` contains information like a name and screen dimensions (for visual devices). Damask has three types: `DeviceType.DESKTOP`, `DeviceType.SMARTPHONE`, and `DeviceType.VOICE`. A fourth type, `DeviceType.ALL`, represents any device.

`InteractionElement` contains methods that return the bounding box and the affine transform that controls its position. These methods are parameterized by a device, represented by an instance of `DeviceType`. For example, let `l` be a label and `e` be its corresponding `InteractionElement` instance. Suppose `l` is in the All Devices layer, and has a size of 100×20 pixels and a location of (40, 30) in every device. Then, `e.getBounds(device)` returns a rectangle of (0, 0, 100, 20) and

`e.getTransform(device)` will return a translation transform of (40, 30), for *all*

devices.

In contrast, now suppose 1 is in the This Device layer of the Desktop view, and

has a size of 80×20 pixels and a location of (70, 50). Therefore,

`e.getBounds(DeviceType.DESKTOP)` returns a rectangle of (0, 0, 80, 20) and

`e.getTransform(DeviceType.DESKTOP)` returns a translation transform of (70, 50).

However, because it is in the This Device layer, 1 does not exist in the other two

devices. Therefore, both `e.getBounds(device)` and `e.getTransform (device)`

return null, if `device` equals `DeviceType.SMARTPHONE` or `DeviceType.VOICE`.
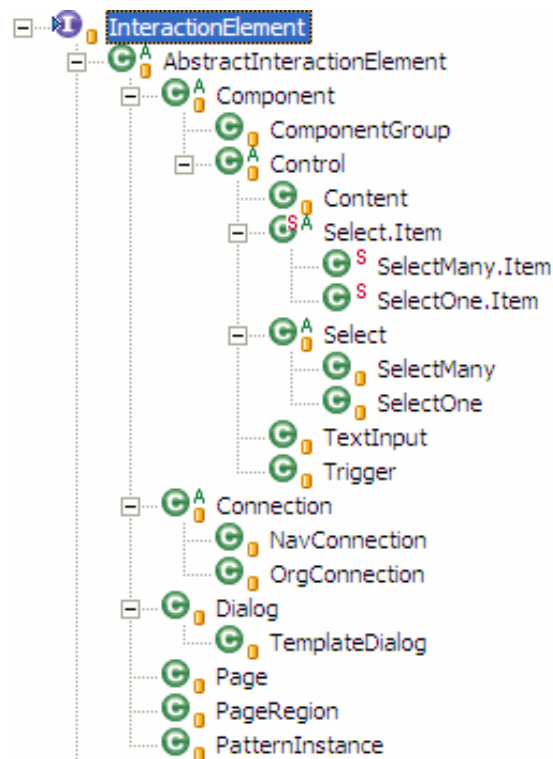
FIGURE 5-1   The class hierarchy for `InteractionElement`. For implementation purposes, `InteractionElement` is actually an interface, but it has only one implementation, `AbstractInteractionElement`.

FIGURE 5-2 The model (left) for a typical smartphone user interface design (right).

5.1.2 Layers
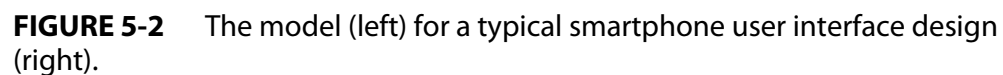
The user interface concept of layers is implemented indirectly. Each `InteractionElement` object has a `deviceType` property that is set when the object is constructed. If the `deviceType` is a single device, such as `DeviceType.DESKTOP`, then the element's view object is in the This Device layer of the corresponding device's view (in this case, the Desktop view). If the `deviceType` is `DeviceType.ALL`, then the element's view object is in the All Devices layer in every device-specific view.

5.1.3 Dialogs and templates

When a designer creates a page in the Desktop or Smartphone view, an instance of Dialog is created in the model. A Dialog contains a list of instances of Pages for each device type (see Figure 5-3). For example, when a designer creates a page on the All Devices layer, the new page's Dialog has three lists, each containing one Page. In contrast, when a designer creates a page on the This Device layer on the Desktop view, only the list of desktop-specific Pages in the Dialog contains an instance of Page, while the other two lists are empty.
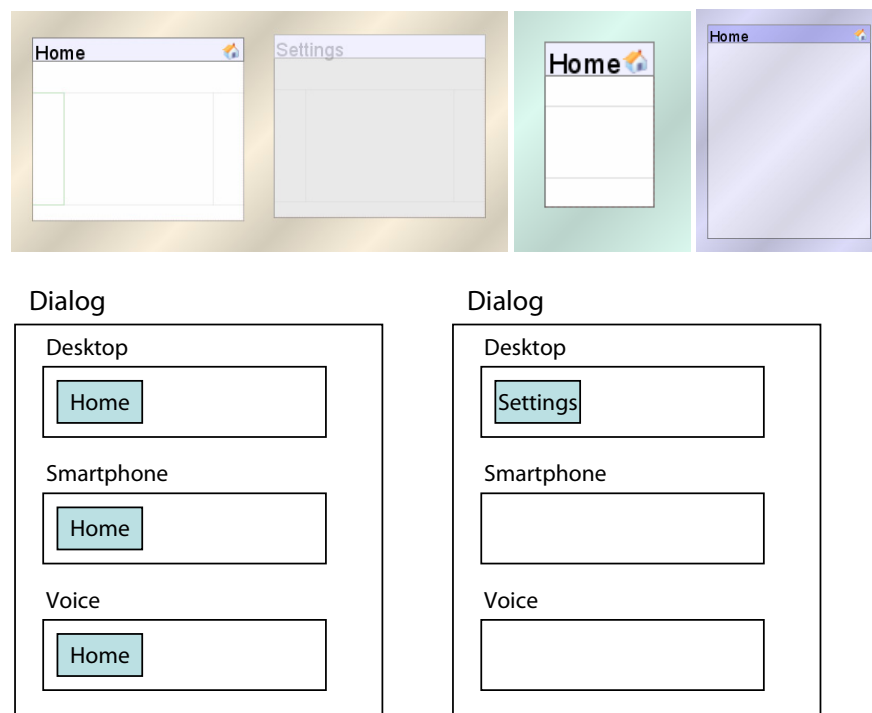
FIGURE 5-3   A page that is on the All Devices layer ("Home") and a page that is on the This Device layer in Desktop view ("Settings"), along with the associated model.

Normally, for a desktop or smartphone design, there is one Page for each supported device within a Dialog. However, splitting a page results in the model adding a new Page to the appropriate list in the Dialog, with the appropriate contents

moved from the original `Page` to the new `Page`. So a desktop or smartphone `Page` in the model represents a desktop or smartphone page in the user interface, and a `Dialog` groups together pages that have been split. `Dialogs` themselves are invisible in the user interface.

Each `Page` contains five `PageRegions`, which correspond to the page regions seen in Figure 4-4. Each `PageRegion` contains a list of zero or more user interface `Controls` (see Figure 5-2).

A template in Damask is implemented by a `TemplateDialog`, which is a subclass of `Dialog`. A `Dialog` object contains a list of `TemplateDialog` objects that are being "applied" to the dialog.

5.1.4 Components

`Control` is the abstract base class of all user interface controls in Damask, which are loosely based on XForms [194] controls. Damask supports the following `Controls`:
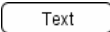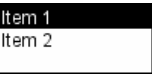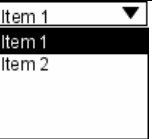
- `Content`: A piece of content, either ink, text, or an image
- `Trigger`: Lets the user transition from one page to another
- `SelectOne`: Allows the user to select one item from a collection
- `SelectMany`: Allows the user to select more than one item from a collection
- `TextInput`: Allows the user to input any text

`SelectOne` and `SelectMany` controls are actually composite `Controls`, each consisting of a list of `SelectOne.Items` and `SelectMany.Items`, respectively. Each `Item` is also a `Control`. `Trigger`, `SelectOne.Item`, and `SelectMany.Item` each contain an instance of `Content` that defines the text, image, or sketch that they display.

Table 5.1 shows the correspondence between controls in the desktop and smartphone views and `Controls` in the model. Both `Trigger` and `SelectOne` have a

`Style` property that determines how it is rendered in the Desktop and Smartphone views.

TABLE 5.1   Views of visual controls and their corresponding model objects.

View in desktop/smartphone		Control in model
Label	Text	Content
Button	Text	Trigger
Hyperlink	Text	
Radio buttons	Item 1 / Item 2	SelectOne
List box	Item 1 / Item 2	SelectOne.Item
Drop-down box	Item 1 / Item 2	SelectOne.Item
Check box	Text	SelectMany / SelectMany.Item
Text box		TextInput

Each `Dialog` also contains a list of `ComponentGroup`s. A `ComponentGroup` contains `Control`s or other `ComponentGroup`s. A `ComponentGroup` belongs to a `Dialog`, instead of a `Page`, so that if a `Page` is split, `Control`s that are in more than one `Page` can still be in the same `ComponentGroup`. The idea behind `ComponentGroup` was to allow groups of controls to be named and manipulated together, although this idea has not been fully explored in the current version of Damask. Currently, `ComponentGroup`s are realized as panels in the user interface (see Figure 5-4).
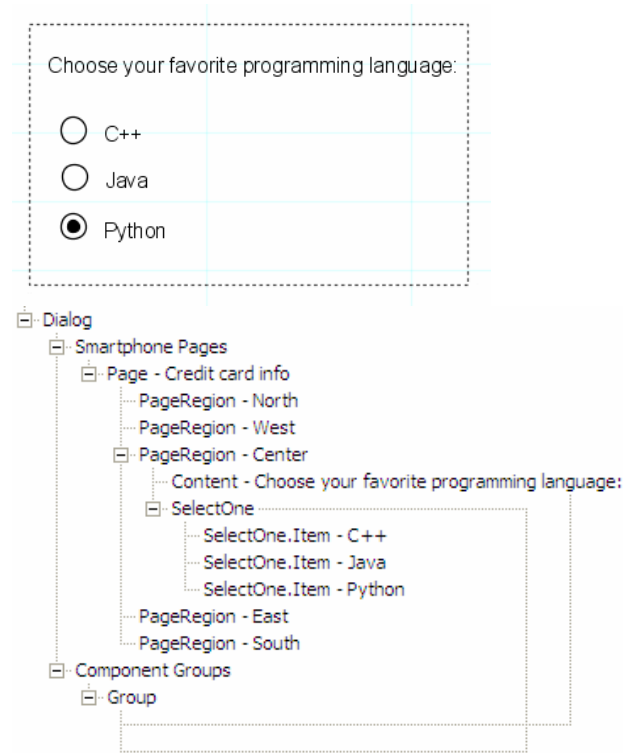
FIGURE 5-4   A panel with a label and three radio buttons, and the backing model. Note how the group only points to controls; it does not contain them.

5.1.5 Connections

The `Connection` class is the abstract base class of all connections in Damask. There are two types of connections. An organizational connection (`OrgConnection`) connects `Page`s together. A navigational connection (`NavConnection`) links a `Control` in one `Page` to another `Page`.

In desktop and smartphone views, `Connection`s are rendered as arrows. `OrgConnection`s are shown as gray arrows, while `NavConnection`s are shown as blue arrows.
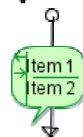
A `NavConnection` also has an event type which needs to be triggered by the end-user for the connection to be activated. There are five event types defined: `Select`, `Invoke`, `SecondaryInvoke`, `HoverOver`, and `HoverOff`. Currently, designers can only

create connections with `Invoke` events attached, which correspond to clicking on a hyperlink or button. `Select` is meant for selecting an item without triggering it, such as from a list. `SecondaryInvoke` is for right-clicking on a GUI or tap-and-hold on a Pocket PC. `HoverOver` and `HoverOff` are for moving the mouse cursor over or off of an object.

5.1.6 *Correspondence between model and voice view*

The correspondence between view objects in voice UI designs and their corresponding controls in the model is more complicated than in the case of desktop and smartphone UI designs. In addition to the basic properties inherited from `InteractionElement`, `Control`s also have optional voice-specific properties, such as the bounds and text of the voice prompt, or the coordinates of the response arrow. Table 5.2 shows the correspondence.

TABLE 5.2   Views of voice controls and their corresponding model objects.

View in voice		Control in model
Prompt		Content with "Text" as its text
Response with no text		Trigger with no content (invisible in desktop/smartphone)
Response "Text"		Trigger with "Text" as its content
Response with *		TextInput, followed by Trigger with content "OK"
Response with two or more lines of text		SelectOne with 2 choices (Item 1, Item 2), followed by Trigger with content "OK"

Note that *every* response created by the designer has a Trigger associated with it. This is because voice responses encapsulate both receiving user input (represented by a control like a `TextInput` or `SelectOne`) and acting on that input (represented by a `Trigger`).

Now we will explain how these controls are linked together to form a voice user interface. In a desktop or smartphone interface, the controls within a page do not have any dependencies with each other, so a list of Controls within a Page is sufficient. However, in a voice UI, a flat list is not enough structure for a network of prompts and responses within a form.

Instead, we group together the `Controls` that represent a prompt and all responses that originate from that prompt, and place them into one `Page`. We then use `NavConnection`s to link the `Trigger`s in one `Page` to another `Page`. This allows us to form a network of prompts and responses. Figure 5-5 shows an example.
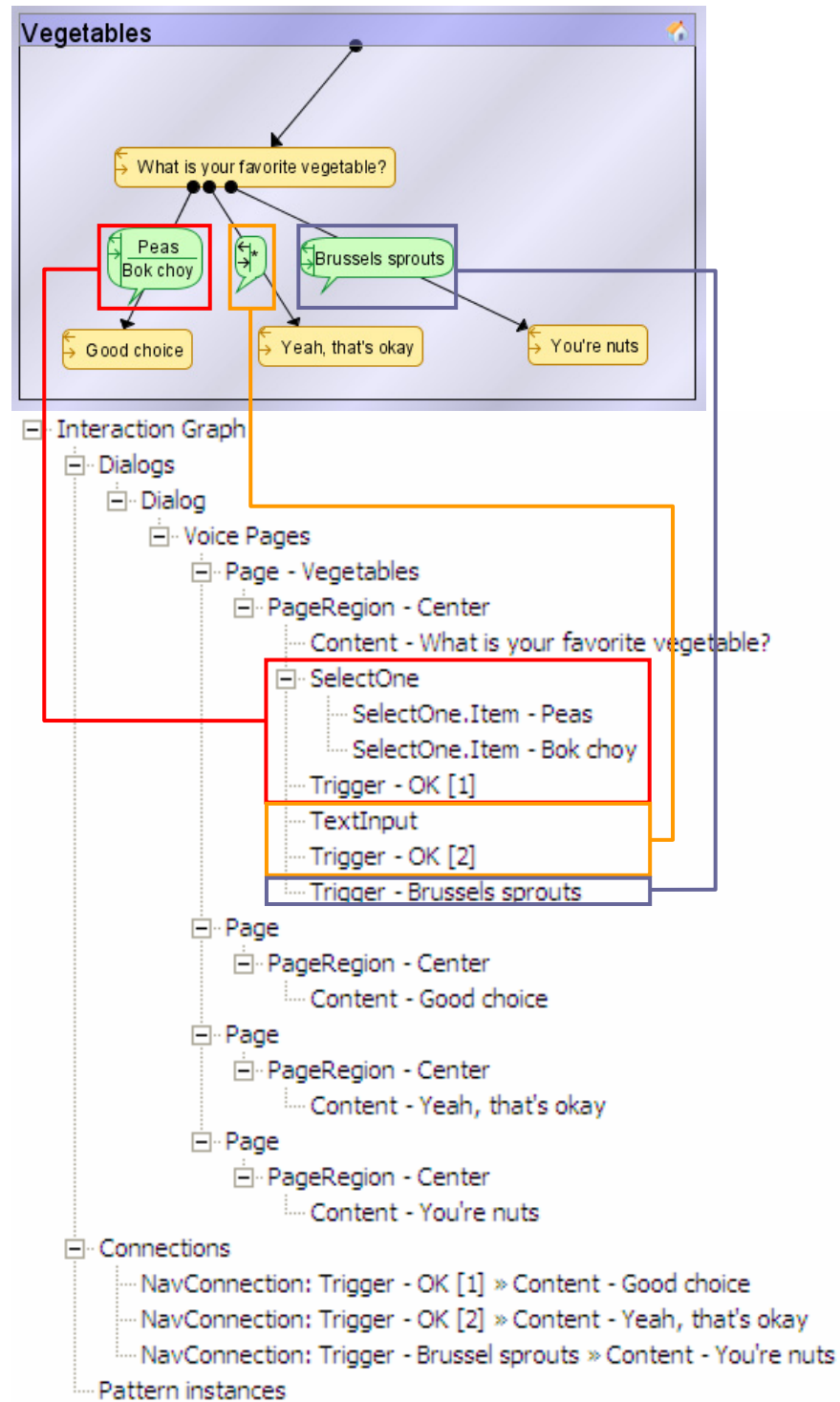
FIGURE 5-5 A voice UI in Damask and its corresponding model. Empty page regions are omitted for brevity.

5.1.7 *Patterns and pattern instances*

The basic description of each pattern is stored in a file in a format called the Pattern Language Markup Language (PLML) [46], which is based on XML. The background image and Damask-based solution are stored in separate files, referenced by the PLML file. When Damask is started, a stub entry for each pattern is placed into Damask's pattern library. The stub is replaced with the actual pattern when the user views the pattern in the Pattern Explorer. This is to save memory.

Damask has several classes to manage patterns. `Pattern` represents a pattern; it has properties for subsections such as `Name`, `Background`, and `Solution`. `PatternSolution` represents the Damask solution that some of the patterns include; it is a subclass of `InteractionGraph`. `PatternInstance` represents an instance of a pattern within a Damask UI design. A `PatternInstance` object does not contain the elements that make up the pattern instance, since members of an instance can cut across pages and groups. Instead, it points to the elements within the main `InteractionGraph` that represents the design.

To add an instance of a pattern within a design:

1 The pattern's solution, an instance of `PatternSolution`, is cloned. This of course also clones the `Dialog`s, `Connection`s, and `PatternInstance`s within the `PatternSolution`.

2 The `Dialog`s, `Connection`s, and `PatternInstance`s in the cloned `PatternSolution` are then removed from the `PatternSolution` and merged directly into the `InteractionGraph` object representing the original design. The cloned `PatternSolution` is disposed.

3   Finally, a new `PatternInstance` object, that references the `Dialogs`,
    `Connections`, and `PatternInstance`s that were moved in Step 2, is created
    and added to the `InteractionGraph`.

See Figure 5-6.
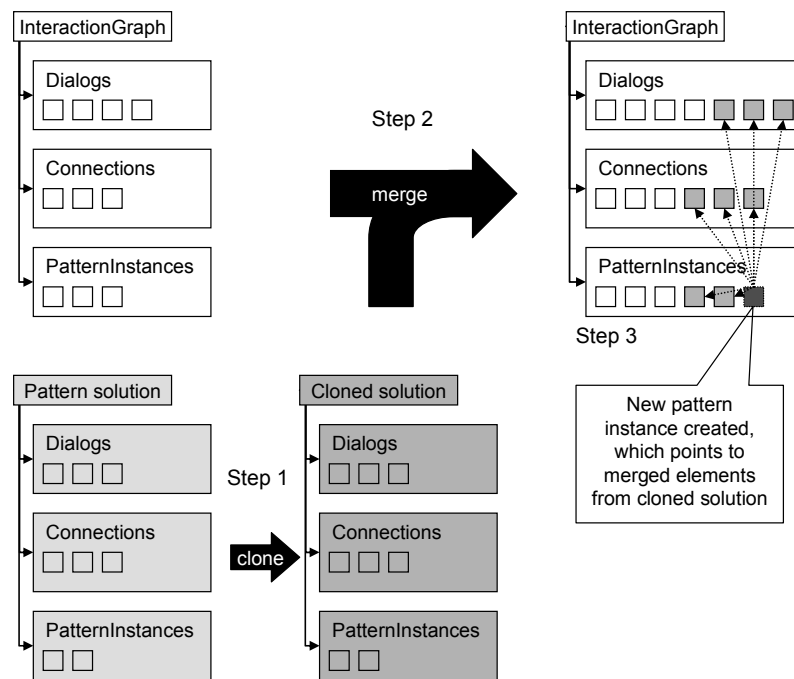
FIGURE 5-6   Instantiating a pattern.

5.2 Implementation of View Objects

Piccolo [21] is a 2D graphics library for Java. It uses a scenegraph to structure the
objects drawn in a canvas, and adds high-level support for zooming, animation, event
handling, picking objects, and so on. Damask uses Piccolo heavily, subclassing many
of its classes for Damask's user interface. All of Piccolo's classes begin with a capital P.

5.2.1 *Canvas*

Each device-specific canvas in Damask is an instance of `DamaskCanvas`, which is a
subclass of `PCanvas`. `PCanvas` is the bridge that allows Piccolo graphics to be

embedded in a Swing interface. The `DamaskCanvas` object views an instance of a subclass of `PLayer`. (This should not be confused with the concept of layers described in Section 4.4.) The actual graphical objects that make up a Damask design reside within the `PLayer`. Desktop and smartphone designs reside on a `VisualLayer`, while voice designs are on a `VoiceLayer`. The zoom slider and the panning buttons in the UI (see Figure 4-1) zoom and pan the canvas by changing the scale and translation transform attached to the `DamaskCanvas`'s camera.

5.2.2   Views of interaction elements

Just like `InteractionElement` is the base class of every model class, `InteractionElementView` is the base class of every view class. `InteractionElementView` is a subclass of `PNode`, which is the base class in Piccolo for all graphical objects. A `PNode` object keeps track of its bounding box, has an affine transform attached to it that affects its scale and position, and can contain other `PNode`s. One can subclass `PNode` to override its drawing behavior. For example, `PPath` draws an arbitrary graphical path that is passed into its constructor.

`PNode`s can also handle UI events, such as keyboard and mouse events, by attaching an event listener. When a UI event occurs, Piccolo dispatches the event to the node in the scenegraph which has the focus, typically a leaf node. If that node has an event listener that can handle the event, it will be called. Otherwise, it will percolate up the scenegraph until it reaches a node that can handle it, or no node handles the event and it is dropped.

Subclasses of `InteractionElementView` handle views for dialogs, pages, controls, connections, and pattern instances. Figure 5-7 shows the class hierarchy for

`InteractionElementView`. We will explain these classes in more detail in the following sections.

```
Object
  PNode
    DamaskPPath
      InteractionElementView
        Arrow
        ComponentView
          ControlView
            Button
            CheckBox
            CheckBoxGroup
            ComboBox
            Hyperlink
            Label
            ListBox
            RadioButton
            RadioButtonGroup
            TextBox
          Panel
        Conversation
        DamaskWindow
          Form
          PageView
        DialogView
        PageRegionView
        PatternInstanceView
        VoicePart
          Prompt
          Response
          VoiceComponent
            VoiceControl
              VoiceContent
              VoiceSelectMany
              VoiceSelectManyItem
              VoiceSelectOne
              VoiceTextInput
              VoiceTrigger
            VoicePanel
```

FIGURE 5-7   The class hierarchy for `InteractionElementView`.

5.2.3 Pages and controls

For almost every model object that represents pages and controls, there is an equivalent view object for desktop/smartphone UIs and voice UIs. Figure 5-8 shows a typical runtime structure, for the same UI that is shown in Figure 5-2.

```
□ VisualLayer
  □ DialogView
    □ PageView - Credit card info
        PageRegionView - North
        PageRegionView - West
      □ PageRegionView - Center
          Label - Please enter your credit card information:
          Label - Cardholder Name
          TextBox
          Label  - Credit Card Type
          ComboBox (with 3 items: Visa, MasterCard, Discover)
          Label - Credit Card Number
          TextBox
          Label - Expiration Date
          TextBox
        □ CheckBoxGroup
            CheckBox - Use my shipping address
          Button - Continue
        PageRegionView - East
        PageRegionView - South
  □ DialogView
    □ PageView - Another page
        PageRegionView - North
        PageRegionView - West
        PageRegionView - Center
        PageRegionView - East
        PageRegionView - South
    Arrow: Button - Continue  » Page - Another page
```

```
□ VoiceLayer
  □ Form - Credit card info
    □ Conversation [1]
      □ VoiceContent
          Prompt - Now we will ask you for information on your credit card.
      □ VoiceTrigger
          Response - (blank): Prompt - Now we will ask...  » Conversation [2]
    □ Conversation [2]
      □ VoiceContent
          Prompt - What is the name on the card?
        VoiceTextInput
      □ VoiceTrigger
          Response - *: Prompt - What is the name...  » Conversation [3]
    □ Conversation [3]
      □ VoiceContent
          Prompt - What type of credit card do you have: Visa, MasterCard, or Discover?
        VoiceSelectOne
      □ VoiceTrigger
          Response - (Visa, MasterCard, Discover): Prompt - What type of...  » Conversation [4]
    □ Conversation [4]
      □ VoiceContent
          Prompt - What is your credit card number?
        VoiceTextInput
      □ VoiceTrigger
          Response - *: Prompt - What is your...  » Conversation [5]
    □ Conversation [5]
      □ VoiceContent
          Prompt - When does the card expire?
        VoiceTextInput
      □ VoiceTrigger
          Response - *: Prompt - What does the...  » Conversation [6]
    □ Conversation [6]
      □ VoiceSelectMany
        □ VoiceSelectManyItem
            Prompt - Is the billing address the same as the shipping address?
      □ VoiceTrigger
          Response: (Yes, No) - Is the billing...  » Conversation [7]
  □ Form - Another form
      Conversation [7]
```

FIGURE 5-8   The scenegraph (top left and bottom left) for a smartphone UI (top right) and its equivalent voice UI (bottom right).

Table 5.3 lists the model objects and the corresponding view objects. All of the view objects are descendants of PNode—none of them are Swing widgets. It should look familiar, as it is the basis of Tables 4.1, 4.2, 5.1, and 5.2.

TABLE 5.3   The model objects for pages and controls, along with their corresponding view objects.

Model	Desktop/Smartphone View	Voice View	Components of VoiceView
Dialog	DialogView (invisible)	Form	
Page	PageView	Conversation	
PageRegion	PageRegionView	(none, merged with Conversation)	
OrgConnection	Arrow	(none)	
NavConnection	Arrow	determines destination of Response	
Content	Label	VoiceContent	Prompt
Trigger	Button Hyperlink	VoiceTrigger	Response
TextInput	TextBox	VoiceTextInput	(determines text of Response of following Trigger)
SelectOne	RadioButtonGroup ListBox ComboBox	VoiceSelectOne	(determines text of Response of following Trigger)
SelectOne.Item	RadioButton	(none)	(none)
SelectMany	CheckBoxGroup	VoiceSelectMany	
SelectMany.Item	CheckBox	VoiceSelectManyItem	Prompt (determines text of Response of following Trigger)

Keeping with the model-view-controller paradigm, virtually all changes to the model go through the controller, which changes the model, which fires events that the views listen to and change themselves. The following explains what happens when the designer wants to add a button to a desktop page in the All Devices layer

(i.e., the equivalent button and trigger also will be added to the smartphone and voice views, respectively). Other events, such as adding a page or deleting an object, occur in essentially the same way.

1.   When the designer selects the button tool, the `VisualCanvas` object attaches the associated event listener, which is an instance of `InsertButtonHandler`, to itself.

2.   When the designer clicks on the `PageRegionView`, the `InsertButtonHandler` handles the event. It creates a new instance of the model object associated with a button, `Trigger`, and fills in the appropriate desktop properties such as location. Then it creates a new command for adding the `Trigger` to the appropriate `PageRegion`. The command figures out what the appropriate smartphone and voice properties of the new `Trigger` should be. Finally, it asks the command queue associated with the current document to execute the command.

3.   The command queue executes the command, which adds the new `Trigger` to the specified `PageRegion`. This fires an `elementAdded` event to anyone listening to changes to the `PageRegion`.

4.   The `PageRegionView`s in Desktop and Smartphone view receives the `elementAdded` event. In response, it creates a Button with the Trigger's properties, and adds the Button to itself. Likewise, the associated Conversation in Voice view receives the `elementAdded` event, creates a `VoiceTrigger`, and adds the `VoiceTrigger` to itself.

All edits go through the same process of setting up a `Command` and having the command queue execute it. When the designer creates or deletes an object, or changes its caption if it has one, Damask constructs the `Command` so that the action

affects all devices if the object is in the All Devices layer. Currently, moving an object results in a `Command` that affects only one device.

To undo or redo an action, Damask simply calls the command queue to undo or redo. All commands in Damask have undo and redo capabilities.

5.2.4 Layers

Layers in Damask are implemented indirectly. Suppose the designer is in the Desktop view and changes the active layer from All Devices to This Device. First, the `VisualLayer` sets a `deviceTypeForNewElement` property from `DeviceType.ALL` to `DeviceType.DESKTOP`. This property determines the device type of all new objects created in the `VisualLayer`. Then every object in the `VisualLayer` compares its model's `deviceType` property with the `VisualLayer`'s `deviceTypeForNewElement` property. If they do not match, then the object is grayed out and is not selectable; otherwise, the object is drawn normally and is selectable.

5.2.5 Templates

The implementation of templates takes advantage of Damask's mvc architecture. As mentioned earlier, a `Dialog` object maintains a list of `TemplateDialog` objects to represent the templates being applied to the dialog. In the corresponding desktop and smartphone views, the `PageRegionViews` that make up the corresponding `DialogView` register listeners for events from the `TemplateDialog`. That way, when `Control`s are added or removed from the `TemplateDialog`, all of the corresponding `DialogViews` can add or remove corresponding `ControlViews`. A similar operation occurs in the voice view.

5.2.6 Patterns and pattern instances

There are two main view classes for patterns and pattern instances. A `PatternInstanceView` object draws the text and the blue dotted box around a pattern instance. A `PatternBrowser` object represents the Pattern Browser window. It uses standard Swing widgets to render the contents of the window, including the Search box, the patterns index, and the pattern itself.

Damask uses Java's standard drag-and-drop mechanism to support dragging a pattern solution and dropping it on to the main window for pattern instantiation. When a designer drags a solution from the Pattern Browser window, the `PatternBrowser` object takes the `PatternSolution` object associated with the current `Pattern` instance and the wraps it in a `Transferable`, which is a standard Java class for handling data being dragged and dropped. When the designer drops it in the main window, the `DamaskCanvas` has a `DropTargetListener`, another standard Java interface, that listens for objects being dropped onto it. The `DropTargetListener` figures out whether the object being dropped is a `DamaskSolution`. If it is, then a `Command` is created that performs the steps for pattern instantiation described in Section 5.1.7.

5.3 Run mode

When the designer opens a page in Run mode, a new window called a `DamaskRunFrame` is created. It contains Back and Forward buttons and a `DamaskRunCanvas`, a descendant of `PCanvas`, where the page is displayed. The `DamaskRunCanvas` takes the page and creates a `PageView`, just like a normal `DamaskCanvas`. It also sets the `PageView`'s `InRunMode` property to true. This attaches

an event listener for every `ControlView` within the `PageView`. The event listener listens for UI events from the designer in the Run window.

For example, when a `Button` is pressed in the Run window, the attached event listener inverts the `Button`'s color when the mouse is pressed. When the mouse is released, it gets the `Trigger` object that is the model for the `Button`, finds the `NavConnection` whose source is the `Trigger`, finds the destination `Page` of the `NavConnection`, and then tells the `DamaskRunCanvas` to display the destination `Page`.

5.4 VoiceXML Generation

Explaining VoiceXML generation is best done with respect to an example (see Figure 5-9).
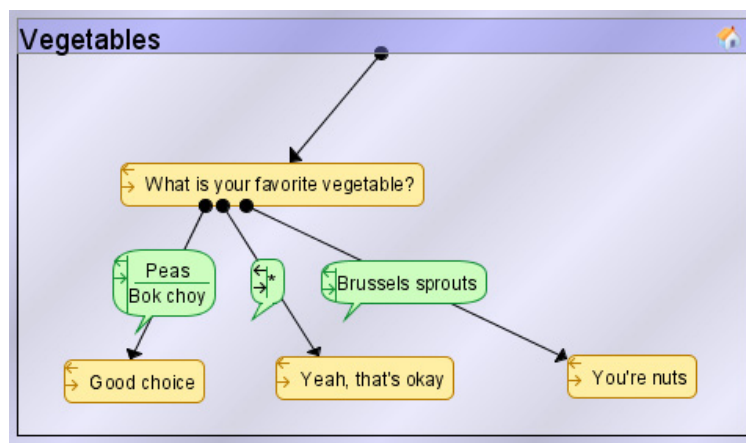
FIGURE 5-9   An example voice UI for generating a VoiceXML file. This is the same as Figure 5-5.

In a VoiceXML interface, groups of related voice functionality are divided into `<form>`s. To generate a VoiceXML file from a voice user interface, first Damask creates a `<form>` for each `Page`, which in a voice ui is a prompt and all responses that originate from that prompt. In this case, there will be four `<form>`s, one for each prompt. Each `<form>` has an associated `<field>`, which is essentially a variable. The

value of the variable will be set depending on what the user says. The field is not used

in all cases, but it does not hurt to generate it.[1]

```xml
<?xml version="1.0" encoding="UTF-8"?>
<vxml version="2.0">
  <form id="form_home">
    <field name="field_vegetable">
    </field>
  </form>
  <form id="form_good">
    <field name="field_good">
    </field>
  </form>
  <form id="form_okay">
    <field name="field_okay">
    </field>
  </form>
  <form id="form_bad">
    <field name="field_bad">
    </field>
  </form>
</vxml>
```

For each prompt in the Damask design, a `<prompt>` tag is added to the

appropriate `<form>`. (The rest of the VoiceXML examples focus on `<form_home>`, since

that is where most of the complexity in this example is.)

```xml
<form id="form_home">
  <field name="field_vegetable">
    <prompt>
      <audio>What is your favorite vegetable?</audio>
    </prompt>
  </field>
</form>
```

---

[1] In the VoiceXML snippets, we are using human-readable names for the `id` and `name` attributes to make them easier to follow. However, Damask actually uses machine-generated GUIDs.

A `<grammar>` tag is set up to handle the user's response. Each entry in the grammar corresponds to one response in the Damask design. The grammar assigns a value to the field depending on what the user says. In this case, if the user says "Brussels sprouts," then the field `field_vegetable` is assigned the value "bad_vegetable." If the user says "peas" or "bok choy," then `field_vegetable` is assigned "good_vegetable."

```
<form id="form_home">
  <field name="field_vegetable">
    <prompt>
      <audio>What is your favorite vegetable?</audio>
    </prompt>
    <grammar type="application/x-gsl" mode="voice">
      <![CDATA[[
      [(brussels sprouts)] {<field_vegetable "bad_vegetable">}
      [peas (bok choy)] {<field_vegetable "good_vegetable">}
      ]]>
    </grammar>
  </field>
</form>
```

The response with the asterisk (*), which matches all utterances that do not match any other response, is handled by the `<nomatch>` tag, which in this case makes the UI go to the `form_okay` form. If there is no response with an asterisk, then a default `<nomatch>` tag is generated, in which the computer says, "I'm sorry, I didn't get that," and then replays the `<prompt>`.

```
<form id="form_home">
  <field name="field_vegetable">
    <prompt>
      <audio>What is your favorite vegetable?</audio>
    </prompt>
    <nomatch>
      <goto next="#form_okay" />
    </nomatch>
    <grammar type="application/x-gsl" mode="voice">
      <![CDATA[[
      [(brussels sprouts)] {<field_vegetable "bad_vegetable">}
```

```
      [peas (bok choy)] {<field_vegetable "good_vegetable">}
      ]]]>
    </grammar>
  </field>
</form>
```

A `<filled>` tag handles what to do once the field has been assigned. In this case,
the UI goes to different forms depending on the field's value.

```
<form id="form_home">
  <field name="field_vegetable">
    <prompt>
      <audio>What is your favorite vegetable?</audio>
    </prompt>
    <nomatch>
      <goto next="#form_okay" />
    </nomatch>
    <grammar type="application/x-gsl" mode="voice">
      <![CDATA[[
      [(brussels sprouts)] {<field_vegetable "bad_vegetable">}
      [peas (bok choy)] {<field_vegetable "good_vegetable">}
      ]]]>
    </grammar>
    <filled>
      <if cond="field_vegetable == 'good_vegetable'">
        <goto next="#form_good" />
        <elseif cond="field_vegetable == 'bad_vegetable'" />
        <goto next="#form_bad" />
      </if>
    </filled>
  </field>
</form>
```

Finally, to handle the case where the user does not say anything within a default
period of time, Damask always inserts a `<noinput>` tag, which says a message and
then replays the `<prompt>`.

```
<form id="form_home">
  <field name="field_vegetable">
    <prompt>
      <audio>What is your favorite vegetable?</audio>
    </prompt>
    <nomatch>
      <goto next="#form_okay" />
```

```
        </nomatch>
        <grammar type="application/x-gsl" mode="voice">
          <![CDATA[[
          [(brussels sprouts)] {<field_vegetable "bad_vegetable">}
          [peas (bok choy)] {<field_vegetable "good_vegetable">}
          ]]]>
        </grammar>
      </field>
        <filled>
          <if cond="field_vegetable == 'good_vegetable'">
            <goto next="#form_good" />
            <elseif cond="field_vegetable == 'bad_vegetable'" />
            <goto next="#form_bad" />
          </if>
        </filled>
        <noinput>
          <audio>I'm sorry, I didn't hear you.</audio>
          <reprompt />
        </noinput>
    </form>
```

Figure 5-10 is the entire generated VoiceXML file for the voice UI in Figure 5-9,

with the original machine-generated IDs.

```
<?xml version="1.0" encoding="UTF-8"?>
<vxml version="2.0">
  <form id="formid_75_37cb61f8f3397d86_5f797ad0_104d8161f48__7fb4">
    <field name="id_75_37cb61f8f3397d86_5f797ad0_104d8161f48__7fb4">
      <prompt>
        <audio>What is your favorite vegetable?</audio>
      </prompt>
      <nomatch>
        <goto
next="#formid_91_37cb61f8f3397d86_5f797ad0_104d8161f48__7fa4" />
      </nomatch>
      <grammar type="application/x-gsl" mode="voice"><![CDATA[[
[(brussel sprouts)] {<id_75_37cb61f8f3397d86_5f797ad0_104d8161f48__7fb4
"id_109_37cb61f8f3397d86_5f797ad0_104d8161f48__7f92">}
[peas (bok choy)] {<id_75_37cb61f8f3397d86_5f797ad0_104d8161f48__7fb4
"id_119_37cb61f8f3397d86_5f797ad0_104d8161f48__7f88">}
]]]></grammar>
      <filled>
        <if cond="id_75_37cb61f8f3397d86_5f797ad0_104d8161f48__7fb4 ==
'id_119_37cb61f8f3397d86_5f797ad0_104d8161f48__7f88'">
          <goto
next="#formid_83_37cb61f8f3397d86_5f797ad0_104d8161f48__7fac" />
          <elseif cond="id_75_37cb61f8f3397d86_5f797ad0_104d8161f48__7fb4
== 'id_109_37cb61f8f3397d86_5f797ad0_104d8161f48__7f92'" />
```

```
            <goto
next="#formid_99_37cb61f8f3397d86_5f797ad0_104d8161f48__7f9c" />
        </if>
      </filled>
      <noinput>
        <audio>I'm sorry, I didn't hear you.</audio>
        <reprompt />
      </noinput>
    </field>
  </form>
  <form id="formid_83_37cb61f8f3397d86_5f797ad0_104d8161f48__7fac">
    <field name="id_83_37cb61f8f3397d86_5f797ad0_104d8161f48__7fac">
      <prompt>
        <audio>Good choice</audio>
      </prompt>
      <noinput>
        <audio>I'm sorry, I didn't hear you.</audio>
        <reprompt />
      </noinput>
      <nomatch>
        <audio>I'm sorry, I didn't get that.</audio>
        <reprompt />
      </nomatch>
    </field>
  </form>
  <form id="formid_91_37cb61f8f3397d86_5f797ad0_104d8161f48__7fa4">
    <field name="id_91_37cb61f8f3397d86_5f797ad0_104d8161f48__7fa4">
      <prompt>
        <audio>Yeah, that's okay</audio>
      </prompt>
      <noinput>
        <audio>I'm sorry, I didn't hear you.</audio>
        <reprompt />
      </noinput>
      <nomatch>
        <audio>I'm sorry, I didn't get that.</audio>
        <reprompt />
      </nomatch>
    </field>
  </form>
  <form id="formid_99_37cb61f8f3397d86_5f797ad0_104d8161f48__7f9c">
    <field name="id_99_37cb61f8f3397d86_5f797ad0_104d8161f48__7f9c">
      <prompt>
        <audio>You're nuts</audio>
      </prompt>
      <noinput>
        <audio>I'm sorry, I didn't hear you.</audio>
```

```
        <reprompt />
      </noinput>
      <nomatch>
        <audio>I'm sorry, I didn't get that.</audio>
        <reprompt />
      </nomatch>
    </field>
  </form>
</vxml>
```

FIGURE 5-10 The generated VoiceXML file for the user interface in Figure 5-9.

5.5 Summary

Damask's architecture is driven by the desire for a single abstract model to represent a cross-device user interface design. The model-view-controller-based implementation decouples the device-specific views from the abstract model. Model-based UI techniques enable designers to quickly see how changes to one device UI manifest themselves in the other device UIs.

6 Damask Evaluation

In this chapter, we present the results of our evaluations of Damask. We wanted to find out whether designers could understand and use the patterns for a particular design task, use layers to control which parts of a user interface design gets retargeted, and create designs that had more functionality and quality with patterns than without patterns, within a fixed amount of time.

We asked eight professional web UI designers and four professional voice UI designers to design user interfaces using Damask under two conditions, one with layers and patterns and one without. For each condition, they designed a desktop UI and a UI for one other platform, either smartphone or voice. We found that compared to not using layers and patterns, designers using layers and patterns spent less time designing a UI for two devices. For desktop UIs, the designs with patterns were more similar to the two most usable commercial UIs in the same domain than the designs without patterns, and they had more functionality. Designers generally understood and liked the design pattern concept, and the patterns were used appropriately during the design process. We also found that designers generally understood how to use layers to control which parts of their user interface designs would appear across all device types, although the implementation needs to be refined to make it more usable.

6.1 Experimental Procedure

The evaluation consisted of two phases. The first phase addressed designing desktop and smartphone UIs, and the second addressed designing desktop and voice UIs. We did not address designing for all three types of devices at the same time, as that would have made the experimental session with each participant prohibitively long. The participants used a Fujitsu T Series Lifebook (1.4 GHz Pentium M with 1 GB RAM) running Windows XP Tablet PC Edition 2005 and Java 2 Standard Edition 5.0, at a screen resolution of 1024×768 (see Figure 6-1).

FIGURE 6-1   The Fujitsu Tablet PC used in the experiments, in tablet mode (left) and laptop mode (right).

The experimental sessions were recorded using a video camera. Out of the 28 sessions, in the first four sessions the camera was aimed at the Tablet PC itself. To improve the video quality, the camera was aimed at an external LCD monitor hooked up to the Tablet PC for the rest of the sessions. I was present for all of the sessions, and for half of the sessions, an undergraduate student working with me was also present to set up the equipment and take additional notes.

6.1.1   Phase 1: Study of desktop and smartphone user interface design

Eight designers participated in Phase 1. Three additional designers were pilot testers. The participants were divided evenly by random selection into two groups. In Group A, participants used Damask without layers and patterns first, and in Group B, participants used Damask with layers and patterns first. In both groups, the evaluation was spread out over two sessions on two different days. The sessions were separated by one to 42 days (mean of 16 days, median of 7½ days, standard deviation of 17.76), depending on the participant's schedule. The following are the tasks that all of the participants did, followed by how they were ordered depending on the group:

- **Basic tutorial (§C.3):** We gave participants a tutorial on Damask, without the layers or patterns features enabled, which lasted about ten minutes.

- **Tablet PC warm-up task (§C.4):** The participants did a short warm-up task to get acquainted with the Tablet PC, where they had to edit a drawing and draw a bumblebee.

- **Damask warm-up task (§C.6.1 Task 1 for desktop/smartphone participants, §C.5.1 for desktop/voice participants):** The participants took an existing Damask design, added a new page with some content, and then linked an existing page to the new page.

- **Online music store (§C.6.1 Task 2 for desktop/smartphone participants, §C.6.2 for desktop/voice participants):** The participants were asked to design an online music store targeting both the desktop web and either smartphones or voice. The design should support browsing through a category to buy a CD, add the CD to a shopping cart, and then checkout the shopping cart. The desktop/smartphone participants were told to also support smartphone users

in buying ringtones. There was no time limit for the design task, but it was designed to take about 1½ to 2 hours.

- **Questionnaire about Damask without layers or patterns (§C.6.3):** Participants filled out a post-test questionnaire regarding their experiences with using Damask without layers or patterns.

- **Layers tutorial (§C.7.1):** We gave participants a tutorial on the layers feature in Damask, which lasted about five minutes.

- **Pattern introduction (§C.7.3):** We demonstrated how to use the Pattern Browser with Damask, which lasted about five minutes.

- **Pattern learning:** The participants browsed the pattern collection for about ten minutes and were told that there would be a quiz afterwards. This encouraged them to look through the collection carefully. The participants then took the quiz (§C.7.4), which was open-book.

- **Layers and patterns warm-up (§C.7.2, §C.7.5):** The participants modified an existing design, using layers and patterns.

- **Online bookstore (§C.7.6):** The participants were asked to design an online bookstore targeting both the desktop web and either smartphones or voice. The design should support browsing through a category to buy a book, add the book to a shopping cart, and then checkout the shopping cart. The desktop/smartphone participants were told to also support smartphone users in finding the nearest physical bookstore to the user's current location. There was no time limit for the design task, but it was designed to take about 1½ to 2 hours.

- **Questionnaire about Damask with layers and patterns (§C.7.7):** Participants filled out a post-test questionnaire regarding their experiences with using Damask with layers or patterns.

TABLE 6.1   The details and task ordering of Phase 1 (desktop/smartphone)

Group A	Group B
Session 1	
1. Basic tutorial 2. Tablet PC warm-up task 3. Damask warm-up task	1. Basic tutorial 2. Tablet PC warm-up task 3. Damask warm-up task 4. Layers tutorial 5. Pattern introduction 6. Pattern learning 7. Layers and patterns warm-up
4. Online music store 5. Questionnaire about Damask without layers or patterns	8. Online bookstore 9. Questionnaire about Damask with layers and patterns
Session 2	
1. Layers tutorial 2. Pattern introduction 3. Pattern learning 4. Layers and patterns warm-up 5. Online bookstore 6. Questionnaire about Damask with layers and patterns	1. Online music store 2. Questionnaire about Damask without layers or patterns

6.1.2 *Phase 2: Study of desktop and voice user interface design*

Four designers participated in Phase 2. Two other designers started Phase 2, but were dropped after they notified us they could not continue after the first session. As in Phase 1, the participants for Phase 2 were divided into two groups, but this time, there were three sessions instead of two. This was to give them more time to learn the UIs for designing both desktop and voice designs, which are very different. The time between sessions 1 and 2 was 1–15 days (mean 7 days) and between sessions 2 and 3 was 1–15 days (mean 6 days). The first session was the same for both conditions, while the second and third sessions were basically swapped between the two groups. The

tasks were essentially the same as in Phase 1, with the addition of another Damask warm-up task in Session 1 to design an online bank (see Section C.5.2). We also de-emphasized sketching for Phase 2, so that text phrases typed into the desktop design would easily be transferred into the voice design.

TABLE 6.2   The details of and task ordering of Phase 2 (desktop/voice)

Group A	Group B
Session 1	
1. Basic tutorial 2. Tablet PC warm-up task 3. Damask warm-up task 4. Damask warm-up task 2	1. Basic tutorial 2. Tablet PC warm-up task 3. Damask warm-up task 4. Damask warm-up task 2
Session 2	
1. Online music store 2. Questionnaire about Damask without layers or patterns	1. Layers tutorial 2. Pattern introduction 3. Pattern learning 4. Layers and patterns warm-up 5. Online bookstore 6. Questionnaire about Damask with layers and patterns
Session 3	
1. Layers tutorial 2. Pattern introduction 3. Pattern learning 4. Layers and patterns warm-up 5. Online bookstore 6. Questionnaire about Damask with layers and patterns	1. Online music store 2. Questionnaire about Damask without layers or patterns

6.2 Participants

In Phase 1, we screened for user interface designers who had experience designing web sites and optional experience designing for mobile phones. Each participant was promised an Amazon.com gift certificate worth $250. We gave priority to designers who had some mobile phone design experience.

All eight participants in Phase 1 had at least five years of experience designing web sites, but their mobile phone UI experience was much less (see Table 6.3). Two

had one to two years of experience, five had less than one year, and one had no experience. There were equal numbers of men and women, as well as equal numbers of those between 21 and 30 years of age and those over 30.

All of the participants use paper and whiteboards during the design process. The three computer programs used by more than half of the participants were Visio (7 out of 8), Microsoft Word (6), and Adobe Photoshop (5).

TABLE 6.3   Demographics of Desktop/Smartphone phase (Phase 1) participants[*]

Participant	4	5	6	7	8	9	10	11	% total
Age	21-30	21-30	21-30	31-40	31-40	41-50	21-30	31-40	
Sex	M	M	M	F	F	F	M	F	
Design areas in which participants felt knowledgeable									
GUI	✓	✓	✓		✓	✓	✓	✓	88
Graphic design	✓			✓			✓	✓	50
Info architect	✓	✓			✓	✓	✓	✓	75
Mobile phone				✓					12
Web	✓	✓	✓	✓	✓	✓	✓	✓	100
Other					[1]	[2]	[3]		
Years of experience	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	
Web	≥5	≥5	≥5	≥5	≥5	≥5	≥5	≥5	
Mobile phone	<1	<1	1-2	1-2	<1	0	<1	<1	
UI tools used									
Dreamweaver					✓	✓	✓	✓	50
Excel		✓						✓	25
Flash					✓				12
FrontPage								✓	12
Illustrator	✓	✓		✓				✓	50
Paper	✓	✓	✓	✓	✓	✓	✓	✓	100
Photoshop		✓	✓		✓		✓	✓	62
PowerPoint	✓		✓					✓	38
Text editor			✓		✓			✓	38
Visio	✓	✓	✓		✓	✓	✓	✓	88
Whiteboard	✓	✓	✓	✓	✓	✓	✓	✓	100
Word		✓		✓	✓	✓	✓	✓	75
OmniGraffle						✓			12

[1] Accessibility design
[2] Product copy for mobile phones
[3] Software design

In Phase 2, we screened for user interface designers who had experience designing voice user interfaces. Each participant was promised an Amazon.com gift certificate worth $375, since there was one more session per person than in Phase 1.

[*] Participants 1, 2, and 3 were pilot subjects.

Three of the four participants had at least five years of experience designing voice user interfaces, and the other one had three to four years (see Table 6.4). None of them had more than a year of web experience. There were equal numbers of men and women, as well as equal numbers of those between 21 and 30 years of age and those over 30. All of the participants in this phase use Visio and Microsoft Word, as well as in-house proprietary tools, during the design process. Over half also used paper and whiteboards.

TABLE 6.4   Demographics of Desktop/Voice phase (Phase 2) participants[†]

Participant	13	15	16	17	% total
Age	21-30	31-40	21-30	31-40	
Sex	F	M	M	F	
Design areas in which participants felt knowledgeable					
GUI	✓	✓			50
Voice	✓	✓	✓	✓	100
Web	✓				25
Mobile phone UI		✓			25
Other	Interaction				
Years of experience	≥ 5	≥ 5	3-4	≥ 5	
Web	< 1	< 1	< 1	< 1	
Voice	≥ 5	≥ 5	3-4	≥ 5	
UI tools used					
Paper	✓	✓	✓		75
Whiteboard	✓	✓	✓		75
Text editor			✓		25
Photoshop		✓	✓		50
Visio	✓	✓	✓	✓	100
Word	✓	✓	✓	✓	100
Excel		✓			
Proprietary voice tools	✓	✓	✓	✓	

[†] Participants 12 and 14 only finished the first session, after which they notified us that they no longer had time to complete the last two sessions.

6.3 Introduction to the Results

Here we report what the design process was like using Damask with and without patterns, the overall Damask experience, and detailed findings related to patterns and layers.

6.4 Results Concerning All Designs Created by the Participants

We looked at several aspects on how patterns affected the design process: the amount of time the participants took, how much they were able to accomplish within that time, and whether they preferred the designs with patterns and layers or without.

6.4.1 Time spent by participants

All of the participants chose to design the desktop user interface first, although they were not instructed to do so, and Damask supports either ordering. There is a clear difference in how much time the designers spent in the non-pattern condition versus the pattern condition.

Among the desktop/smartphone participants, designers spent about an hour designing the desktop interface in both conditions, although in the patterns condition, an average of 9 minutes and 35 seconds of that hour was spent in the pattern browser while designing the desktop UI (see Table 6.5). However, they spent statistically significantly less time designing the smartphone user interface using patterns and layers (on average, 21 minutes with patterns versus 42 minutes without patterns), and only two designers out of 8 spent any time in the pattern browser while designing for the second device (average over all 8 designers, 12 seconds).

This shows that patterns and layers help cut down the amount of time spent retargeting an interface design after the first device design is mostly complete. Over

extended use, we would expect the desktop time to go down as well, as designers would become more familiar with the patterns included in Damask and the ten-minute pattern browsing time might be eliminated.

TABLE 6.5   Mean time spent by desktop/smartphone participants creating UI design, in hours and minutes (gray background signifies $p < 0.05$, 2-tailed t-test)

	Desktop	Pattern Browser during Desktop design	Smartphone	Pattern Browser during Smartphone design	Total
Non-patterns	1:07		**0:42**		1:49
Patterns	1:03	0:10	**0:21**	12 secs	1:24

Among the desktop/voice participants, the results are not as statistically strong. Designers spent more time designing the desktop interface in the pattern condition (55 minutes) than the non-pattern condition (44 minutes), but the difference is not statistically significant, and in the patterns condition, an average of 5 minutes and 51 seconds of that time was spent in the pattern browser while designing the desktop UI (see Table 6.6). They spent less time designing the voice user interface using patterns and layers (on average, 34 minutes with patterns versus 39 minutes without patterns), but this is also not statistically significant ($p > 0.30$).

TABLE 6.6   Mean time spent by desktop/voice participants creating UI design, in hours and minutes ($p > 0.30$, 2-tailed t-test)

	Desktop	Pattern Browser during Desktop design	Voice	Pattern Browser during Voice design	Total
Non-patterns	0:44		0:39		1:23
Patterns	0:55	0:06	0:34	0:00	1:29

Much of this can be explained by the fact that Designer 16 only used one pattern in the patterns condition, so he did not take full advantage of the patterns capabilities. If we remove this designer, then the time spent on the desktop design is almost the

same in the two conditions (48 minutes for non-patterns versus 50 minutes for patterns), and the difference in the time spent in total and in voice design between the two conditions becomes bigger and closer to being statistically significant (29 minutes for non-patterns versus 16 minutes for patterns); see Table 6.7. It is difficult to see statistically significant differences when there only three participants' worth of data, and we feel confident that we would get significance with more data.

TABLE 6.7   Mean time spent by desktop/voice participants creating UI design, without Designer 16, in hours and minutes

	Desktop	Pattern Browser during Desktop design	Voice	Pattern Browser during Voice design	Total
Non-patterns	0:48		0:29		1:17
Patterns	0:50	0:08	0:16	0:00	1:06
p for 2-tailed t-test	> 0.50		0.13		0.09

6.4.2 Extent of designs created by participants

Using patterns, the designers were able to accomplish more during their design sessions. As a measure of this, we counted how many pages, elements within a page, and arrows between pages the designers created in the desktop and smartphone designs, and how many forms, prompts, and responses were created in the voice designs. This way, we can see whether or not the designers were faster in the patterns condition because their designs were simpler.

There are big differences between the non-patterns and patterns conditions, all of them statistically significant except for the voice UI designs (see Table 6.8). In general, in the patterns condition, the designers created about twice as many pages or forms, and about 2½ to 3 times as many other objects, compared to the non-patterns condition. Also, the vast majority of objects created in the patterns condition were

part of a pattern, showing that the participants successfully incorporated the patterns in their designs.

TABLE 6.8 Completeness of designs (gray background signifies $p < 0.05$, 2-tailed t-test)

Condition	Desktop			Smartphone		
	Pages	Elements	Connections	Pages	Elements	Connections
Non-patterns	6	95	11	8	62	11
Patterns	13	281	29	17	215	27
% from patterns	88%	92%	76%	88%	92%	77%

Condition	Voice		
	Forms	Prompts	Responses
Non-patterns	5	18	22
Patterns	10	72	90
% from patterns	77%	88%	90%

If we remove Designer 8, who used no patterns, and Designer 16, who used only one pattern, then almost all of the differences are statistically significant (see Table 6.9).

TABLE 6.9 Completeness of designs among designers who used more than 1 pattern in the patterns condition (gray background signifies $p < 0.05$, 2-tailed t-test)

Condition	Desktop			Smartphone		
	Pages	Elements	Connections	Pages	Elements	Connections
Non-patterns	6	102	11	8	64	11
Patterns	14	324	34	19	240	30
% from patterns	94%	95%	79%	93%	94%	80%

Condition	Voice		
	Forms	Prompts	Responses
Non-patterns	4	19	22
Patterns	11	91	115
% from patterns	88%	92%	71%

6.4.3 *Preference of designs created by participants*

We asked designers whether they preferred the designs they made with patterns or without patterns (see Section C.7.7, Question 33). Seven out of the twelve participants said they preferred the design with patterns and layers. One of those participants, Participant 16, said, "The patterns made me realize I'd forgotten a lot of things in the first one, like all the functionality for shipping addresses/credit cards etc."

Three of the participants said they preferred the design without patterns and layers. However, two of these three used at most one pattern; they said they liked the designs they had created in the phase without patterns and layers because it was the second phase for them and they had become more comfortable with the tool. The other one explained that she had become more familiar with the tool and that the performance of the tool was better without patterns or layers.

Participant 6 said it depended on what the design sketch was for: the design without patterns was better for giving a high level overview because it had less detail, while the design with patterns was better for conducting a usability study or a scoping meeting with engineers. (Participant 5 misunderstood the question and did not respond to repeated requests to clarify, so his answer is not counted.)

6.5 Desktop Designs Created by the Participants

We analyzed the desktop designs in three ways: by asking other user interface designers to evaluate them, and by comparing the features and structure of the designs with those of two well-known e-commerce web sites.

6.5.1 Examples of desktop designs

Here are two desktop web designs that are typical of the ones our participants created. All of the designs can be found in Appendix D.
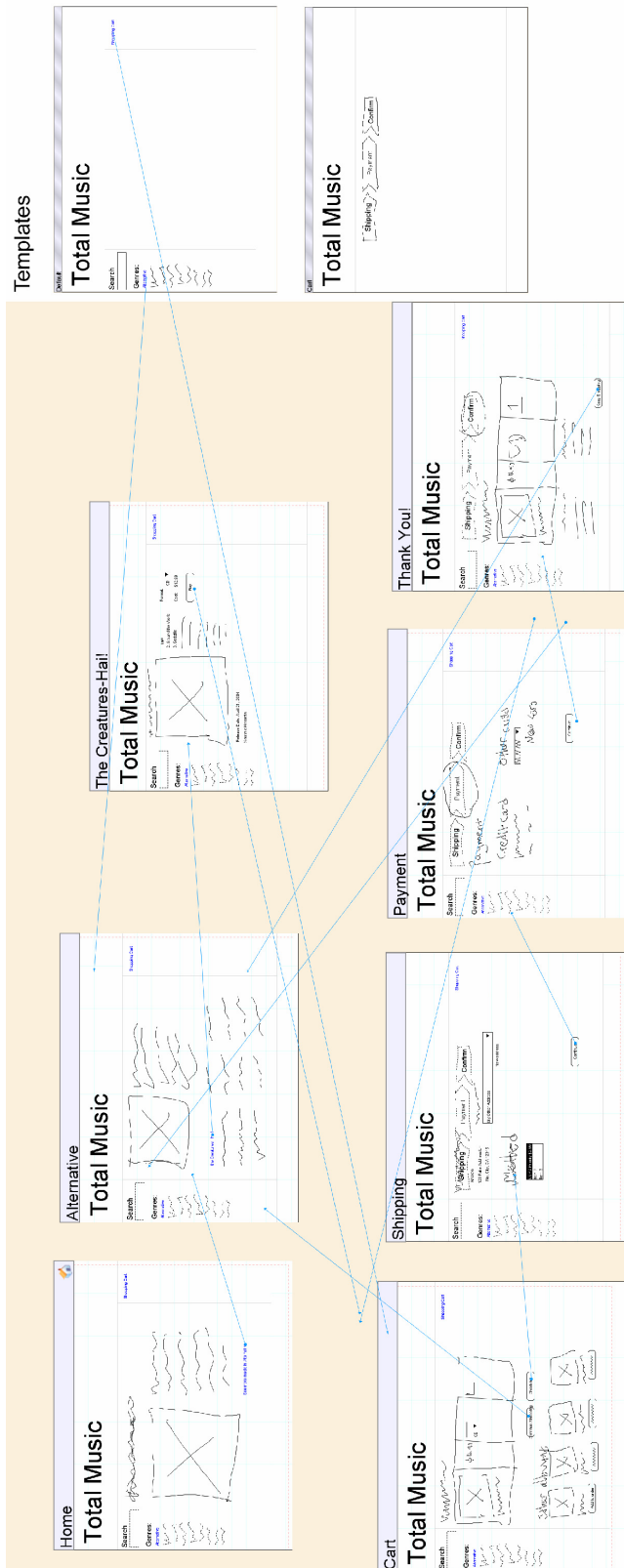
122

FIGURE 6-2   Participant 6's desktop design for TotalMusic.com, created without patterns or layers.

FIGURE 6-3 Participant 6's desktop design for TotalBooks.com, created with patterns and layers.

Figure 6-2 shows a typical TotalMusic.com design created without patterns or layers, created by Participant 6. While it has pages for the basic functionality, it does not have much page detail. For example, the checkout pages do not allow the user to type in a new address or a new credit card, even though those were explicit design requirements; they have placeholders instead. Figure 6-3 shows a TotalBooks.com design created with patterns and layers by the same participant, after the TotalMusic.com design. It specifies features in more detail, especially the checkout process. However, it is somewhat harder to follow because of the detail.

Participant 6 believed each sketch had merits. He thought his TotalMusic.com sketch (Figure 6-2) would be useful if he "wanted to convey the basic design to a project team and help them envision it." His TotalBooks.com sketch (Figure 6-3) would be good "to run a usability test or rough project scoping meeting with engineers."

6.5.2 Quality analysis of desktop designs

We wanted to find out whether the patterns and layers affected the quality of the desktop designs created in that condition, compared to the designs without patterns or layers. Since the designs are not complete enough to do a full usability analysis, we instead created an online questionnaire for judges to fill out.

There are 24 desktop designs over the two conditions. Obviously, no single person would want to evaluate all 24 of them. Therefore, we recruited 18 professional designers online (via the mailing lists BayCHI Discussions and CHI-WEB) and randomly assigned four designs to each evaluator, so that each design was evaluated by three people. The four designs came from two designers (patterns and non-patterns), and the order of the four designs was randomized. The judges did not

know that the four designs were from only two designers, nor were they made aware of anything related to patterns or Damask.

Table 6.10 shows the demographics of the evaluators, along with those of the designers for comparison. Overall, the evaluators are somewhat older on average and have more experience designing e-commerce web sites. See Appendix F, Questions 13–30 for the raw questionnaire data.

TABLE 6.10 Demographics of the evaluators of the desktop designs. The demographics of the designers are included for comparison.

	Evaluators			Designers		
Total		18			12	
Gender						
Male		11	61%		6	50%
Female		7	39%		6	50%
Age						
	19 and under	0	0%	under 20	0	0%
	20-29	5	28%	21-30	6	50%
	30-39	11	61%	31-40	5	42%
	40-49	1	6%	41-50	1	8%
	50 or above	1	6%	51 or above	0	0%
Years of design experience						
< 1		0	0%		0	0%
1–2		3	17%		0	0%
3–4		1	6%		1	8%
≥ 5		14	78%		11	92%
Years of web design experience						
< 1		0	0%		4	33%
1–2		4	22%		0	0%
3–4		2	11%		0	0%
≥ 5		12	67%		8	67%
Number of e-commerce web sites designed						
0		2	11%		3	25%
1–2		4	22%		5	42%
3–4		6	33%		2	17%
≥ 5		6	33%		2	17%

	Evaluators		Designers	
Which platforms were the e-commerce sites designed for?				
Web	12	67%	9	75%
PDA or mobile phone	4	22%	3	25%
Voice	1	6%	1	8%
Other	2	11%	0	0%
Design knowledge				
IA	17	94%	6	50%
Graphic design	10	56%	4	33%
Web design	18	100%	9	75%
GUI design	14	78%	9	75%
Mobile phone UI design	3	17%	2	17%
Voice UI design	1	6%	4	33%
Other	2	11%	4	33%
How many times have you bought anything online in past 12 months?				
Never	0	0%	0	0%
1–3	0	0%	1	8%
4–6	5	28%	1	8%
7–11	5	28%	4	33%
≥ 12	8	44%	6	50%
How did you buy those items?				
Web	18	100%	11	92%
Mobile phone display	1	6%	0	0%
Automated voice	2	11%	1	8%
Other	1	6%	0	0%
No answer	0	0%	1	8%
How many times have you bought books online in past 12 months?				
Never	0	0%	0	0%
1–3	8	44%	5	42%
4–6	7	39%	3	25%
7–11	1	6%	2	17%
≥ 12	2	11%	2	17%

	Evaluators		Designers	
How did you buy those books?				
Web	18	100%	12	100%
Mobile phone display	0	0%	0	0%
Automated voice	0	0%	0	0%
Other	1	6%	0	0%
How many times have you bought albums online in past 12 months?				
Never	7	39%	1	8%
1–3	6	33%	3	25%
4–6	3	17%	6	50%
7–11	1	6%	0	0%
≥ 12	1	6%	2	17%
How did you buy those albums?				
Web	11	61%	10	83%
Mobile phone display	0	0%	0	0%
Automated voice	0	0%	0	0%
Other	1	6%	0	0%
No answer	0	0%	1	6%

For each design, we asked judges to evaluate the information architecture and the page layout for finding a product, checking out a shopping cart, and overall. We also asked how skilled they think the designer is and how complete the design is (see Appendix F for the actual questionnaire and the raw answers).

The judges did not look at the original Damask designs. Instead, we converted the sketches to "sketchy"-looking HTML. This removed the participants' sketching and handwriting abilities as a confounding factor. We also added a collapsible site map to the left-hand side, which shows the titles of all of the pages in the site and the current page's title in bold (see Figure 6-4 and Appendix D).
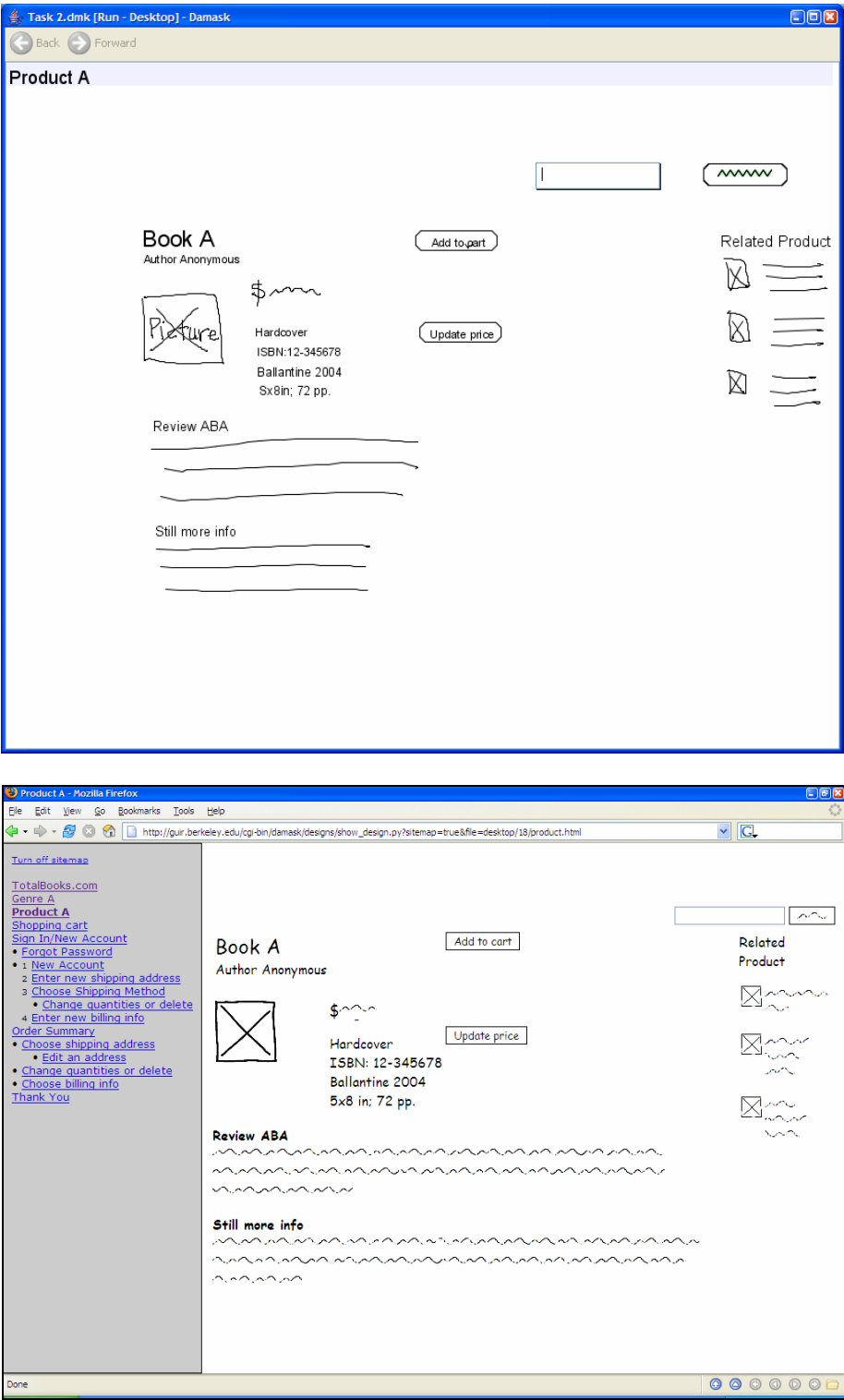
FIGURE 6-4 A desktop Damask design (above) and its cleaned-up HTML version (below) used in the online evaluation.

We wanted to find out if there was an overall effect of the availability of patterns on the answers to the quantitative questions in the questionnaire (questions 1, 3, 5, 7, and 9-11). First, for each condition, designer, and quantitative question, we calculated the mean of the responses from the three evaluators. We then conducted a multivariate analysis of variance (MANOVA) to determine the effect of the availability of patterns on the answers to the quantitative questions in the questionnaire. The availability of patterns and layers was the independent variable, and each question was a dependent variable. We found no statistically significant effect (Wilks' λ = .62, $F_{7,16}$ = 1.39, p = 0.28).

However, we noticed that for each question, the designs with patterns were rated higher than the designs without patterns, on average. To see if any of the questions had significant differences, we conducted analyses of variances (ANOVA) on each question. Using Fisher's PLSD method, each ANOVA was tested at the 0.05 level. The ANOVAs were statistically significant for two of the questions (ratings for the page layout and design of the shopping cart and checkout process, and completeness of the design) and not significant for the other five. See Table 6.11.

TABLE 6.11 Average ratings for the desktop designs (1 = low, 5 = high), along with *F* and *p* values from ANOVAs.

Question	No patterns	Patterns	$F_{1,22}$	p
1 Please give a rating for how well the pages for browsing for a (CD/book) were *linked together*.	3.02	3.11	0.12	0.73
3 Please give a rating for the page *layout and design* for (CD/book) browsing.	2.72	3.11	2.42	0.13
5 Please give a rating for how well the pages for shopping cart and checkout were *linked together*.	3.14	3.36	0.58	0.46
7 Please give a rating for the page *layout and design* for shopping cart and checkout.	2.53	3.22	6.12	0.02
9 Please give an overall rating.	2.86	3.33	2.85	0.11
10 How complete do you consider this design to be?	2.44	3.06	5.81	0.02
11 How skilled do you think this designer is?	2.69	3.02	1.38	0.25

We then did the same analysis without the two designers that used one or no patterns, Designers 8 and 16, so that we could see the effect of pattern usage, as opposed to just exposure to patterns. Overall there was still no overall statistically significant effect from the availability of patterns (MANOVA, Wilks' λ = .53, $F_{7,12}$ = 1.54, p = 0.24). However, after running ANOVAs on each question, we found statistically significant differences for *three* of them: ratings for the page layout and design of the shopping cart and checkout process, and completeness of the design (as above), and the overall rating. See Table 6.12.

TABLE 6.12 Average ratings for the desktop designs (1 = low, 5 = high), excluding Designers 8 and 16, along with *F* and *p* values from ANOVAs.

Question	No patterns	Patterns	$F_{1,18}$	p
1 Please give a rating for how well the pages for browsing for a (CD/book) were *linked together*.	2.87	3.12	1.87	0.19
3 Please give a rating for the page *layout and design* for (CD/book) browsing.	2.63	3.13	3.66	0.07
5 Please give a rating for how well the pages for shopping cart and checkout were *linked together*.	3.03	3.40	1.35	0.26
7 Please give a rating for the page *layout and design* for shopping cart and checkout.	2.43	3.30	8.33	<0.01
9 Please give an overall rating.	2.73	3.37	5.55	0.03
10 How complete do you consider this design to be?	2.33	3.17	9.96	<0.01
11 How skilled do you think this designer is?	2.63	3.13	2.76	0.11

Overall, the results of the questionnaire show that the design patterns had their biggest effect on two areas. The fact that the layout and designs of the pages in the shopping cart and checkout process were rated higher is not surprising. It is difficult to adequately design and layout shopping cart and checkout pages that handle changing the quantities in a cart, shipping options, shipping and billing addresses, credit card numbers, and so on in only a couple of hours. Designers using the Damask shopping cart and checkout patterns were able to add this functionality in very little time.

For example, two of the designs that Evaluator 16 evaluated were Designer 13's desktop designs. For the design without layers or patterns, he said about the shopping cart and checkout, "The ordering of items on the page doesn't seem to work that well," and goes on to make detailed suggestions on how to improve it. In contrast, for the design with layers and patterns, he said, "This is really good. The flow is sensible, and the final invoice-like form that you accept works really well. It would seem this design has done a better job at understanding the details of information flow on a page."

Similarly, the ease of adding pre-built functionality from patterns contributed to the higher completeness rating for the designs with patterns. This reinforces the completeness metrics that were described in Section 6.4.2.

However, patterns did not make a significant difference on how well the shopping cart/checkout pages were linked together. This may be because in the designs without patterns, the shopping cart/checkout pages usually were linked into a simple linear structure, which made it as easy to navigate as the more complete shopping cart/checkout pages in the designs with patterns. For example, Evaluator 2 evaluated the desktop designs by Designer 7. He was positive about both the design without patterns ("The checkout process is simple, one click done. But user can't easily add another item or change the cart. The best of all, user doesn't need to go to separate page to enter the address and credit card information.") and with patterns ("Very good check out process. Can change the address and credit card in one page. Can navigate to continue shopping.").

Patterns also did not make a significant difference on how well the product browsing pages were linked together. This is probably because the relevant Damask patterns mainly addressed the content of those pages, not how they are linked.

Patterns also did not make a significant difference on the ratings for the design and layout of the product browsing pages. This may be due to two factors. Our requirements for the product pages were not as extensive as for the shopping cart/checkout pages, making it easier to implement most of the functionality by hand. Also, the relevant Damask patterns originally had placeholder text that described how they should be filled in, such as "95% visitor link," or UI elements that were not relevant for CDs and books, such as a drop-down menu labeled "Options." This text often was not changed by the designers, causing the evaluators to become confused.

6.5.3 *Functional analysis of desktop designs*

We also looked at what features were implemented in the checkout process of the desktop designs, to see how they differed between the patterns and non-patterns conditions. We looked for several features that are standard across major e-commerce web sites and observed how many of the designs with and without patterns included them. We also made the same observations for the ten e-commerce web sites that had the most traffic during the week before Christmas 2004 according to Hitwise [68], and the five most usable e-commerce sites according to Keynote Systems [87], excluding those sites that did not have a checkout process (such as eBay and Yahoo Shopping).

We found that the designs with patterns were more likely to include these features than the designs without patterns, except for two of the features (see Table 6.13). None of the designs created in the patterns condition included the ability to edit the billing address or the payment information. This is because both of these features were unintentionally omitted from the pattern solutions, yet another example of how influential patterns were in the patterns condition.

TABLE 6.13   Common features in the checkout process.

	Non-Pattern (out of 12)		Pattern (out of 12)		Top 5 Usable (out of 4)		Top 10 Popular (out of 7)	
Separate shopping cart	10	83%	10	83%	4	100%	7	100%
Order summary	3	25%	9	75%	4	100%	7	100%
Change shipping method	9	75%	11	92%	4	100%	7	100%
Change quantities during checkout	0	0%	7	58%	4	100%	4	57%
Edit shipping address	1	8%	10	83%	4	100%	7	100%
Edit billing address	1	8%	0	0%	3	75%	5	71%
Edit payment information	1	8%	0	0%	3	75%	5	71%
Create new shipping address	8	67%	11	92%	3	75%	5	71%
Create new billing address	7	58%	10	83%	2	50%	4	57%
Create new payment information	9	75%	10	83%	2	50%	4	57%
Average	*4.9*	*41%*	*7.8*	*65%*	*3.3*	*83%*	*5.5*	*79%*

6.5.4 *Structural analysis of desktop designs*

To further characterize the desktop designs, we analyzed the designs' functionality and flow to see how they compare to that of popular, high-usability commercial web sites. To do this, we created abstract sitemaps that captured the functionality of each page and the flow between pages (see Figure 6-6 and Figure 6-7 and the key for the symbols in Figure 6-5).

FIGURE 6-5 The key to the symbols used in the abstract sitemaps.
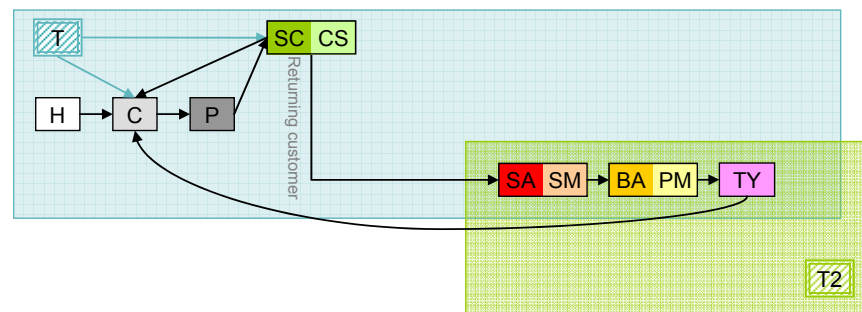
FIGURE 6-6 The abstract sitemap for Participant 6's TotalMusic.com design for the desktop, shown in Figure 6-2, which was created without layers or patterns.Figure **6-2** Participant 6's desktop design for TotalMusic.com, created without patterns or layers.
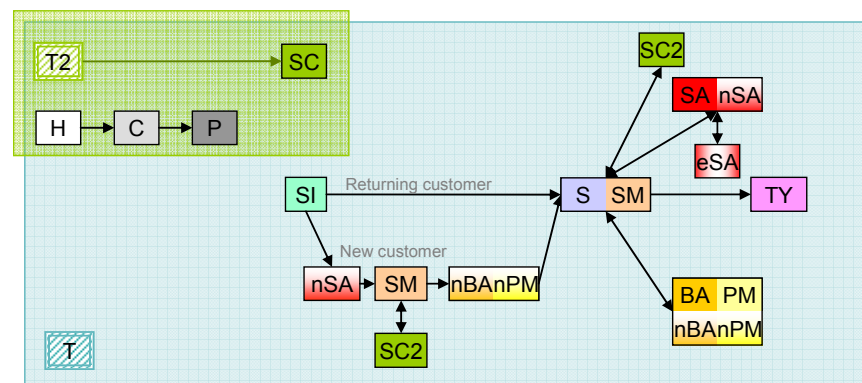
FIGURE 6-7   The abstract sitemap for Participant 6's TotalBooks.com design for the desktop, shown in Figure 6-3.

Then we also created sitemaps that focused on the checkout processes of the web sites of Amazon and Barnes & Noble, which were the top two e-commerce sites in terms of usability, according to online usability studies run by Keynote Systems [87] (see Figure 6-8). The sitemaps primarily covered the checkout process because we had asked the designers to focus more on the checkout process than, say, browsing or searching for products.
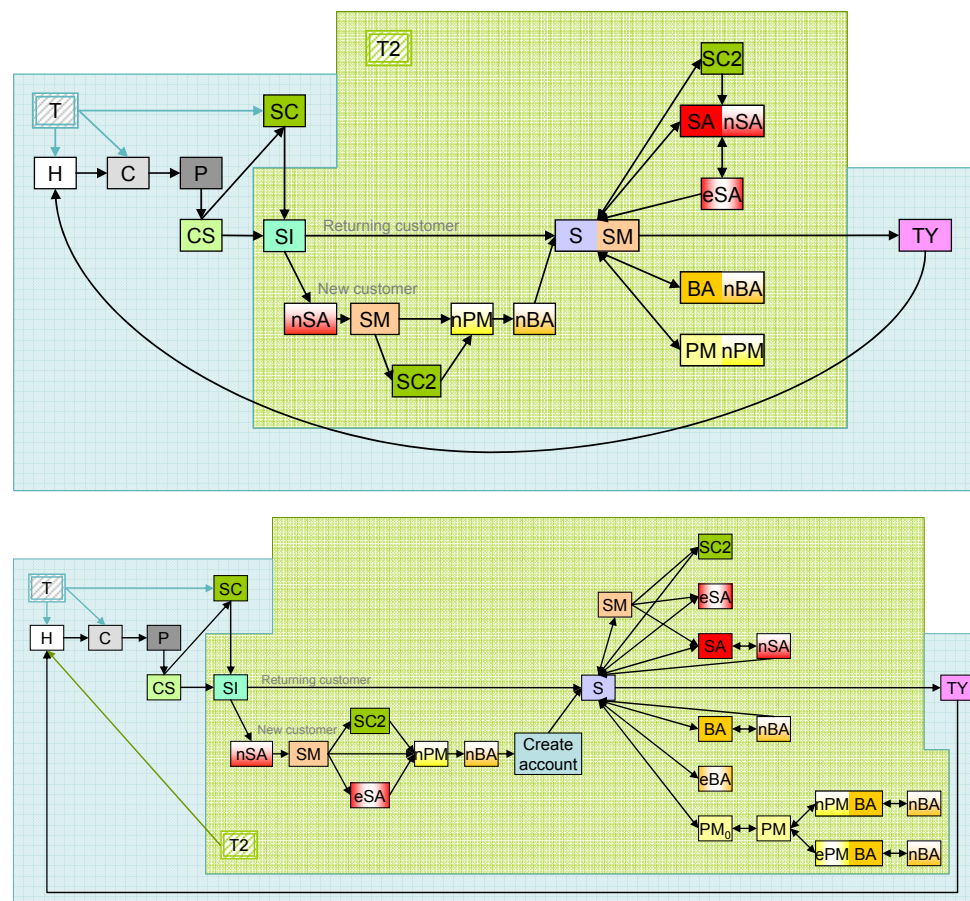
FIGURE 6-8   The abstract sitemaps for Amazon.com (top) and BarnesAndNoble.com (bottom).

We removed the "New Customer" branch from all of the sitemaps, because our design instructions said the participants could assume the user already had an account

with the e-commerce site. We then counted how many editing steps it would take to transform a sitemap of a design that a participant created into the sitemaps of Amazon and Barnes & Noble. Here are the possible types of edits:

- Creating a template

- Apply or unapplying a template to a page

- Adding or removing a link that originates from a normal page

- Adding or removing a link that originates from a template

- Adding or removing a page

- Merging or splitting pages

The fewer the steps, the closer the structure of the design is to that of a widely-accepted good design (see Figure 6-9). In graph theory, this metric is called the *graph edit distance*. See Appendix D for the sitemaps and the actual designs of the participants, and Appendix E for those of Amazon and Barnes & Noble.
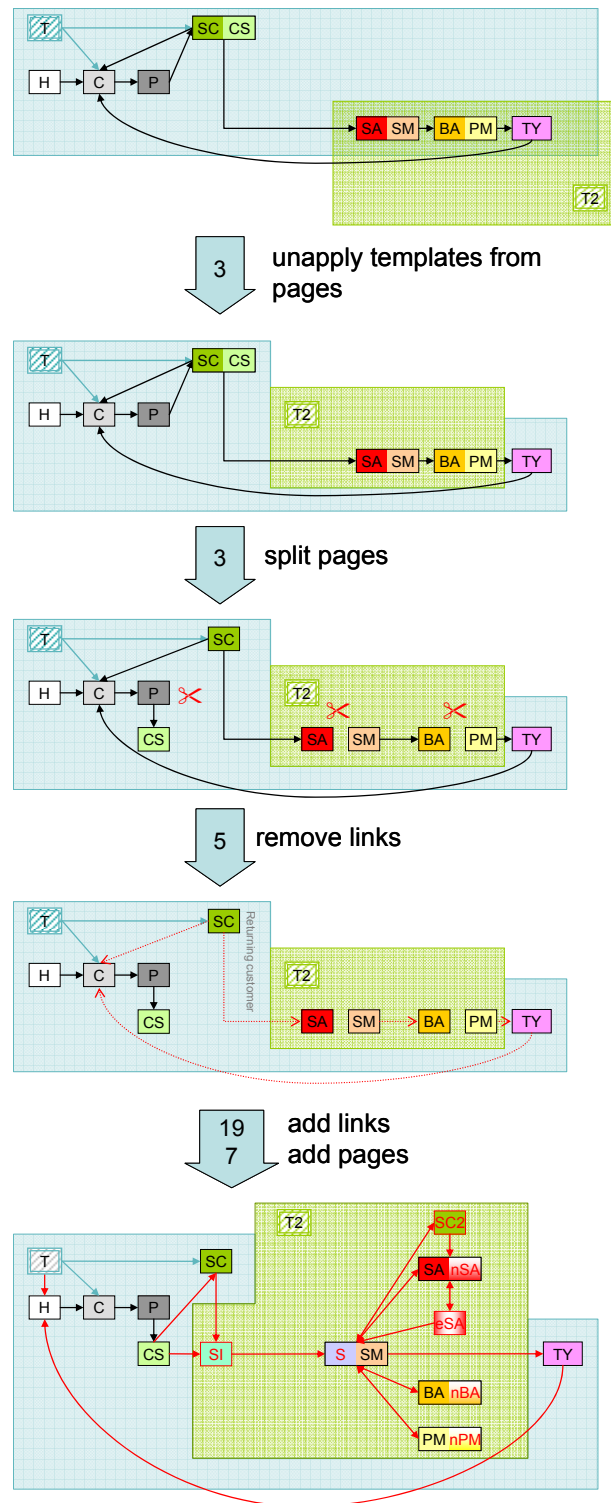
FIGURE 6-9   Transforming the design shown in Participant 6's TotalMusic.com to the Amazon.com sitemap.

To see whether the patterns had an effect on the number of steps across types, we conducted multivariate analyses of variance (MANOVAs) where the availability of patterns and layers was the independent variable, and each edit type was a dependent variable (except for removing pages, which was 0 in every case). In both Amazon and Barnes & Noble, we found no overall statistically significant effect when we included all designs. However, if we exclude the outliers, we see that there is a significant effect on Barnes & Noble, and an effect that is close to significant on Amazon (see Table 6.14).

TABLE 6.14 Results of MANOVAs on edit distances for desktop designs.

	Amazon	Barnes & Noble
All designs	Wilks' $\lambda = 0.50$ $F_{9,14} = 1.55$ $p = 0.22$	Wilks' $\lambda = 0.55$ $F_{9,14} = 1.28$ $p = 0.33$
All except Designers 8, 16	Wilks' $\lambda = 0.27$ $F_{9,10} = 3.01$ $p = 0.05$	Wilks' $\lambda = 0.25$ $F_{9,10} = 3.40$ $p = 0.03$

To see which types of edits had significant differences, we conducted analyses of variances (ANOVA) on each edit. Using Fisher's PLSD method, each ANOVA was tested at the 0.05 level. We did this over all of the designs (see Table 6.15) and all of the designs except Designers 8 and 16 (see Table 6.16).

TABLE 6.15 Average edit distances for the desktop designs, along with F and p values from ANOVAS (NP = no patterns, P = patterns).

Edit type	Amazon				Barnes & Noble			
	NP	P	$F_{1,22}$	p	NP	P	$F_{1,22}$	p
Unapply template	1.17	1.50	0.16	0.69	1.17	1.50	0.16	0.69
New template	1.08	1.08	0.00	1.00	1.08	1.08	0.00	1.00
Apply template	3.25	5.33	3.00	0.10	3.25	5.58	3.65	0.07
Split pages	2.33	1.25	7.41	0.01	3.83	4.25	0.52	0.48
Remove template links	0.17	0.33	0.58	0.45	0.17	0.33	0.58	0.45
Remove normal links	3.67	2.50	2.31	0.14	3.83	4.00	0.05	0.82
Add template links	2.08	2.17	0.06	0.80	3.33	3.08	0.53	0.47
Add normal links	17.00	11.83	17.3	<0.01	38.59	34.59	11.88	<0.01
Add pages	6.17	3.08	9.91	<0.01	13.08	9.92	11.43	<0.01

TABLE 6.16 Average edit distances for the desktop designs, without the outliers from Designers 8 and 16, along with F and p values from ANOVAS (NP = no patterns, P = patterns).

Edit type	Amazon				Barnes & Noble			
	NP	P	$F_{1,18}$	p	NP	P	$F_{1,18}$	p
Unapply template	1.30	1.70	0.17	0.68	1.30	1.70	0.17	0.68
New template	1.00	1.00	0.00	1.00	1.00	1.00	0.00	1.00
Apply template	2.90	5.70	5.39	0.03	2.90	6.00	6.41	0.02
Split pages	2.20	1.00	9.53	0.01	3.90	4.40	0.68	0.42
Remove template links	0.10	0.30	0.72	0.41	0.10	0.30	0.72	0.41
Remove normal links	3.60	2.10	3.01	0.10	3.80	4.10	0.13	0.73
Add template links	2.20	2.20	0.00	1.00	3.60	3.10	3.08	0.10
Add normal links	17.00	10.60	33.39	<0.01	38.60	33.50	22.75	<0.01
Add pages	6.10	2.10	26.77	<0.01	13.00	8.90	38.89	<0.01

If we look at the individual steps, we see that there is a significant difference for adding a page and adding normal links in all cases, for splitting a page in Amazon only, and applying a template only when outliers are not considered. We will now describe each in detail.

- *Adding a page.* On average, fewer pages were added to a design with patterns than a design without patterns. This indicates that the designs with patterns were more likely to have the same features as Amazon and Barnes & Noble than designs without patterns. This backs up the discussion in the previous section on functional analysis.

- *Adding a link that originates from a normal page (as opposed to a template).* On average, fewer links were added to a design with patterns than a design without patterns. This implies that designs with patterns have a more similar structure to Amazon and Barnes & Noble than designs without patterns.

- *Applying a template to a page.* Interestingly, templates were applied to *more* pages in the designs with patterns than those without. This is due to two factors. The patterns in Damask do not give much guidance on how and when to apply templates, so the designs with patterns were as likely as those without patterns to use templates differently than in Amazon and Barnes & Noble. Also, the designs with patterns had more pages than those without, so when a template needed to be applied to match Amazon and Barnes & Noble, there were more pages that need to be "fixed" in the designs with patterns than those without.

- In addition, in the case of Amazon.com, fewer pages were split (statistically significantly) in the designs with patterns than those without. This means that the contents of a page in the designs with patterns were more likely to match those of Amazon. This is not surprising since many of the patterns were inspired by Amazon.

This metric is complicated by the fact that not all of the features that Amazon and Barnes & Noble have in their checkout processes were required in our design

tasks. These extra features include the ability to change the quantities of the items in your shopping cart during the checkout process, and the ability to edit your shipping and billing address. Therefore, we removed the optional features from the participants' sitemaps and the target sitemaps, and recounted. We then computed more MANOVAS, but they could not be computed, because of the characteristics of the data (the mean, standard deviation, and standard error for designs without patterns for three of the edit types is 0). Looking at the data, it is unlikely there is an overall statistically significant difference.

We conducted analyses of variances (ANOVA) on each edit to see which of them had significant differences. Using Fisher's PLSD method, each ANOVA was tested at the 0.05 level. We did this over all of the designs (see Table 6.17) and all of the designs except Designers 8 and 16 (see Table 6.18).

From this, we see that there are significant differences in roughly the same types of edits as in the measurements including the optional features: splitting a page, adding a normal link, and adding a page. We believe this is for the reasons stated above—that patterns do not currently give guidance about templates, and that designs with patterns have more pages that are affected by templates.

TABLE 6.17   Average edit distances for the desktop designs, excluding optional features, along with F and p values from ANOVAs (NP = no patterns, P = patterns).

Edit type	Amazon				Barnes & Noble			
	NP	P	$F_{1,22}$	p	NP	P	$F_{1,22}$	p
Unapply template	0.00	0.50	1.00	0.33	0.00	0.50	1.00	0.33
New template	0.00	0.08	1.00	0.33	0.00	0.08	1.00	0.33
Apply template	0.00	0.58	1.36	0.26	0.00	0.83	2.90	0.10
Split pages	2.33	1.25	7.41	0.01	3.83	4.25	0.52	0.48
Remove template links	0.08	0.33	1.48	0.24	0.08	0.33	1.48	0.24
Remove normal links	3.33	2.50	1.24	0.28	3.33	4.00	1.11	0.30
Add template links	1.92	2.17	0.44	0.51	3.17	3.08	0.04	0.83
Add normal links	11.33	9.08	5.32	0.03	26.58	23.75	9.04	<0.01
Add pages	4.25	2.50	4.53	0.04	7.08	5.33	4.96	0.04

TABLE 6.18   Average edit distances for the desktop designs, excluding optional features, without the outliers from Designers 8 and 16, along with F and p values from ANOVAs (NP = no patterns, P = patterns).

Edit type	Amazon				Barnes & Noble			
	NP	P	$F_{1,18}$	p	NP	P	$F_{1,18}$	p
Unapply template	0.00	0.60	1.00	0.33	0.00	0.60	1.00	0.33
New template	0.00	0.10	1.00	0.33	0.00	0.10	1.00	0.33
Apply template	0.00	0.70	1.37	0.26	0.00	1.00	3.00	0.10
Split pages	2.20	1.10	9.53	<0.01	3.90	4.40	0.68	0.42
Remove template links	0.10	0.30	0.72	0.41	0.10	0.30	0.72	0.41
Remove normal links	3.20	2.10	1.74	0.20	3.20	4.10	1.57	0.23
Add template links	2.10	2.20	0.14	0.71	3.50	3.10	1.95	0.18
Add normal links	11.20	8.20	11.07	<0.01	26.60	22.90	17.78	<0.01
Add pages	4.20	1.80	11.47	<0.01	7.00	4.60	15.07	<0.01

6.6 Smartphone Designs Created by the Participants

We analyzed the smartphone designs by asking other user interface designers to evaluate them. Unlike with the desktop designs, we did not compare them to mobile

commerce ("m-commerce") web sites, because there are no m-commerce sites at which one can buy books or music that have features comparable to those created by our participants.

6.6.1 Examples of smartphone designs

Figure 6-10 shows a typical TotalMusic.com design created by Participant 7 without patterns or layers. Figure 6-11 shows a TotalBooks.com design created with patterns and layers by the same participant, after she had created the TotalMusic.com design.

145

FIGURE 6-10 Participant 7's smartphone design for TotalMusic.com, made without patterns or layers.
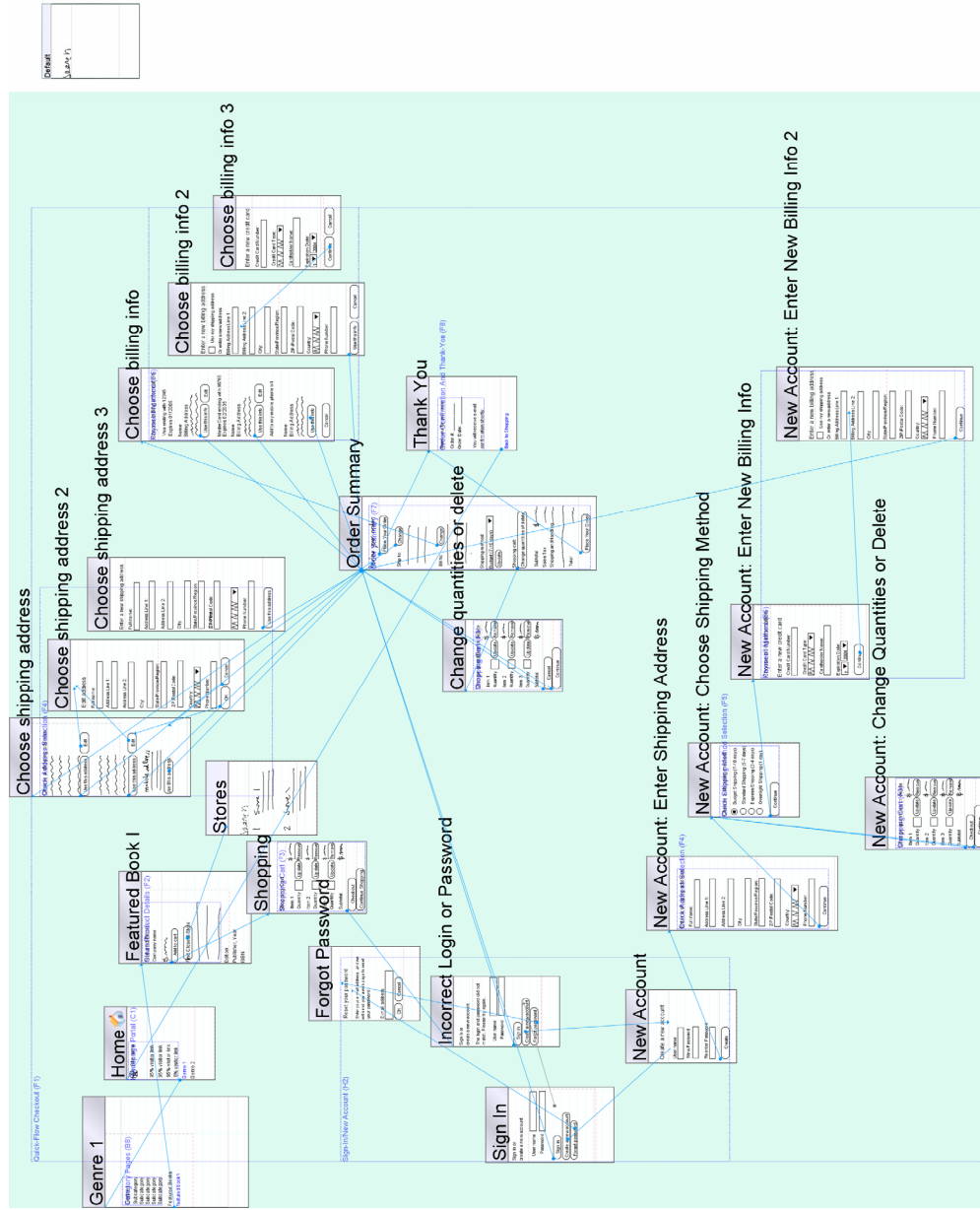
FIGURE 6-11 Participant 7's smartphone design for TotalBooks.com, made with patterns and layers.

Once again, the TotalBooks.com design has more detail and features but is harder to follow than the TotalMusic.com design. Participant 7 believed that in the limited time she had, "TotalBooks is the better design. I'm sure I missed some stuff in TotalMusic." As for the patterns, she found the amount of detail useful. "At some point I'd need all of that stuff, and I think it'd be easier to delete screens than remember to add them in, especially at this stage of the design."

6.6.2   Quality analysis of smartphone designs

We performed an online evaluation of the quality of the smartphone designs, using the same questionnaire and method as for the desktop designs, described in Section 6.5.2. There are 16 smartphone designs over the two conditions. We recruited 12 professional designers online and randomly assigned four designs to each evaluator, so that each design was evaluated by three people. The four designs came from two designers (patterns and non-patterns), and the order of the four designs was randomized.

Table 6.19 shows the demographics of the smartphone evaluators, along with those of the smartphone designers (Designers 4–11) for comparison. Overall, the evaluators are somewhat older on average and have more experience designing for mobile phones and buying ringtones. See Appendix F, Questions 13–30 for the raw questionnaire data.

TABLE 6.19 Demographics of the evaluators of the smartphone designs. The demographics of the smartphone designers (Designers 4–11) are included for comparison.

	Evaluators			Designers		
Total		12			8	
Gender						
Male		8	67%		4	50%
Female		4	33%		4	50%
Age						
	19 and under	0	0%	under 20	0	0%
	20-29	3	25%	21-30	4	50%
	30-39	5	42%	31-40	3	38%
	40-49	3	25%	41-50	1	13%
	50 or above	1	8%	51 or above	0	0%
Years of design experience						
< 1		0	0%		0	0%
1–2		0	0%		0	0%
3–4		0	0%		0	0%
≥ 5		12	100%		8	100%
Years of web design experience						
< 1		0	0%		0	0%
1–2		3	25%		0	0%
3–4		0	0%		0	0%
≥ 5		9	75%		8	100%
Years of mobile phone design experience						
0		0	0%		1	13%
< 1		0	0%		5	63%
1–2		9	75%		2	25%
3–4		1	8%		0	0%
≥ 5		2	17%		0	0%
Number of e-commerce web sites designed						
0		1	8%		0	0%
1–2		3	25%		4	50%
3–4		4	33%		2	25%
≥ 5		1	8%		2	25%
Which platforms were the e-commerce sites designed for?						
Web		11	92%		8	100%
PDA or mobile phone		4	33%		2	25%
Voice		1	8%		0	0%
Other		0	0%		0	0%

	Evaluators		Designers	
Design knowledge				
IA	10	83%	6	75%
Graphic design	5	42%	4	50%
Web design	11	92%	8	100%
GUI design	7	58%	7	88%
Mobile phone UI design	4	33%	1	13%
Voice UI design	3	25%	0	0%
Other	1	8%	3	38%
How many times have you bought anything online in past 12 months?				
Never	0	0%	0	0%
1–3	0	0%	0	0%
4–6	2	17%	0	0%
7–11	2	17%	2	25%
≥ 12	8	67%	6	75%
How did you buy those items?				
Web	12	100%	7	88%
Mobile phone display	2	17%	0	0%
Automated voice	3	25%	0	0%
Other	0	0%	0	0%
No answer	0	0%	1	13%
How many times have you bought books online in past 12 months?				
Never	0	0%	0	0%
1–3	5	42%	3	38%
4–6	5	42%	1	13%
7–11	0	0%	2	25%
≥ 12	2	17%	2	25%
How did you buy those books?				
Web	12	100%	8	100%
Mobile phone display	0	0%	0	0%
Automated voice	0	0%	0	0%
Other	0	0%	0	0%

	Evaluators		Designers	
How many times have you bought albums online in past 12 months?				
Never	3	25%	0	0%
1–3	4	33%	2	25%
4–6	3	25%	4	50%
7–11	1	8%	0	0%
≥ 12	1	8%	2	25%
How did you buy those albums?				
Web	8	67%	7	88%
Mobile phone display	1	8%	0	0%
Automated voice	0	0%	0	0%
Other	3	25%	0	0%
No answer	0	0%	1	13%
How many times have you bought ringtones online in past 12 months?				
Never	7	58%	6	75%
1–3	4	33%	2	25%
4–6	1	8%	0	0%
7–11	0	0%	0	0%
≥ 12	0	0%	0	0%
How did you buy those ringtones?				
Web	4	33%	2	25%
Mobile phone display	5	42%	0	0%
Automated voice	0	0%	0	0%
Other	0	0%	0	0%

Once again, for each design, we asked judges to evaluate the information architecture and the page layout for finding a product, checking out a shopping cart, and overall. We also asked how skilled they think the designer is and how complete the design is (see Appendix F for the questions and the raw answers). The judges judged "sketchy"-looking HTML versions of the designs (see Figure 6-12 and Appendix D).
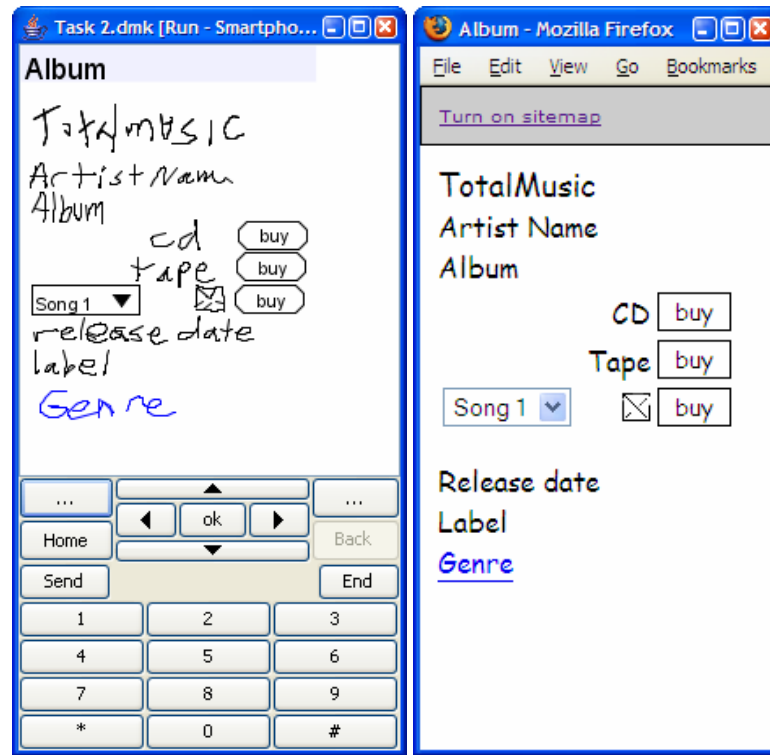
FIGURE 6-12   A smartphone Damask design (left) and its cleaned-up HTML version (right) used in the online evaluation.

To analyze the questionnaire results, we first calculated the mean of the responses from the three evaluators, for each condition, designer, and quantitative question. We conducted a multivariate analysis of variance (MANOVA) to determine the effect of the availability of patterns on the answers to the quantitative questions in the questionnaire. The availability of patterns was the independent variable, and each question was a dependent variable. We found no overall statistically significant effect (Wilks' λ = .52, $F_{7,8}$ = 1.06, p = 0.46).

To see if any of the questions had significant differences, we conducted analyses of variances (ANOVA) on each question as follow-up tests. Using Fisher's PLSD method, each ANOVA was tested at the 0.05 level. We found no statistically significant differences in any of the questions. See Table 6.20.

TABLE 6.20 Average ratings for the smartphone designs (1 = low, 5 = high), along with *F* and *p* values from ANOVAs.

Question	No patterns	Patterns	$F_{1,14}$	*p*
1 Please give a rating for how well the pages for browsing for a (CD/book) were *linked together*.	3.25	2.88	1.33	0.27
3 Please give a rating for the page *layout and design* for (CD/book) browsing.	2.79	2.46	0.94	0.35
5 Please give a rating for how well the pages for shopping cart and checkout were *linked together*.	3.00	3.33	0.93	0.35
7 Please give a rating for the page *layout and design* for shopping cart and checkout.	2.50	3.17	3.39	0.09
9 Please give an overall rating.	2.75	3.17	2.01	0.18
10 How complete do you consider this design to be?	2.12	2.79	3.51	0.08
11 How skilled do you think this designer is?	2.71	2.92	0.42	0.53

We then did the same analysis without the two designers that used one or no patterns, Designers 8 and 16, so that we could see the effect of pattern usage, as opposed to just exposure to patterns. Overall there was still no overall statistically significant effect from the availability of patterns (MANOVA, Wilks' λ = .25, $F_{7,12}$ = 2.61, p = 0.13).

After running ANOVAs on each question, we found statistically significant differences for two of them: ratings for the page layout and design of the shopping cart and checkout process, and completeness of the design. See Table 6.21.

TABLE 6.21   Average ratings for the smartphone designs (1 = low, 5 = high), excluding Designer 8, along with *F* and *p* values from ANOVAs.

Question	No patterns	Patterns	$F_{1,12}$	*p*
1 Please give a rating for how well the pages for browsing for a (CD/book) were *linked together*.	3.33	2.81	2.17	0.17
3 Please give a rating for the page *layout and design* for (CD/book) browsing.	2.90	2.43	1.62	0.23
5 Please give a rating for how well the pages for shopping cart and checkout were *linked together*.	3.05	3.43	1.01	0.33
7 Please give a rating for the page *layout and design* for shopping cart and checkout.	2.48	3.33	5.37	0.04
9 Please give an overall rating.	2.76	3.29	2.86	0.12
10 How complete do you consider this design to be?	2.14	2.95	4.90	0.05
11 How skilled do you think this designer is?	2.71	3.00	0.63	0.44

As with the desktop designs, the results of the questionnaire show that the design patterns had their biggest effect on two areas: higher ratings for the layout and designs of the pages in the shopping cart and checkout process, and the higher completeness rating for the designs with patterns. We believe this is due to similar reasons as the desktop designs: that the shopping cart and checkout process is complex enough that using patterns is a big advantage, and that the completeness of the patterns leads to a more complete design overall.

6.7 Voice Designs Created by the Participants

Similarly to the smartphone designs, we analyzed the voice designs by asking other user interface experts to evaluate them. We did not compare them to voice commerce ("v-commerce") sites, because there are no v-commerce sites at which one can buy books or music that have features comparable to those created by our participants.

6.7.1 Examples of voice designs

Figure 6-13 shows a typical TotalMusic.com voice UI design created by Participant 15 without patterns or layers. Figure 6-14 shows a TotalBooks.com voice UI design created with patterns and layers by the same participant, prior to creating the TotalMusic.com design. The TotalMusic.com design is more linear, but the prompts and responses are well crafted for the task. The TotalBooks.com design has more features, but the complexity of the layout makes this design harder to grasp. Given the number of arrows in a voice UI design in Damask, an improved layout algorithm would greatly improve the readability of voice designs.
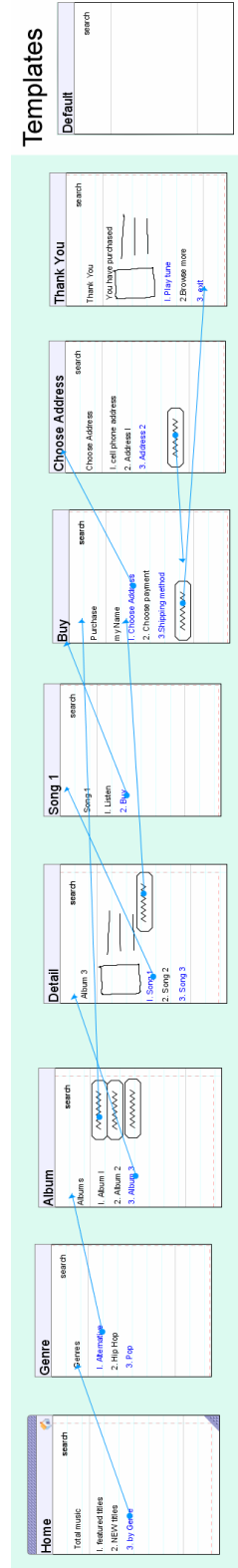
FIGURE 6-13 Participant 15's voice design for TotalMusic.com, made without patterns or layers.
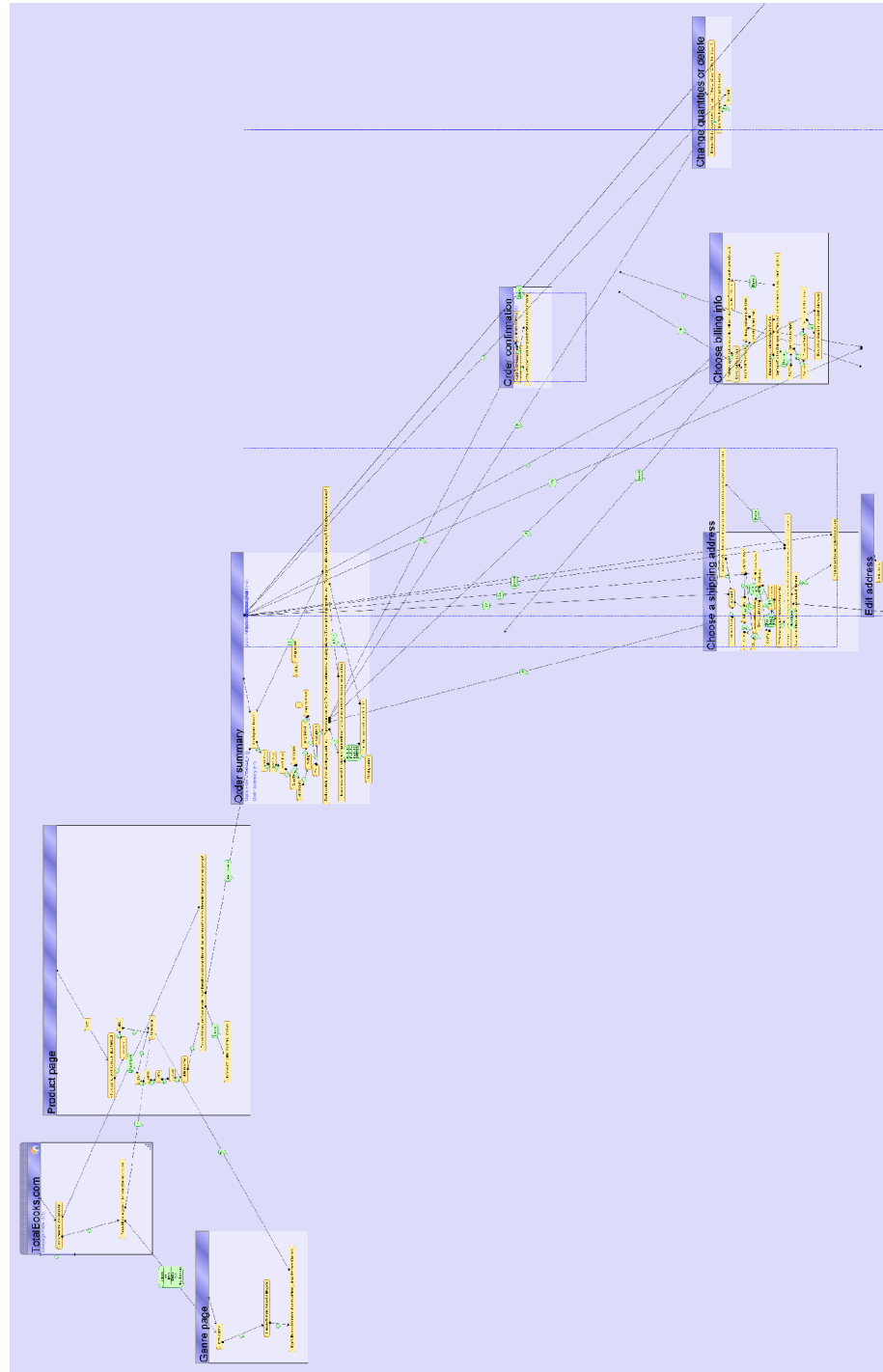
FIGURE 6-14 Participant 15's voice design for TotalBooks.com, made with patterns and layers.

6.7.1 *Quality analysis of voice designs*

To evaluate the voice designs, we used experts to judge the voice UI designs. We first modified the voice designs to fill in placeholders with actual items to give the illusion of finished designs. We then asked four people, three HCI researchers and one HCI engineer, to listen to each of the eight voice designs. The order in which each judge listened to the designs was random. For each design, they were given a specific book or music album to "buy," along with enough information to complete the purchase. They then answered five questions: the confirmation number and the total price of the purchase (to make sure they were paying attention to the interface), what they did and did not like about the voice interface, and then a rating of the design from 1 to 7, where 1 was "did not like" and 7 was "liked very much." See Appendix G for the experimental questions and raw data.

The results are mixed, as shown in Table 6.22. There is no statistically significant difference between the voice designs with and without patterns. (Order effects were not significant.) However, it is instructive to specifically look at what the judges did and did not like about the designs, and infer how patterns affected their opinions.

TABLE 6.22 Average ratings of all eight voice designs (four non-patterns and four patterns) and the voice designs except those from Designer 16, who only used one pattern in the Patterns condition (1 = did not like, 7 = liked very much).

	Participants					
	13	15	16	17	All designs	All designs except Designer 16
Non-Patterns	5.50	4.75	4.00	5.00	4.81	5.08
Patterns	3.00	5.00	6.00	4.50	4.63	4.17
p (2-tailed *t*-test)					0.85	0.38

Of the designs that include patterns, many of the evaluations described them as being efficient and fast to use. However, there were also many complaints about the excessive wordiness, the unnecessary repetition of items in the shopping cart, and the lack of a "goodbye." These comments stem directly from the parts of the design that came from patterns.

Since the patterns in *The Design of Sites* [188], on which the Damask patterns are based, do not contain voice-specific solutions, we created the solutions ourselves. Unfortunately, we did not have the opportunity to consult voice designers at the time they were designed. This led to voice solutions which were sometimes too similar to the desktop solutions. For example, in a desktop web site, it is fine to display the contents of a shopping cart after adding an item to it, because the user can quickly glance at the contents. But in a voice UI, adding an item to a cart should *not* result in the user listening to a possibly long list of items. Instead, there should only be a brief confirmation statement like, "OK, it's been added." Fixing the patterns would dramatically improve these designs without any more effort on the designers' part.

Interestingly, during the study of Damask itself, out of the four desktop/voice participants, only Participant 17 said that the voice user interface that she created with patterns was somewhat awkward. This may be because during Run mode, they did not actually listen to the interface, but instead read it in a dialog box. All of them knew the importance of actually listening to an interface to get it right, but thought the visual Run mode was adequate for this early phase of design.

The designs without patterns had their own pluses and minuses. In general they were praised for their efficiency, but some judges noticed that three of the four designs without patterns also did not have a "goodbye" message. One design did not

include a confirmation number, and another did not say the final total cost, problems that would have been easily avoided by using the QUICK-FLOW CHECKOUT pattern.

6.8 Pattern Usage and Ratings

Table 6.23 contains a list of patterns that designers used, along with which designers used them. We only implemented solutions for the patterns that we thought the designers would use, so the participants were limited to using only the eleven patterns listed in the table.

TABLE 6.23   Patterns used by the participants

Participant #	# patterns explicitly used	# total patterns used	B8: Category Pages	C1: Homepage Portal	F1: Quick Flow Checkout	F2: Clean Product Details	F3: Shopping Cart	F4: Quick Address Selection	F5: Quick Shipping Method Selection	F6: Payment Method	F7: Order Summary	F8: Order Confirmation and Thank You	H2: Sign In/New Account
4	5	11	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙
5	6	6	○	●		●	●	●	○	●		●	○
6	4	10	●	○	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙
7	5	11	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙
8	0	0	○	○	○	○	○						○
9	5	11	●	●	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙
10	7	8	●²	○		●	●	●	⊙	●	●	●	○
11	4	10	●²	○	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙
13	4	10	●	○	●	●	●	⊙	⊙	⊙	⊙	⊙	⊙
15	2	8	○	●	●		○	⊙	⊙	⊙	⊙	⊙	⊙
16	1	1	●	○						○			○
17	9	9	○	●		●	●	●	●	●	●	●	●
Average	4.3	8											
# designers explicitly used			8	6	7	9	9	3	1	3	2	3	1
# designers used			8	6	7	9	9	10	10	10	9	10	8

● = used once
●² = used twice
⊙ = embedded within another pattern that was used
○ = viewed during the pattern learning phase but not used in the main task

Out of twelve participants, six used 10 or 11 patterns, four used 6 to 9 patterns, one used 1 pattern, and one used none. On average, the participants explicitly used 4.3 patterns and implicitly used 8 patterns, since QUICK-FLOW CHECKOUT (F1) and ORDER SUMMARY (F7) contain other patterns. Also, out of the eleven patterns that had

Damask solutions, all of them were used by at least six out of twelve participants, and nine of them were used by at least eight. This indicates that most designers were able to find the patterns in Damask that were relevant to their design task, even though they only had fifteen minutes to look through the pattern collection (containing 90 patterns) and the e-commerce patterns were not explicitly pointed out to the participants.

Although we did not ask most of the participants why they did not use certain patterns, we noticed that when participants did not use a pattern that we expected them to use, it was usually because they did not look through the pattern during the learning task or the main design task. Therefore, it is likely that the participants simply did not know about the pattern and its title was not descriptive enough to catch their eye; this was the reason we got when we asked participants 15, 16, and 17 about not using particular patterns during the post-test debriefing. Since the participants were given only fifteen minutes to learn as much they could about ninety patterns, this is not surprising, and the fact that designers used 8 patterns on average is a very positive sign. In the case of HOMEPAGE PORTAL, some designers did look at it but decided not to use it, because its solution did not look like an e-commerce home page.

The participants who used design patterns extensively said that patterns saved them time because they would not have to "reinvent the wheel." Participant 9 said, "They let you skip the step of creating them and just pick up stuff that's already been proven to work." Participant 10 said, "They help enforce consistency and they also save a bunch of time when designing something that doesn't really require a whole bunch of innovation. Nice that the patterns are flexible, too. I can delete portions if I don't want to use them."

As for the two participants who used one pattern or less, Participant 16 said that he did not feel familiar enough to use the patterns and did not want to take more time to look them up, besides CATEGORY PAGES, which he had already used in the layers and patterns warm-up task. Participant 8 thought that the task was too simple to need to use patterns, but said that the patterns overall had "lots of possibilities—would be good for client meetings/needs analysis." Note that not only did Participants 8 and 16 not use many patterns, they barely looked through the patterns during the main design task, if at all.

Most of the participants liked the patterns that Damask provided for the given task. The average rating for the patterns' usefulness in the given task was 6 out of 7 (only 1 out of 12 ranked usefulness less than a 6, and that participant did not use the patterns for the task; see Table 6.24).

TABLE 6.24   Participants' ratings on the usefulness of the patterns for the TotalBooks.com design task (1 = not useful, 7 = very useful)
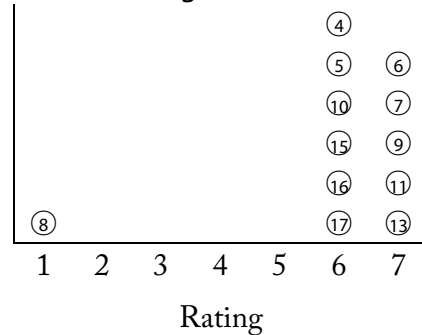
mean = 6, median = 6, std dev = 1.65

For general usefulness, the opinion was less strong but still positive overall. Seven of the twelve participants gave a rank of 6 or 7 (average = 5.33). Many of them talked about how patterns saved them time. Participant 9 said, "They let you skip the step of creating them and just pick up stuff that's already been proven to work." Participant 10 noted, "They help enforce consistency and they also save a bunch of time when

designing something that doesn't really require a whole bunch of innovation. Nice that the patterns are flexible, too. I can delete portions if I don't want to use them."

The other five of the twelve participants gave the patterns' usefulness a rank of 3, 4, or 5. Two of them mentioned how the patterns' solutions seemed to assume too much. Participant 4 said, "Sometimes they assumed I was using them in a particular way." Participant 15 said, "Even with 80 [sic] patterns, sometimes the pattern you pick does not match what you want" (see Table 6.25).

TABLE 6.25   Participants' ratings on the general usefulness of the patterns
(1 = not useful, 7 = very useful)
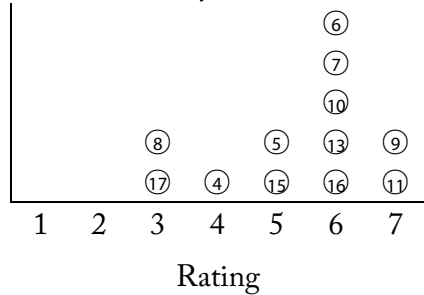
mean = 5.33, median = 6, std dev = 1.37

Besides the patterns we expected the participants to use, there were several patterns that the participants tried to use but which did not have any Damask-based solutions that they could directly incorporate into their designs. On average, the designers tried to use 3.5 patterns that were unimplemented, 4.2 if we do not consider Participants 8 and 16 (see Table 6.26). The time spent trying to use these patterns also cost these designers time on the task. One could imagine the task times for the patterns condition would have been even lower had these patterns been implemented.

The three patterns most frequently tried were PERSONAL E-COMMERCE, FEATURED PRODUCTS, and SEARCH ACTION MODULE. Had we implemented the latter two, it would have shortened the participants' design time even more, but it is not as clear what the impact of using the PERSONAL E-COMMERCE pattern would be.

PERSONAL E-COMMERCE is a genre pattern that references all of the lower-level patterns in the E-Commerce genre. It would have included more functionality than the designers would have needed, but it also would have been so overwhelming that designers might have decided not to use it or might have had trouble deciding what to remove from the pattern instance for the purposes of the design task.

TABLE 6.26 Patterns that participants tried to use but had no Damask solutions. The highlighted columns indicate the patterns most frequently tried.

Participant #	# patterns explicitly used	A1: Personal E-Commerce	A7: Valuable Company Sites	B1: Multiple Ways to Navigate	B2: Browsable Content	B3: Hierarchical Organization	B4: Task-Based Organization	B5: Alphabetical Categorization	B7: Popularity-Based Organization	C2: Up-Front Value Proposition	D1: Page Templates	D2: Content Modules	G1: Featured Products	G2: Cross-Selling and Up-Selling	G4: Recommendation Community	G5: Multiple Destinations	J1: Search Action Module	J2: Straightforward Search Forms	K1: Unified Browsing Hierarchy	K2: Navigation Bar	K10: Obvious Links
4	2	⊘															⊘				
5	5												⊘	⊘	⊘		⊘	⊘			
6	7	⊘				⊘		⊘					⊘						⊘	⊘	⊘
7	10	⊘		⊘	⊘	⊘				⊘	⊘	⊘	⊘		⊘		⊘				
8	0																				
9	0																				
10	4	⊘					⊘										⊘	⊘			
11	8	⊘			⊘					⊘	⊘	⊘	⊘		⊘	⊘					
13	4	⊘	⊘										⊘	⊘							
15	1								⊘												
16	0																				
17	1	⊘																			
Total		7	1	1	2	2	1	1	1	2	2	2	5	2	3	1	4	2	1	1	1

While all of the designers liked the amount of detail in the patterns, they found some of the larger patterns intimidating and hard to use. For example, the layout of the solution of the QUICK-FLOW CHECKOUT pattern made it hard for designers to figure out how to link the instance with the rest of their design. Participant 6 said, "A somewhat cleaner layout of pages would help, to make it easier to see what you've just pasted in."

Also, when we first created the solution, some of the page titles were not descriptive enough, which also resulted in a couple of designers not using the pattern as intended. We tried to mitigate this by including a Preview button right above the

solutions, which allows designers to interact with the solutions in Run mode, but it was rarely used. Adding descriptive features, such as annotations to describe parts of the design and making important arrows stand out more, would help designers understand the patterns faster. Also, making parts of patterns collapsible would allow designers to learn patterns more gradually.

Adding to the intimidation factor was that after designers instantiate a pattern, they cannot move all of the pages in the pattern instance at the same time. This made them a bit more hesitant to instantiate a large pattern, and it was a chore to easily move an instance of a large pattern such as QUICK-FLOW CHECKOUT to another part of the canvas. This could be alleviated by letting designers drag the box surrounding the pattern instance, thus moving the entire instance.

Some of the participants voiced concerns about the broadness of the individual patterns. For example, the participants who did not use the HOMEPAGE PORTAL pattern said that the introductory photo or the solution did not look like a typical e-commerce site. One way to address this is to have more than one solution per pattern, each tailored to particular genre. For example, a solution for a news site homepage would be different than one for an e-commerce site homepage.

Another interesting aspect is how the participants interacted with the Pattern Explorer during the design task. Most of them concluded that a design pattern would be useful only if it had a solution, so instead of reading a pattern carefully, they quickly scrolled through the pattern, and if they didn't find a solution, they moved on to another pattern. This behavior may have stemmed from the somewhat artificial scenario, but we believe that many designers will not bother to read the entire pattern in real life, just like most users do not read documentation. This may require that the

patterns be written in a more bulleted outline format, using hyperlink expansion for more detailed discussions.

6.9 Layers Usage and Ratings

All of the participants understood layers well enough to perform the task. Six out of eight desktop/smartphone designers said that the concept of layers was easy or somewhat easy to understand (rated at least 5 out of 7), and two said they were hard or somewhat hard to understand (rated 2 and 3). Two out of four voice designers found the concept easy to understand (rated 6), and the other two found it somewhat hard (rated 3). The overall average was 4.92 on a scale of 1 to 7 (7 being best), but it is clearly bimodal (standard deviation = 1.73). See Table 6.27.

TABLE 6.27   Participants' ratings on how easy to understand layers are (1 = not easy, 7 = very easy).

1	2	3	4	5	6	7
					6	
		10			8	
		13		4	15	9
	7	17		5	16	11

mean = 4.92, median = 5.5, std dev = 1.73
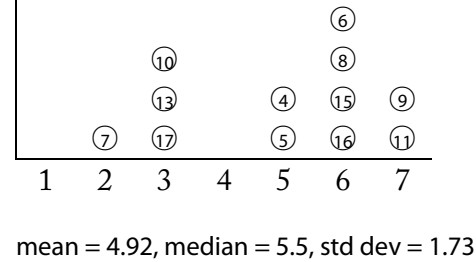
The participants' preferences for layers were also mixed. Three out of eight desktop/smartphone designers and three out of four voice designers said they liked layers (at least 5 out of 7); the overall average was 4.75 (see Table 6.28).

TABLE 6.28   Participants' ratings on how much they like layers (1 = do not like, 7 = like very much).

1	2	3	4	5	6	7
		5			8	
	4	6			15	9
7	10	17	13		16	11

mean = 4.75, median = 4.5, std dev = 1.66
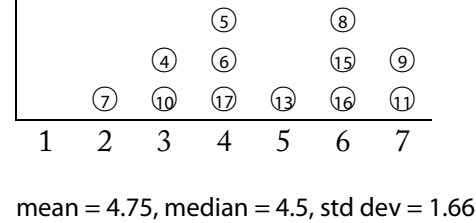
The most frequent mistake that participants made was forgetting which layer they were currently in, and therefore making changes that did not propagate the way they expected. One participant suggested that since most of the participants start with the desktop design first and then modify the other generated designs, the default layer in the smartphone and voice designs should be This Device instead of All Devices.

Another usability problem that most of the participants ran into was moving objects between layers. Originally, the Move Object to This Device button actually took an object that was in all devices, and made a separate object for *each* device. None of the seven participants (Participants 4–10) who used Damask with this behavior understood that. They assumed that if they were in the desktop view and used the Move Object to This Device button on an object, then the object would be removed from the smartphone and voice views. We later changed Damask to do this, and the remaining five participants had no problems understanding the new behavior.

However, using that button still was not always natural. For example, suppose there was a button that appeared in all devices. If designers wanted to remove the button from the smartphone user interface only, their natural inclination was to try to use the eraser and erase the object in smartphone view, rather than going back to the desktop view and moving the object from All Devices to This Device.

We discuss possible improvements to layers in Section 8.3.

6.10 Usability of Damask

Overall, we found that designers had little problem understanding the basic concepts of Damask's user interface. Although they all ran into Damask's quirks, by the second session, they had all gotten much more comfortable using the interface. Many of the

participants verbally commented how they liked the informal, fluid interaction style of Damask. This was a new experience for most of the participants—four of the participants had only used DENIM a little bit, and the other eight had never used DENIM.

For the two main design tasks, every designer started designing the desktop web UI first, including the voice designers who did not consider themselves web designers. They said that they considered that the "main" interface.

After each session, the designers were asked to write down what they liked about Damask, without being prompted for anything specific. All of the answers can be found in Section C.6.3, Question 3 and Section C.7.7, Question 3; also see Section C.8.1 for a detailed summary. We will give the highlights below.

- Seven out of twelve designers mentioned design patterns. Participant 9 said she liked "being able to grab ready-made plans, because it helps avoid reinventing the wheel." Participant 17 said, "For building the web prototype it was very useful to have the patterns, so I didn't have to do some things from scratch (like login, shopping cart, etc.)"

- Seven designers mentioned Run mode. Participant 6 said that "the 'runtime' mode for simulating user experience" is "easily" one of his "favorite aspects."

- Five designers mentioned either layers specifically or being able to create a user interface for more than one device simultaneously. Participant 11 said she particularly liked, "the ability to enter device-specific info in the form of layers." Participant 7 said that the "ability to reuse elements from desktop view to smartphone view saved me time."

- Five designers mentioned either the sketching interface or the pen user interface. Participant 4 said he liked "sketching non-standard UI widgets (tables, copy

blocks) without spending time drawing lines and getting the right number of characters." Participant 13 said, "I also like the idea of how 'sketchy' the windows seem—it really allows for informal brainstorming to be formalized a bit, and easily shared."

- Four designers mentioned the templates. Participant 6 said he liked "The ability to quickly templatize site elements."

- Four designers mentioned how they were able to create a prototype quickly. Participant 10 said, "I felt like I could pretty quickly create both a flow chart and a usable prototype. I like that a lot."

- Two designers mentioned the zooming interface. Participant 11 said she liked "the ability to quickly generate a top-down view of the site and then zoom in on the details of each page."

- Two designers mentioned being able to link sketches together with arrows. Participant 7 said, "I liked the showing the flow through linking on Damask."

The designers were asked what they did not like about Damask and what was missing. All of the answers can be found in Section C.6.3, Questions 4 and 5, and Section C.7.7, Questions 4 and 7; see Section C.8.2 for a detailed summary. The range of topics was much broader than in the previous question, but the top three concerns, each mentioned by four designers, were:

- Layers. Participant 6 said, "I'm still on the fence about the layers." Participant 10 said, "The concept of layers was a little hard to grasp. With more experience I could pick it up, but I had to keep thinking about it."

- The awkwardness of the sketching interface as implemented in Damask. Participant 7 said, "Writing with a pen didn't translate well."

- The difficulty of panning and zooming around the canvas. Participant 6 said, "The most frustrating part was trying to move about the workspace. Many tasks involved this laborious traversal of space, from copying and pasting elements between pages to linking distant pages to objects on the current page." Participant 10 said, "Certain features could probably be moved more in the direction of how other applications do them. An example would be zooming (i.e., Photoshop)."

Note that layers were mentioned both positively and negatively.

There were also some usability issues that the participants experienced. Most participants were confused that one tool, the pencil, had three uses: creating pages, drawing inside pages, and linking pages together, especially because every other tool performed only one function. This design decision originated with Damask's predecessor, DENIM, where the pencil was the only tool available to create pages and objects. There are several possible ways to fix this. Some involve making the user interface more pen-centric. One way is to eliminate the other control tools, keeping only the pencil, and rely on recognition for inserting controls, like SILK [99]. Another is to use a "stamping" metaphor for the control tools, similar to the augmented DENIM that we described in Chapter 4, which would reinforce the overall sketching metaphor. A completely different route is to make the user interface *less* pen-centric and more conventional, by adding another tool for creating a page. We found that Visio was the most commonly used tool among our participants (11 out of 12), so making the tool more similar to Visio may ease the learning curve.

Screen real estate was another usability issue. Since the Pattern Browser was in its own large window, it was hard to have it on-screen at the same time as the main Damask window. One designer specifically suggested that Damask should include a

mini-browser, with thumbnails of the pattern solutions, which would be a sidebar just next to the main window.

The template pane had similar problems: its zoom level was tied to the main window, and its width was fixed depending on the zoom level. If the designers zoomed in to modify a template, the template became so wide that most of the rest of the canvas was not visible. This made it hard to do actions such as finding a page to link to the template. This can be fixed by making the template pane's width and zoom level independent of the main canvas. It could possibly be put into another window, although this would make linking template elements to the main canvas difficult.

Designers had problems remembering how to link template elements to other pages. Instead of drawing an arrow from a link in the template pane to the link's destination, they instead drew an arrow from a page that used the template in the main window to the link's destination. This unwittingly created an organizational arrow instead of a navigational arrow, which caused designers to be confused when their link did not work. They did not notice that the organizational arrow was a different color. Damask should allow designers to link template elements from within normal pages in addition to the template pane, but indicate that the link is global, perhaps by animating the source of the link to the template pane.

Designers experienced some performance problems with Damask. It had trouble keeping up with participants' writing many letters by hand. Using a framework that is optimized for pen input, such as the Digital Ink APIs in Windows XP Tablet PC Edition, would greatly alleviate that. Also, the system slowed down and became less responsive if the participants inserted many pattern instances. Since the code has not

been optimized, there are plenty of opportunities for improving the performance of Damask.

6.11 Summary

Our experiment with Damask shows that designers are enthusiastic about the concept of patterns and can use them effectively. Using patterns during the early stages of design saves time and results in design concepts that include more functionality with a more standard interaction flow. However, there are issues with learning and using large patterns with lots of functionality. We have also shown that layers are a powerful metaphor for distinguishing UI elements for all devices versus those for only one device. Even though the current implementation of layers is complex and somewhat confusing, eight of the twelve designers still prefer this metaphor over an alternate metaphor that we presented (which is described in Section 8.3.3), implying that the concept is on the right track, but the details and implementation need to be improved.

7 Related Work

This chapter contrasts Damask's approach to other related work, including model-based UI tools, tool support for patterns, combinations of model-based and pattern-based approaches, tools to transform UIs from one device or modality to another, and user interface design tools in general.

7.1 Model-Based UI Tools

Szekely [178] identifies five approaches that model-based UI tools have taken: automatic interface design, specification-based model-based interface development environments, help generation, tools to help designers create models, and design critics and advisors. We address all of these except help generation, which is not part of the target domain of Damask.

7.1.1 Automatic interface design tools

Automatic interface design tools [16, 26, 49, 66, 89, 102, 157, 199] strive to automatically create the user interface of an application, given a task or domain model of the application.

As Szekely describes [178], an automatic design tool typically takes the following steps to generate a user interface:

1 Determine the presentation units. The tool figures out the windows that will be used and the contents of those windows.

2 Determine the navigation between presentation units. The tool constructs a graph of presentation units that defines which presentation units can be reached from other units.

3 For each presentation unit, determine the abstract interaction objects, which define the behavior for each element in a presentation unit in an abstract manner, for example, "select one from a list."

4 Map abstract interaction objects into concrete interaction objects, which are actual widgets available in a toolkit.

5 Determine the window layout, in other words, where the widgets are placed in the window.

The first three steps build the abstract UI specification, and the last two build the concrete interface.

As Szekely discusses, each of these steps is difficult to automate, especially steps 1 and 3, which require a deep understanding of the user's tasks. For example, it is hard for a tool to tell whether a set of data is better displayed as a table or as a graphical display like a map. Consequently, designers have not accepted the tools since it is harder to create a model and guess what the tool will generate than it is to design it directly themselves. Some tools, such as Tadeus [164], explicitly involve the designer in each step instead of trying to do each step automatically, as a way to address this problem.

In Damask, we sidestep the automation problems since Damask does not require explicit definition of a domain or task model. Instead, a designer using Damask designs a concrete interface for one device embedded with design patterns. Damask

uses information in the existing concrete design and the design patterns it uses to generate an appropriate UI for the other devices.

7.1.2 *Specification-based model-based interface development environments*

Unlike automatic interface design tools, specification-based model-based interface development environments (MB-IDEs) do not try to automatically generate a user interface from task or domain models. Instead, designers directly create and interact with task, domain, or presentation models, which the MB-IDE then uses to generate a final UI. Letting designers directly interact with models enables them to more easily specify a design, change it, retarget it, and so on.

Early specification-based MB-IDEs [85, 165, 179, 180, 197] use modeling languages that tend to look like traditional programming languages, which are inappropriate for designers, who often have little programming background. Also, the languages are at a level of abstraction that we feel is inappropriate at the early stages of design and prototyping.

A newer generation of specification-based MB-IDEs [5, 11, 36, 37, 45, 75, 84, 92, 110, 132, 134, 147, 159, 194, 201] use XML-based languages for describing user interface models. (Souchon and Vanderdonckt [173] have a good overview of many of these languages.) Many of these languages were designed with targeting multiple types of devices in mind. Designers are more likely to be comfortable with the syntax of these languages, since they are superficially similar to HTML. However, they are still more similar to programming than to existing early-stage design practices, and they are still at a level of abstraction not appropriate for early-stage design and prototyping, in the same way that most web designers do not create their designs initially in HTML.

Damask takes a different approach. It leverages the existing work practices of designers, who sketch rather than program, to generate cross-device UIs. Damask builds the interaction model of a design from both the designer's sketch and the design patterns it uses.

7.1.3 *Modeling tools*

Some MB-IDEs include a modeling tool to help a UI designer create a model-based UI without creating the model directly. FUSE [107] and Adept [199] have simple form interfaces to edit models, but they have not been extensively evaluated. We also believe that a form-based interface is not a good match for UI designers' existing work practices, which involve freeform sketching of UI designs. Inference Bear [53] and Grizzly Bear [52] use a programming-by-demonstration interface builder as a front-end to creating a model; however, the model itself is exposed to the designer through a special-purpose modeling language. More recent modeling tools, such as TERESA [132], PLANES [117], Windows Transition Notation UIDA [190], and XIML Task Simulator and DialogGraphEditor [50], allow the creation of models using a graphical language such as ConcurTaskTrees [153] or Windows Transition Notation [190]. Several projects [23, 117, 152] have proposed using the Unified Modeling Language (UML) for UI modeling.

In contrast, Damask does not expose the abstract model directly to designers, since they do not usually think about their interfaces in terms of abstract models.

UI Pilot [158] takes a different approach to modeling. Designers using UI Pilot create a user-task model in a simple outline mode, including the types of data and users in the application. Then they construct a "wireframe" for each screen or web page of the system, by dragging the appropriate tasks, user types, and data into a

blank wireframe. They can also add links to related wireframes. Designers can also construct wireframes without directly constructing a model, by creating data on the fly within a wireframe. In this way it is similar to Damask, which also does not require explicitly building a model. U i Pilot and Damask are complementary—currently, ui Pilot does not handle actual screen layout of user interface controls, while in Damask, the dominant design paradigm is sketching out ui controls within a page.

7.1.4 Design critics and advisors

Design critics and advisors use information provided by models to give an analysis of the user interface design. There are three basic types [178]:

- Property verifiers [49, 151, 154] verify that a design satisfies certain properties, such as whether all parts of the design are reachable.

- End-user simulators [88] simulate users using the application and predict task times learning times, and errors. Some tools, such as critique [73] and the CogTool [83], create predictive models of a task based on a person demonstrating the task.

- Summative evaluators [35, 166] analyze a design and give it a score based on a set of criteria or a theory of, say, layout quality.

Generally, these tools have been hampered by the fact that it is currently difficult to encode high-level design guidelines into a precise set of rules that a tool can check. Damask takes a different approach, by collecting various types of actual usage data during a "Run mode" and then using other tools, such as WebQuilt [70] and suede [91], to display that data in an "Analysis mode" for designers to evaluate. In this way,

designers can draw upon their design experience when analyzing their designs. In addition, the included patterns encode design guidelines and best practices.

7.1.5 *Prototyping vs. finished interfaces*

The philosophy of most model-based UI research is that the model-based tools would be the primary way to create the finished user interface, although many tools expect the user interface to be modified somewhat by a designer. In contrast, Damask is targeted towards prototyping. We do not expect the designer to use Damask to create the final user interface, nor do we expect Damask's generated user interfaces to be used without modification. Since we are targeting prototyping, the generated user interface does not need to be ideal, since in the early stages of design, the designer is concerned more with the user's interaction flow rather than the details of the interface [195, 200].

7.2 UI Tools and Languages for Multiple Devices

Many model-based tools and languages specifically address the issue of creating user interfaces targeted at multiple devices [22, 23, 33, 36, 37, 39-41, 62, 67, 75, 92, 109, 110, 117, 119, 120, 130, 132, 134, 159, 194]. They all take the same basic approach: the designer or developer describes a user interface using one or more abstract models, either directly in the textual modeling language or by using a GUI tool. These models are then rendered into a concrete user interface, either during development or at run-time using a supporting renderer. Sometimes, the models are annotated to give hints to the renderer about how to display the user interface for a particular device.

Using these tools, it is generally difficult to create an application where parts of the presentation model are different from one device to the next, even if the same

overall task or concept is in common. For example, to specify that an interface should use a graphical map of locations on a PC but a textual list of addresses on a mobile phone display, the designer would essentially need to create two interfaces from scratch, and somehow link the two interfaces together if he or she cared about keeping the abstract models consistent. There are no tools that can recognize a map and automatically generate a list for use on another device. Damask uses patterns for this purpose: a pattern represents a general concept where the abstract models for each device may be quite different. So for the previous example, Damask would have a pattern containing a map for the PC and a list for the mobile phone already linked up, which designers could then use directly in their designs.

GADGET [48] and SUPPLE [55] take a different approach: they view user interface generation as an optimization problem. GADGET is actually an optimization toolkit for interface layout. One can use GADGET to take an existing collection of user interface controls and generate a layout for those controls. This makes GADGET potentially useful to Damask for creating, for example, a smartphone UI from a desktop UI, since many of the controls would be the same, but makes it less useful for generating voice UIs from desktop UIs, where the controls may be very different. SUPPLE takes an abstract model (called a *functional specification*), a device model, and a trace of UI events created by a user to generate an interface. Damask could potentially use SUPPLE's algorithms to generate device-specific UIs, provided there is a robust way to create a functional specification from a concrete user interface that a designer creates for a specific device.

There have been several projects that aim to create a platform for creating universal remote controls [69, 80, 142, 143, 155, 201]. These projects envision appliances that export high-level descriptions of a remote control user interface to

another device, such as a PDA or a Braille reader, which then renders that description into a concrete UI. The UI would take the user's input to the remote control UI and send it back to the appliance for processing. There are two important distinctions between the problems these projects are solving and Damask's problem area. The target domain of universal remote controls is narrower (remote controls for appliances vs. web interaction), but the UIs that are rendered from the abstract remote control description must be appealing and useful immediately, without additional tweaking. Damask, on the other hand, is targeting a broader set of UIs (general web-style interaction on PCs, mobile phones, and voice applications) but the interfaces that are generated will most likely be modified by the UI designers before being released.

Calvary, Coutaz, and Thevenin [31] discuss a process framework for developing plastic interfaces, which can adapt to different devices. In addition to the typical model-based approach, in which a designer creates a series of models from top-level abstract models to a concrete interface, the framework also covers translations between platforms, which may happen at any model abstraction level. This framework provides a useful way of thinking about how to develop cross-device user interfaces, although with Damask, top-level abstract models are not directly exposed, so the framework is not directly applicable.

Wiecha et al [198] discusses the possibility of factoring web services so that issues such as device, navigation style, localization, and personal preferences are separated into transforms that are then applied, one by one, to an abstract application definition. Each transform in this chain of transforms could then be implemented as proxies or intermediaries between content providers and consumers. This paper discusses run-time issues, which are actually orthogonal to the early-stage design and prototyping

issues that Damask addresses. Once a cross-device UI is designed with Damask, Wiecha et al's chain of transforms could be used to implement such a user interface.

7.3 Tool Support for Patterns

There has been much discussion about using design patterns in HCI [27, 182, 183, 188, 189], but few HCI tools have been created that support patterns. Paternò [153] describes extending a task and architecture model editor to support patterns that are made up of model fragments themselves. Paternò focuses on abstract task and architecture patterns. A task pattern describes what steps a user performs to execute a particular task, such as searching, independent from a particular user interface. An architecture pattern describes how the program implements a task, such as how a program accesses a database to perform a search. On the other hand, since designers create concrete UI designs using Damask, the patterns in Damask also consist of concrete UI fragments.

In computer science, patterns have made the most impact in software engineering. Software engineers use patterns to talk about how classes in object-oriented programs are organized and how they communicate with each other. Patterns were first used in this way by Beck and Cunningham [20], and this approach was popularized in a book by Gamma, Helm, Johnson, and Vlissides [56], commonly known as the "Gang of Four." Consequently, software tools that support patterns have mostly targeted object-oriented software development.

Budinsky et al [29] describes a system that generates design pattern code automatically, using pattern templates and application-specific information provided by the programmer. The tool also provides an online version of [56] to allow programmers to quickly browse and access information about patterns.

Florijn et al [47] describes a tool that allows programmers to view their programs in three different views: pattern, design (i.e., class diagrams), and code. This tool allows programmers to instantiate patterns from a repository, to bind existing code to a pattern, and to check whether their code still conforms to a pattern's constraints.

Pagel and Winter [150] describe a pattern metamodel that can describe all object-oriented design patterns known up to when the paper was written, how to instantiate an abstract pattern from a pattern repository into a concrete pattern used in a design, and a tool that supports the use of patterns in software design.

Face [118] is a system in which a developer builds an application by directly customizing abstract design patterns, which are represented with a representation of classes and their relationships similar to the Object-Modeling Technique (omt) [160], a modeling language that is a predecessor of uml.

Rational Software Architect [78], Software Modeler [79], and xde [77]; ModelMaker [127]; OmniBuilder [148]; and objectiF [126] are case tools that allow developers to use design patterns in developing their applications. These tools typically let developers browse patterns, take existing designs and instantiate patterns in them, and check the design to make sure it still fits a pattern's specification. In objectiF's pattern catalog, each pattern is structured using the template structure found in [56]. Rational Software Architect can also detect patterns and anti-patterns in code.

Pattern-Lint [167] lets programmers determine whether a section of code conforms to a pattern, through static analysis of the code, and a visualization of the classes and their relationships during runtime.

These tools only address software engineering issues, not user interface issues, but there are some aspects of these tools which address issues that any pattern-based tool

needs to support, such as browsing and searching for patterns, and customizing patterns for a particular application. However, customizing patterns with these tools usually involves a form-based interface, which would fit awkwardly with Damask's sketch-based interface. Also, if a developer wants to use a pattern, some of these tools force the developer to change his solution to make it fit the pattern. Damask will not do this. One of the most important aspects of patterns is their flexibility: using the Alexandrian definition of patterns, a developer should be able to use a pattern many times but never the same way twice. Designers using Damask are free to greatly modify how a pattern is used in their particular design.

7.4 Combining Models and Patterns

Other groups have proposed combining patterns and model-based approaches. Hussey and Carrington [74] discuss designing user interfaces by starting out with an abstract UI specification, and then methodically applying transformation patterns to it to create a concrete UI specification. In contrast, designers using Damask interact with concrete UI specifications that contain UI design patterns. Paternò [153] and Sinnig et al [169] describe extending a model editor to support patterns that are made up of model fragments themselves. Trætteberg [184] discusses using fragments of models to help define design patterns, which in turn could help us understand UI models better. Damask also uses model fragments to represent patterns internally, although unlike Trætteberg's proposal, Damask does not expose the models directly to the designer.

Javahery et al [82] describe a manual process of redesigning an existing UI for another device using design patterns. The designer identifies the patterns in the UI and mechanically transforms each pattern into the appropriate form for the target

device. However, they have not yet produced a tool that would allow the designer to automatically extract patterns and replace them with device-appropriate examples, as is done in Damask.

7.5 User Interface Transformation Tools

There has been much work on automatically transforming an existing user interface meant for one device or modality to another. Many of these projects have focused on *transcoding* finished desktop web interfaces to PDA interfaces at run-time [18, 19, 25, 30, 51, 59, 97, 108, 111]. However, automatically shrinking interfaces from large desktop displays to such small PDA displays often results in awkward interaction. Others have worked on converting GUIs to audio interfaces mostly to benefit the blind and visually impaired. With many of these systems [6, 54, 138] designers cannot modify the results of the interface transformation process. Since Damask is a prototyping tool, not a tool to adapt finished UIs, designers are free to modify the generated user interface design. Other systems [12, 72, 146] require external data to assist in translation and are not meant to be used by user interface designers.

Ultraman [171] provides a way for designers to control the transformations, but it assumes they are comfortable with the concept of trees, grammars, and writing code in Java. Damask is targeting a different audience for a different part of the design cycle: designers who have little or no experience programming, and early-stage design, before any interface is completely specified and ready to run. One of Damask's key aspects is its informal interface, which allows designers to defer unimportant design details until later in the process and focus on their tasks without having to worry about precision. Many research systems have taken this direction in recent years,

either by not processing the ink [187] or by processing the ink internally while displaying the unprocessed ink [38, 61, 98, 131, 162, 163].

7.6 User Interface Design Tools

There are many tools, both from the research and commercial communities, which are related to the design of user interfaces.

7.6.1 *Research web and GUI design tools*

Damask is closely related to SILK [99], a sketch-based user interface prototyping tool. Using SILK, individual screens can be drawn, with certain sketches recognized as interface widgets. These screens can be linked to form storyboards [100], which can be tested in a run mode.

Damask is also closely related to DENIM [105, 141], SILK's successor. DENIM takes many of the ideas in SILK and extends them to the domain of web site design. However, DENIM de-emphasizes recognition of sketched widgets, focusing instead on the creation of whole web sites. Furthermore, instead of the separate screen and storyboard views in SILK, all of the views in DENIM are integrated through zooming. Also, SILK attempts to recognize the user's sketches and display its interpretation as soon as possible. DENIM intentionally avoids doing much recognition in order to support more free-form sketching. Damask's storyboarding behavior is very similar to that of DENIM. The main difference is that Damask supports multiple devices, while DENIM concentrates on desktop web design.

Damask's use of storyboarding for behaviors is based on showing what the user interface looks like before and after a user's action and is similar to the techniques used in DENIM and SILK. Other design systems that use storyboarding include DEMAIS

[14, 15], Anecdote [63] and PatchWork [187]. Similarly, Chimera [94-96] and Pursuit [128, 129], tools for graphic editing and end-user shell programming respectively, are based on a before-and-after comic strip metaphor. These systems infer what action causes a transition from examples, while in Damask, DENIM and SILK, the user interface designer states explicitly what user action causes a transition.

WebStyler [65] is a simple sketch-based tool for prototyping individual web pages. However, Damask addresses many more aspects of web site design, including designing the site structure and being able to interact with the sketches, as well as the use of design patterns and support for multiple devices.

7.6.2 *Commercial web and GUI design tools*

There is a lack of early-stage, commercial prototyping tools for web interfaces or desktop GUIs. Newman and Landay's study of web designers [140] shows that designers use other tools to fill this gap. Macromedia Director [112] and Flash [114] are often used to assemble storyboards, while Visio [122] is used for modeling the high-level information architecture of a web site. However, Director and Flash are multimedia authoring tools, and Visio is a general purpose diagramming tool. This makes using them for such high-level web site design awkward at best, since they were not designed for those tasks.

Axure RP [13] and iRise Studio [81] are prototyping tools for web sites that are aimed at designers and business analysts. They allow users to draw wireframes of web sites and create functioning prototypes without programming. Unlike Damask, they do not have a sketch-based interface, they do not include patterns for encapsulating reusable solutions, and they are focused on desktop web design, not cross-device UI design.

Currently, the most popular tools for creating web sites include Microsoft FrontPage [121] and Macromedia Dreamweaver [113]. These tools focus on designing page layout rather than the site architecture. Admittedly, each of them has a "site structure view" of a web site. However, this view often constrains any edits so that the tree structure remains intact. Furthermore, you cannot edit the site structure and the page layout in the same view. Most importantly, these tools focus on producing high-fidelity representations, which is inappropriate in the early stages of design, and they focus only on desktop web design. These are all important issues that we addressed in Damask.

Popular and influential tools for prototyping desktop GUIs include Microsoft Visual Basic [123] and Visual Studio [124], Apple HyperCard [9], Macromedia Director [112], and the NeXT Interface Builder (now the Mac OS X Interface Builder [10]). All of these tools allow designers to visually layout their interfaces, instead of writing code. However, these tools also focus on producing high-fidelity representations, and if designers want to test the interaction of their designs, they still have to write code to define all but the simplest behaviors. Because many designers do not have strong technical backgrounds, we have designed the visual language of Damask to be accessible to such designers, while still allowing them to specify enough interaction to evaluate their designs.

Virtual toolkits [135] are systems that allow one to create a GUI that runs on multiple desktop platforms. Some toolkits, such as XVT [156], AppWare [144], wxWidgets [170], Java AWT [57, 174], and SWT [42], use the widgets of the underlying platform, while others, such as Qt [185], Tk [149], Galaxy [7], Amulet [137], GTK+ [116], Java Swing [58, 175], and XUL [133], implement the widgets themselves. Unlike Damask, these frameworks only try to bridge differences within the desktop world

and do not support the creation of mobile phone or voice UIs, and they target developers, not designers. There are visual interface builders for these toolkits that allow designers to lay out a UI design (e.g., NetBeans [139] and the Eclipse Visual Builder [43]), but they have the same drawbacks as the tools mentioned in the previous paragraph.

7.6.3 Commercial mobile UI design tools

Current tools for designing user interfaces for PDAs and mobile phones include IBM WebSphere Studio Device Developer [76], Microsoft Visual Studio with the .NET Compact Framework [125], and AppForge Crossfire [8]. These tools allow developers to target many mobile platforms at the same time from one code base. However, these tools are geared mostly to developers, not user interface designers, and assume substantial programming expertise. They also do not handle creating desktop or voice applications from the same design.

7.6.4 Voice UI design tools

Damask's voice view is a simplified version of SUEDE [91, 168], a voice UI prototyping tool. SUEDE lets designers create a lo-fi prototype of a voice user interface, collect usability data for the design using a Wizard-of-Oz (WOz) [86] mode, and then analyze the data within the context of the original design. Damask currently does not have many of SUEDE's features, including WOz and usability data collection, but a full version of Damask should include them.

Other voice design tools include CSLU Rapid Application Developer [176, 177], Unisys' Natural Language Speech Assistant [186] and Nuance's V-Builder [145]. These tools are focused more on creating and implementing finished voice user

interfaces, allowing fine-grained control over voice recognition grammars, for example. While they are powerful, they are not suitable for lo-fi prototyping for the same reason Dreamweaver is not suitable for lo-fi web prototyping: the designer is more likely to start fiddling with details instead of concentrating on the overall design. However, one can imagine a designer exporting a Damask design into a format that could then be imported into one of the above tools, so that the designer can add details to create the finished design.

7.7 Summary

Most existing projects in the area of cross-device user interface design either require designers to specify a user interface at an abstract level, which does not match the designers' skills or current work practices, or they retarget an existing interface to other devices, which often results in awkward interaction. These tools are also focused on creating finished user interfaces. In contrast, Damask uses design patterns to help designers bridge the gap between devices. It also concentrates on early stage design and prototyping, employing a sketch-based interface so that designers can focus on important structural and navigational issues, instead of details that are better left for later stages.

8 Future Work

While we have established the usefulness of patterns in early-stage design of cross-device user interfaces, there are still many open research issues in this area. Here we discuss four areas for future work: patterns, annotations, layers, and other cross-device design issues in general.

8.1 Patterns

While we have focused mostly on using patterns in the design process, there are other aspects of design patterns that are as important.

8.1.1 Creating and sharing patterns

An important aspect of supporting design patterns is allowing designers to create their own patterns and share them with a community of designers. To create a pattern, we imagine that inside the Pattern Browser, there would be a New Pattern button that would create an empty pattern. Fields such as name, background, and context would be filled in simply by typing and importing images and text. To add the Damask solution part, the designer would take parts of an existing design and drag it into the Solution section of the pattern browser. In other words, it basically would be instantiating a pattern in reverse (see Figure 8-1).
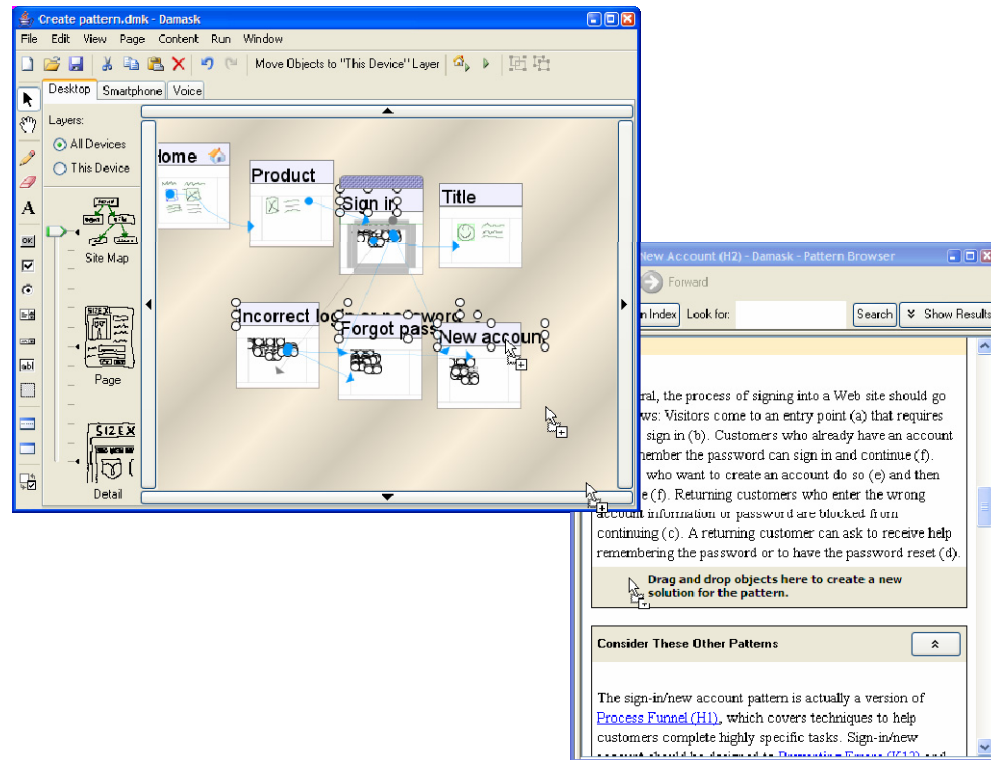
FIGURE 8-1   Mockup of creating a solution for a new pattern.

For sharing patterns, a Damask patterns community web site could be set up for designers to submit patterns, and then a shepherding process [64] would give the pattern author a chance to refine the pattern before having it published. Or a pattern could simply be published, and other people could rate it and comment on it, similar to the process used at the Python Cookbook web site [115]. The pattern could be published to a web site internal to a group or company, or to a public web site.

8.1.2   *Showing previous uses of patterns*

It would also be useful to show how a pattern has been used in previous projects. We could do this by adding an "Example" section to a description of a pattern in the Pattern Browser that would show an instance of the pattern within existing designs, and would also download examples from the patterns community web site. These

examples could then act as alternate solutions, allowing designers to "instantiate" the example into their current design (see Figure 8-2).
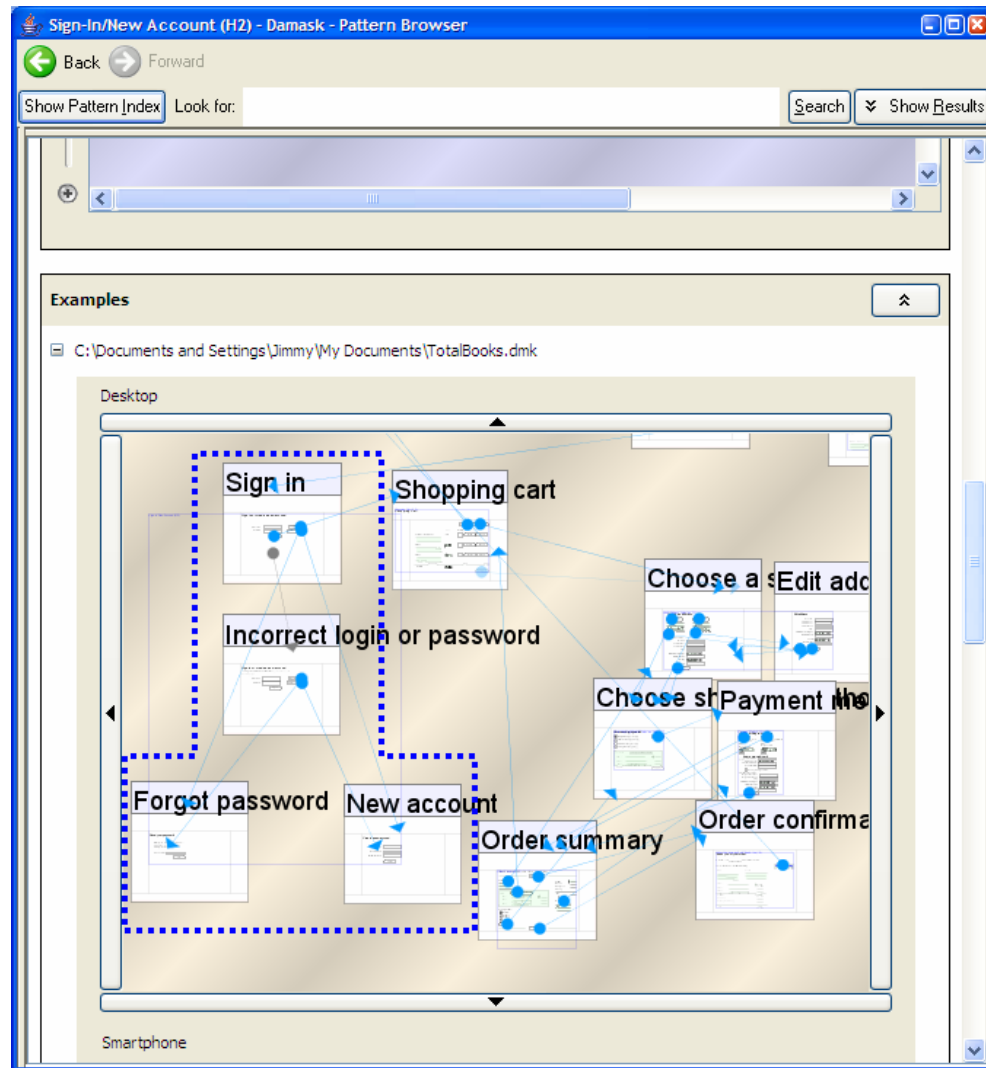
FIGURE 8-2   Mockup of an Examples section in the Pattern Browser.

8.1.3 Handling large patterns

Understanding and interacting with large patterns is an issue that needs to be addressed. Designers had a hard time understanding the scope of a large pattern such as QUICK-FLOW CHECKOUT. Typically, a pattern will explain the various tradeoffs in

using it in the Forces section, which Damask did not include. However, we found that the designers in our study did not read any of the included text anyway. Also, designers may not need all of the functionality of a pattern but may have a hard time removing parts of it. If we expand Damask to include very large patterns such as PERSONAL E-COMMERCE, the issue will only become worse.

The solution section of such a large pattern could be augmented by check boxes that would turn on or off various features. For example, a full-fledged QUICK-FLOW CHECKOUT pattern would include check boxes for adding or editing shipping addresses, handling multiple destination addresses, gift giving options, and so on. The check boxes can be on a per-device basis, so that designers can choose which features will be available on which devices (see Figure 8-3). The labels of the check boxes can be supplemented with a more detailed description of the forces at work in the pattern. This mechanism could also be useful for pattern instances themselves. Within the design itself on the main canvas, sections of a pattern instance could also be made collapsible, or the entire pattern instance could be collapsed to one screen, to make it easier to see the main flow of the interaction.
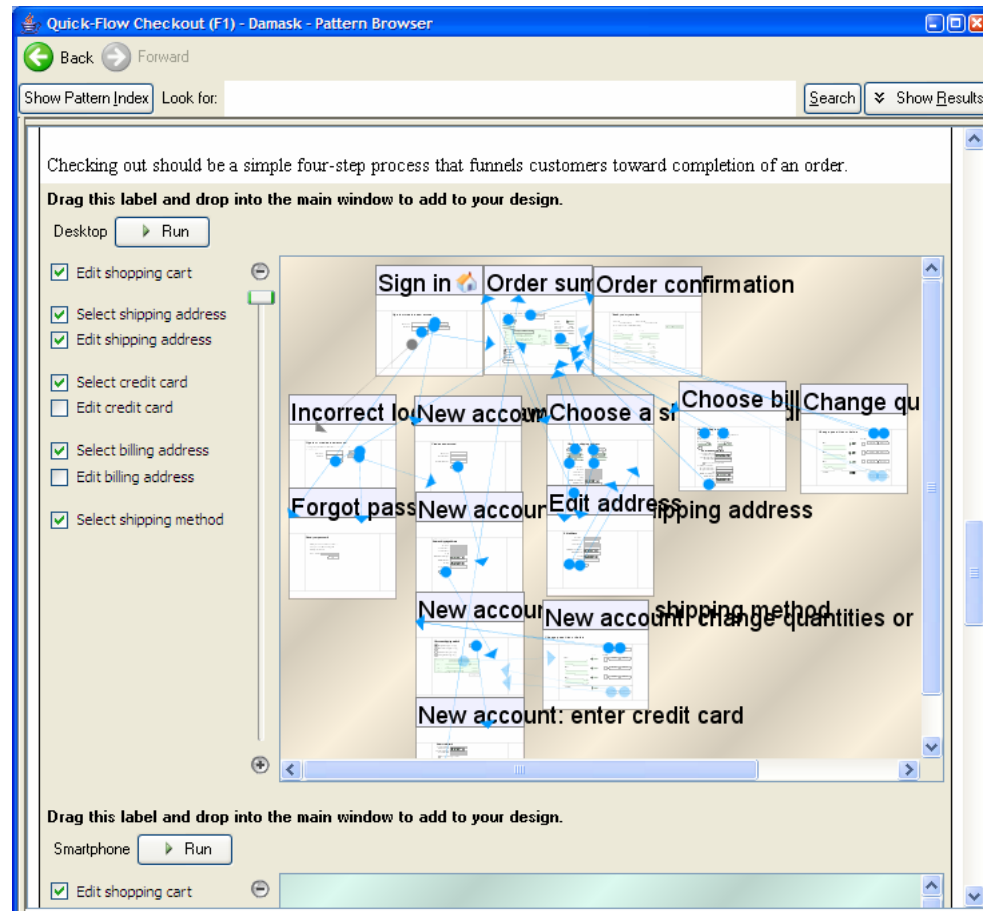
FIGURE 8-3   Mockup of a checklist for choosing features within a pattern solution.

8.1.4 Recognizing patterns

Designing an interface often does not begin from scratch. Designers often take existing user interfaces, whether their own or someone else's, as a starting point for their design. Being able to take an existing interface, import it into Damask, and automatically detect patterns within the interface would greatly improve the utility of Damask. However, there are many unsolved issues in this area, including how patterns would be recognized, how designers would fix errors in the recognition

process, and whether the recognition process would be accurate enough for designers to want to use it.

8.1.5 Versioning of patterns

Patterns evolve over time. As technologies change, the pattern solutions bundled with Damask may not remain the best ones. For example, Lazlo Systems has demonstrated a checkout process using Flash that is unlike most checkout processes for the web and is more similar to a traditional GUI interaction [101]. Setting aside whether Laszlo's system is better than current web-based systems, what would happen if designers could take their design with an instance of the original checkout pattern and replace it with an instance of a Laszlo-based pattern? Any changes made to the original instance would be lost if it were simply replaced, but the changes might not be relevant to the new instance. These issues need to be studied in greater detail.

8.1.6 Scope of patterns

Since the patterns in *The Design of Sites* [188], on which the Damask patterns are based, do not contain voice-specific solutions, we created the solutions ourselves. However, we have almost no experience designing voice UIs, and we did not have an opportunity to refine our solutions with the help of experienced voice UI designers. Improving our voice-specific solutions with the help of professional voice UI designers would go a long way towards making Damask more suitable for voice UI design.

Also, the patterns that Damask currently includes are most suitable for desktop web sites and not as appropriate for mobile phone or voice user interfaces. The patterns do not take advantage of the mobility and location-awareness that mobile

devices have [34], or that people often do different tasks with different devices, even if it is the same high-level activity. For example, one could imagine a pattern that involves using standard web technologies for notifications on the desktop, but using sms on mobile phones.

8.2 Annotations

Allowing designers to sketch annotations that are not directly part of the user interface is an important feature that is currently unaddressed in Damask. Annotations serve as design rationale and design history, and are valuable when presenting the idea to other people. Damask could be extended to include an annotation pen, which would not be interpreted by the system, as is done in silk [99] (see Figure 8-4). Damask could also infer which object the annotation is attached to, so that it moves when the object does, as is done in The Designers' Outpost [90]. A menu item could turn annotations on or off.
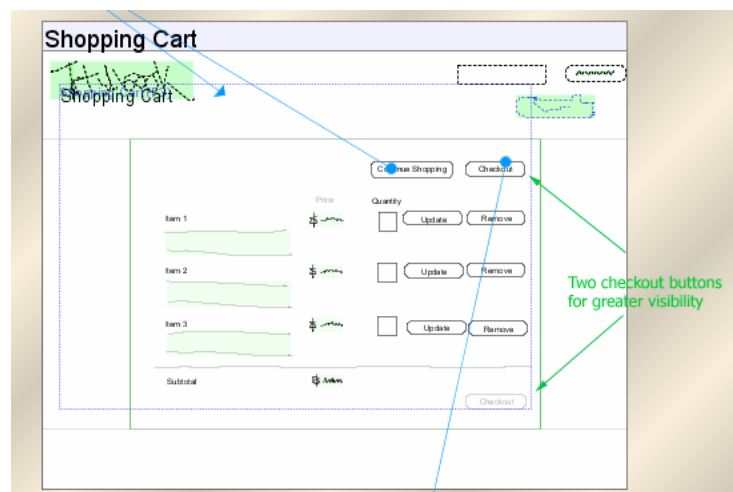
FIGURE 8-4   Mockup of annotations (in green)

It would also be useful to add annotations to pattern solutions. This would make it easier to understand the solution, and the annotations could be merged directly into

the main design when the pattern is instantiated. Embedding the rationale of the pattern within the design would allow the designer to see it in context, instead of in a separate window. However, too many annotations could also overwhelm designers; finding the right balance is critical.

8.3 Layers

Layers provide a powerful mechanism to control which devices an object appears in, but the current implementation is confusing. We have proposed several extensions and alternatives to layers. One of these ideas was presented to our Damask evaluation participants for some early feedback.

8.3.1 The "All" tab

Currently, each tab has two layers, All Devices and This Device, and the devices in which an object appears depend on which layer you create the object on. Several designers suggested eliminating the layers, and instead adding a tab next to the three device tabs called All. An object created in the All tab would appear on all devices, while one created in, say, the Desktop tab would appear only on the desktop.

What layout would be displayed in the All tab? One option is to simply show the Desktop layout; to see the layout of the other devices, you would need to go to that device's tab. Another option is to have child tabs within the All tab for each device (see Figure 8-5).
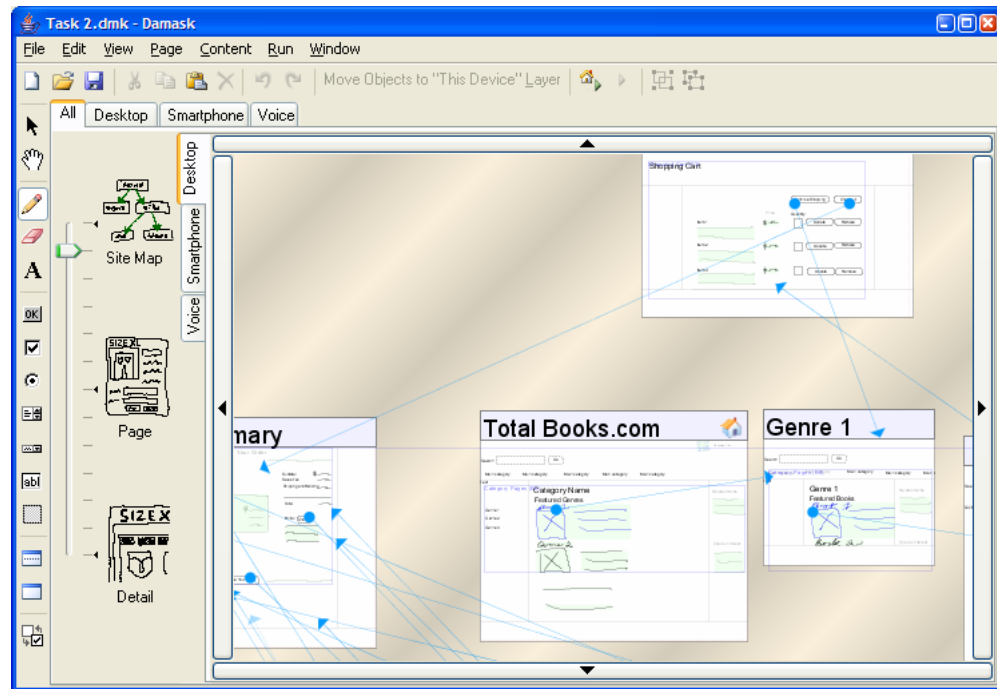
FIGURE 8-5   Mockup of an "All" tab in Damask.

8.3.2 *Device-specific tools*

Another proposal is to have two sets of tools. One set would be for all devices, the other would be for one device. For example, in Section 6.9, we discussed how a designer who wanted to remove an all-device-button from the smartphone would have to go to Desktop view, select the button, and click Move to This Device. With device-specific tools, the designer would stay in Smartphone view, select the device-specific eraser, and tap on the button to erase it. Similarly, the all-device button tool would create a button visible on all devices, while the device-specific button would appear only on the current device. The device-specific text tool would change the text of an object for only one device, leaving the text for the other devices alone (see Figure 8-6).
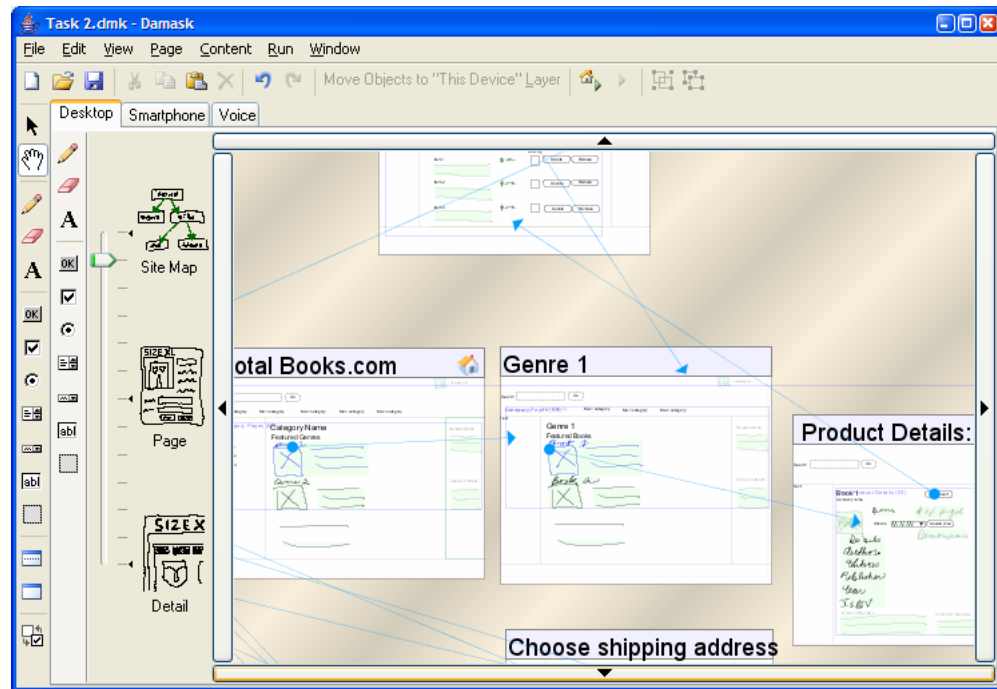
FIGURE 8-6   Mockup of device-specific tools within the lighter-colored toolbox in the Desktop tab.

The objects would still need to be in different colors so that the designer could tell which objects were visible on all devices versus one device, and there would need to be a special button to convert a device-specific object to an all-devices object. Also, having two sets of tools may be confusing.

8.3.3 Trays

In the Trays design, every page would have a "tray" associated with it, which the user could expand or collapse. When designers add a control to a page in one device type, the control would be added to the trays of the corresponding pages in the other device types. Designers could then go to another device type, look at the elements in a tray, and drag them onto the page itself if they decided they want those elements in the UI design for that device type. They could also click on the element to let Damask auto-position it (see Figure 8-7).
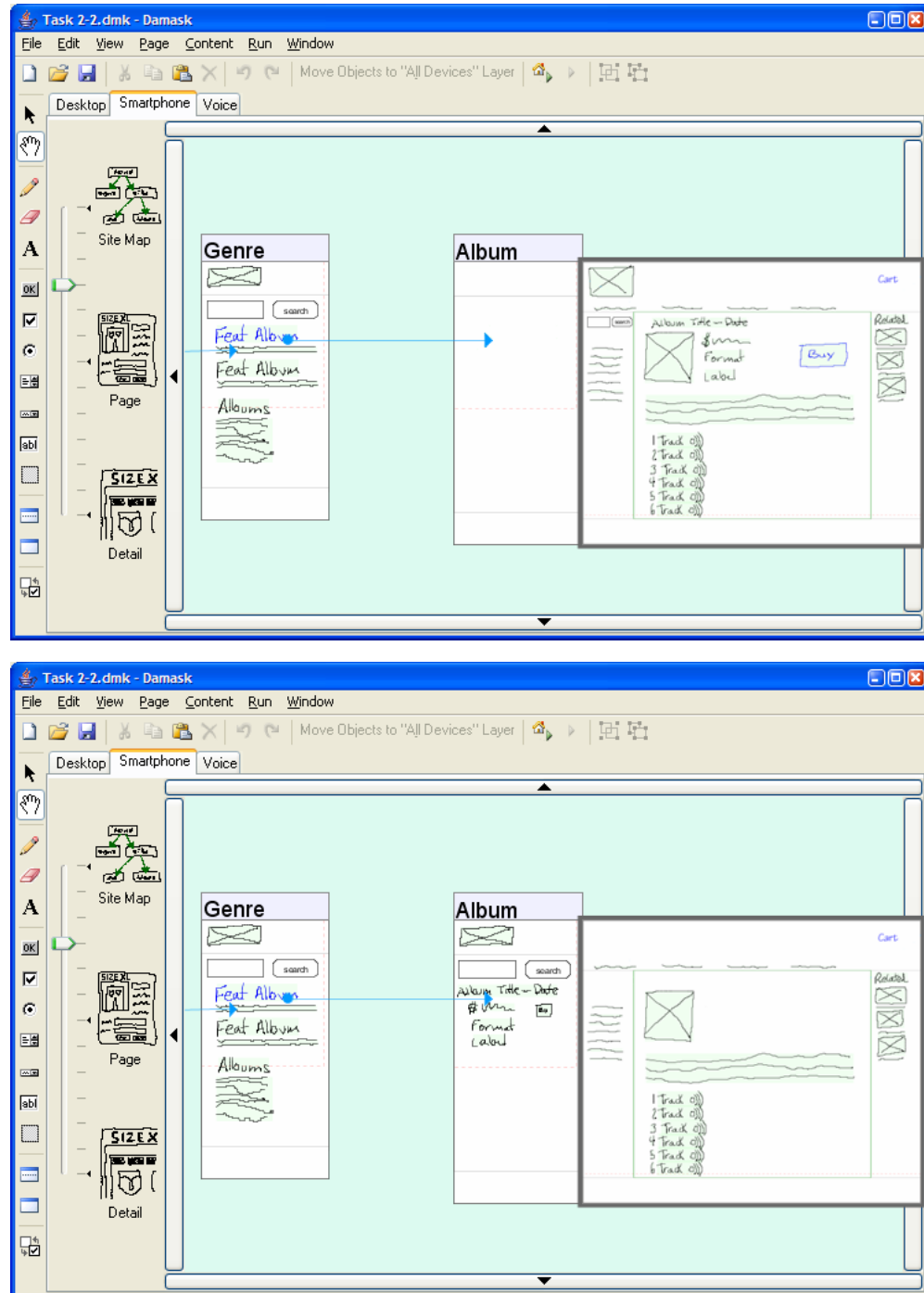
FIGURE 8-7   *Top* A tray for the Album page, containing desktop objects to add.
Bottom The Album page with objects added from the tray.

A variation of this idea is for elements to appear on all device types when added, just like how the All Devices layer currently works, and then designers would drag an element into the tray if they did *not* want it for that device type.

Compared to our current implementation of layers, trays allow finer control over which device type an object can appear in. In layers, an object can either be for All Devices or This Device only. In trays, an object can be, for example, in a page for desktop and smartphone views but not in the corresponding form for voice view. Trays can also be used to help designers learn how a control in desktop or smartphone views corresponds to one in voice view: as a control is dragged from the tray into the form, the control's corresponding voice version can be shown as a ghost image.

One challenge with the trays idea is letting designers know how editing an object in one device type affects the other device types. An object that is visible on more than one device type would need to be differentiated in some way, perhaps with a different color.

After each participant had finished the layers and patterns phase of the Damask evaluation, we presented the trays concept. When we asked whether they preferred layers or trays, they were evenly split.

Four designers preferred trays to layers. They thought trays would be less confusing than layers, and it would be easier for them to keep track of which elements were for all devices and which were for only one device. Interestingly, three out of the four designers who preferred trays were voice designers. It is much harder to figure out which controls in the desktop view correspond to the voice view and vice-versa, than it is to figure out the correspondence between a desktop control and a smartphone control. Therefore, the voice designers liked dragging a control from a

tray to a voice form; it gave them more control. Designer 16 said, "I like [the tray] a lot better than having [controls] go over automatically."

Four designers preferred layers to trays; they found the trays idea a little too unfamiliar, or that it would require them to keep track mentally of more concepts. Designer 17 said, "It takes some getting used to the layers, but once you're used to them, it's clearer to see what [colors] means what and [on which devices] things are."

The last four did not have a strong preference. Designer 9 said that while trays offer "more control," the layers concept was still fine. However, she added that improving the automatic layout algorithm, as discussed in Section 4.4.1, would be necessary to make Damask more useful overall.

There is not a significant correlation between whether a designer preferred layers and whether that designer currently uses a tool that has layers, such as Photoshop or Visio.

8.4 Synchronization Between Voice and Graphical UI Designs

The degree of synchronization between voice and desktop/smartphone controls remains an open issue. Creating controls that exist on both the desktop and the smartphone makes sense, since they are visually similar. But creating controls that exist across desktop, smartphone, and voice are more problematic, since the voice controls and their corresponding desktop/smartphone controls look very different, and the mapping between them is not necessarily obvious. Therefore, the tight synchronization that now exists between desktop/smartphone and voice may not be necessary. For example, when a desktop control is created, the corresponding voice control could be created at the same time, so that the designer has something to start with. But any subsequent changes to one of them would not affect the other.

8.5 Extending Damask's Visual Language

Another issue is adding more capabilities to Damask's visual language of pages, components, and connections, while not detracting from its simplicity. Damask's visual language is very similar to DENIM's. In previous work, we extended DENIM's visual language to include custom components and conditional transitions [106]. Custom components are components that designers create themselves. Conditional transitions are transitions between pages where the endpoint of the transition depends on the state of the components in a page, such as the state of a check box.

Extending this to multiple devices presents new challenges, especially concerning synchronization. For example, if a transition is dependent on a certain set of component states in desktop view, should it also be dependent on the same states in the smartphone and voice views? If they should not, how does the designer indicate that?

Damask's visual language also does not handle user interface designs where certain parts are generated from a data source. There is no way to take the text typed into a text box, and display it in another page, or to display different data depending on that text. One of the voice interface designers said it is one of the primary reasons he would not use Damask in his daily tasks. Enabling more dynamic interfaces within the existing visual language paradigm will take more research.

8.6 Summary

Damask's approach to handling cross-device user interface design can be extended in many ways. This ranges from more complete support for using and creating design patterns and letting designers annotate their designs, to more sophisticated mechanisms for handing which parts of a UI design occur on which devices.

9 Conclusion

Here we summarize the benefits and limitations of Damask and review the contributions of the research.

9.1 Benefits of Damask's Approach

In current practice, designers who want to design a user interface that targets more than one type of device have essentially two choices. They can either design one UI for each device, or they can create one UI and use a tool to automatically generate the UIs for the other devices.

Damask allows designers to pursue a different path. Designers create a user interface design for one device by sketching the design, using layers to control which parts of the design appear on other devices, and instantiating design patterns. Damask creates user interface designs for other devices, giving designers a head start in designing for those devices. The informal interface and Run mode allow designers to quickly test and refine their ideas. The user studies I conducted show that designers can produce higher-quality user interfaces for multiple devices in less time than designing each interface independently, which is the current practice. Overall, designers especially liked the fluid interaction style and the design patterns in Damask.

9.2 Limitations of Damask's Approach

There were several issues that were outside Damask's research scope. As discussed in Section 4.4.1, Damask's algorithm for taking a UI in one device and automatically laying out the UI for the other devices is very simplistic and would need to be improved to ensure more widespread acceptance, possibly by using a combination of inferring which controls are grouped together and a more robust automatic layout algorithm.

The patterns that included interactive solutions were limited to one domain, e-commerce, and were originally designed for the desktop web. While these patterns turned out to be useful in the cross-device domain, discovering patterns related to issues specifically for cross-device applications, such as location-based applications or interacting with ubiquitous computing environments, would further improve the usefulness of Damask.

Damask's desktop and smartphone views are focused on web-style interaction. It is not clear whether they are appropriate for certain highly dynamic and interactive application domains, such as 3-D visualization and games. These domains are clearly beyond the scope of this work. Damask's voice view is geared towards guided prompt-and-response voice systems, as opposed to open-ended natural conversational systems. The latter would require significant new innovations, as that problem has not been solved even in voice-only design tools.

9.3 Contributions

Damask supports my thesis that:

> **A tool that uses design patterns to bridge the gap between device-**
> **specific UIs will enable designers to create cross-device UIs with at**

> least the same functionality as if the designer designed each device-
> specific UI separately, but in less time.

Here we discuss each of the specific contributions of the research in more detail.

- *An understanding of current work practices for cross-device user interface design*

As discussed in Chapter 2, we found that for designers currently doing cross-device UI design, consistency and dealing with multiple devices were major burdens, and that teams were usually organized so that a designer works on the same set of features across devices.

- *The novel application of the following techniques to cross-device user interface design:*

  1 *Design patterns allow designers to describe their designs at a high level of abstraction and, by capturing interaction semantics, make it easier for a design tool to create interfaces appropriate for different devices.*

Damask provides a Pattern Browser for designers to explore a collection of design patterns and add them to their designs, as described in Section 4.5. The evaluation results described in Sections 6.3–6.10, especially 6.8, show patterns achieved their goal.

  2 *Layers can provide a clean conceptual model for designers to keep track of which UI elements are consistent across devices and which are device specific.*

The Damask canvas provides layers for designers to add UI objects. These layers determine in which devices an object is visible, as described in Section 4.4. The evaluation results described in Section 6.3–6.10, especially Section 6.9, show that layers achieved their goal, albeit with some difficulty with the execution.

- *A data model to represent cross-device UIs that incorporates design patterns and layers and links corresponding elements across devices*

As discussed in Section 4.6, Damask uses a single scenegraph of objects to represent a design. Each object contains both overall information and information

specific to each device. The scenegraph also has pattern instance objects that point to the objects that make up the instance.

- *A user interface design tool called Damask that improves the design of cross–device UIs by implementing the concepts above*

Chapter 4 describes Damask's user interface and how it incorporated design patterns and layers throughout the application.

- *An understanding of how cross-device user interface design is influenced by design patterns and layers*

We discuss how designers used design patterns and layers in Chapter 6. Among other findings, we found designers using design patterns and layers for cross-device UI design completed their design tasks in less time than when they designed a UI for each device separately. Compared to designs created without patterns and layers, those created with patterns and layers were at least as good in terms of layout and interaction flow and were more complete. Also, the designers overall found design patterns to be generally useful.

9.4 Final Remarks

As computers become more pervasive [196], they will continue to take new shapes and forms. Applications that take advantage of the wide variety of devices will have an advantage over those limited to a PC, but the challenge of designing such applications is much higher. Design patterns and layers show great promise in helping user interface designers tackle the challenge of cross-device user interface design.

Damask is available for download at http://bid.berkeley.edu/damask and http://dub.washington.edu/damask.

Bibliography

1.   Amazon going mobile, *CNNfn*, 2000.
        http://money.cnn.com/2000/02/28/technology/amazon/

2.   Adobe, *Illustrator*, 1985. Adobe Systems Inc.: San Jose, CA.
        http://www.adobe.com/products/illustrator/

3.   Adobe, *Photoshop*, 1990. Adobe Systems Inc.: San Jose, CA.
        http://www.adobe.com/products/photoshop/

4.   Alexander, Christopher, Sara Ishikawa, Murray Silverstein, Max Jacobson,
        Ingrid Fiksdahl-King, and Shlomo Angel, *A Pattern Language*. New York:
        Oxford University Press, 1977.

5.   Ali, Mir Farooq, Manuel A. Pérez-Quiñones, Marc Abrams, and Eric Shell.
        Building Multi-Platform User Interfaces With UIML. In Proceedings of *2002
        International Workshop of Computer-Aided Design of User Interfaces: CADUI'2002*.
        Valenciennes, France. pp. 225-236, May 15-17, 2002.

6.   Alva, *outSPOKEN*, 1988. Alva Access Group (originally by Berkeley Systems,
        Inc.): Oakland, CA.

7.   Ambiencia Information Systems, Inc., *Galaxy Application Environment*, 1992.
        Ambiencia Information Systems, Inc. (originally by Visix Software, Inc):
        Breckenridge, CO. http://www.ambiencia.com/

8.   AppForge, *Crossfire*, 2004. AppForge, Inc.: Atlanta, GA.
        http://www.appforge.com/crossfire/

9.   Apple, *HyperCard*, 1987. Apple Computer, Inc.: Cupertino, CA.

10.   Apple, *Mac OS X Interface Builder*, 1991. Apple Computer Inc. (originally by
        NeXT Computer, Inc.): Cupertino, CA.
        http://developer.apple.com/tools/interfacebuilder.html

11.   Arsanjani, Ali, David Chamberlain, Dan Gisolfi, Ravi Konuru, Julie Macnaught,
        Stephane Maes, Roland Merrick, David Mundel, T.V. Raman, Shankar
        Ramaswamy, Thomas Schaeck, Rich Thompson, Angel Diaz, John Lucassen,

and Charles F. Wiecha, *Web Service Experience Language, Version 2*: IBM Corporation, 2002. http://www.ibm.com/developerworks/library/ws-wsxl/

12. Asakawa, Chieko and Hironobu Takagi. Annotation-Based Transcoding for Nonvisual Web Access. In Proceedings of *The Fourth International ACM SIGCAPH Conference on Assistive Technologies: ASSETS 2000.* Arlington, VA. pp. 172-179, November 13-15, 2000.

13. Axure Software Solutions, *Axure RP*, 2003. Axure Software Solutions, Inc.: San Francisco, CA. http://www.axure.com/

14. Bailey, Brian P., *DEMAIS: A Behavior–Sketching Tool for Early Multimedia Design*, Unpublished Ph.D., Computer Science Department, University of Minnesota, Minneapolis, MN, 2002.
http://orchid.cs.uiuc.edu/publications/tech-report-02-020.pdf

15. Bailey, Brian P. and Joseph A. Konstan, Are Informal Tools Better? Comparing DEMAIS, Pencil and Paper, and Authorware for Early Multimedia Design. *CHI 2003, ACM Conference on Human Factors in Computing Systems, CHI Letters*, 2003. **5**(1): pp. 313-320.

16. Balzert, Helmut, Frank Hofmann, Volker Kruschinski, and Christoph Niemann. The JANUS Application Development Environment—Generating More than the User Interface. In Proceedings of *1996 International Workshop of Computer–Aided Design of User Interfaces: CADUI '96*. Namur, Belgium: Namur University Press. pp. 183-205, June 5-7, 1996.

17. Banavar, Guruduth, Lawrence D. Bergman, Yves Gaeremynck, Danny Soroker, and Jeremy Sussman, Tooling and System Support for Authoring Multi-Device Applications. *Journal of Systems and Software (Special Issue on Ubiquitous Computing)*, 2004. **69**(3): pp. 227-242.

18. Banerjee, Somnath, Arobinda Gupta, and Anupam Basu. Online Transcoding of Web Pages for Mobile Devices. In Proceedings of *The 5th International Symposium on Human Computer Interaction with Mobile Devices and Services: Mobile HCI 2003*. Udine, Italy: Springer. pp. 271-285, September 8-11, 2003.

19. Baudisch, Patrick, Xing Xie, Chong Wang, and Wei-Ying Ma. Collapse-to-Zoom: Viewing Web Pages on Small Screen Devices by Interactively Removing Irrelevant Content. In Proceedings of *UIST 2004, ACM Symposium on User Interface Software and Technology*. Santa Fe, NM. pp. 91-94, 2004.

20.   Beck, Kent and Ward Cunningham, *Using Pattern Languages for Object-Oriented Programs*. Technical Report CR-87-43, Tektronix, Inc., 1987.

21.   Bederson, Benjamin B., Jesse Grosjean, and Jon Meyer, Toolkit Design for Interactive Structured Graphics. *IEEE Transactions on Software Engineering*, 2004. **30**(8): pp. 1-12.

22.   Bergman, Lawrence D., Guruduth Banavar, Danny Soroker, and Jeremy Sussman. Combining Handcrafting and Automatic Generation of User-Interfaces for Pervasive Devices. In Proceedings of *2002 International Workshop of Computer-Aided Design of User Interfaces: CADUI'2002*. Valenciennes, France: May 15-17, 2002.

23.   Bertini, Enrico and Giuseppe Santucci. Modelling Internet Based Applications for Designing Multi-Device Adaptive Interfaces. In Proceedings of *The Working Conference on Advanced Visual Interfaces: AVI 2004*. Gallipoli, Italy. pp. 252-256, May 25-28, 2004.

24.   BeVocal, *BeVocal Café*, 1999. BeVocal, Inc.: Mountain View, CA. http://cafe.bevocal.com/

25.   Bickmore, Timothy, Andreas Girgensohn, and Joseph W. Sullivan, Web Page Filtering and Re-Authoring for Mobile Users. *The Computer Journal*, 1999. **42**(6): pp. 534-546.

26.   Bodart, François, Anne-Marie Hennebert, Jean-Marie Leheureux, and Jean Vanderdonckt. Computer-Aided Window Identification in TRIDENT. In Proceedings of *Fifth IFIP TC13 Conference on Human-Computer Interaction: INTERACT'95*. Lillehammer, Norway: Chapman & Hall. pp. 331-336, June 25-29, 1995.

27.   Borchers, Jan, *A Pattern Approach to Interaction Design*. Chicester, England: John Wiley & Sons. 268 pp., 2001.

28.   British Broadcasting Corporation, BBC Mobile. http://www.bbc.co.uk/mobile/

29.   Budinsky, Frank J., Marilyn A. Finnie, John M. Vlissides, and Patsy S. Yu, Automatic Code Generation from Design Patterns. *IBM Systems Journal*, 1996. **35**(2): pp. 151-171.

30.   Buyukkokten, Orkut, Hector Garcia-Molina, Andreas Paepcke, and Terry Winograd, Power Browser: Efficient Web Browsing for PDAs. *CHI 2000, ACM*

Conference on Human Factors in Computing Systems, CHI Letters, 2000. **2**(1): pp. 430-437.

31.   Calvary, Gaëlle, Joëlle Coutaz, and David Thevenin. A Unifying Reference Framework for the Development of Plastic User Interfaces. In Proceedings of *Engineering for Human-Computer Interaction: EHCI 2001*. Toronto, ON, Canada: Springer-Verlag. pp. 173-192, May 11-13, 2001.

32.   Charny, Ben and Jim Hu, Yahoo battles Google for the cell phone, *CNET News.com*, 2004. http://news.com.com/2100-1038_3-5428926.html

33.   Chu, Hao-hua, Henry Song, Candy Wong, Shoji Kurakake, and Masaji Katagiri, Roam, a Seamless Application Framework. *Journal of Systems and Software (Special Issue on Ubiquitous Computing)*, 2004. **69**(3): pp. 209-226.

34.   Chung, Eric, Jason I. Hong, James Lin, Madhu K. Prabaker, James A. Landay, and Alan L. Liu. Development and Evaluation of Emerging Design Patterns for Ubiquitous Computing. In Proceedings of *Designing Interactive Systems: DIS 2004*. Cambridge, MA. pp. 233–242, August 1–4, 2004.

35.   Comber, Tim and John Maltby. Investigating Layout Complexity. In Proceedings of *1996 International Workshop of Computer-Aided Design of User Interfaces: CADUI '96*. Namur, Belgium: Namur University Press. pp. 211-229, June 5-7, 1996.

36.   CONSENSUS Project, *RIML Language Specification, Version 2*. 105 pp., 2004. http://www.consensus-online.org/publicdocs/20040317-RIML-II-Final-public.pdf

37.   Cover, Robin, *Cover Pages: Multi-Channel Access XML (MAXML)*, January 6, 2001. http://xml.coverpages.org/maxml.html

38.   Davis, Richard C., James A. Landay, Victor Chen, Jonathan Huang, Rebecca B. Lee, Francis C. Li, James Lin, III Charles B. Morrey, Ben Schleimer, Morgan N. Price, and Bill N. Schilit. NotePals: Lightweight Note Sharing by the Group, for the Group. In Proceedings of *Human Factors in Computing Systems: CHI 99*. Pittsburgh, PA. pp. 338-345, May 15-20, 1999. http://dub.washington.edu/projects/notepals/pubs/notepals-chi99-final.pdf

39.   Dery-Pinna, Anne-Marie, Jérémy Fierstone, and Emmanuel Picard. Component Model and Programming: A First Step to Manage Human Computer Interaction Adaptation. In Proceedings of *The 5th International Symposium on*

Human Computer Interaction with Mobile Devices and Services: Mobile HCI 2003. Udine, Italy: Springer. pp. 456-465, September 8-11, 2003.

40. Ding, Yun, Heiner Litz, and Dennis Pfisterer. A Graphical Single-Authoring Framework for Building Multi-platform User Interfaces. In Proceedings of *The 9th International Conference on Intelligent User Interfaces: IUI '04*. Madeira, Funchal, Portugal. pp. 235-237, January 13-16, 2004.

41. Dourish, Paul and André van der Hoek. Émigré: Metalevel Architecture and Migratory Work. In Proceedings of *The 4th International Symposium on Human Computer Interaction with Mobile Devices: Mobile HCI 2002*. Pisa, Italy: Springer. pp. 281-285, September 18-20, 2002.

42. Eclipse Foundation, *Standard Widget Toolkit*, 2001. Eclipse Foundation. http://www.eclipse.org/swt/

43. Eclipse Foundation, *Visual Editor Project*, 2004. Eclipse Foundation. http://www.eclipse.org/vep/

44. Ecma International, *Standard ECMA-262: ECMAScript Language Specification*. 3rd ed. Geneva. 172 pp., 1999. http://www.ecma-international.org/publications/standards/Ecma-262.htm

45. Elting, Christian, Stefan Rapp, Gregor Möhler, and Michael Strube. Architecture and Implementation of Multimodal Plug and Play. In Proceedings of *Fifth International Conference on Multimodal Interfaces: ICMI-PUI '03*. Vancouver, BC, Canada. pp. 93-100, November 5-7, 2003.

46. Fincher, Sally, Perspectives on HCI Patterns: Concepts and Tools (Introducing PLML). *Interfaces*, 2003(56): pp. 26-28.

47. Florijn, Gert, Marco Meijers, and Pieter van Winsen. Tool Support for Object-Oriented Patterns. In Proceedings of *European Conference for Object-Oriented Programming: ECOOP 97*. Jyväskylä, Finland: Springer-Verlag. pp. 472-495, June 9-13, 1997.

48. Fogarty, James and Scott E. Hudson, GADGET: A Toolkit for Optimization-Based Approaches to Interface and Display Generation. *UIST 2003, ACM Symposium on User Interface Software and Technology, CHI Letters*, 2003. **5**(2): pp. 125-134.

49. Foley, James D. and Piyawadee "Noi" Sukaviriya. History, Results and Bibliography of the User Interface Design Environment (UIDE), an Early

Model-Based System for User Interface Design and Implementation. In Proceedings of *Design, Specification and Verification of Interactive Systems: DSV-IS'94*. Carrara, Italy. pp. 3-14, June 8-10, 1994.

50. Forbrig, Peter, Anke Dittmar, Daniel Reichart, and Daniel Sinnig. User-Centred Design and Abstract Prototypes. In Proceedings of *Perspectives in Business Informatics Research: BIR 2003*. Berlin, Germany: Shaker Verlag. pp. 132-145, September 18-20, 2003.

51. Fox, Armando, Ian Goldberg, Steven D. Gribble, David C. Lee, Anthony Polito, and Eric A. Brewer. Experience With Top Gun Wingman: A Proxy-Based Graphical Web Browser for the 3Com PalmPilot. In Proceedings of *IFIP International Conference on Distributed Systems Platforms and Open Distributed Processing: Middleware '98*. Lake District, UK, September 15-18, 1998.

52. Frank, Martin R. Grizzly Bear: A Demonstrational Learning Tool for a User Interface Specification Language. In Proceedings of *ACM Symposium on User Interface Software and Technology: UIST '95*. Pittsburgh, PA. pp. 75-76, November 15-17, 1995.

53. Frank, Martin R., Piyawadee "Noi" Sukaviriya, and James D. Foley. Inference Bear: Designing Interactive Interfaces through Before and After Snapshots. In Proceedings of *ACM Symposium on Designing Interactive Systems: DIS '95*. Ann Arbor, MI. pp. 167-175, August 23-25, 1995.

54. Freedom Scientific, *JAWS for Windows*, 1995. Freedom Scientific, Inc. (originally by Henter-Joyce, Inc.): St. Petersburg, FL. http://www.freedomscientific.com/fs_products/software_jaws.asp

55. Gajos, Krzysztof and Daniel S. Weld. SUPPLE: Automatically Generating User Interfaces. In Proceedings of *The 2004 International Conference on Intelligent User Interfaces: IUI '04*. Madeira, Funchal, Portugal. pp. 93-100, January 13-16, 2004.

56. Gamma, Erich, Richard Helm, Ralph Johnson, and John Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*. Addison-Wesley Professional Computing Series. Reading, MA: Addison-Wesley. 395 pp., 1995.

57. Geary, David M., *Graphic Java 1.2, Volume 1: AWT*. 3rd ed: Prentice Hall PTR. 970 pp., 1998.

58. Geary, David M., *Graphic Java 2, Volume 2: Swing*. 3rd ed: Prentice Hall PTR. 970 pp., 1998.

59.   González-Castaño, Francisco J., Luis E. Anido-Rifón, and Enrique Costa-Montenegro. A New Transcoding Technique for PDA Browsers, Based on Content Hierarchy. In Proceedings of *4th International Symposium on Human Computer Interaction with Mobile Devices: Mobile HCI 2002*. Pisa, Italy: Springer. pp. 69-80, September 18-20, 2002.

60.   Gould, John D. and Clayton Lewis, Designing for Usability: Key Principles and What Designers Think. *Communications of the ACM*, 1985. **28**(3): pp. 300-311.

61.   Gross, Mark D. and Ellen Yi-Luen Do. Ambiguous Intentions: A Paper-like Interface for Creative Design. In Proceedings of *ACM Symposium on User Interface Software and Technology: UIST '96*. Seattle, WA. pp. 183-192, November 6–8, 1996.

62.   Grundy, John and Biao Yang. An Environment For Developing Adaptive, Multi-Device User Interfaces. In Proceedings of *The 4th Australasian User Interface Conference: AUIC2003*. Adelaide, Australia, Feburary 4-7, 2003.

63.   Harada, Komei, Eiichiro Tanaka, Ryuichi Ogawa, and Yoshinori Hara. *Anecdote*: A Multimedia Storyboarding System with Seamless Authoring Support. In Proceedings of *ACM International Multimedia Conference 96*. Boston, MA. pp. 341-351, November 18-22, 1996.

64.   Harrison, Neil B. The Language of Shepherding: A Pattern Language for Shepherds and Sheep. In Proceedings of *The 6th Annual Conference on Pattern Languages of Programming: PLoP 1999*. Monticello, IL, August 15-18, 1999. http://hillside.net/language-of-shepherding.pdf

65.   Hearst, M. A., M. D. Gross, J. A. Landay, and T. E. Stahovich, Sketching Intelligent Systems. *IEEE Intelligent Systems*, 1998. **13**(3): pp. 10-19.

66.   Hinrichs, Tom, Ray Bareiss, Lawrence Birnbaum, and Gregg Collins. An Interface Design Tool Based on Explicit Task Models. In Proceedings of *CHI '96 Conference Companion on Human Factors in Computing Systems*. Vancouver, BC, Canada: ACM Press. pp. 269-270, April 13-18, 1996.

67.   Hinz, Michael, Zoltán Fiala, and Frank Wehner. Personalization-Based Optimization of Web Interfaces for Mobile Devices. In Proceedings of *The 6th International Symposium on Human Computer Interaction with Mobile Devices and Services: Mobile HCI 2004*. Glasgow, Scotland: Springer. pp. 204-215, September 13-16, 2004.

68. Hitwise Pty. Ltd., *A Merry Christmas For E-Commerce: 2004 Online Holiday Shopping Up 26%*, December 28, 2004. http://www.hitwise.com/info/news/hitwiseHS2004/wrapUp_Issue6.html

69. Hodes, Todd, Mark Newman, Steven McCanne, Randy Katz, and James Landay. Shared Remote Control of a Videoconferencing Application: Motivation, Design, and Implementation. In Proceedings of *SPIE Multimedia Computing and Networking: MMCN '99*. San Jose, CA. pp. 17-28, January 25-27, 1999.

70. Hong, Jason I., Jeffrey Heer, Sarah Waterson, and James A. Landay, WebQuilt: A Proxy-based Approach to Remote Web Usability Testing. *ACM Transactions on Information Systems*, 2001. **19**(3): pp. 263-285.

71. Hong, Jason I. and James A. Landay, SATIN: A Toolkit for Informal Ink-based Applications. *UIST 2000, ACM Symposium on User Interface Software and Technology, CHI Letters*, 2000. **2**(2): pp. 63-72.

72. Huang, Anita W. and Ned Sundaresan. Aurora: A Conceptual Model for Web-Content Adaptation to Support the Universal Usability of Web-based Services. In Proceedings of *ACM Conference on Universal Usability: CUU 2000*. Arlington, VA. pp. 124-131, November 16-17, 2000.

73. Hudson, Scott E., Bonnie E. John, Keith Knudsen, and Michael D. Byrne, A Tool for Creating Predictive Performance Models from User Interface Demonstrations. *UIST 99, ACM Symposium on User Interface Software and Technology, CHI Letters*, 1999. **1**(1): pp. 93-102.

74. Hussey, Andrew and David Carrington, *Using Patterns in Model-based Design*. Technical Report 99-15, Software Verification Research Centre, School of Information Technology, University of Queensland, Queensland, Australia, March, 1999. http://svrc.it.uq.edu.au/Bibliography/svrc-tr.html?99-15

75. IBM, *Abstract User Interface Markup Language Toolkit*, 2004. IBM Corp.: Armonk, NY. http://www.alphaworks.ibm.com/tech/auiml/

76. IBM, *IBM WebSphere Studio Device Developer*, 2002. IBM Corp.: Armonk, NY. http://www.ibm.com/software/wireless/wsdd/

77. IBM, *Rational Rose XDE Developer*, 2002. IBM Corp., (originally by Rational Software Corp.): Armonk, NY. http://www.ibm.com/software/awdtools/developer/rosexde/

78.   IBM, *Rational Software Architect*, 2004. IBM Corp.: Armonk, NY.
        http://www.ibm.com/software/awdtools/architect/swarchitect/

79.   IBM, *Rational Software Modeler*, 2004. IBM Corp.: Armonk, NY.
        http://www.ibm.com/software/awdtools/modeler/swmodeler/

80.   International Committee for Information Technology Standards (INCITS), V2
        Technical Committee on Information Technology Access Interfaces.
        http://www.incits.org/tc_home/v2.htm

81.   iRise, *iRise Studio*, 2003. iRise: El Segundo, CA. http://www.irise.com/

82.   Javahery, Homa, Ahmed Seffah, Daniel Engelberg, and Daniel Sinnig,
        Migrating User Interfaces Across Platforms Using HCI Patterns, in *Multiple
        User Interfaces: Cross-Platform Applications and Context-Aware Interfaces*, Ahmed
        Seffah and Homa Javahery, Editors. John Wiley & Sons: Chichester, England,
        UK. pp. 241-259, 2003.

83.   John, Bonnie E., Konstantine Prevas, Dario D. Salvucci, and Ken Keodinger,
        Predictive Human Performance Modeling Made Easy. *CHI 2004, ACM
        Conference on Human Factors in Computing Systems, CHI Letters*, 2004. **6**(1): pp.
        466-473.

84.   Katsurada, Kouichi, Yusaku Nakamura, Hirobumi Yamada, and Tsuneo Nitta.
        XISL: A Language for Describing Multimodal Interaction Scenarios. In
        Proceedings of *Fifth International Conference on Multimodal Interfaces: ICMI-PUI
        '03*. Vancouver, BC, Canada. pp. 281-284, November 5-7, 2003.

85.   Kawai, Shiro, Hitoshi Aida, and Tadao Saito. Designing Interface Toolkit with
        Dynamic Selectable Modality. In Proceedings of *International ACM Conference
        on Assistive Technologies: ASSETS '96*. Vancouver, BC, Canada. pp. 72-79, April
        11-12, 1996.

86.   Kelley, John F., An Iterative Design Methodology for User-Friendly Natural
        Language Office Information Applications. *ACM Transactions on Office
        Information Systems*, 1984. **2**(1): pp. 26-41.

87.   Keynote Systems, *Online Retail Competition Heating Up as Consumers Become
        Savvier on the Web, Says Keynote*, February 16, 2005.
        http://www.keynote.com/news_events/releases_2005/05feb16.html

88.   Kieras, David, A Guide to GOMS Model Usability Evaluation Using
        NGOMSL, in *The Handbook of Human-Computer Interaction*, Martin Helander,

Thomas Landauer, and Prasad Prabhu, Editors. North-Holland: Amsterdam. pp. 733-766, 1996.

89. Kim, Won Chul and James D. Foley. Providing High-level Control and Expert Assistance in the User Interface Presentation Design. In Proceedings of *Human Factors in Computing Systems: INTERCHI '93*. Amsterdam, The Netherlands: ACM Press. pp. 430-437, April 24-29, 1993.

90. Klemmer, Scott R., Mark W. Newman, Ryan Farrell, Mark Bilezikjian, and James A. Landay, The Designers Outpost: A Tangible Interface for Collaborative Web Site Design. *UIST 2001, ACM Symposium on User Interface Software and Technology, CHI Letters*, 2001. **3**(2): pp. 1–10.

91. Klemmer, Scott R., Anoop K. Sinha, Jack Chen, James A. Landay, Nadeem Aboobaker, and Annie Wang, SUEDE: A Wizard of Oz Prototyping Tool for Speech User Interfaces. *UIST 2000, ACM Symposium on User Interface Software and Technology, CHI Letters*, 2000. **2**(2): pp. 1-10.

92. Kost, Stefan, Dynamically Generated Multimodal Application Interfaces. Position paper for AVI 2004 Workshop: Developing User Interfaces with XML: Advances on User Interface Description Languages, 2004. http://krishna.imn.htwk-leipzig.de/ensonic/publications/paper-avi2004.pdf

93. Krasner, Glenn E. and Stephen T. Pope, A Description of the Model-View-Controller User Interface Paradigm in the Smalltalk-80 System. *Journal of Object-Oriented Programming*, 1988. **1**(3): pp. 26-49.

94. Kurlander, David, Chimera: Example-Based Graphical Editing, in *Watch What I Do: Programming by Demonstration*, Allen Cypher, Editor. MIT Press: Cambridge, MA. pp. 271-290, 1993.

95. Kurlander, David, *Graphical Editing by Example*, Unpublished Ph.D., Department of Computer Science, Columbia University, New York, 1993.

96. Kurlander, David and Eric Bier, Graphical Search and Replace. *Computer Graphics: Proceedings of SIGGRAPH 88*, 1988. **22**(4): pp. 113-120.

97. Lam, Heidi and Patrick Baudisch, Summary Thumbnails: Readable Overviews for Small Screen Web Browsers. *CHI 2005, ACM Conference on Human Factors in Computing Systems, CHI Letters*, 2005. **7**(1): pp. 681-690.

98. Landay, James A., *Interactive Sketching for the Early Stages of User Interface Design*, Unpublished Ph.D., Computer Science Department, Carnegie Mellon

University, Pittsburgh, PA, 1996.

http://www.cs.berkeley.edu/~landay/research/publications/Thesis.pdf

99. Landay, James A. and Brad A. Myers, Sketching Interfaces: Toward More Human Interface Design. *IEEE Computer*, 2001. **34**(3): pp. 56-64.

100. Landay, James A. and Brad A. Myers. Sketching Storyboards to Illustrate Interface Behavior. In Proceedings of *CHI '96 Conference Companion on Human Factors in Computing Systems*. Vancouver, BC, Canada. pp. 193-194, April 13–18, 1996.

101. Laszlo Systems, Amazon Store Demo, 2004.

http://www.laszlosystems.com/lps/sample-apps/amazon/amazon2.lzx?lzt=html

102. Lawson, Jeff. Automated Rich-Client Generation from XML Schemas. In Proceedings of *XML Conference & Exposition 2004*. Washington, DC, November 15-19, 2004. http://xchainj.com/XML2004/XchainJ3.zip

103. Lewis, Clayton and John Rieman, *Task-Centered User Interface Design: A Practical Introduction*. Boulder, CO: University of Colorado, 1993.

ftp://ftp.cs.colorado.edu/pub/cs/distribs/clewis/HCI-Design-Book/

104. Lin, James and James A. Landay. Damask: A Tool for Early-Stage Design and Prototyping of Multi-Device User Interfaces. In Proceedings of *The 8th International Conference of Distributed Multimedia Systems (2002 International Workshop on Visual Computing)*. San Francisco, CA. pp. 573-580, Sept. 26-28, 2002.

105. Lin, James, Mark W. Newman, Jason I. Hong, and James A. Landay, DENIM: Finding a Tighter Fit Between Tools and Practice for Web Site Design. *CHI 2000, ACM Conference on Human Factors in Computing Systems, CHI Letters*, 2000. **2**(1): pp. 510-517.

106. Lin, James, Michael Thomsen, and James A. Landay, A Visual Language for Sketching Large and Complex Interactive Designs. *CHI 2002, ACM Conference on Human Factors in Computing Systems, CHI Letters*, 2002. **4**(1): pp. 307-314.

107. Lonczewski, Frank and Siegfried Schreiber. The FUSE-System: An Integrated User Interface Design Environment. In Proceedings of *1996 International Workshop of Computer-Aided Design of User Interfaces: CADUI '96*. Namur, Belgium: Namur University Press. pp. 37-56, June 5-7, 1996.

108.   Lopez, Juan F. and Pedro Szekely, Web Page Adaptation for Universal Access, in *Universal Access in HCI: Towards an Information Society for All (Proceedings of 1st International Conference on Universal Access in Human-Computer Interaction, New Orleans, LA, August 8-10, 2001)*, Constantine Stephanidis, Editor. Lawrence Erlbaum Associates: Mahwah, NJ. pp. 690-694, 2001.

109.   López-Jaquero, Victor, Francisco Montero, José Pascual Molina, Antonio Fernández-Caballero, and Pascual González. Model-Based Design of Adaptive User Interfaces Through Connectors. In Proceedings of *The 10th International Workshop on the Design, Specification, and Verification of Interactive Systems: DSV-IS 2003*: Springer. pp. 245-257, 2003.

110.   Luyten, Kris, Chris Vandervelpen, and Karin Coninx. Migratable User Interface Descriptions in Component-Based Development. In Proceedings of *The 9th International Workshop on the Design, Specification, and Verification of Interactive Systems: DSV-IS 2002*. Rostock, Germany. pp. 44-58, June 12-14, 2002.

111.   MacKay, Bonnie, Carolyn Watters, and Jack Duffy. Web Page Transformation When Switching Devices. In Proceedings of *The 6th International Symposium on Human Computer Interaction with Mobile Devices and Services: Mobile HCI 2004*. Glasgow, Scotland: Springer. pp. 228-239, September 13-16, 2004.

112.   Macromedia, *Director*, 1989. Macromedia, Inc. (originally by MacroMind, Inc.): San Francisco, CA. http://www.macromedia.com/software/director/

113.   Macromedia, *Dreamweaver*, 1997. Macromedia, Inc.: San Francisco, CA. http://www.macromedia.com/software/dreamweaver/

114.   Macromedia, *Flash*, 1996. Macromedia, Inc. (originally by FutureWave Software, Inc.): San Francisco, CA. http://www.macromedia.com/software/flash/

115.   Martelli, Alex, Anna Ravenscroft, and David Ascher, *Python Cookbook*. 2nd ed. Sebastopol, CA: O'Reilly Media. 807 pp., 2005. Based on the online Python Cookbook at http://aspn.activestate.com/ASPN/Python/Cookbook/

116.   Mattis, Peter, Spencer Kimball, Josh MacDonald, and GTK+ Team, *GTK+: The GIMP Toolkit*, 1997. GTK+ Team. http://www.gtk.org/

117.   Mayora-Ibarra, Oscar, Edgar Cambranes-Martínez, Carlos Miranda-Palma, Alejandro Fuentes-Penna, and Oscar De la Paz-Arroyo. UML Modelling of Device-Independent Interfaces and Services for a Home Environment Application. In Proceedings of *The 4th International Symposium on Human*

Computer Interaction with Mobile Devices: Mobile HCI 2002. Pisa, Italy: Springer. pp. 296-301, September 18-20, 2002.

118. Meijler, Theo Dirk, Serge Demeyer, and Robert Engel. Making Design Patterns Explicit in FACE, a Framework Adaptive Composition Environment. In Proceedings of *European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering: ESEC/FSE '97*: Springer-Verlag LNCS 1301. pp. 94-110, 1997.

119. Menkhaus, Guido and Wolfgang Pree. User Interface Tailoring for Multi-Platform Service Access. In Proceedings of *International Conference on Intelligent User Interfaces: IUI 2002*. San Francisco, CA. pp. 208-209, January 13-16, 2002.

120. Microsoft, *ASP.NET Mobile Controls*, 2002. Microsoft Corp.: Redmond, WA. http://msdn.microsoft.com/mobility/othertech/asp.netmc/

121. Microsoft, *FrontPage*, 1996. Microsoft Corp. (originally by Vermeer Technologies, Inc.): Redmond, WA. http://office.microsoft.com/frontpage/

122. Microsoft, *Visio*, 1992. Microsoft Corp. (originally by Visio Corp.): Seattle, WA. http://office.microsoft.com/visio/

123. Microsoft, *Visual Basic*, 1991. Microsoft Corp.: Redmond, WA. http://msdn.microsoft.com/vbasic/

124. Microsoft, *Visual Studio*, 1997. Microsoft Corp.: Redmond, WA. http://msdn.microsoft.com/vstudio/

125. Microsoft, *Visual Studio .NET 2003*, 2003. Microsoft Corp.: Redmond, WA. http://msdn.microsoft.com/vstudio/

126. microTOOL, *objectiF*. microTOOL GmbH: Berlin, Germany. http://www.microtool.de/objectif/en/

127. ModelMaker, *ModelMaker*. ModelMaker Tools: Oosterbeek, Netherlands. http://www.modelmakertools.com/

128. Modugno, Francesmary, *Extending End-User Programming in a Visual Shell with Programming by Demonstration and Graphical Language Techniques*, Unpublished Ph.D., Computer Science Department, Carnegie Mellon University, Pittsburgh, PA, 1995.

129. Modugno, Francesmary and Brad A. Myers, Graphical Representation and Feedback in a PBD System, in *Watch What I Do: Programming by Demonstration*, Allen Cypher, Editor. MIT Press: Cambridge, MA. pp. 415-422, 1993.

130. Molina, Pedro J., Santiago Meliá, and Oscar Pastor. JUST-UI: A User Interface Specification Model. In Proceedings of *The 4th International Conference on Computer-Aided Design of User Interfaces: CADUI 2002*. Valenciennes, France. pp. 323-334, May 15-17, 2002.

131. Moran, Thomas P., Patrick Chiu, and William van Melle. Pen-Based Interaction Techniques For Organizing Material on an Electronic Whiteboard. In Proceedings of *the ACM Symposium on User Interface Software and Technology: UIST '97*. Banff, Alberta, Canada. pp. 45-54, October 14-17, 1997.

132. Mori, Giulio, Fabio Paternò, and Carmen Santoro. Tool Support for Designing Nomadic Applications. In Proceedings of *The 8th International Conference on Intelligent User Interfaces: IUI 2003*. Miami, FL. pp. 141-148, January 13-15, 2003.

133. Mozilla Foundation, *XML User Interface Language (XUL)*, 2001. Mozilla Foundation. http://www.mozilla.org/projects/xul/

134. Müller, Andreas, Peter Forbrig, and Clemens Cap. Model-Based User Interface Design Using Markup Concepts. In Proceedings of *The 8th International Workshop on the Design, Specification, and Verification of Interactive Systems: DSV-IS 2001*. Glasgow, Scotland, UK: Springer. pp. 16-27, June 13-15, 2001. http://www.dcs.gla.ac.uk/~johnson/papers/dsvis_2001/muller/

135. Myers, Brad A., Graphical User Interface Programming, in *Computer Science Handbook*, Allen B. Tucker, Editor. Chapman & Hall/CRC Press, Inc.: Boca Raton, FL. pp. 48-1 – 48-29, 2004.

136. Myers, Brad A., Rich McDaniel, Rob Miller, Brad Vander Zanden, Dario Giuse, David Kosbie, and Andrew Mickish, Our Experience with Prototype-Instance Object-Oriented Programming in Amulet and Garnet. *Interfaces*, 1998(39): pp. 4–9.

137. Myers, Brad A., Richard G. McDaniel, Robert C. Miller, Alan Ferrency, Andrew Faulring, Bruce D. Kyle, Andrew Mickish, Alex Klimovitski, and Patrick Doane, The Amulet Environment: New Models for Effective User Interface Software Development. *IEEE Transactions on Software Engineering*, 1997. **23**(6): pp. 347–365.

138. Mynatt, Elizabeth D. and W. Keith Edwards. An Architecture for Transforming Graphical Interfaces. In Proceedings of *ACM Symposium on User Interface*

Software and Technology: UIST '94. Marina del Rey, California. pp. 39-47, November 2-4, 1994.

139. NetBeans Community, *NetBeans*, 1997. NetBeans Community (originally by NetBeans, Inc.). http://www.netbeans.org/

140. Newman, Mark W. and James A. Landay. Sitemaps, Storyboards, and Specifications: A Sketch of Web Site Design Practice. In Proceedings of *DIS 2000: Designing Interactive Systems*. New York, New York. pp. 263-274, August, 2000.

141. Newman, Mark W., James Lin, Jason I. Hong, and James A. Landay, DENIM: An Informal Web Site Design Tool Inspired by Observations of Practice. *Human-Computer Interaction*, 2003. **18**(3): pp. 259–324.

142. Nichols, Jeffrey. Informing Automatic Generation of Remote Control Interfaces with Human Designs. In Proceedings of *Human Factors in Computing Systems: CHI 2002 Extended Abstracts*. Minneapolis, MN. pp. 864-865, April 20-25, 2002.

143. Nichols, Jeffrey, Brad A. Myers, Michael Higgins, Joseph Hughes, Thomas K. Harris, Roni Rosenfeld, and Mathilde Pignol, Generating Remote Control Interfaces for Complex Appliances. *UIST 2002, ACM Symposium on User Interfaces and Software Technology, CHI Letters*, 2002. **4**(2): pp. 161-170.

144. Novell, *AppWare*, 1994. Novell, Inc.: Provo, UT.

145. Nuance, *V-Builder*, 2000. Nuance Communications, Inc.: Menlo Park, CA. http://www.nuance.com/prodserv/nae.html

146. Olsen, Dan R., Scott E. Hudson, Raymond Chung-Man Tam, Genevieve Conaty, Matthew Phelps, and Jeremy M. Heiner. Speech Interaction with Graphical User Interfaces. In Proceedings of *IFIP TC.13 Conference on Human Computer Interaction: INTERACT2001*. Tokyo, Japan: IOS Press, 2001.

147. Olsen, Dan R., Sean Jefferies, Travis Nielsen, William Moyes, and Paul Fredrickson, Cross-modal Interaction using XWeb. *UIST 2000, ACM Symposium on User Interface Software and Technology, CHI Letters*, 2000: pp. 191-200.

148. OmniSphere, *OmniBuilder*. OmniSphere Information Systems Corporation: Toronto, Ontario, Canada. http://www.omnibuilder.com/

149.   Ousterhout, John K., *Tcl and the Tk Toolkit*. 1st ed. Reading, MA: Addison-Wesley Professional. 480 pp., 1994. Tcl/Tk is available for download at http://www.tcl.tk/

150.   Pagel, Bernd-Uwe and Mario Winter. Towards Pattern-Based Tools. In Proceedings of *European Conference on Pattern Languages of Programs: EuroPLoP '96*. Kloster Irsee, Germany, July 11-13, 1996. http://www.informatik.fernuni-hagen.de/import/pi3/publikationen/abstracts/EuroPLoP96.pdf

151.   Palanque, Philippe, Rémi Bastide, and Louis Dourte. Contextual Help for Free with Formal Dialogue Design. In Proceedings of *5th International Conference on Human-Computer Interaction: HCI International '93*. Orlando, FL: Elsevier, August 8-13, 1993.

152.   Paternò, Fabio. ConcurTaskTrees and UML: How to Marry Them? In Proceedings of *Workshop Towards a UML Profile for Interactive Systems Development (TUPIS 2000) at the Third International Conference on the Unified Modeling Language: UML 2000*. York, United Kingdom, October 2–3, 2000. http://giove.cnuce.cnr.it/Guitare/Document/ConcurTaskTrees_and_UML-new.htm

153.   Paternò, Fabio, *Model-Based Design and Evaluation of Interactive Applications*. Applied Computing, ed. Ray Paul, Peter Thomas, and Jasna Kuljis. London: Springer-Verlag. 192 pp., 2000.

154.   Paternò, Fabio and Menica Mezzanotte. Formal Verification of Undesired Behaviours in the CERD Case Study. In Proceedings of *Engineering for Human-Computer Interaction: EHCI '95*. Jackson Hole, WY: Chapman & Hall. pp. 213-226, August 14-18, 1995.

155.   Ponnekanti, Shankar R., Brian Lee, Armando Fox, Pat Hanrahan, and Terry Winograd. ICrafter: A Service Framework for Ubiquitous Computing Environments. In Proceedings of *The 3rd International Conference on Ubiquitous Computing: Ubicomp 2001*. Atlanta, GA: Springer. pp. 56-75, 2001.

156.   Providence Software Solutions, *eXtensible Virtual Toolkit (XVT)*, 1988. Providence Software Solutions, Inc. (originally by XVT Software, Inc.): Cary, NC. http://www.xvt.com/

157.   Puerta, Angel. The Mecano Project: Comprehensive and Integrated Support for Model-Based Interface Development. In Proceedings of *1996 International*

Workshop of Computer-Aided Design of User Interfaces: CADUI '96. Namur, Belgium: Namur University Press. pp. 19-36, June 5-7, 1996.

158.   Puerta, Angel, Michael Micheletti, and Alan Mak. The UI Pilot: A Model-Based Tool to Guide Early Interface Design. In Proceedings of *The 10th International Conference on Intelligent User Interfaces: IUI 2005*. San Diego, CA. pp. 215–222, Jan. 9–12, 2005.

159.   Puerta, Angel R. and Jacob Eisenstein. XIML: A Common Representation for Interaction Data. In Proceedings of *2002 International Conference on Intelligent User Interfaces: IUI 2002*. San Francisco, CA. pp. 216-217, January 13-16, 2002.

160.   Rumbaugh, James, Michael Blaha, William Premerlani, Frederick Eddy, and William Lorenson, *Object-Oriented Modeling and Design*. Englewood Cliffs, N.J.: Prentice Hall. 500 pp., 1991.

161.   Saund, Eric, David J. Fleet, Daniel Larner, and James Mahoney, Perceptually Supported Image Editing of Text and Graphics. *UIST 2003, ACM Symposium on User Interface Software and Technology, CHI Letters*, 2003: pp. 183-192.

162.   Saund, Eric and Thomas P. Moran. A Perceptually-Supported Sketch Editor. In Proceedings of *the ACM Symposium on User Interface Software and Technology: UIST '94*. Marina del Rey, CA. pp. 175-184, November 2–4, 1994.

163.   Schilit, Bill N., Gene Golovchinksy, and Morgan N. Price. Beyond Paper: Supporting Active Reading with Free Form Digital Ink Annotations. In Proceedings of *Human Factors in Computing Systems: CHI '98*. Los Angeles, CA. pp. 249-256, April 18-23, 1998.

164.   Schlungbaum, Egbert and Thomas Elwert. Automatic User Interface Generation from Declarative Models. In Proceedings of *1996 International Workshop of Computer-Aided Design of User Interfaces: CADUI '96*. Namur, Belgium: Namur University Press. pp. 3-18, June 5-7, 1996.

165.   Schreiber, Siegfried. Specification and Generation of User Interfaces with the BOSS-System. In Proceedings of *East-West International Conference on Human-Computer Interaction: EWHCI'94*. St. Petersburg, Russia: Springer-Verlag. pp. 107-120, August 2-6, 1994.

166.   Sears, Andrew. AIDE: A Step Toward Metric-Based Interface Development Tools. In Proceedings of *ACM Symposium on User Interface Software and Technology: UIST '95*. Pittsburgh, PA. pp. 101-110, November 15-17, 1995.

167. Sefika, Mohlalefi, Aamod Saney, and Roy H. Campbell. Monitoring Compliance of a Software System With Its High-Level Design Models. In Proceedings of *18th International Conference on Software Engineering: ICSE-18 '96*. Berlin, Germany. pp. 387-396, March 25-29, 1996.

168. Sinha, Anoop K., Scott R. Klemmer, and James A. Landay, Embarking on Spoken-Language NL Interface Design. *International Journal of Speech Technology*, 2002. **5**(2): pp. 159-169.

169. Sinnig, Daniel, Homa Javahery, Peter Forbrig, and Ahmed Seffah. The Complicity of Model-Based Approaches and Patterns for UI Engineering. In Proceedings of *Perspectives in Business Informatics Research: BIR 2003*. Berlin, Germany: Shaker Verlag. pp. 120-131, September 18-20, 2003.

170. Smart, Julian, Robert Roebling, Stefan Csomor, Markus Holzem, Vadim Zeitlin, Guilhem Lavaux, and Vaclav Slavik, *wxWidgets*, 1992. wxWidgets Team. http://www.wxwidgets.org/

171. Smith, Ian, *Support for Multi-Viewed Interfaces*, Unpublished Ph.D. Dissertation, College of Computing, Georgia Institute of Technology, Atlanta, GA, 1998.

172. Smith, Randall B. and David Ungar. Programming as an Experience: The Inspiration for Self. In Proceedings of *The 9th European Conference on Object Oriented Programming: ECOOP '95*. Aarhus, Denmark: Springer. pp. 303-330, August 7-11, 1995. http://research.sun.com/self/papers/programming-as-experience.html

173. Souchon, Nathalie and Jean Vanderdonckt. A Review of XML-Compliant User Interface Description Languages. In Proceedings of *The 10th International Workshop on the Design, Specification and Verification of Interactive Systems: DSV-IS 2003*. Funchal, Madeira Island, Portugal: Springer. pp. 377-391, June 11-13, 2003.

174. Sun Microsystems, *Abstract Window Toolkit*, 1995. Sun Microsystems, Inc.: Santa Clara, CA. http://java.sun.com/products/jdk/awt/

175. Sun Microsystems, *Java Foundation Classes (JFC/Swing)*, 1998. Sun Microsystems, Inc.: Santa Clara, CA. http://java.sun.com/products/jfc/

176. Sutton, Stephen and Ronald Cole. The CSLU Toolkit: Rapid Prototyping of Spoken Language Systems. In Proceedings of *The 10th Annual ACM Symposium*

on User Interface Software and Technology: UIST '97. Banff, Alberta, Canada. pp. 85-86, 1997.

177. Sutton, Stephen, David G. Novick, Ronald Cole, Pieter Vermeulen, Jacques de Villiers, Johan Schalkwyk, and Mark Fanty. Building 10,000 Spoken Dialogue Systems. In Proceedings of *The 4th International Conference on Spoken Language Processing: ICSLP 96*. Philadelphia, PA. pp. 709-712, October 3-6, 1996.

178. Szekely, Pedro. Retrospective and Challenges for Model-Based Interface Development. In Proceedings of *Design, Specification and Verification of Interactive Systems: DSV-IS'96*. Namur, Belgium. pp. 1-27, June 5-7, 1996.

179. Szekely, Pedro, Ping Luo, and Robert Neches. Beyond Interface Builders: Model-Based Interface Tools. In Proceedings of *Human Factors in Computing Systems: INTERCHI '93*. Amsterdam, The Netherlands: ACM Press. pp. 383-390, April 24-29, 1993.

180. Szekely, Pedro, Piyawadee "Noi" Sukaviriya, Pablo Castells, Jeyakumar Muthukumarasamy, and Ewald Salcher. Declarative Interface Models for User Interface Construction Tools: the Mastermind Approach. In Proceedings of *Engineering for Human-Computer Interaction: EHCI '95*. Jackson Hole, WY: Chapman & Hall. pp. 120-150, August 14-18, 1995.

181. Tellme, *Tellme Studio*, 2000. Tellme Networks, Inc.: Mountain View, CA. http://studio.tellme.com/

182. Tidwell, Jenifer, *Common Ground: A Pattern Language for Human-Computer Interface Design*, 1999. http://www.mit.edu/~jtidwell/common_ground.html

183. Tidwell, Jenifer, *Designing Interfaces: Patterns for Effective Interaction Design*. Sebastopol, CA: O'Reilly Media. 384 pp., 2005. http://time-tripper.com/uipatterns/

184. Trætteberg, Hallvard, Model based design patterns. April 1-6, 2000: Position paper for CHI 2000 Workshop: Pattern Languages for Interaction Design: Building Momentum. http://www.idi.ntnu.no/~hal/publications/design-patterns/CHI00-position.pdf

185. Trolltech, *Qt*, 1991. Trolltech AS: Oslo, Norway. http://www.trolltech.com/products/qt/

186. Unisys, *Natural Language Speech Assistant*, 1999. Unisys Corporation.

187.   van de Kant, Maarten, Stephanie Wilson, Mathilde Bekker, Hilary Johnson, and Peter Johnson. PatchWork: A Software Tool for Early Design. In Proceedings of *CHI 98 Conference Summary on Human Factors in Computing Systems*. Los Angeles, CA. pp. 221-222, April 18-23, 1998.

188.   van Duyne, Douglas K., James A. Landay, and Jason I. Hong, *The Design of Sites*. Boston: Addison-Wesley, 2002.

189.   van Welie, Martijn and Hallvard Trætteberg. Interaction Patterns in User Interfaces. In Proceedings of *The 7th Pattern Languages of Programs Conference: PLoP 2000*. Monticello, Illinois, August 13-16, 2000. http://jerry.cs.uiuc.edu/~plop/plop2k/proceedings/Welie/Welie.pdf

190.   Vanderdonckt, Jean, Quentin Limbourg, and Murielle Florins. Deriving the Navigational Structure of a User Interface. In Proceedings of *Ninth IFIP TC13 International Conference on Human-Computer Interaction: INTERACT 2003*. Zurich, Switzerland: IOS Press. pp. 455-462, September 1-5, 2003.

191.   Voxeo, *Voxeo Evolution*, 2002. Voxeo Corp.: Orlando, FL. http://community.voxeo.com/

192.   W3C HTML Working Group, *XHTML™ 1.0: The Extensible HyperText Markup Language (Second Edition)*: World Wide Web Consortium, 2002. http://www.w3.org/TR/xhtml1/

193.   W3C Voice Browser Working Group, *Voice Extensible Markup Language (VoiceXML) Version 2.0*: World Wide Web Consortium, 2004. http://www.w3.org/TR/voicexml20/

194.   W3C XForms Working Group, *XForms 1.0*: World Wide Web Consortium, 2003. http://www.w3.org/TR/xforms/

195.   Wagner, Annette, Prototyping: A Day in the Life of an Interface Designer, in *The Art of Human-Computer Interface Design*, Brenda Laurel, Editor. Addison-Wesley: Reading, MA. pp. 79-84, 1990.

196.   Weiser, Mark D., The Computer for the 21st Century. *Scientific American*, 1991. **265**(3): pp. 94–104.

197.   Wiecha, Charles, William Bennett, Stephen Boies, John Gould, and Sharon Greene, ITS: A Tool for Rapidly Developing Interactive Applications. *ACM Transactions on Information Systems*, 1990. **8**(3): pp. 204-236.

198.   Wiecha, Charles, Stephen Boies, Margaret Gaitatzes, Stephen Levy, Julie
        Macnaught, Paul Matchen, Scott Mcfaddin, David Mundel, and Rich
        Thompson, Position paper for CHI 2001 Workshop: Transforming the UI for
        Anyone. Anywhere. April 1-5, 2001: Seattle, WA.

199.   Wilson, Stephanie and Peter Johnson. Bridging the Generation Gap: From
        Work Tasks to User Interface Designs. In Proceedings of *1996 International
        Workshop of Computer-Aided Design of User Interfaces: CADUI '96*. Namur,
        Belgium: Namur University Press. pp. 77-94, June 5-7, 1996.

200.   Wong, Yin Yin. Rough and Ready Prototypes: Lessons From Graphic Design.
        In Proceedings of *Human Factors in Computing Systems: CHI '92*. Monterey, CA.
        pp. 83-84, May 3–7, 1992.

201.   Zimmermann, Gottfried, Gregg Vanderheiden, and Al Gilman. Prototype
        Implementations for a Universal Remote Console Specification. In Proceedings
        of *Human Factors in Computing Systems: CHI 2002 Extended Abstracts*.
        Minneapolis, MN. pp. 510-511, April 20-25, 2002.

APPENDIX

A Questions for Study on Current Practices

This open-ended set of questions was used to guide the study described in Chapter 2.

1. What is your educational background and job experience?

2. Which devices have you designed for?

3. Which devices were targeted for the project you worked on?

4. Please choose the organizational structure that most closely fits your situation:

    a. Desktop group (project A, project B), Mobile group (project A, project C, project D)

    b. Project A, Project B (desktop, mobile), Project C

    c. Project A, Project B desktop, Project B mobile, Project C

5. Does this division make sense?

6. Pick the statement that most closely fits your situation:

    a. There are desktop and mobile versions of our software product. The desktop version is managed and designed separately from the mobile versions. However, we do synchronize our releases.

b. There are desktop and mobile versions of our software product. The desktop version is managed and designed separately from the mobile versions, and we do not synchronize our releases.

c. There are desktop and mobile versions of our software product, and we design and manage all of the versions together as one project.

d. There is one product that has desktop and mobile components. We don't think of "desktop" and "mobile" versions of the product.

7. How many UI designers work in your company? On your cross-device project?

8. Pick the statement that most closely fits your situation:

a. All of the designers are responsible for designing for all of the devices.

b. All of the designers are responsible for designing the whole system. We don't think in terms of different versions for each device.

c. Each designer concentrates on designing a version targeting only 1 or 2 devices.

9. If same project:

a. How do the designers keep the interfaces across devices synchronized? Meetings? Tools? Web site? Simply looking at sketches?

b. Did you do design first, then meet with other designers? Or also do some initial design in the first joint meeting?

c. How much design takes place at meetings with other designers?

10. If different projects:

a. Why? Is it timing? Was it because only later did the company decide to target a program to several devices? Or do you do PC-Mobile-PC-Mobile... as the version cycle?

b. Was it a different group that designed the second interface, or the same?

c. If different, how much consultation was there with the group that designed the original interface? Informally or meetings? One-time or regular?

d. Were design documents for the original interface used at all? Or did the design team only look at the final interface?

e. How much of the original interface was used as the basis of the final (in interaction flow, tasks, in spirit only, almost nothing?)

f. In future cross-device projects, will there be more coordination (i.e., one team, synchronization of releases)? Should there be?

g. What if you could take original interface, generate a new interface automatically, and then tweak it? How much detail would the generated interface need?

11. What was good and bad about your design process? What's your wish list (both ideal and more realistic)? Auto-generated interfaces? What if the generated interfaces are bad? How much tweaking?

12. Do you ever see patterns in your multi-device design work?

Reaction to pattern idea:

13. Does pattern idea make sense? Do you think this way now? If not, do you think you could think this way (i.e., how much of a stretch is this)?

14. Suppose there were still several people designing. How could a tool like this still help? Would auto-generate still be useful? More coordination issues as opposed to auto-generate issues? Perhaps each designer could do one, auto-generate the other, then compare.

15. Should there be other types of explicit multi-designer support? What type?

16. Would you like to see, if you changed one interface, how the other interfaces would change, in real-time?

17. How would you deal with the question of which changes would propagate? For example, if you removed a whole interaction sequence in mobile because it was not appropriate, how would the PC version know not to delete it? Should the tool present multiple choices? If so, when?

18. How important would creating your own patterns be?

APPENDIX

B Prototype Evaluation and Questionnaire

B.1 HopiSketch Test Plan

B.1.1 Roles

Test administrator (Jimmy): reads instructions, handles transitions from one section of test to another, handles participant questions & gets participants unstuck if necessary

Observer & Logger (Larry, Guru, Danny, or Rich): records times & tallies of tracked metrics, handles note-taking

Demo Giver (Jimmy): gives a demonstration of HopiSketch

B.1.2 Introduction

Thank you very much for helping us to evaluate HopiSketch. HopiSketch is a prototype of an application that we hope will help designers such as yourself design multi-device web sites. The purpose of this study is to determine how useful HopiSketch could be to designers.

Here's what we have planned for the next 2 hours:

1. First, we will give you a short overview of HopiSketch.
2. Next, we will ask you to perform a short warm-up task to get familiar with the system.

3. After that, we will ask you to create a preliminary design for a web site based on a set of requirements. You will have 60 minutes or so to sketch out some ideas for a multi-device web site using HopiSketch.

4. Finally, after the main design task is done, we will ask you to fill out a questionnaire to give us feedback on HopiSketch and your experience using it.

Throughout the study, feel free to ask for help if you have trouble with any of the tasks we ask you to perform. Also, *(recorder)* will be taking notes as you perform your tasks.

This consent form just says that you understand what this test is about, that you understand we will respect your privacy wishes, and that you will allow us to publish any results from this study.

B.1.3 Tasks

For each of the following tasks, the participant will be given a printout of the task description (one at a time). All users will use a Wacom tablet attached to an IBM ThinkPad. Task 1 should take 15 minutes and Task 2 should take 60–75 minutes.

Task 0: *We open the file "flower.bmp" for them. Ask them to move the watering can over the flower. Then add a bee to the drawing, then handwrite the label "Flower with bee."*

Task 1: *Walk through creating a site with the participant. Cover:*

- *Sitemap creation*
- *Sketching*
- *Transition specification (arrows)*
- *Pie menus*
- *Zooming*
- *Gestures for cut, copy, paste, pan, move, and delete*

- *Running*

- *Retargeting*

- *Editing retargeted design: add, delete, edit pages*

Task 2: *Give them the requirements for the TotalMusic.com project (in task2_requirements.doc). Each participant has 60 to 75 minutes to create a preliminary design for the site.*

- *Give user the first task description (task2_requirements.doc)*

- *After test, **save the dnm files**.*

B.1.4 Post-test questions

Hand the participant the questionnaire.

B.1.5 Debriefing

Do you have any final comments about the system, this study, the questionnaire, or anything else?

Would you like to hear about some future improvements we're thinking about making to HopiSketch?

Thank you for participating in our experiment. The purpose of the experiment was to see whether designers can use a new electronic sketching tool to design multi-device web sites. Additionally, we wished to get feedback on how designers feel a tool like HopiSketch could fit into their current design practices. Ultimately, we wish to know whether HopiSketch encourages the exploration of a wider variety of design ideas and the production of higher quality user interfaces.

Our plan is to continue to use the feedback from this experiment and observation of any problems with the HopiSketch user interface to improve the application.

B.2 Consent Form for HopiSketch User Study

This study is being conducted as part of a research project at the IBM Watson Research Center. This study should take about 2 hours and poses no hazards to you other than those normally encountered working in an office environment.

All of the information that we obtain from your session will be kept confidential. We will not use your name or identifying information in any reports of my research.

Your participation in this research is voluntary. You are free to refuse to participate or leave at any point during the study. Whether or not you choose to participate will have no bearing on your standing in relation to IBM or to UC Berkeley.

If you have any questions about the research, you may call Guruduth Banavar at (914) 784-7755, or send e- mail to banavar@us.ibm.com. You may keep the other copy of this form for future reference.

By signing this form you agree to the following statement:

I agree to participate in the evaluation of HopiSketch. I understand that I will be using an experimental web design application. I know that the researchers are studying how people perform web site design and are evaluating HopiSketch, an experimental multi-device web design application. I realize that I will be asked to discuss some designs over 1-2 hours.

I understand that any information obtained during this study will be kept confidential. Only members of the Group for User Interface Research or IBM will view the video tapes in detail, and no other individuals will have access to these tapes.

I give Jimmy Lin, Guruduth Banavar, and their associates permission to present the results of this work in written/oral form, without further permission from me.

Date & Signature

_____

B.3 Task 1

Go through the following steps to add the ability to make lodging reservations to the Northern California Tourism site shown on the screen:

a) Create a new page entitled "Make Reservations."
b) Quickly sketch the "Make Reservations" page, including spaces for the user to indicate
    a. Number of guests
    b. Length of stay
    c. Credit card number and expiration date
c) Link the "Make Reservations" page to the "Pinot Grigio Inn" page. The text for the link should be "Make a reservation."
d) Use the "Run" feature to run through the site, showing how a user coming into the home page would find her way through the site and make a reservation at the Pinot Grigio Inn.

B.4 Task 2

You have been hired to design an online music store that will target two types of devices: a PC and a mobile phone with a PDA-sized screen. Some requirements for the service are included on the next page. Please spend 60–75 minutes creating a preliminary design for the site.

The purpose of this exercise is to see how well HopiSketch can be used to conduct a realistic design task. This is not intended in any way to be a test of your ability as a designer or your ability to use this particular tool. *It is intended as an evaluation of the tool.*

We would like you to try to create the best design you can in the time provided using HopiSketch. Feel free to ask for assistance using HopiSketch. You can also use paper and pencil for part of the design process.

We have given many requirements, and it is very possible that you will not be able to "finish" your design. This is fine. By the way, since we are interested in the design process for multiple devices, it is better to have two partial designs for two devices than one complete design for only one device. Conversely, it is also okay if you feel your design is done before the allotted time is up. You can stop at any time before the time is up.

We will also remind you to think aloud while using HopiSketch so we can get an idea of what you are thinking while using the tool.

TotalMusic.com Requirements

A new startup called TotalMusic.com is creating a web site that will let customers buy CDs, MP3s for download, and even snippets of music for mobile phone ringtones. TotalMusic.com will launch two versions of its site, one targeted to PC users, and the other targeted to users of mobile phones with PDA-sized screens.

Please create a preliminary design for the online store, following as many of the requirements below as possible:

Common Requirements

Make Search function available on every page

Allow users to sample music

Album listing should include format (CD, cassette), release date, and label

Allow users to rate music on a scale (1–5)

Desktop-specific Requirements

List special offers on home page

Show reviews and recommendations from other customers

Allow users to create and read reviews

Allow users to access shopping cart from every page

Offer albums related to or similar to the album being browsed

Mobile-specific Requirements

Allow users to download sample of music for ringtone

Purchasing music must be via one-click

B.5 Post-Test Questionnaire

Each question is followed by the participants' answers. Freeform answers are given in their entirety, while numerical answers are shown in chart form and as a mean, median, and standard deviation where appropriate.

1) Can you think of something that you did differently by using HopiSketch compared to what you normally do?

   ❶ Worked more with whole concept of site, not on individual pages. Would work more on experience threads, not pages

   ❷ Nature of cartoons was more constrained by tool: normally, cartoon purely for visual communication. HopiSketch: also functional. Wouldn't be a problem, would just get used to it. Functional: think in a different way about the design: usually think at more conceptual level than functional

   ❸ Dragging lines connecting specific buttons and links to their targets

❹ I began by writing text and objects freehand as opposed to using the text tool, but I'm not sure why. I think I may have thought of it more as a sketching tool than a design tool.

❺ Not really. Would sketch pages, site map on paper (Haven't designed for multiple devices at the same time before)

❻ Testing using Run mode: good to show were you missed links. Normally would use paper for key parts of site map, didn't do so for testing purposes

2) Did HopiSketch help you see new ideas, or did it prevent you from exploring ideas?

❶ Helps you see "there is way too much stuff here for the Palm" earlier than normal. Allows non-artist into the artist/designer's mind (glimpse into design process) – the key

❷ Helped keep ideas organized: translation kept raw material from first PC design, felt more confident throwing things away. Hard to deal with mode changes of objects (e.g., various states of shopping cart)

❸ It did both. It helped me experience my design, but it made editing my designs more difficult through its gestural user interface.

❹ This may be a function of limited exploration and/or familiarity with the tool, including not using the "Run" feature that much. It may also be a function of shifting my mental paradigm from a Visio-type visualization to a more "white board" type of visualization; currently, my facility with Visio, as well as its being a building block in a final deliverable, means that I tend to "sketch" using Visio more than I do freehand (i.e. on paper, on a white board), so this, in addition to my lack of familiarity with the product, may have impeded my ability to see and/or explore ideas. In addition, the difficulty in manipulating (selecting, grouping, etc.) objects within the tool was a barrier as it took time and effort away from actively creating something.

❺ Normally, I would have more time to play with more ideas (because of learning curve with DENIM, stylus)

❻ No to both

3) What aspects of HopiSketch do you particularly *like*?

❶ Takes napkin sketching to a new experiential level without making it beautiful. Focuses on idea, whether idea is valid. Selecting, linking napkin-sketch type gestures

❷ linking, rudimentary support for widgets. Run mode

❸ I liked the ability to zoom in and out easily.

❹ Being able to see how a page might actually function (i.e. the prototype/"Run" feature").

❺ The Site Map view, and showing the structure of the site

❻ Run mode, the potential of gestures

4) What aspects of HopiSketch do you particularly *dislike*?

❶ Interdevice problem is hard—haven't gotten there yet. Size estimates of page (5 MB page, hard to download on Palm). Need priorities: in PC design, what parts can make it to Palm, what cannot?

❷ Emphasis on page/site map paradigm too heavy. Would like more "object" emphasis

❸ The gestural user interface and the requirement to hand-draw UI elements.

❹ • pen (rather have mouse)

• visible groups (should be invisible)

• should smooth out strokes

• sketches not suitable for clients

• keystroke grouping, alignment tool, pre-made shapes, ability to customize page sizes and set default values for lines, pages, boxes, etc

❺ Interaction is quirky (and buggy)

❻ Using pen for selecting, manipulating objects; bugs; interaction did not flow; not used to zooming besides zooming in and out in place

5) What benefits do you see in using a tool that can automatically retarget a web user interface to another device?

❶ It's a good starting point. Good to explain to non-designers the limitations

❷ Thoroughness. It's easier to make sure that all the work you did on one platform gets carried over to the other platforms

❸ I do not see a tool such as this is appropriate

❹ Time savings

❺ Time savings! Great advantage. Especially it it's a matter of hundreds or thousands of pages

❻ Help see potential pitfalls (or opportunities), over time, I could see this product helping designers to predict needs across devices

6) Did you use the results of the retargeting process? Were the results beneficial? If not, why not?

❶ It makes a good case for content deletion, but without "groupings" it's impossible to "hone" down

❷ They were a good starting point. I still have a philosophical problem with the notion of PDAs and cell phones presenting subsets of desktop functionality. I believe that these devices should serve as complements instead. So it is entirely possible that the design for the hand-held device could contain none of the same functionality as the desktop product. Perhaps if the exercise involved creating a set of GUIs for a variety of different hand-held devices, then the theme and variation functionality would make more sense.

❸ The results were unsatisfactory

❹ Yes (results were used). (No) the results weren't (beneficial) as the grouping didn't hold. There was no continuity of function intra- or interpage.

❺ I used them, but had to move things around quite a bit.

❻ Not really 1) false assumptions were made about size of text/widgets causing extra pages when they were not needed.

7) What additional features would you like to see in HopiSketch? What would it take for it to be truly *useful* to you?

❶ Content prioritization, groupings, new tools

❷ I use sketching tools in the early stage of design, when I am trying to define functionality, rather than layout. Creating derivative GUIs for a variety of platforms is a later-stage activity for me. Therefore the sketching functionality would be very useful to me, but the multi-platform functionality would be more useful to me in a higher-fidelity tool.

> ❸ N/A
>
> ❹ Simplified grouping, alignment tools, prioritization of elements, ability to select elements to retarget (as opposed to all), "fuzzy" layout logic
>
> ❺ Persistent navigation or templates—would save much time
>
> ❻ Ability to "program" conditions that aid in retargeting process. Ability to work on multiple targets simultaneously

8) How likely would you use a commercial-strength sketching application?

> ❷❺ Very Likely
>
> ❶❻ Somewhat Likely
>
> ❹ Neither Likely nor Unlikely
>
> Somewhat Unlikely
>
> ❸ Very Unlikely

Assuming 1 = Very unlikely, 3 = Neither likely nor unlikely, 5 = Very likely:

Mean = 3.67
Median = 4
Std dev = 1.51

9) How likely would you use a commercial-strength tool that can retarget your design to multiple devices?

> Very Likely
>
> ❺❻ Somewhat Likely
>
> ❷❹ Neither Likely nor Unlikely
>
> ❶ Somewhat Unlikely
>
> ❸ Very Unlikely

Assuming 1 = Very unlikely, 3 = Neither likely nor unlikely, 5 = Very likely:

Mean = 2.83
Median = 3
Std dev = 1.17

10) Did you find the Run mode useful for PC? All: yes

For the PDA? ❻ yes | ❶❸: no | ❷❹❺: didn't use

11) Suppose you had to design a user interface for multiple devices. How many devices would it take before HopiSketch became useful?

❶❹❺❻: 2 devices
❷: 2 devices of similar form factors
❸: it will never be useful

12) What effect do you think incorporating HopiSketch into your process would have on each of the following factors? (1 = negative, 7 = positive)

Ability to communicate with…

a) clients
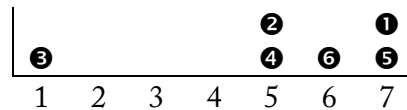
mean = 5.17, median = 5.5, std dev = 2.23

b) programming/development team members
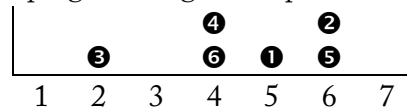
mean = 4.5, median = 4.5, std dev = 1.52

c) information architects

mean = 4.83, median = 5, std dev = 1.72

d) user interface designers
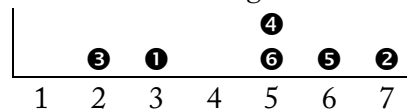
mean = 4.67, median = 5, std dev = 1.86

e) graphic designers
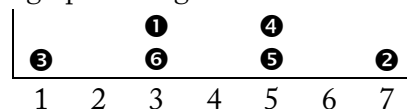
mean = 4, median = 4, std dev = 2.10

f) copywriters
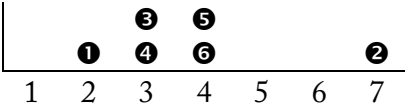
mean = 3.83, median = 3.5, std dev = 1.72

g) design team members
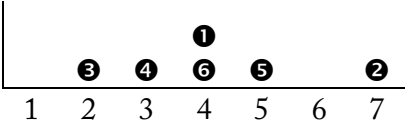
mean = 4.17, median = 4, std dev = 1.72

h) internal managers
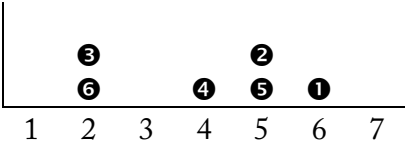
mean = 4, median = 4.5, std dev = 1.67

i) usability engineers/testers
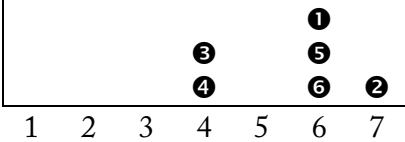
mean = 5.5, median = 6, std dev = 1.22

j) users
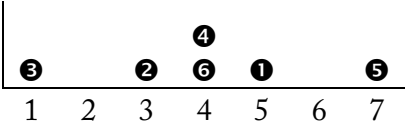
mean = 4, median = 4, std dev = 2

k) Ability to conduct usability tests
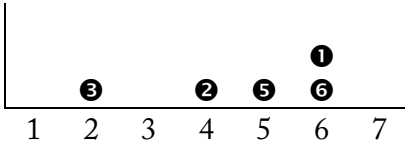
❹ did not answer

mean = 4.6, median = 5, std dev = 1.67

l) Overall expressiveness
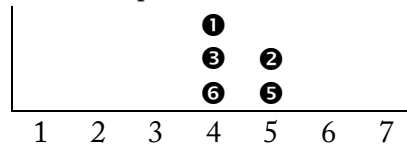
❹ did not answer

mean = 4.8, median = 4, std dev = 1.10

m) Overall efficiency
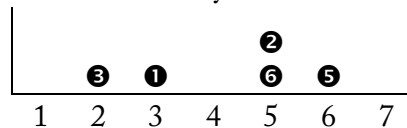
❹ did not answer

mean = 4.2, median = 5, std dev = 1.64

13) What tools would you use in your normal work practice? *(free text entry)*

❶❷❸❹ Adobe Photoshop

❶❺❻ Adobe Illustrator

❷ Macromedia Fireworks

❸❹❻ Microsoft Visio

❸ Macromedia Flash

❷❺ Macromedia Dreamweaver

❶❷❸ Microsoft PowerPoint

❶❸❺ Microsoft Word

❶ Microsoft Excel

❻ Text editor

14) Which of the following activities do you engage in as part of your *current* design responsibilities?

❶❷❸❹❺❻ Information architecture

❶❷❸❹❺❻ Navigation design

❶❷❸❹❺❻ User interface design

❶❷❸❹❺❻ Interaction design

❶❸❻ Graphic design

❶❷❸❹❺❻ Usability testing

❶❷❸❹❺❻ Usability evaluation (e.g. Heuristic Evaluation,
Cognitive Walkthroughs)

❶❷❸❹❻ Project management

❶❸ Web site programming/development

❶❸❹❻ Development of interactive prototypes

❶❸❹❻ Copywriting

❶ Other

15) Which of the following best describes your *primary* responsibility with respect to design?

❸❹ Information architecture

Navigation design

❶❺❻ User interface design

❷❺ Interaction design

Graphic design

❺ Usability testing

❺ Usability evaluation (e.g. Heuristic Evaluation, Cognitive Walkthroughs)

Project management

Web site programming/development

Development of interactive prototypes

Copywriting

Other

16) What percentage of your *current workload* is made up of PC-based web site design projects?

❺ 0-25%

❶❸ 26-50%

❷ 51-75%

❹❻ 76-100%

17) What percentage of your *current workload* is made up of mobile device design projects?

     ❷❸❹❻ 0-25%

         ❶ 26-50%

         ❺ 51-75%

           76-100%

18) What percentage of your current workload is made up of design projects which target multiple types of devices (e.g., PDA and cell phone)?

     ❷❸❹❺❻ 0-25%

         ❶ 26-50%

           51-75%

           76-100%

19) What other types of design projects are part of your current workload?

     ❶❷❸❻ User interface design for non-web desktop PC productivity software

     ❶❸❹ User interface design for non-web PDA software

           Game design for a PC or game console

           Game design for a PDA or cell phone

     ❶❺❻ Other multimedia design for a PC

     ❶❹❺ Other multimedia design for a PDA or cell phone

         ❻ Design for voice-based applications

     ❶❸❻ Print design

         ❸ Industrial design

           Other type of design

20) How long have you been involved in web site design?

           Less than one year

         ❺ 1-2 years

           2-3 years

       ❷❹ 3-5 years

     ❶❸❻ More than 5 years

21) How long have you been involved in design for mobile devices?

           Less than one year

❹❺ 1-2 years

❸❻ 2-3 years

❶❷ 3-5 years

           More than 5 years

22) How long have you been involved in any kind of design (including user interface, print, multimedia, etc.)?

           Less than one year

           1-2 years

           2-3 years

❺ 3-5 years

❷ 5-10 years

❶❸❹❻ More than 10 years

23) Other than interaction design, which of the following best describes your background?

❶❻ Graphic design

           Industrial design

           Other design

❸❺ Programming/Computer Science

           Other engineering

❸ Business

❷ Liberal arts

❹ Media (TV, photography)

24) Including ongoing projects, how many web sites for the PC have you helped design?

❺[1] 1-5

❹ 6-10

❷ 11-20

❸❻ 20-50

❶ More than 50

¹But big ones, more than 10,000 pages

25) Including ongoing projects, how many UIs for mobile devices have you helped design?

❷❹❺❻ 1-5

❸ 6-10

11-20

20-50

❶ More than 50

26) Including ongoing projects, how many UIs have you helped design for more than one device for the same project?

❸❺ 0

❷❹❻ 1-5

6-10

11-20

❶ 20-50

More than 50

27) What is the highest level of education that you have completed?

Some High School

High School Diploma

Some College

❶❷❸❹ College Degree

❻ Some Graduate School

❺ Graduate or Professional Degree

28) Which of the following degrees/higher education experiences do you have? (Please write the field of study after the degree.)

❶ BFA, illustration

❷ BA, fiction writing

❸ BS, engineering—human interface design

❹ BA, history

❺ MS, human-computer interaction

❻ BFA, graphic design; some grad school, interactive communications; other degree, graphic design

APPENDIX

C Damask Evaluation Materials

C.1 Consent Forms

C.1.1 Consent form for desktop/smartphone participants

My name is James Lin. I am a graduate student in Computer Science at UC Berkeley. I would like to invite you to take part in my research. It consists of possibly taking a short quiz, using a computer program to design a user interface that runs on two types of devices, and a questionnaire. The user interface design task will be videotaped with your agreement. The purpose of the study is to learn more about this design process.

If you agree to take part in my research, I will conduct a study with you at the time and location of your choice. There will be two sessions. For each session, I ask that you schedule 3 hours for this study, though it is possible that you will finish early. The study will consist of a task to design a user interface for two types of devices, and a written questionnaire. I would like to emphasize that this experiment should be approached as a fun activity and a contributing effort. It is okay if you do not complete the task. I may ask to contact you by telephone or e-mail if there are any follow-up questions I have after our interviews.

I may want to use some of the information and videotape in public presentations of the research. There is a Video Records Release Consent Form attached that

outlines several possible uses for the tapes and asks for specific consent to use these items in each way. If you agree to allow these items to be used after this research study is over, please read, initial, and sign that form as well. I will not use the tapes or other identifiable information about you in any future presentation without your consent.

If you agree to participate, you will receive a $250 gift certificate from Amazon.com after the second session to thank you for your participation.

There are no known risks to you from taking part in this research, and no foreseeable direct benefit to you either. However, your participation will contribute to my efforts to improve the state of the art in user interface design.

The design that you will create will be kept on my secured computer, and the videotapes will be stored in a secure location in my office. We will not use any identifying information in any reports of my research. After this research is completed, I may save this data for use in future research by others or myself.

Your participation in this research is voluntary. You are free to refuse to take part. You may refuse to answer any questions and may stop taking part in the study at any time. Whether or not you participate in this research will have no bearing on your job or your relationship with UC Berkeley. If you decide to stop in the middle of the session for any reason, you will still receive the $250 gift certificate as a sign of our appreciation for your effort.

If you have any questions about the research, you may contact me, James Lin, at (510) 643-7354 or jimlin@cs.berkeley.edu. If you agree to take part in the research, please sign the form below. Please keep the other copy of this agreement for your future reference.

If you have any question regarding your treatment or rights as a participant in this research project, please contact uc Berkeley's Committee for the Protection of Human Subjects at (510) 642-7461 or subjects@uclink.berkeley.edu.

I have read this consent form and I agree to take part in this research.

_____   _____   _____

Name (please print)   Signature   Date

C.1.2 Consent form for desktop/voice participants

My name is James Lin. I am a graduate student in Computer Science at uc Berkeley. I would like to invite you to take part in my research. It consists of possibly taking a short quiz, using a computer program to design a user interface that runs on two types of devices, and a questionnaire. The user interface design task will be videotaped with your agreement. The purpose of the study is to learn more about this design process.

If you agree to take part in my research, I will conduct a study with you at the time and location of your choice. There will be three sessions. For each session, I ask that you schedule 3 hours for this study, though it is possible that you will finish early. The study will consist of a task to design a user interface for two types of devices, and a written questionnaire. I would like to emphasize that this experiment should be approached as a fun activity and a contributing effort. It is okay if you do not complete the task. I may ask to contact you by telephone or e-mail if there are any follow-up questions I have after our interviews.

I may want to use some of the information and videotape in public presentations of the research. There is a Video Records Release Consent Form attached that outlines several possible uses for the tapes and asks for specific consent to use these items in each way. If you agree to allow these items to be used after this research study is over, please read, initial, and sign that form as well. I will not use the tapes or other identifiable information about you in any future presentation without your consent.

If you agree to participate, you will receive a $375 gift certificate from Amazon.com after the second session to thank you for your participation.

There are no known risks to you from taking part in this research, and no foreseeable direct benefit to you either. However, your participation will contribute to my efforts to improve the state of the art in user interface design.

The design that you will create will be kept on my secured computer, and the videotapes will be stored in a secure location in my office. We will not use any identifying information in any reports of my research. After this research is completed, I may save this data for use in future research by others or myself.

Your participation in this research is voluntary. You are free to refuse to take part. You may refuse to answer any questions and may stop taking part in the study at any time. Whether or not you participate in this research will have no bearing on your job or your relationship with uc Berkeley. If you decide to stop in the middle of the session for any reason, you will still receive the $375 gift certificate as a sign of our appreciation for your effort.

If you have any questions about the research, you may contact me, James Lin, at (408) 927-2687 or jimlin@cs.berkeley.edu. If you agree to take part in the research,

please sign the form below. Please keep the other copy of this agreement for your future reference.

If you have any question regarding your treatment or rights as a participant in this research project, please contact uc Berkeley's Committee for the Protection of Human Subjects at (510) 642-7461 or subjects@uclink.berkeley.edu.

I have read this consent form and I agree to take part in this research.

_____   _____   _____

Name (please print)   Signature   Date

C.1.3 Video records release consent form

As part of this project we have made a video recording of you while you participated in the research. Although we will only visually record the computer screen, your voice will also be recorded, which might allow someone to identify you. We would like you to indicate below what uses of these records you are willing to consent to, by initialing in the appropriate blanks. This is completely up to you. We will only use the records in ways that you agree to. In any case, your name will not be associated with these records.

If you have any question regarding your treatment or rights as a participant in this research project, please contact uc Berkeley's Committee for the Protection of Human Subjects at (510) 642-7461 or subjects@uclink.berkeley.edu.

1. The record can be studied by the research team for use in the research project.

    _____

2. The records can be shown to subjects in other experiments.

   _____

3. The record can be used for scientific publications.

   _____

4. The record can be shown at meetings of researchers interested in human-computer interaction.

   _____

5. The record can be shown in classrooms to students.

   _____

6. The record can be shown in public presentations to nonscientific groups.

   _____

I have read the above description and give my consent for the use of the records as indicated above.

_____ _____ _____

Name (please print) Signature Date

C.2 Oral Instructions

Thank you very much for helping us with our evaluation. Today we are exploring how designers create user interfaces that are targeted to many different types of

devices, in our case, the web and mobile phones, by using a tool called Damask.

Here's what we have planned for the next 3 hours:

1. First, we will give you a short overview and demo of Damask.

2. Next, we will ask you to perform a couple of short warm-up tasks to get familiar with the Tablet PC and with Damask.

3. After that, we will ask you to create a preliminary design for an application based on a set of requirements. You will have 2 hours or so to sketch out some ideas for the application using Damask.

4. Finally, after the main design task is done, we will ask you to fill out a questionnaire to give us feedback on Damask and your experience using it.
(*Disclaimer*)

We would like to stress that we are testing the system, not you. We are looking for places where the system may be difficult to use. If you have trouble with some of the tasks we ask you to perform, it is the system's fault, not yours. Do not feel bad—trouble spots are exactly what we're looking for. And please remember that this is totally voluntary. Although I don't know any reason why this should happen, if you become uncomfortable or find this objectionable in any way, feel free to quit at any time.

This consent form just says that you understand what this test is about, you allow us to videotape the test, that you understand we will respect your privacy wishes, and that you will allow us to publish any results from this study.

C.3 Damask Tutorial

Give a 10-minute demonstration of Damask, showing

- *Sitemap creation*

- *Sketching*
- *Change content type*
- *Pages*
- *Page fold*
- *Page regions*
- *Title bar and moving pages*
- *Transition specification (arrows)*
- *Thumbnail view*
- *Panning and zooming*
- *Tools and controls*
- *Resizing text*
- *Cut, copy, paste, delete elements and pages*
- *Templates*
- *Running*

C.4 Introductory Session for All Participants

We open the file "flower.bmp" for them. Ask them to move the watering can over the flower.

Then add a bee to the drawing, then handwrite the label "Flower with bee."

C.5 Introductory Session for Desktop/Voice Participants

C.5.1 Task 1

Go through the following steps to add the ability to make lodging reservations to the Northern California Tourism site shown on the screen:

a) Create a new page entitled "Make a Reservation."

b) Quickly sketch the "Make a Reservation" page, including spaces for the user to indicate

    a. Number of guests

b. Length of stay

c. Credit card number and expiration date

c) Create a link on the "Pinot Grigio Inn" page called "Make a reservation", and link it to the new "Make a Reservation" page.

d) Use the "Run" feature to run through the site, showing how a user coming into the home page would find her way through the site and make a reservation at the Pinot Grigio Inn.

Do the analogous steps for the Voice version. For part b, put all of the prompts and responses in one form.

C.5.2 Task 2

You have been hired to design an online bank that can be accessed through the web and over the phone using a prompt-and-response voice interface. Some requirements for the service are included on the next page.

The purpose of this exercise is to see how well Damask can be used to conduct a realistic design task. This is not intended in any way to be a test of your ability as a designer or your ability to use this particular tool. *It is intended as an evaluation of the tool.*

We would like you to try to create the best design you can using Damask. Feel free to ask for assistance using Damask. You can also use paper and pencil for part of the design process.

We will also remind you to think aloud while using Damask so we can get an idea of what you are thinking while using the tool.

Bank88.com Requirements

A bank called Bank88 is creating a web site that will let customers access their accounts. Bank88 will launch two versions of its site, one targeted to PC users, and the other targeted to speech.

Please create a preliminary design for the online bank, implementing the requirements below. It's more important that you implement something for every requirement than to implement a few requirements in a detailed manner.

Common Requirements

o Assume the user has a checking and savings account. For each account, the user should be able to view

   o balance

   o recent activity

      ▪ checks and withdrawals

      ▪ deposits and credits

      ▪ interest earned

o Transfer funds from one account to another

o Reorder checks

o Pay bills by phone/web

   o For each payee, enter amount due, account to pay from, and date to be posted

   o For the purposes of this exercise, we will ignore adding payees

Desktop-specific Requirements

o Users sign in with a username and password that they previously set up.

Mobile-specific Requirements

o Users sign in with their account number and a PIN that they previously set up.

C.6 No Patterns or Layers Condition

C.6.1 Desktop/smartphone participants

Task 1

(This task was skipped if the participant had already done the patterns and layers condition. This is the same as section C.5.1 except for the last sentence.)

Go through the following steps to add the ability to make lodging reservations to the Northern California Tourism site shown on the screen:

a) Create a new page entitled "Make a Reservation."

b) Quickly sketch the "Make a Reservation" page, including spaces for the user to indicate

    a. Number of guests

    b. Length of stay

    c. Credit card number and expiration date

c) Create a link on the "Pinot Grigio Inn" page called "Make a reservation", and link it to the new "Make a Reservation" page.

d) Use the "Run" feature to run through the site, showing how a user coming into the home page would find her way through the site and make a reservation at the Pinot Grigio Inn.

Be sure to do these steps for both Desktop and Mobile Phone versions

Task 2

You have been hired to design an online music store that will target two types of devices: a PC and a smartphone (a mobile phone with a screen size of about 180×215). Some requirements for the service are included on the next page.

The purpose of this exercise is to see how well Damask can be used to conduct a realistic design task. This is not intended in any way to be a test of your ability as a designer or your ability to use this particular tool. *It is intended as an evaluation of the tool.*

We would like you to try to create the best design you can using Damask. Feel free to ask for assistance using Damask. You can also use paper and pencil for part of the design process.

We will also remind you to think aloud while using Damask so we can get an idea of what you are thinking while using the tool.

TotalMusic.com Requirements

A new startup called TotalMusic.com is creating a web site that will let customers buy CDs and snippets of music for cell phone ringtones. TotalMusic.com will launch two versions of its site, one targeted to PC users, and the other targeted to users of smartphones. Both sites will be in HTML.

Please create a preliminary design for the online store, implementing the requirements below. It's more important that you implement something for every requirement than to implement a few requirements in a detailed manner.

Common Requirements

o   Make Search function available on every page.

o   The home page should include a list of genres. Implement a page for one genre of music linked off the home page. The genre page should contain "featured albums" in this genre.

o   On a product page:

  o   Allow users to listen to a sample of each song in the album

  o   Album listing should include

- format (CD, cassette)

- release date

- record label

o Have shopping cart and checkout functionality. Besides the usual requirements, be sure to include the following:

  o Allow users to choose from multiple shipping addresses.

  o Provide a way for users to choose a shipping method and a payment method

  o Provide a thank-you page with an order summary

o Assume users are already logged into their account.

Desktop-specific Requirements

o When choosing from multiple addresses, users should be able to choose an address they stored before, or type in a new address.

o When choosing a payment method, users should be able to choose a credit card they stored before, or type in a new card and billing address.

o Allow users to access shopping cart from every page.

o Offer albums related to or similar to the album being browsed.

o Desktop users cannot buy ringtones.

Mobile-specific Requirements

o When choosing from multiple addresses, users should be able to choose an address they stored before, or have it shipped to their cell phone billing address.

o When choosing a payment method, users should be able to choose a credit card they stored before, or have their order billed to their cell phone bill.

o For each song in an album, allow users to listen to sample of the song for a ringtone.

o Allow users to download a ringtone directly to the phone.

C.6.2 Desktop/voice participants

(This is largely the same as Task 2 for desktop/smartphone participants.)

You have been hired to design an online music store that will target two types of platforms: the web and voice. Some requirements for the service are included on the next page.

The purpose of this exercise is to see how well Damask can be used to conduct a realistic design task. This is not intended in any way to be a test of your ability as a designer or your ability to use this particular tool. *It is intended as an evaluation of the tool.*

We would like you to try to create the best design you can using Damask. Feel free to ask for assistance using Damask. You can also use paper and pencil for part of the design process.

We will also remind you to think aloud while using Damask so we can get an idea of what you are thinking while using the tool.

TotalMusic.com Requirements

A new startup called TotalMusic.com is creating a web site that will let customers buy CDs. TotalMusic.com will launch two versions of its site, a web version and a voice version.

Please create a preliminary design for the online store, implementing the requirements below. It's more important that you implement something for every requirement than to implement a few requirements in a detailed manner.

Common Requirements

o The home page should include a list of genres. Implement a page for one genre of music linked off the home page. The genre page should contain "featured music" in this genre.

o For each product:

o Allow users to listen to a sample of each song in the album

o Album listing should include

▪ format (CD, cassette)

▪ release date

▪ record label

o Include shopping cart and checkout functionality.

Desktop-specific Requirements

o Make Search function available on every page.

o Allow users to access shopping cart from every page.

o Offer albums related to or similar to the album being browsed.

o You can assume that the user already has a user name and password, and has already stored shipping addresses and credit card info before.

o For checkout, be sure to include the following:

o Allow users to choose from several shipping addresses stored before, or enter a new address.

o Provide a way for users to choose a shipping method and a payment method

o Provide a thank-you page with an order summary

o When choosing a payment method, users should be able to choose a credit card they stored before, or enter a new card and billing address.

Voice-specific Requirements

o   From the home page, the user should be able to say a genre, which will go to a genre page, or say the title of an album, which will go to a product page.

o   You can assume that the user already has an account number and PIN, and has already stored shipping addresses and credit card info before.

C.6.3 Questionnaire A

1. Can you think of something that you did differently by using Damask compared to what you normally do?

④   Normally I don't do wireframes and sitemaps simultaneously, but I like this better.

⑤   Having the templating tool allow you to link back to other documents is a nice feature.

⑥   I might have filled in slightly less detail than I would using pencil and paper or even HTML, due to the difficulty of using the handwriting recognition or pencil tools. I would ordinarily be able to scribble down simple labels much faster and would use more of them.

⑦   I normally start with site maps. In this case, I just winged it with roughly hand drawn ones. After that it was all pretty much the same.

⑧   I used less detail, because it was hard to enter text.

⑨   Couldn't copy and paste repeating individual elements from page to page.

⑩   I liked being able to copy/paste elements between pages quite a bit. I sometimes do 1 paper/pencil sketch of the standard UI components for a design and then run it through the copy machine to get a standard UI. Copy/paste does that for me in a more flexible way, which I liked a lot.

⑪   I generally do most of my site architecture and layout on paper; with Damask, I did a lot of the same "sketching" tasks in the application. I also did a lot more conceptualization on page layout in the application than I would normally do.

⑬ Being able to hear the TTS version of the app so quickly after put it down on "paper" was really great. I think it makes a huge difference in the design process to be able to hear what you have written for a purely audio medium. I critiqued my own work in a different way because of being able to listen to the call flow so early on in the design process.

⑮ I did less - because the interface can only do so much.

⑯ Yes, I wrote mock prompts and designed the flow in the same step. Normally, the first concrete design step (after req gathering and user profiling, etc.) is to design a workflow / callflow. Here, I was creating a rough sketch at the same time as the flow.

⑰ As soon as I had a callflow, I was able to run it.

2. Did Damask help you see new ideas, or did it prevent you from exploring ideas?

④ It sped up the process of looking at alternate designs. For example, the checkout process functions were easier to flesh out and understand their behavior by using damask.

⑤ It helped me get things down, but I could only refer to things that I could implement immediately. I make use of notes or comments often in apps I use to keep track of ToDos within my list of tasks.

⑥ I probably didn't explore as much as I might have ordinarily. However, this is probably due to the time limit as much as the tool.

⑦ because I was getting up to speed with using a new application, it hindered me from exploring new ideas and was a bit more focused on just using Damask to do the basics that I needed to get the flow through.

⑧ see above (question 1).

⑨ I spent a lot of time struggling with basic functions like entering text, and Damask didn't do any cleanup; in fact it jumbled up elements that I transferred from desktop to cellphone mode. I would have found an app like Visio easier to use.

⑩ Damask seemed to help me work at more of a middle level of "fidelity" where I was working at a more detailed level than a simple flow chart, so I was able to

think a little about how certain features might actually work. I might be able to find certain issues with my design if I actually have to think a little about how features would work, rather than just representing a page as a box.

⑪ It definitely helped with new ideas, as it allowed me views of my design that I can't normally get as quickly using conventional design tools. I would definitely be able to explore additional ideas and design approaches if I were a regular user of the application; I would expect to utilize the design patterns a great deal, as well as to develop "my own" design patterns.

⑬ In combination with my answer from #1, I think it helped me see new ideas. I liked being able to actually draw graphics on the desktop mode-- wire frames don't allow for that type of expression very easily.

⑮ Both. There are new ideas around the parallels between the two interfaces, but there are also certain limitations when you start with one interface and map that to the other.

I'd say the patterns actually make it easier to see new ideas as opposed to hinder. They are a good reminder of what kinds of things are needed to implement a certain aspect.

⑯ Difficult to say, but I'd say both. My answer really hasn't changed since yesterday. *(See Participant 16's answer to Question 2 in Questionnaire B, section.)*

⑰ For voice, I would say neither--I don't think it helped me see new ideas or kept me from exploring ideas. But for web, I don't have any kind of equivalent tool, so I felt it helped me see new ideas because now I could lay everything out quickly and link things together easily.

3. What aspects of Damask do you particularly like?

④ Sketching non-standard ui widgets (tables, copy blocks) without spending time drawing lines and getting the right # of characters.

⑤ I like the zoomability, templating, the playback, use of text and lines (greeking).

⑥ The ability to quickly templatize site elements and the "runtime" mode for simulating user experience are easily my favorite aspects. Because of the latter especially, this would be more valuable to me in early user testing than in the

initial brainstorming/design process. I imagine it would be good for rapid
prototyping in a user test situation.

⑦ I liked the showing the flow through linking on Damask

⑧ I did like the trace function for finding bugs, but wish there could be an
automated tree-traverse.

⑨ The patterns and layers in the other version.

⑩ I felt like I could pretty quickly create both a flow chart and a usable prototype...
I like that a lot. I can turn out a pencil/paper flow chart pretty quickly, but
getting to a prototype would require all kinds of HTML, or lots of shuffling of
papers (for a paper prototype). The application without layers felt easier to use,
less to worry about and keep track of.

⑪ I liked the sketching functionality, the device-specific layering and templates,
and the ability to quickly generate a top-down view of the site and then zoom
in on the details of each page.

⑬ I like being able to hear the call flow so quickly after putting down the ideas.
That would be really useful. I also like the idea of how 'sketchy' the windows
seem-- it really allows for informal brainstorming to be formalized a bit-- and
easily shared.

⑮ 1) the ability to create a parallel interface automatically.
2) the ability to quickly set up a prototype web site
3) the templates and patterns
I like #2. Of course, having the templates and patterns are helpful towards being
able to quickly set up the prototype.

⑯ I like being able to prototype quickly and not feeling constrained to make
something beautiful on the first cut. My advice: NEVER add color options, that's
the first step towards shifting the focus from design concepts to art. But maybe
I'm just bitter because my colleagues are better artists. ;)

⑰ It's very quick to add new pages and to link items together, or change links.

4. What aspects of Damask do you particularly dislike?

④ Not having keyboard shortcuts to zoom, scroll, and center.

⑤   Latency, a bit of wonkiness between the Java interface and the Windows tablet UI

⑥   The most frustrating part was trying to move about the workspace. Many tasks involved this laborious traversal of space, from copying and pasting elements between pages to linking distant pages to objects on the current page.

⑦   no alignment; would like to see better templating/copying capabilities.

⑧   The platform (tablet PC) was hard to deal with.

⑨   See answer 2.

⑩   Speed is an issue, of course. I think using screen real estate is also extremely important - It's a little hard to link pages if you can't see both pages on the screen, for instance. Generally I thought the application conformed to UI standards established in some other applications I use as a designer (like photoshop), but certain features could probably be moved more in the direction of how other applications do them. An example would be zooming (ie photoshop)

⑪   I found the performance to be the most hindering aspect of the application; it also could use some refinement in terms of shortcut keys, retaining focus between tabbed views, and the like. But, I had no major "dislikes" of the application.

⑬   I had a slight annoyance with having to switch modes -- for example, using the selector button vs. the pencil vs. etc. I would have preferred that the tool were a little bit more robust and know that if I draw in a 'response' bubble, the next thing I would likely want to do is type in the response options. Also, I would have liked a drag and drop feature on the desktop.

⑮   1) automatic interface creation introduces several non-ideal defaults in the other device

2) voice interface in particular was quite limiting

3) lack of ability to map to even a fake backend

4) the use of patterns is useful but it is not intuitive how these may play with each other or with the templates

5) the reminders for how a change made in one device will also impact the other device should be displayed more often.

#4 and #1 were probably the worst offenders here, in my opinion.

⑯ Today word wrap and view were big issues, especially in the voice workspace. Damask partially defeats what I think is one of its greatest strengths by making it difficult for the user to view the prompts s/he's writing and their responses. It would help to have the prompts wrap better and place the responses ('grammars') closer to the prompt that provoked them. It would also be nice to have different views - sometimes I just want to see flow between forms, especially when there are a lot of them, and sometimes I just want to read my prompts. It would be nice if I could switch between them.

⑰ Sometimes I would forget what mode I was in and not be able to type or drag when I thought I would be able to. Also sometimes I had difficult maneuvering (e.g. scrolling around)

5. What additional features would you like to see in Damask? What would it take for it to be truly useful to you?

④ Annotations for individual widgets or pages. Pixel size information for the mobile screens.

⑤ notations, additional screen resolutions, a delete selected toolbar icon, history of previous files, less obtrusive navigation pane, export to some other type of document type like TIFF or exporting to a type of document like Activity Diagrams

⑥ I'd like to see a quick index of pages I can jump to or link items to. I'd like to be able to create not only page templates but common-element templates so that I could quickly store a library of components to add to pages on a less "regular" basis (I see how the template system could allow this, but it didn't initially occur to me to use it that way). I'd like a few simple graphics tools, so I could add color and quick shapes.

It's truly useful to me now, because of the runtime mode alone. But for it to be comfortable, the navigation issues would have to be fixed (easy jumping between page mode and sitemap mode, quick paging across the workspace).

⑦ does it come out on the Mac? ability to type rather than using pen. Also ability to selectively copy elements from desktop mode to smartphone mode

⑧ Large screen output (even if input is on a touch screen or tablet). Automated tree-traverse (go down all the branches).

⑨ Patterns and layers. Also easier text entry, i.e., a bigger screen and a setup that lets you use the tablet only when you want.

⑩ Conditional linking would be very useful (if user selects A, button goes to 1, if selects B, button goes to 2). Better zooming, better sketching with the pen tool (faster), etc.

⑪ I would like the ability to also link up images/graphics with the pages and to create/access basic page templates (in addition to the design pattern library).

The application as is is already useful to me; however, the performance issues and handwriting sensitivity would need to be refined for me to incorporate it into daily use.

⑬ I would like the ability to record the prompts using the tool. and a click-through-play feature with those recorded prompts.

⑮ speed of prototype development

⑯ I just listed a few in (4) and will expand on my last point: it would be nice to be able to view the design at a high level as a flowchart connecting all the nodes to each other, and at an individual page/form level. This is partially accomplished by zoom, but could be cleaner. It would also be nice to see the prompts in a sample dialog format of some kind, something like:

System: Would you like a stock quote or driving information.

Caller: Driving information

System: Okay, driving information. First, let me get your location. Say a city and

state, or say or enter your zip code.

This would be a nice way to list them for quick reading, especially since the prompts and responses are just samples anyway, and not any attempt at a full spec.

ⓘ⑦ The ability to use dynamic info, e.g. when caller gives some info, confirm with that actual info. For voice, I'd need real error/help handling, more complex grammars (maybe the ability to point to an external grammar file).

6. How likely would you use a commercial-strength version of Damask?

(1 = very unlikely, 7 = very likely)

			⑤		④	
			⑦	⑥	⑩	⑪
⑨		⑰	⑧	⑮	⑯	⑬
1	2	3	4	5	6	7
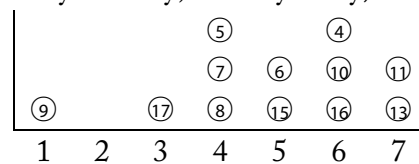
mean = 4.83, median = 5, std dev = 1.75

7. What for? (or if not, why not?)

④ For early brainstorming of site structure and page templates, but eventually would want it to export into a program that cleans up presentation (visio or illustrator).

⑤ Rapid prototyping for usability tests, maybe for use for creating graphics for use in storyboard docs

⑥ I'd use it for quick sketches to present to project teams and for rapid prototyping for user testing.

⑦ interaction design work... happy with the run mode; not too happy with how the pages look; pages still need to be cleaned up as far as writing with pencil and alignment

⑧ would depend on how much it cost, and what other development tools I was using (if it could take in html files it would be much more useful - for site redesign).

⑨ See answer 2.

⑩   flowcharts, proofs of concept, prototypes, testing

⑪   I would use it regularly (daily, or multiple times a week) for professional design and conceptualization.

⑬   Sample call creation at work. Potentially some kind of wizard of Oz tool. Also, it would be very useful for brainstorming with a tangible end result (well, as tangible as waveforms could be! ;o)).

⑮   Mostly for prototyping - not for real development

⑯   Rapid prototyping.

⑰   We already have a more powerful tool (V-Builder) in-house.

8. Did you find the Run mode useful for…

Desktop?

    all participants: Yes

    no participants: No

Smartphone

    ④⑥⑦⑧⑨⑩⑪: Yes

    ⑤: No

Voice?

    ⑬⑮⑯⑰: Yes

    no participants: No

9. How easy was it to accomplish the task? (1 = not easy, 7 = very easy)

				⑥		
				⑧	⑩	
		④		⑬	⑮	
	⑨	⑦	⑤	⑰	⑯	⑪
1	2	3	4	5	6	7
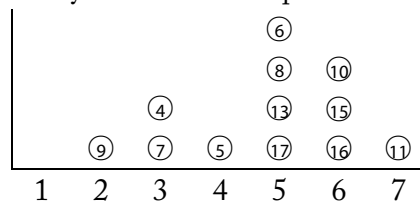
mean = 4.75, median = 5, std dev = 1.48

10. How easy was it to maintain appropriate consistency between both devices? (1 = not easy, 7 = very easy)
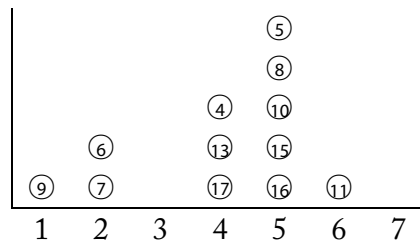
mean = 4, median = 4.5, std dev = 1.

11. How easy was it to transfer relevant parts of the design from one device to

another? (1 = not easy, 7 = very easy)
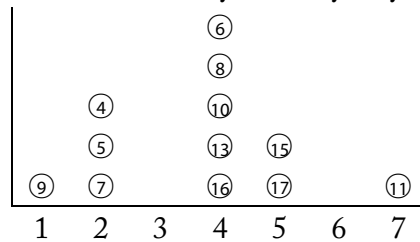
mean = 3.67, median = 4, std dev = 1.67

12. What is your age?

under 20

④⑤⑥⑩⑬⑯ 21-30

⑦⑧⑪⑮⑰ 31-40

⑨ 41-50

51 or above

13. How many years of design experience do you have?

Less than 1 year

1-2 years

⑯ 3-4 years

④⑤⑥⑦⑧⑨⑩⑪⑬⑮⑰ At least 5 years

14. How many years of web design experience do you have?

I have never designed for the web

⑬⑮⑯⑰ Less than 1 year

1-2 years

3-4 years

④⑤⑥⑦⑧⑨⑩⑪ At least 5 years

15. *(asked desktop/smartphone participants)* How many years of mobile phone or PDA

UI design experience do you have?

⑨ I have never designed a UI for mobile phones or PDAs

④⑦⑧⑩⑪ Less than 1 year

⑤⑥ 1-2 years

3-4 years

At least 5 years

(asked desktop/voice participants) How many years of voice UI design experience do

you have?

I have never designed a UI for voice

Less than 1 year

1-2 years

⑯ 3-4 years

⑬⑮⑰ At least 5 years

16. *(asked desktop/smartphone participants)* If you have designed mobile apps, please

give a brief summary of the types of apps you've designed:

④   A sales rep contact organizer, and a shopping comparison tool.

⑤   Apps that are mostly used for PDAs: data entry forms, command forms for

operators of hardware

⑥   Web browsing for PDA and WAP (AvantGo Mobile Internet)

⑦   photo app, messenger apps, wap mode

⑧   ATM machine. CSS-based website.

⑨　(N/A)

⑩　I worked on some apps for data collection on the Apple Newton in 1998-1999. They were oriented towards farmers (believe it or not) who would need to track crop development in the field. The tool was also used by bio students for field research. The data was then used to create reports on a desktop PC.

⑪　e-commerce sites

(asked desktop/voice participants) If you have designed voice apps, please give a brief summary of the types of apps you've designed:

⑬　Bilingual apps (English and Spanish)

Banking, Tech support lines, Singapore Post, Call center routing apps, Natural Language (How may I help you? sort of apps), SBC, Australian Centrelink (Australian Welfare) call router and income logging, unified communications, Gas and Electric self service app. Car rental

⑮　I've designed a wide variety of voice applications - here are some examples:

a yellow pages application coupled with getting directions (at my previous job)

a voice-enable conferencing system

a call routing application for a wireless company

a voice authentication application, etc.

⑯　Reusable Voice Apps (vertical), Voice Portals, Call Routers, Directory Assistance, Finance, Dating services.

⑰　All over-the-phone speech apps. Banking, travel, personal assistant, etc.

17. Please check the kinds of design in which you feel you are knowledgeable.

④⑤⑧⑨⑩⑪ Information architecture

④⑦⑩⑪ Graphic design

④⑤⑥⑦⑧⑨⑩⑪⑬ Web design

④⑤⑥⑧⑨⑩⑪⑬⑮ GUI design

(the overall interaction for desktop applications)

⑦⑮ Mobile phone UI design

⑬⑮⑯⑰ Voice UI design

Other:

⑧ 508 accessibility issues

⑨ I've used WAP phones and have written product copy for mobile phones

⑩ software design

⑬ Interaction design

18. Which of the following do you normally use when you design UIs?

Adobe GoLive

④⑤⑦⑪ Adobe Illustrator

⑤⑥⑧⑩⑪⑮⑯ Adobe Photoshop

Macromedia Director

⑧⑨⑩⑪ Macromedia Dreamweaver

⑧ Macromedia Flash

⑤⑪⑮ Microsoft Excel

⑪ Microsoft FrontPage

④⑥⑪ Microsoft PowerPoint

④⑤⑥⑧⑨⑩⑪⑬⑮⑯⑰ Microsoft Visio

⑤⑦⑧⑨⑩⑪⑬⑮⑯⑰ Microsoft Word

⑥⑧⑪⑯ Text editor

④⑤⑥⑦⑧⑨⑩⑪⑬⑮⑯ Paper and pencil

④⑤⑥⑦⑧⑨⑩⑪⑬⑮⑯ Whiteboard

Other:

⑨ OmniGraffle (Mac product)

⑬ Internal Software, Audio processing software

⑯ Every voice company has internal proprietary design tools

ⓗ Nuance V-Builder

19. *(Desktop/smartphone participants only)* Do you own a mobile phone?

④⑤⑥⑦⑧⑨⑩⑪ Yes

No

20. *(Desktop/smartphone participants only)* If so, how often do you use your mobile

phone for online services (e-mail, web, sms, etc.)? (1 = not often, 7 = very often)

④
⑤ ⑥
⑧ ⑩ ⑪ ⑨ ⑦
1 2 3 4 5 6 7
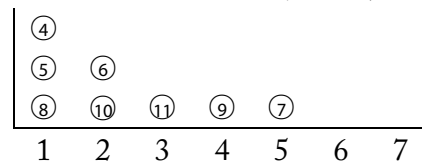
mean = 2.38, median = 2, std dev = 1.51

21. *(Desktop/smartphone participants only)* Do you own a PDA?

⑤⑧⑩⑪ Yes

④⑥⑦⑨ No

22. *(Desktop/smartphone participants only)* If so, how often do you use your PDA for

online services (e-mail, web, etc.)? (1 = not often, 7 = very often)

⑩
⑧ ⑪   ⑤
1 2 3 4 5 6 7
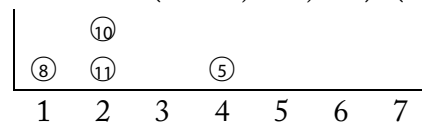
mean = 2.25, median = 2, std dev = 1.26

23. *(Desktop/smartphone participants only)* Do you own a wireless e-mail device like a

BlackBerry?

Yes

④⑤⑥⑦⑧⑨⑩⑪ No

24. *(Desktop/smartphone participants only)* If so, how often do you use it?

(N/A)

25. How often do you use a tablet (such as a Wacom tablet, display tablet, or Tablet PC)? (1 = never, 7 = very often)

④						
⑥						
⑦						
⑩						
⑪						
⑮						
⑯	⑨		⑤			
⑰	⑬		⑧			
1	2	3	4	5	6	7
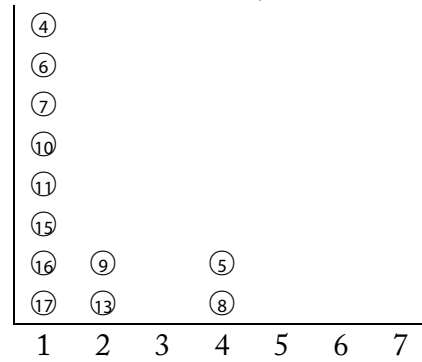
mean = 1.67, median = 1, std dev = 1.15

26. How often have you bought anything online in the past 12 months?

                    Never

         ⑮ 1-3 times

         ⑰ 4-6 times

    ⑤⑨⑬⑯ 7-11 times

④⑥⑦⑧⑩⑪ At least 12 times

27. If you have, how have you bought stuff?

④⑥⑦⑧⑨⑩⑪⑬⑮⑯⑰ Through the web on a desktop PC

                    Through a mobile phone display

        ⑬ Through an automated voice system
over the phone

                    Other

        ⑤ No answer

28. How often have you bought music albums online in the past 12 months?

         ⑮ Never

     ⑧⑨⑰ 1-3 times

⑤⑥⑦⑩⑬⑯ 4-6 times

7-11 times

④⑪ At least 12 times

29. If you have, how have you bought them?

④⑥⑦⑧⑨⑩⑪⑬⑯⑰ Through the web on a desktop PC

Through a mobile phone display

Through an automated voice system
over the phone

Other

⑤ No answer

30. *(Desktop/smartphone participants only)* How often have you bought ringtones
online in the past 12 months?

④⑦⑧⑨⑩⑪ Never

⑤⑥ 1-3 times

4-6 times

7-11 times

At least 12 times

31. *(Desktop/smartphone participants only)* If you have, how have you bought them?

⑤⑥ Through the web on a desktop PC

Through a mobile phone display

Other

32. How often have you used a web design and prototyping tool called DENIM?

⑦⑬⑮⑯⑰ I've never heard of DENIM

⑧⑨⑪ I've heard of DENIM but haven't used it

④⑤⑥⑩ I've played around with DENIM a bit

I've used DENIM for 1 or 2 projects

I've used DENIM for 3 or more projects

33. *(Voice participants only)* How often have you used a speech design and prototyping tool called SUEDE?

⑮⑯ I've never heard of SUEDE

⑬ I've heard of SUEDE but haven't used it

⑰ I've played around with SUEDE a bit

I've used SUEDE for 1 or 2 projects

I've used SUEDE for 3 or more projects

34. Additional comments:

④   jimmy rocks

⑥   Since I never use a tablet, I would hope that I could accomplish a lot with the tool using mouse and keyboard. I'd probably end up drawing less and typing more!

⑩   I like Damask quite a bit during this session - I probably advanced up the learning curve during the test yesterday which made things easier to use today... It felt like it helped me get a lot of work done relatively quickly.

⑪   Great application - can't wait to see it available commercially! :)

C.7 With Patterns and Layers Condition

C.7.1 *Oral introduction to layers*

If this is the first session, then give the 10-minute demonstration described in section C.3.

Give a 5-minute demonstration of layers:

- *Radio buttons for selecting layers*

- *Describing when you can link objects between layers*

- *Change in background color between layers*

- *"Move Object to Other Layer" button in toolbar*

C.7.2 Task 1, Part 1

(This part was skipped by desktop/smartphone participants if they had already done the no patterns or layers condition, and by desktop/voice participants)

Go through the following steps to add the ability to make lodging reservations to the Northern California Tourism site shown on the screen:

a) Create a new page titled "Make a Reservation".

b) Sketch the "Make a Reservation" page, including spaces for the user to indicate

    a. Number of guests

    b. Length of stay

    c. Credit card number and expiration date

c) Create a link on the "Pinot Grigio Inn" page called "Make a reservation", and link it to the new "Make a Reservation" page.

C.7.3 Oral introduction to pattern browser

Give a 5-minute demonstration of the pattern browser:

- *Pattern index and genres*

- *Format of a pattern*

- *Searching for patterns*

- *Adding a pattern instance*

- *Editing a pattern instance*

Let the participant browse the Pattern Browser for 15 minutes, then give him or her the patterns quiz.

C.7.4 Patterns quiz

This quiz is open notes!

1. Please name and briefly describe four pattern groups:

    Name: _____

    Description: _____

    _____

    _____

    _____

    Name: _____

    Description: _____

    _____

    _____

    _____

    Name: _____

    Description: _____

    _____

    _____

    _____

    Name: _____

    Description: _____

    _____

    _____

    _____

2. Name three other patterns that "C1: Homepage Portal" uses:

    a) _____

b) _____

c) _____

3. Which pattern is concerned with a web site identifying and tracking customers, so that it can provide personalized services?

_____

4. Briefly describe how the "Context-Sensitive Help" and "Pop-Up Windows" patterns can be used in conjunction?

_____

_____

_____

_____

C.7.5 Task 1, Part 2

d) Using the CATEGORY PAGES pattern, create a new page titled "Wine Country". Link the "Wine Country" label in the home page to this new page.

e) *For the desktop only,* in the "Wine Country" page, modify the contents of the center region so that it includes placeholders for two blurbs, on V. Sattui Winery and the Culinary Institute of America.

f) In the "Wine Country" page, there are 5 subcategories. Rename the first 3 to "Hotels", "Restaurants", and "Attractions." Link the "Hotel" subcategory to the Hotel page. Remove the other 2 subcategories.

g) Use the "Run" feature to run through the site, showing how a user coming into the home page would find her way through the site and make a reservation at the Pinot Grigio Inn.

Make sure all user interface changes occur in both the desktop and [mobile phone or voice] versions (except step e).

C.7.6 Task 2

Desktop/smartphone participants

You have been hired to design an online book store that will target two types of devices: a pc and a smartphone (a mobile phone with a screen size of about 180×215). Some requirements for the service are included on the next page.

The purpose of this exercise is to see how well Damask can be used to conduct a realistic design task. This is not intended in any way to be a test of your ability as a designer or your ability to use this particular tool. *It is intended as an evaluation of the tool.*

We would like you to try to create the best design you can using Damask. Feel free to ask for assistance using Damask. You can also use paper and pencil for part of the design process.

We will also remind you to think aloud while using Damask so we can get an idea of what you are thinking while using the tool.

TotalBooks.com Requirements

A bookstore called TotalBooks is setting up a companion web site called TotalBooks.com that will let customers buy books. TotalBooks.com will launch two versions of its site, one targeted to PC users, and the other targeted to users of smartphones. Both sites will be in HTML.

Please create a preliminary design for the online store, implementing the requirements below. It's more important that you implement something for every requirement than to implement a few requirements in a detailed manner.

Common Requirements

- o Make Search function available on every page.

- o The home page should include a list of genres. Implement a page for one genre of books linked off the home page. The genre page should contain "featured books" in this genre.

- o On a product page, book info should include

    - o title

    - o author

    - o price

    - o edition (hardback, paperback)

    - o publisher and year

    - o ISBN

- o Have shopping cart and checkout functionality. Besides the usual requirements, be sure to include the following:

    - o Allow users to choose from multiple shipping addresses.

    - o Provide a way for users to choose a shipping method and a payment method

    - o Provide a thank-you page with an order summary

- o You can assume users are already logged into their account.

Desktop-specific Requirements

- o On the product page:

    - o Also include number of pages and dimensions

    o Sketch out placeholders for editorial reviews and reviews from customers

o When choosing from multiple addresses, users should be able to choose an address they stored before, or type in a new address.

o When choosing a payment method, users should be able to choose a credit card they stored before, or type in a new card and billing address.

o Allow users to access shopping cart from every page.

o Offer books related to or similar to the book being browsed.

Mobile-specific Requirements

o On the product page, link to a page that tells customers where the nearest TotalBooks bricks-and-mortar store is where they can pick up the book. Customers don't need to enter where they are, because the web site can automatically detect it from the mobile phone's location. (Let's assume such technology exists, is widespread, and is accepted by customers because of rigorous privacy enforcement.)

o When choosing from multiple addresses, users should be able to choose an address they stored before, or have it shipped to their cell phone billing address.

o When choosing a payment method, users should be able to choose a credit card they stored before, or have their order billed to their cell phone bill.

Desktop/voice participants

You have been hired to design an online book store that will target two types of platforms: the web and voice. Some requirements for the service are included on the next page.

The purpose of this exercise is to see how well Damask can be used to conduct a realistic design task. This is not intended in any way to be a test of your ability as a designer or your ability to use this particular tool. *It is intended as an evaluation of the tool.*

We would like you to try to create the best design you can using Damask. Feel free to ask for assistance using Damask. You can also use paper and pencil for part of the design process.

We will also remind you to think aloud while using Damask so we can get an idea of what you are thinking while using the tool.

TotalBooks.com Requirements

A bookstore called TotalBooks is setting up a companion web site called TotalBooks.com that will let customers buy books. TotalBooks.com will launch two versions of its site, a web version and a voice version.

Please create a preliminary design for the online store, implementing the requirements below. It's more important that you implement something for every requirement than to implement a few requirements in a detailed manner.

Common Requirements

- o The home page should include a list of genres. Implement a page for one genre of books linked off the home page. The genre page should contain "featured books" in this genre.

- o On a product page, book info should include

   - o title

   - o author

   - o price

     o   edition (hardback, paperback)

     o   publisher and year

     o   Include shopping cart and checkout functionality.

Desktop-specific Requirements

o   Make Search function available on every page.

o   Allow users to access shopping cart from every page.

o   On the product page:

     o   Also include ISBN, number of pages and dimensions

     o   Sketch out placeholders for editorial reviews and reviews from customers

     o   Offer books related to or similar to the book being browsed.

o   You can assume that the user already has a user name and password, and has already stored shipping addresses and credit card info before.

o   For checkout, be sure to include the following:

     o   Allow users to choose from several shipping addresses stored before, or enter a new address.

     o   Provide a way for users to choose a shipping method and a payment method

     o   Provide a thank-you page with an order summary

     o   When choosing a payment method, users should be able to choose a credit card they stored before, or enter a new card and billing address.

Voice-specific Requirements

o   From the home page, the user should be able to say a genre, which will go to a genre page, or say the title of a book, which will go to a product page.

    o You can assume that the user already has an account number and PIN, and has already stored shipping addresses and credit card info before.

C.7.7 Questionnaire B

1. Can you think of something that you did differently by using Damask compared to what you normally do?

    ④   I went into a lot more detail on functionality that normally would take a long time to create from scratch (like forgotten passwords, etc)

    ⑤   worked on two interfaces simultaneously

    ⑥   Obviously I wouldn't normally have access to canned templates in building a sitemap.

    ⑦   used the pre-fab patterns rather than think through the pages and starting from zero

    ⑧   I was more inclined to create new screens for the handheld interaction.

    ⑨   Grab ready-made plans (IA and page-level interaction) for existing sites.

    ⑩   I usually use pen/paper to do this kind of sketching, so this was quite a bit different. It's also impossible to link pen/paper drawings, so Damask would basically allow me to create a low-fi mockup that includes links… which is great!

    ⑪   Drawing and sketching directly onscreen was the biggest difference between what I normally do and what I did using Damask.

    ⑬   Using Damask, I was able to consider both the GUI and the speech UI at the same time. Features from one translated into features or flow in the other.

    ⑮   I did less - because the interface can only do so much.

    ⑯   Yes, I designed the web UI and speech UI in parallel. Typically, I'll do this in the sense of mapping different traversals through a common problem, but not with the actual content, as the layers function does here. I also like how painless it is to include drawings in an otherwise digital design.

    ⑰   I don't normally construct web and voice designs at the same time

2. Did Damask help you see new ideas, or did it prevent you from exploring ideas?

④ I may have limited my initial explorations on other ways to solve the problem, but this was a fairly standard store so I didn't feel the need to explore more.

⑤ neutral

⑥ This version probably would have helped me see many new ideas and different ways of looking at a site design. The pattern browser was excellent for remembering usability concerns I might not have remembered at this stage of the design.

⑦ patterns reminded me of things I might have left out, but on the whole, the technical issues prevented me from exploring ideas

⑧ The tablet PC text input was a pain - I didn't bother going into detail on several pages

⑨ If I had been able to print out the pages so that I could see them all at once, it would have helped me grasp the functionality of an existing site very quickly. I don't know of another way to do this but to enter fake data into an existing site and try to click all the links and recreate all errors.

A second monitor might also make Damask easier to use (one for zooming out and one for zooming in, or one for each device view).

⑩ I learned a lot about the tool while using it, so I have the impression that I explored lots of new ideas! Actually I think Damask would get kind of cumbersome if I really worried about linking all of the pages in all of the possible ways, so I'd have to be sure to stay at a higher level in order to stay productive. The patterns helped out with this in some ways because I could drop in a set of functionality without having to worry about linking, etc.

⑪ I saw new ideas, particularly in applying the design patterns from the library. However, the performance issues I encountered prevented me from exploring these as much as I would have liked.

⑬   using the patterns, it saved quite a bit of time-- esp with the e-commerce website functionality. this allowed a lot of work to be done and allowed for time to be spent exploring other ideas.

⑮   Both. There are new ideas around the parallels between the two interfaces, but there are also certain limitations when you start with one interface and map that to the other.

⑯   Both. Mostly, it helped me stay organized while prototyping rapidly. Designers have needed better tools like this for a long time, and Damask allows a designer to develop his or her ideas faster that s/he could otherwise. The downside was mostly in cases where layering complicated parts of the process that should have been left separate. But overall I like the idea of layering, I just think the division in a design between 'all devices' objects and 'this device' needs to be more distinct. For example, objects in all devices could have a reddish background, and those in local devices could have a bluish background.

⑰   I think it might prevent me from seeing a voice design in the bigger picture--for example I might create my web design and it creates my initial voice design, and I might then be tied into thinking of my dialog in a certain style, whereas if I thought about it from scratch I might have chosen a different dialog flow.

3.   What aspects of Damask do you particularly like?

     ④   The patterns that save me time creating common functions.

     ⑤   I like the grouping of objects and the drag to link feature

     ⑥   I love the new hand scroll tool. I'm keen on the patterns, too, as you might have noticed. Otherwise, see previous answers (as for almost all of these questions).

     ⑦   patterns and the ability to reuse elements from desktop view to smartphone view saved me time

     ⑧   the layers concept (though not the execution)

     ⑨   Being able to grab ready-made plans, because it helps avoid reinventing the wheel.

     ⑩   The pen input was really good. We talked a bit about using a "pure" sketch model where the tool wouldn't have any form widgets to choose from, but to

some extent I liked that I could simple "drop" a widget and not have to draw it out each time… this may more may not actually save time versus drawing, though.

⑪   the ability to draw directly on the "canvas", the ability to visualize the site as it's being built, the ability to use both templates and design patterns from the library, the ability to enter device-specific info in the form of layers

⑬   I like the vxml being generated so quickly-- it would be wonderful if I could have that functionality for sample calls etc in my job.

⑮   1) the ability to create a parallel interface automatically.

2) the ability to quickly set up a prototype web site

3) the templates and patterns

⑯   Quick 'n dirty, quick 'n dirty. I like the feeling that this really is just a sketch, it really is rapid prototyping, and I don't have to worry about impressing someone with the finer points of my design, just getting a concept out there. I think this would be especially powerful on a team of designers trying to focus on the larger conceptual issues - the whole app sets a tone where you're not going to worry about a subtle difference in color or wording, just how the thing hangs together as a whole unit and concept.

⑰   For building the web prototype it was very useful to have the patterns, so I didn't have to do some things from scratch (like login, shopping cart, etc.) I think the same could work for voice patterns--having things we do commonly (like yes/no, account balance, list traversal, etc) be patterns. I'm not sure if we could have them be for both web and voice though.

4. What aspects of Damask do you particularly dislike?

④   Lack of ability to write comments

⑤   The templates are a bit funky, the window for the templates is massive and is hard to use in conjunction w/ the main window. Also a bit hard to scroll

⑥   I'm still on the fence about the layers. Perhaps it's just that I don't work across devices that much anymore, but I can imagine forgetting which mode I was in quite often. The grayed-out icons could be even more grayed-out, also; they

tended to look like they were intentionally dark. As I mentioned, consider playing up the arrow part of the icon more. Finally—I still find it very cumbersome to move around the page. That's the single biggest complaint I have this time around and it's a make-or-break issue.

⑦   input device... writing with a pen didn't translate well

⑧   The layers execution - the background shading in particular. The infinite field, and no scroll bars.

⑨   Text entry (selecting, typing) is way too awkward and slow.

⑩   The concept of layers was a little hard to grasp. With more experience I could pick it up, but I had to keep thinking about it.

⑪   I struggled with the performance issues and the implementation glitches the most. The handwriting and drawing capabilities weren't as precise as the corresponding ones in Windows, which made it more difficult.

⑬   I had a hard time remembering to switch between modes (selector mode v. pencil mode v. text)

⑮   1) automatic interface creation introduces several non-ideal defaults in the other device

2) voice interface in particular was quite limiting

3) lack of ability to map to even a fake backend

4) the use of patterns is useful but it is not intuitive how these may play with each other or with the templates

5) the reminders for how a change made in one device will also impact the other device should be displayed more often.

⑯   I wanted more functionality for making margin notes, highlighting pieces, and tying strings. When you're designing quickly, you have to leave notes for yourself and other designers, and unfortunately, there weren't a lot of ways to do this gracefully.

⑰   I'm just not sure it's possible to build a website and a voice app at the same time--I think the designs need to be thought of in different ways because web and voice are very different modalities.

5. What benefits do you see in using a tool that can automatically retarget a web user interface to another device?

⑤ I rarely have projects at work that require us to do both at the same time, but if I created smaller applications from scratch or was playing around with prototypes, it would be useful.

⑥ cuts the time required to design and develop the mockup

⑦ Well, clearly it could save plenty of time in reproducing controls. The consistency value would be the obvious answer, but obviously a better algorithm for preserving the layout of controls would be needed to make that easier than cutting and pasting.

⑧ saves on time and makes pages more consistent

⑨ (So can CSS). It should save some design time, and could be useful in demos.

⑩ Huge. Also the patterns could be especially useful for phone interface design.

⑪ If done properly I think there would be lots of benefits for products that want to be available in multiple devices. Lots of web sites probably want a phone-enabled interface.

⑫ Many benefits, namely that I can design for both devices in tandem and maintain a top-down view of the sites that I'm working on. I can also easily transfer elements and artifacts between the two devices, while optimizing the layout for each, respectively.

⑭ Lots of benefits-- it's a huge time saver and allows effort to be spent on other areas when using patterns. it would be very beneficial to use in internal meetings and customer presentations.

⑯ speed of prototype development

⑰ In the case of speech, even if the so-called 'voice-web' never got off the ground, one of the biggest problems with the concept of a voice web and voice sites was content. A tool that was able to quickly convert existing web pages to voice sites would be incredible, even if it wasn't perfect. On our web UI / speech UI design tasks, I think the result was pretty much a mixed bag - I'm sure the

results with a Smartphone interface would be better. Better web -> speech design patterns would help, too. How should Damask's existing design patterns sound in a speech interface?

⑰   Maybe if it's web + another visual device, like a cell phone screen, it would be useful to have the design already partially completed for the 2nd device once you've created it for the first,

6. Did you use the UI design that was automatically generated for the second device? Were the results beneficial? If so, why? If not, why not?

④   Yes, it saved me a lot of time, but sometimes the layers confused me.

⑤   yes, included all the necessary elements of the UI

⑥   I did use it, but to be honest it was hard to tell if the results were good or bad because I didn't have time to scrutinize the details of the layout.

⑦   yes, I used the ui design automatically generated for the second device. It was beneficial in that it saved me time to not have to redraw the same elements and maintain a consistent experience for the user.

⑧   yes. helped find architecture bugs.

⑨   Didn't really get to the second device, but what I saw seemed sort of jumbled. I liked that it removed some items automatically, but maybe make those elements visible by clicking (i.e., a tray that opens and closes) instead of dragging the page layout box.

⑩   The patterns tended to be a lot more useful in this capacity than my own sketches were. My sketches don't really happen in chronological order, so the field order on the second device wasn't really useful. I think it might be cumbersome to assign a layer to each new bit in the sketch, too - like I'd have to say "this device" or "all devices" for each thing I draw to determine what device it shows up in.

⑪   Yes, I did. The results were beneficial because for the most part, the second device layout was optimized for me due to the fact that I based the design on design patterns provided.

⑬   yes, I did use it-- very beneficial. see #5

⑮   yes, I did. They provided a beneficial starting point.

⑯   Yes, and the benefit was probably organization. Once I'd generated the page, it was easy to remember what needed to be in the speech UI by looking at the objects in the speech UI workspace. However, I don't think there was a single prompt that I didn't rewrite, so it seemed wrong to link text in web and speech interfaces by default.

⑰   I did reuse it for the shopping cart/login/order confirmation. It was useful to have something immediately available but there was a lot of stuff I'd change if I were creating a real system (changing prompts, number of prompts, expected responses, etc.)

7. What additional features would you like to see in Damask? What would it take for it to be truly useful to you?

④   I would like to see comments about other design patterns, or be able to make my own comments. I would also like it to tell me more information about what page I'm currently working on (patterns used, alternate device views, etc)

⑤   zoom tool. A panel for the patterns

⑥   Same as previous answer, really, except that the patterns do add some benefit. I mentioned custom patterns and custom components earlier, which would really make it massively useful, since I work on a site with a custom style guide and we reuse elements all the time.

⑦   hard to say, b/c there's a fine line between too many features (confusing) and keeping it simple and easy to use. I would like to see an advance mode where I could align elements (I like anything that's in electronic format to be perfect)

⑧   a flow-chart view using page names. keyboard interface.

⑨   Easier text entry. A bigger screen and a more precise tablet interface would help...

⑩   I'd want some more powerful grouping functionality - so that I could draw a series of widgets and then have them stay together as a cohesive set of functionality (ie radio buttons).

⑪   Additional features = retained focus on views when switching between tabs; comparative views within the same window (instead of opening a new window to compare between tabs), floating toolbars and palettes, short cut keys on the window, faster zoom capabilities

To be truly useful, the system would need to improve in performance and precision. I felt frustrated accomplishing work that I clearly understood the path to completing because I was hindered by the UI.

⑬   I'd like to be able to record prompts in a human voice and play those in the run mode. that would be really useful and a good demo for customers.

⑮   1) fewer but more flexible patterns
2) addition of a fake backend
3) improved richness for the voice interface

⑯   In addition to the issues I've already mentioned, it would be nice to be able to size individual forms, etc. to fit the entire screen when you're working inside them.

⑰   I think I'd unhook the web--> voice stuff being so connected. Still not sure that it's a good idea. To be useful to me the voice part would need to be more powerful, as I mentioned before--ability to use real grammars, have dynamic info, etc.

8. How likely would you use a commercial-strength version of Damask? (1 = very unlikely, 7 = very likely)

1	2	3	4	5	6	7
					④	
					⑨	
		⑦	⑥	⑩	⑪	
⑰	⑤	⑧	⑮	⑯	⑬	
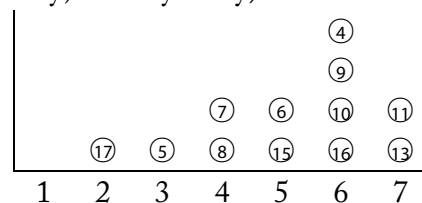
mean = 5.08, median = 5.5, std dev = 1.56

9. What for? (or if not, why not?)

④ I like having a sketching tool for early brainstorming. I would rarely use the multiple devices at once.

⑤ To build prototypes for rapid testing of new interfaces. Unlikely b/c my interfaces are far more dynamic than simple point and click

⑥ As before, I'd use it for quick sketches to present to project teams and for rapid prototyping for user testing.

⑦ I would still initially sketch on paper.. then transfer it to Damask to edit so that I could run through.. sort of like a check process.

⑧ The page layout tool would have to be better than dreamweaver. The whiteboard would have to be able to handle hundreds of pages.

⑨ For other existing designs for common apps such as logging in/out, and to create my own templates for various kinds of content pages.

⑩ rapid-prototyping would be very useful, less work that creating a full prototype.

⑪ Professional web and UI design and development, primarily desktop.

⑬ sample call generation. demoing ideas for applications for potential customers

⑮ Mostly for prototyping - not for real development

⑯ Rapid prototyping. Of course, I'd want it to handle some of the issues I mentioned above. :)

⑰ Already have a more powerful tool in-house.

10. Did you find the Run mode useful for…

Desktop?

all participants: Yes

no participants: No

Smartphone?

all desktop/smartphone participants: Yes

no desktop/smartphone participants: No

Voice?

all desktop/voice participants: Yes

no desktop/voice participants: No

11. Suppose you had to design a user interface for several types of devices. How many types of devices would it take before Damask became useful? (Enter 0 if you don't think Damask would become useful at all.)

⑪⑰ 1

④⑥⑦⑨⑩⑬⑮ 2

⑤⑯ 3

⑧ 4

mean = 2.17, median = 2, std dev = 0.83

12. How easy was it to accomplish the task? (1 = not easy, 7 = very easy)

```
                              ⑤
                    ④    ⑧
                    ⑨    ⑬
              ⑦    ⑩    ⑮
              ⑪    ⑰    ⑯    ⑥
     _____
      1    2    3    4    5    6    7
```
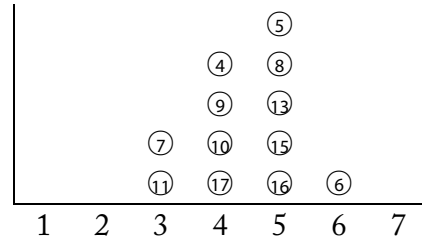
mean = 4.42, median = 4.5, std dev = 0.90

13. How easy was it to maintain appropriate consistency between both devices? (1 =

not easy, 7 = very easy)

```
                         ⑤
                         ⑥
                         ⑧
              ④         ⑩
              ⑮         ⑪
         ⑰    ⑯    ⑨    ⑬              ⑦
     _____
      1    2    3    4    5    6    7
```
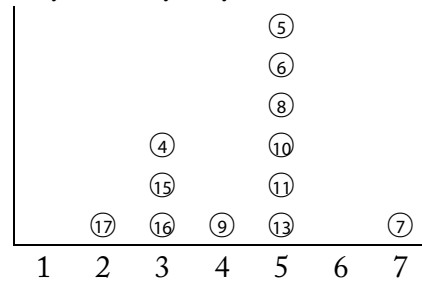
mean = 4.33, median = 5, std dev = 1.37

14. How easy was it to transfer relevant parts of the design from one device to

another? (1 = not easy, 7 = very easy)

```
                    ④
                    ⑩
         ⑦         ⑮    ⑥    ⑤
         ⑰    ⑧    ⑯    ⑬    ⑪    ⑨
     _____
      1    2    3    4    5    6    7
```
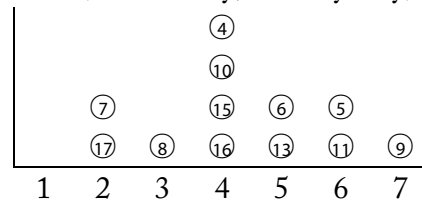
mean = 4.33, median = 4, std dev = 1.56

15. How much did you like the sketch-based interface of Damask? (1 = did not like,

7 = liked a lot)

```
                    ⑥         ⑩
                    ⑨         ⑪
                    ⑮         ⑬
         ⑦    ⑧         ⑰    ⑤    ⑯    ④
     _____
      1    2    3    4    5    6    7
```
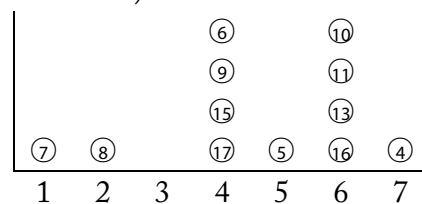
mean = 4.58, median = 4.5, std dev = 1.78

16. How easy to understand was the concept of layers in Damask? (1 = hard to

understand, 7 = easy to understand)

```
                              ⑥
          ⑩                   ⑧
          ⑬            ④      ⑮      ⑨
    ⑦     ⑰            ⑤      ⑯      ⑪
    1     2     3      4      5      6      7
```
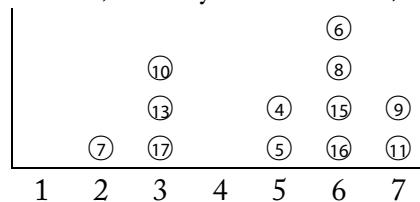
mean = 4.92, median = 5.5, std dev = 1.73

17. Did you like the concept of layers in Damask? (1 = did not like, 7 = liked a lot)

```
                ⑤            ⑧
          ④     ⑥            ⑮      ⑨
    ⑦     ⑩     ⑰     ⑬      ⑯      ⑪
    1     2     3     4      5      6      7
```
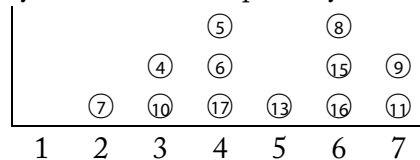
mean = 4.75, median = 4.5, std dev = 1.66

18. Have you used design patterns before?

④⑤⑦⑧⑨⑬⑯ Yes

⑥⑩⑪⑮⑰ No

19. If so, please briefly describe what projects and how they were used:

④   I refer to them a lot for projects I have done to validate that I haven't missed any

common issues.

⑤   I use them in all of my UI work, but I don't typically use a formal index of them

⑦   we are in the midst of writing design patterns for Yahoo! properties

⑧   Technical writing - manual layout

⑨   -web sites, for content at different levels of a site and for standard repeated

elements

-books, for page layout and for standard repeated elements

-technical documents, for standard repeated elements

⑬   in my job I routinely use modules of pre-designed and coded speech

recognition contexts

⑯ That's a weak yes. I've used templates and pattern suggestions such as what Damask had, but mostly in school projects. In professional settings, we've had to make the look and feel or sound and tone of our designs match other components, but it was never a formal design patterns process.

20. How useful do you feel the design patterns in this study were for the design task?

(1 = not useful, 7 = very useful)

```
                              ④
                        ⑤     ⑥
                        ⑩     ⑦
                        ⑮     ⑨
                        ⑯     ⑪
  ⑧                     ⑰     ⑬
  1    2    3    4    5    6    7
```

mean = 6, median = 6, std dev = 1.65
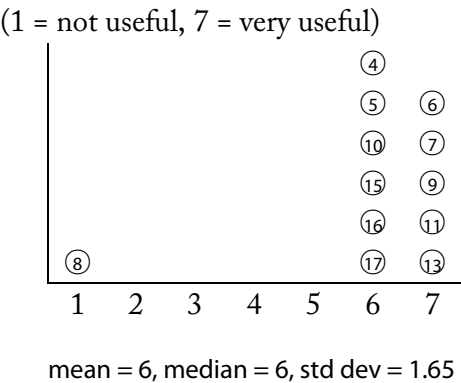
21. How useful do you feel the design patterns in this study might be for other

projects you do (current or future)? (1 = very unlikely, 7 = very likely)

```
                              ⑥
                              ⑦
                              ⑩
        ⑧           ⑤    ⑬    ⑨
        ⑰    ④      ⑮    ⑯    ⑪
  1    2    3    4    5    6    7
```

mean = 5.33, median = 6, std dev = 1.37
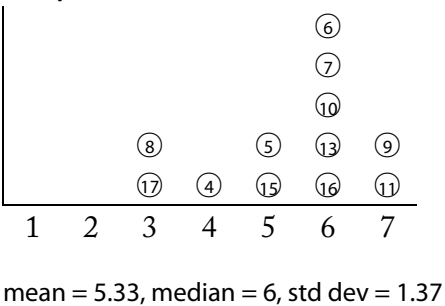
22. How many design patterns did you use in your design for Task 2?

Participant	Answer given by participant	No. of patterns explicitly used	No. of total patterns used
④	4	5	11
⑤	4	6	6
⑥	3	4	10
⑦	6	5	11
⑧	0	0	0

⑨	5	5	11
⑩	4	7	8
⑪	5	4	10
⑬	6	4	10
⑮	1	2	8
⑯	1	1	1
⑰	9	9	9

23. What did you like about the design patterns?

④ Saves me time.

⑤ drag an drop simplicity. Included all links

⑥ I didn't have time to study them closely enough to comment on the subpage contents of them. But I appreciated that they existed, corresponded well to patterns that really do occur frequently in my work, and easily functioned as independent units.

⑦ saved me a bunch of steps in designing those pages.

⑧ lots of possibilities - would be good for client meetings/needs analysis.

⑨ They let you skip the step of creating them and just pick up stuff that's already been proven to work.

⑩ The help enforce consistency and they also save a bunch of time when designing something that doesn't really require a whole bunch of innovation. Nice that the patterns are flexible, too. I can delete portions if I don't want to use them.

⑪ The 'templatized' approach they brought to the site I was designing; the clarify with which they were presented and laid out; the fact that they saved me a great deal of time in both creating pages AND optimizing them between the two devices.

⑬ they saved a ton of time

⑮ get something for free

ⓖ It made the process faster without sacrificing quality.

ⓗ Some of them were practically finished without having to change anything, like login.

24. What did you not like about the design patterns? How can the provided design patterns be improved (e.g., any patterns that you disagreed with)?

④ Sometimes they assumed I was using them in a particular way.

⑤ had to have both windows open, hard to access them from a window

⑥ A somewhat cleaner layout of pages would help, to make it easier to see what you've just pasted in. The sketches are very clean and the patterns should correspond to them as much as possible. I didn't see any I thought were invalid.

⑦ It would be nice if the patterns and templates worked together better.

⑧ too hard to integrate and customize

⑨ Hard to move around precisely. Hard to enter text.

⑩ I thought the conversion from PC to Smart Phone was a little strange in the case of Category Pages and Product Pages. I don't think I'd want to list *every* book on a category page in the Smart Phone, but I don't know how else I'd do it!

⑪ I would have liked to had templates available for ALL the design patterns in the library. There wasn't much that I didn't like about them otherwise.

⑬ the arrows were a bit difficult to organize

⑮ even with 80 patterns, sometimes the pattern you pick does not match what you want.

ⓖ Little thing - it would be nice to drag the design pattern itself onto the workspace, not just the text.

ⓗ Can't think of anything

25. You may have noticed that the Quick-Flow Checkout pattern has a lot of detail and functionality. Is it useful for this pattern to have this much functionality? Does it help you in your design process?

④ Yes, I'd rather have more detail then less.

⑤ I think that this would be helpful. I think it would be best if I could make some edits to the pattern so that it matches my org's needs.

⑥ Absolutely it's helpful. At some point I'd need all of that stuff, and I think it'd be easier to delete screens than remember to add them in. especially at this stage of the design.

⑦ It's very useful as a plug and play templated interaction. It also serves as a good reminder of functionality that I may have forgotten. However, I would need to play with it more to see if when using it as a starting point, it helps or hinders designing the interaction.

⑧ I would usually put in this level of functionality late in the design process, and use black-box designs earlier. There is usually a detour into terminology decisions, so I would also use more "greeking", or words that are clearly not the final version ("Acme" "foo book" etc.)

⑨ The detail seems like the whole point of the template - it's there so a designer doesn't have to figure it out. But if there were a written summary or list of the functions that could help some designers. (It would help me.)

⑩ I thought it was useful to have fairly complete functionality as part of each pattern. As long as it's easy to delete pages and section within pages (it seemed easy), then I think there's no problem with having a fairly complete set of base functionality.

⑪ Yes and yes. It provided a solid "blueprint" for designing the checkout process.

⑬ For the website design, it was very useful to have that much functionality, however, it caused the speech application to be pretty messy.

⑮ It helps - but I think maybe there is too much detail. It may be more helpful to have the basic functionality and then reminders fo what else "could" be added.

⑯ Yes, but I think it's too noisy in its present form (especially for voice interfaces). Perhaps only displaying the arrows for the page in scope, or allowing the user to turn certain functionality on and off would solve the problem. In the voice dialogs, I feel it would also be useful to put the user responses/commands closer to the prompts, as we discussed before.

⑰ I think so... these are things that it's very common to group together

26. A design that uses patterns has them embedded in the design, surrounded by blue dotted boxes. Do you feel that this way of showing which patterns your design uses would help you explain your design to other designers? (1 = would not help, 7 = would help a lot)

```
⑥
⑦
⑧           ④    ⑩    ⑬
⑨    ⑤    ⑯    ⑰    ⑮    ⑪
─────────────────────────────
1    2    3    4    5    6    7
```
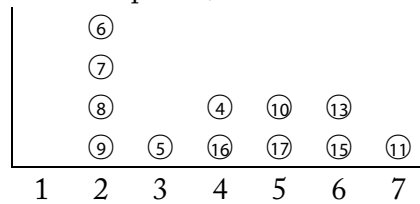
mean = 4, median = 4, std dev = 1.81

Comments:

④ it would help somewhat, but most designers I work with don't understand patterns (yet!)

⑥ only if they used this too. As presented, it adds visual noise; my design ended up overlapping the blue captions. If you could find a way to avoid that problem (some kind of hover text? of course, that wouldn't print...) it might go up to 4 or 5.

⑦ What is the benefit of showing that I'm using a pattern? Esp. if I'm going to use it as a starting point and modify it... I could see the benefit if I don't modify it... Maybe as a mental model of what to expect, but I don't think it would really help.

⑧ most designers would see the patterns anyway (like chess experts see the lines of attack and defense, without having to trace them out).

⑩ it'd take a little time for people to become familiar with this kind of notation.

⑪ definitely helpful information

⑬ Especially if they were familiar with the software and patterns too.

⑯ Perhaps for complicated designs, but only if it can be easily toggled. If a design is complicated enough to warrant this, it probably has enough noise already, and designers are likely to recognize general patterns with or without this.

It also depends on the designer. Some love thinking in patterns and understanding the reusable components of a design, while others prefer to focus on the unique solution to a problem presented by a design. Of course, competent designers tend to think both ways, but this only further stresses that it should be easy to toggle.

27. To potential clients? (1 = would not help, 7 = would help a lot)

```
 ⑤
 ⑥
 ⑦              ⑪   ⑧
 ⑨   ④  ⑩  ⑰  ⑮  ⑯  ⑬
─────────────────────────
 1   2   3   4   5   6   7
```
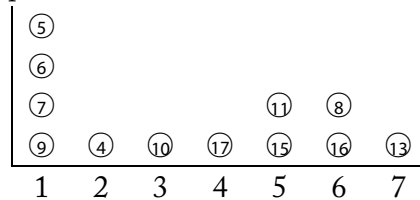
mean = 3.5, median = 3.5, std dev = 2.28

Comments:

④   most clients would not want to think their site is not designed specifically for them.

⑥   They don't care anyway. I could see using the boxes to corral groups of pages, but again the main problem is that it's hard to read. A clearer presentation would go up to maybe a 4.

⑦   In order for the pattern to be useful, clients would need to understand what patterns are and the difference between different patterns. Currently, I don't feel they have that kind of knowledge.

⑧   yes, this would help, and might open the option for presenting different designs of the same type of page.

   (but it's hard to read the blue under the black text)

⑩   I feel like it's less likely that my clients would be familiar with this kind of notation.

⑬   Clients would be able to follow along-- the concept is an easy one to grasp-- however, I don't necessarily think that all clients would need to know that a pattern was being used.

⑯   6/7 - Yes, I think this would definitely help explain a design to clients without forcing them to see the general patterns that designers are likely to see naturally.

28. How often have you bought books online in the past 12 months?

               Never

⑦⑧⑩⑮⑰ 1-3 times

⑨⑬⑯ 4-6 times

⑤⑥ 7-11 times

④⑪ At least 12 times

29. If you have, how have you bought them?

all participants: Through the web on a desktop PC

no participants: Through a mobile phone

no participants: Through an automated voice system over the phone

no participants: Other

30. How many e-commerce web sites have you designed, if any?

⑬⑮⑰ 0

⑥⑩ 1

④⑤⑯ 2

⑧⑨ 3

⑦ 5–7

⑪ 7

Comments:

⑤   One I worked on over a period of 2 years and a number of iterations

⑤⑦   Depends on your definition.

    1.   I'm one of three designers working on http://www.vendio.com/, and many

         parts of it were designed years ago and just haven't been revamped yet.

         We do sell our services on it, but our services consist of e-commerce sites, in

         a way; we do online stores among other things. So in a way I currently help

         design a meta-e-commerce site.

    2.   I'm about to embark on a revamp of http://www.national-comedy.com/, for

         the improv group I perform with. We sell tickets on our site. But that's not

         exactly e-commerce, I guess, and I haven't done it yet. :)

    That's really about it, I think!

⑦   Depends on your definition.

⑨   One with e-commerce via Amazon. Consulted on two "real" ones.

⑪   I'm working at eBay, which I guess qualifies as e-commerce. Other than that, 0.

⑫   (all or part of 7)

⑰   One and a half. The full one was included everything checked below, the other

    was a desktop-only draft that we never fully implemented.

31. If you have designed e-commerce web sites, what platforms were they targeted at?

   ⑤⑥⑦⑧⑨⑩⑪⑫⑰ Desktop web

             ⑧⑫⑰ PDA or Mobile phone

                ⑰ Voice

                  Other

32. Additional comments:

⑤   jimmy rocks

⑦   Thanks for allowing me to participate -- very interesting and exciting stuff. I'm

    now looking forward to seeing how the project develops further, and this 2nd

    phase has definitely convinced me to give it a try if and when it become

    available.

⑦ we talked about exploring another metaphor for the different views... maybe more of a parent/child relationship where the child (desktop, smartphone, voice) view takes on some/all of the elements of the parent (All view).

⑪ Great application and concepts - this could be very applicable commercially for UI designers, engineers, web designers and anyone else who designs professionally and for cross-device sites and applications.

⑬ I really would like to see a version of this tool to use in my daily job.

33. *(This was asked after the participant completed both sessions, over e-mail. Participants were sent URLs of their designs.)* Which of your designs did you feel was a better design?
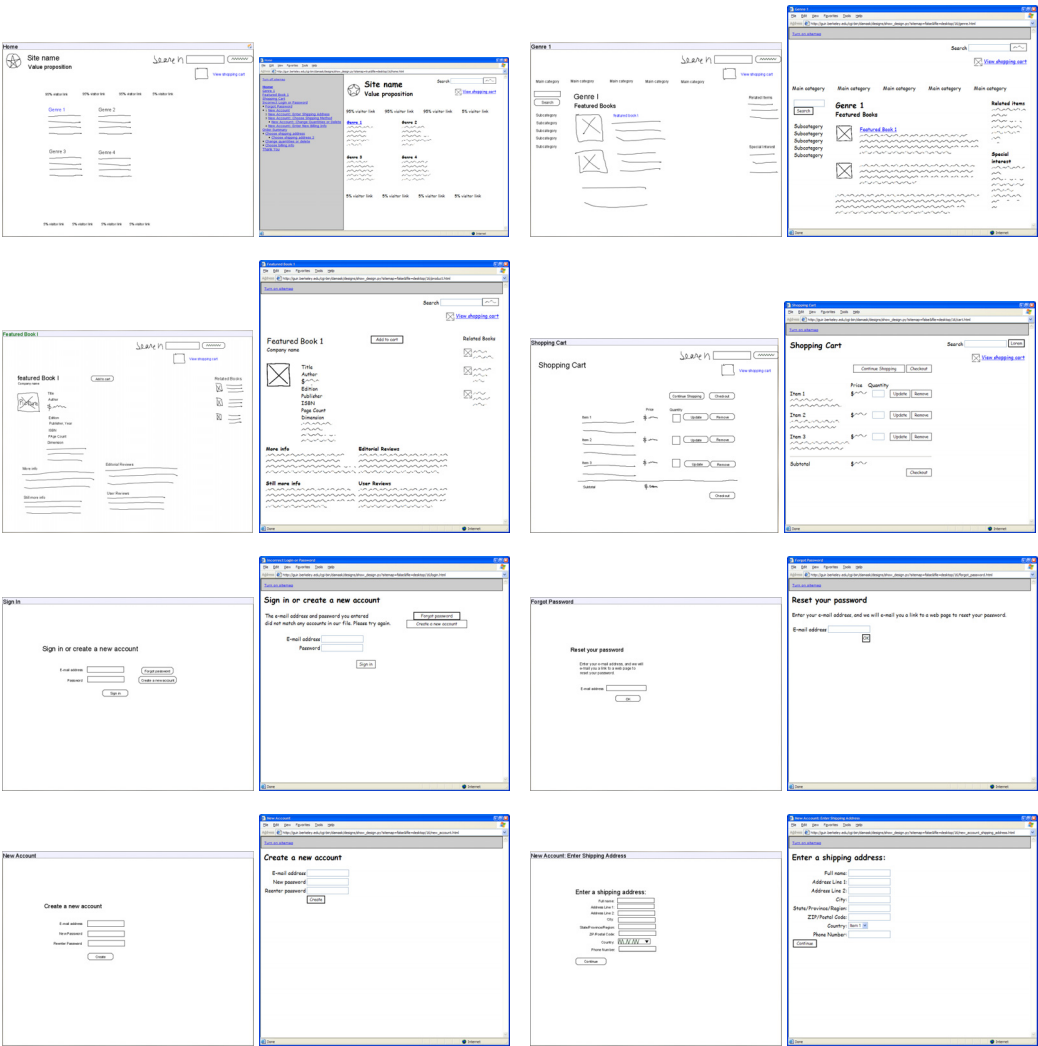
⑧⑪⑯ TotalMusic.com (without layers or patterns)

④⑦⑨⑩⑬⑮⑰ TotalBooks.com (with layers and patterns)

They are about the same

⑥ It depends

⑤ Did not reply

Why?

TotalMusic.com (without layers or patterns)

⑧ My second session, because I was more comfortable with the interface at that point, so was actually thinking about the design process.

⑪ My second design was the better of the two. The design was easier to produce and the details easier to remember and include because I was much more familiar with the tool and was also not fighting with the design-pattern-related performance issues in the application.

⑯ I would say TotalMusic.com is my superior design, although I hesitate slightly because I can't seem to pull up my desktop design for TotalMusic.

Since I was designing a similar interface using the same tools and nearly the same method as the first time, it's natural that my second design would be

superior, but it's more than that. By my memory, I was still fighting with a few of Damask's features the first time around, and sometimes found myself thinking it would be faster and easier with a pencil and paper, and perhaps the first design would have been better had I sketched on a blank sheet of paper.

However, by the second design I was not only more comfortable with Damask, I found myself appreciating many of Damask's features and finding them far superior to anything I could produce that quickly with pencil and paper.

Damask also seems a LOT easier to use when you have a rough idea in mind vs. starting from scratch, as I did on the second design. Perhaps part of the Damask design process could encourage the designer to develop that sort of big, general picture before beginning anything on Damask, rather than drafting from absolute scratch.

TotalBooks.com (without layers or patterns)

④   I felt more comfortable in the 2nd round, that alot more details were covered by the patterns

⑦   In the scenario where I had only 0.5-1 hour to come up with the interaction for a site, TotalBooks is the better design. I'm sure I missed some stuff in TotalMusic. In a more real scenario where I had maybe a couple of days to design, hard to say...

⑨   Because the templates included a lot more worked-out functionality than I could think up on the fly.

⑩   I think I actually liked parts of my 2nd session design better, but the 1st session offered a more complete picture of the workflow, so it's kind of a tossup. The 1st session is probably the winner in my book because it contains all of the steps in the browsing/purchase process. Wireframes should be more about boxes and arrows than design/layout within the pages, so the 1st design is probably better.

⑬   I suppose the second session's design was better in that it was a more complete design. It allowed users more freedom to do the tasks they would want to do

when ordering books. Although it was more complex, it was still easy to navigate and was more useful to the customer.

⑮ The first session - honestly, I was still new to using the tool and it was fun to do it. It was more interesting at that time.

⑰ The patterns made me realize I'd forgotten a lot of things in the first one, like all the functionality for shipping addresses/credit cards etc

C.8 Summary of Likes and Dislikes of Damask

C.8.1 *What did you like about Damask?*
(Section C.6.3, Question 3 and Section C.7.7, Question 3)

④⑥⑦⑨⑪⑮⑰ Patterns

⑤⑥⑧⑩⑬⑮⑯ Run mode

④⑤⑩⑪⑯ Sketching or pen input

⑩⑮⑯⑰ Speed of creating prototypes

⑤⑥⑪⑮ Templates

⑨⑪ (⑧ concept only) Layers

⑦⑮ Automatic generation of designs for other devices

⑤⑦ Sitemap view

⑤⑪ Zooming

C.8.2 *What do you not like about Damask? What additional features would you like to see?*
(Section C.6.3, Questions 4 and 5, and Section C.7.7, Questions 4 and 7)

⑥⑧⑩⑮ Layers

⑤⑦⑧⑪ Sketching and/or pen input

⑤⑥⑧⑰ Panning/zooming

⑤⑩⑪ Bugs/performance problems

⑥⑦⑨ No tools for alignment, shapes, or colors

⑮⑰ Cannot simulate a data-driven web site

⑮⑰ Can only create simple voice UIs (e.g.,

cannot incorporate user's input)

⑥⑩ Linking

⑬⑰ Mode switching

④⑯ No annotations

④⑪ Not enough keyboard shortcuts

⑨⑯ Text entry is awkward, or no word wrap

⑰ Automatic generation of designs for other devices

⑬ Cannot record voice prompts

⑯ Cannot view a sample conversation (ala SUEDE)

⑩ Lack of conditional transitions

⑤ Needs exporting to more formats

⑯ Needs more views (e.g., only flow, only prompts)

⑧ No automatic testing of UI

⑯ Semantic zooming

⑦ Templates

C.9 Debriefing

Do you have any final comments about the system, this study, the questionnaire, or
anything else?

After the second session:

Would you like to hear about some future improvements we're thinking about making to Damask? *(Talk about the Trays concept, explained in Section 8.3.3.)*

Thank you for participating in our experiment. The purpose of the experiment was to see whether designers can use a new electronic sketching tool, called Damask, to design and prototype cross-device user interfaces. Ultimately, we wish to know whether Damask makes it easier for designers to create cross-device user interfaces.

Our plan is to continue to use the feedback from this experiment and observation of any problems with the Damask user interface to improve the application. We hope to release Damask for free to the public within a few months.

APPENDIX

D Designs Created in Damask Evaluation

For each desktop and smartphone design, the overall structure and a diagrammatic

sitemap version is first shown. The key for the sitemap is at the beginning of this

chapter. Each page is then shown in detail, next to the cleaned-up version that was

used in the online evaluations described in Sections 6.5.2 and 6.6.2. For the cleaned-

up versions, the sitemap is shown for the home page and hidden for the rest.

D.1 Key for Sitemaps
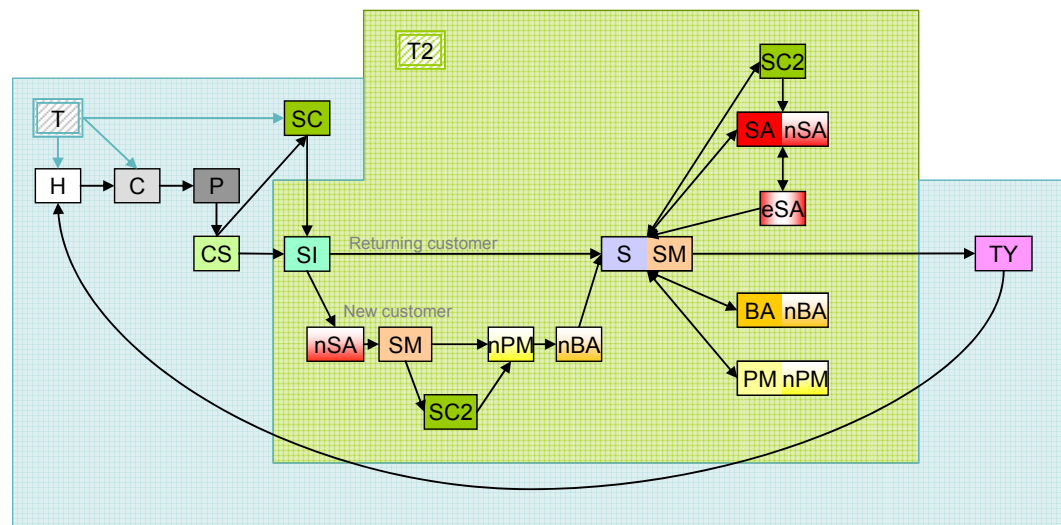
T T2 Templates

H Home
C Category
P Product
CS Cross-selling and up-selling
SC Shopping cart
SI Sign-in/New account
SA Select shipping address   eSA Edit shipping address   nSA New shipping address
SM Shipping method
SC2 Change quantities or delete in shopping cart
BA Select billing address   eBA Edit billing address   nBA New billing address
PM Select payment method   ePM Edit payment method   nPM New payment method
S Order summary
TY Order confirmation and thank you

D.2 Designer 4

D.2.1 TotalMusic (no layers or patterns)
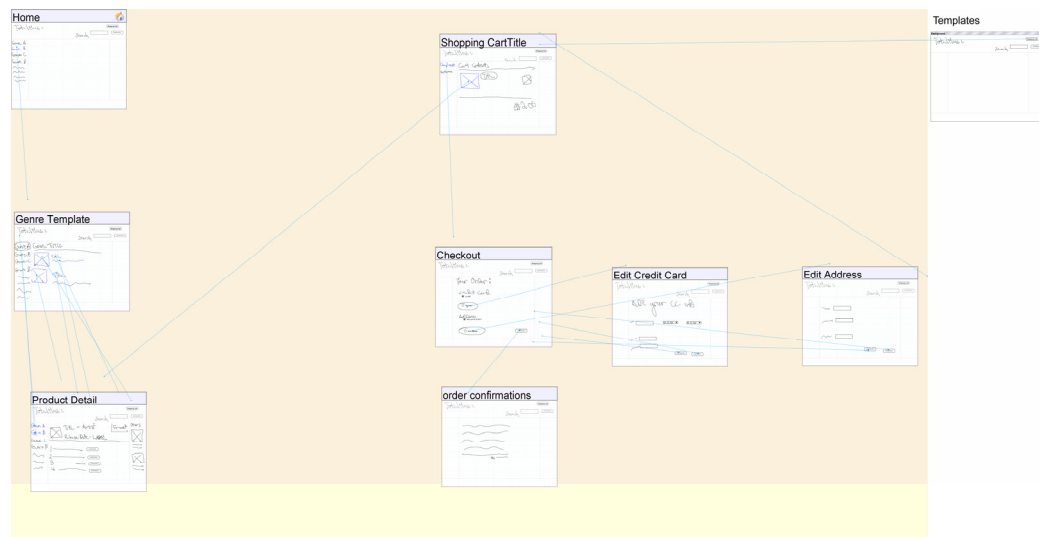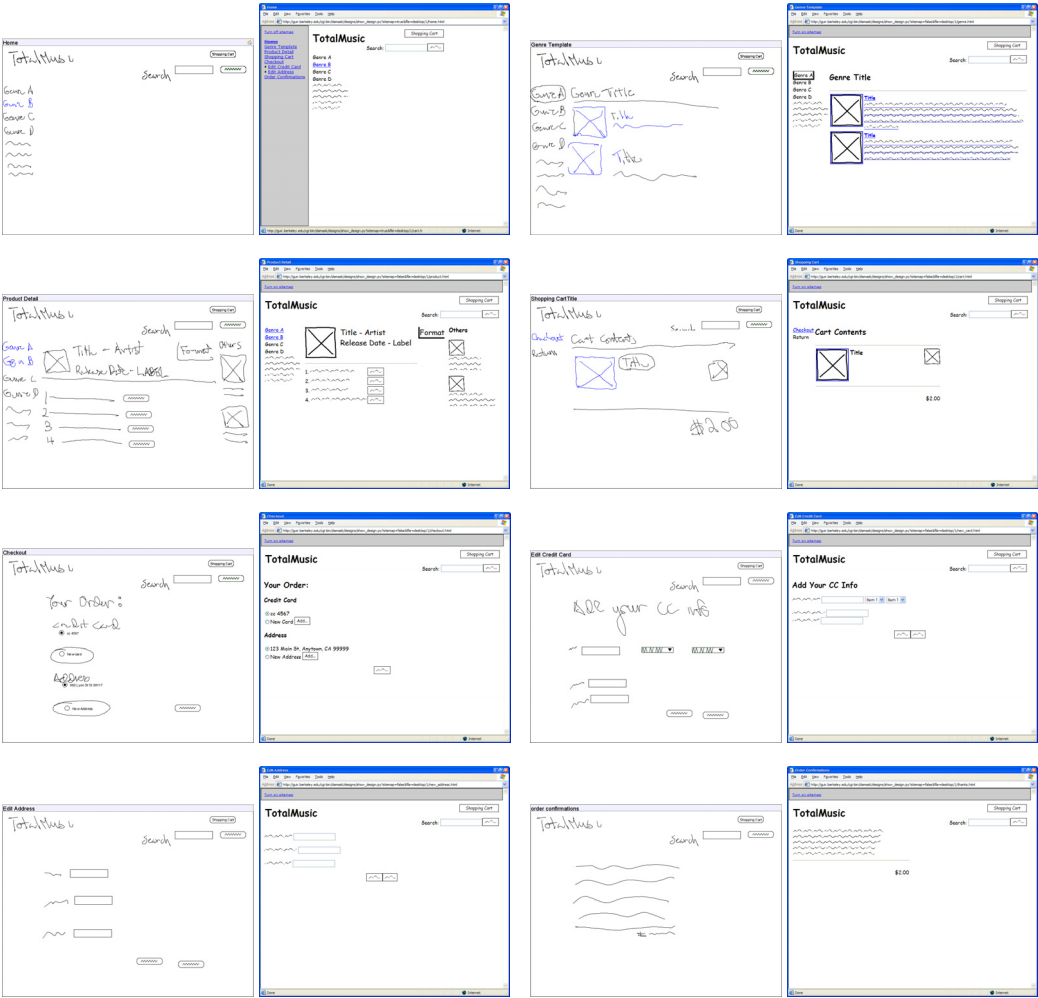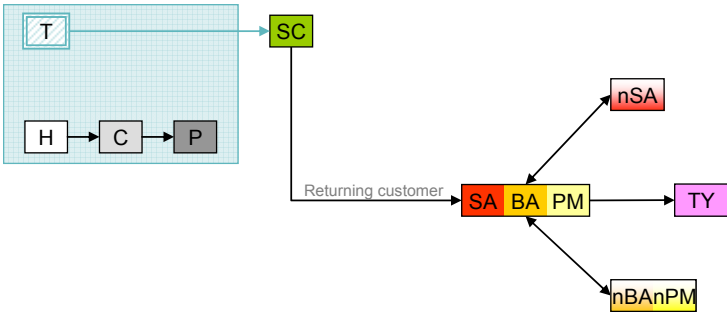
Desktop
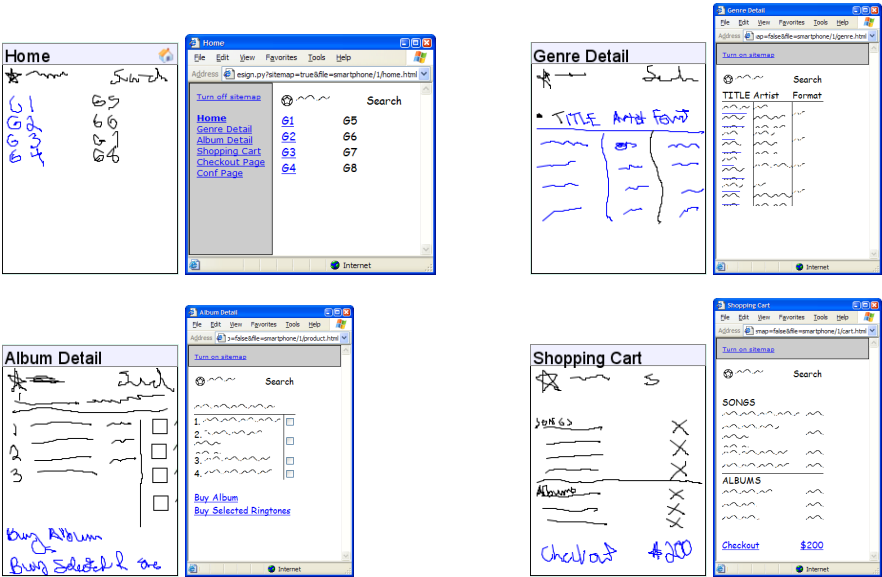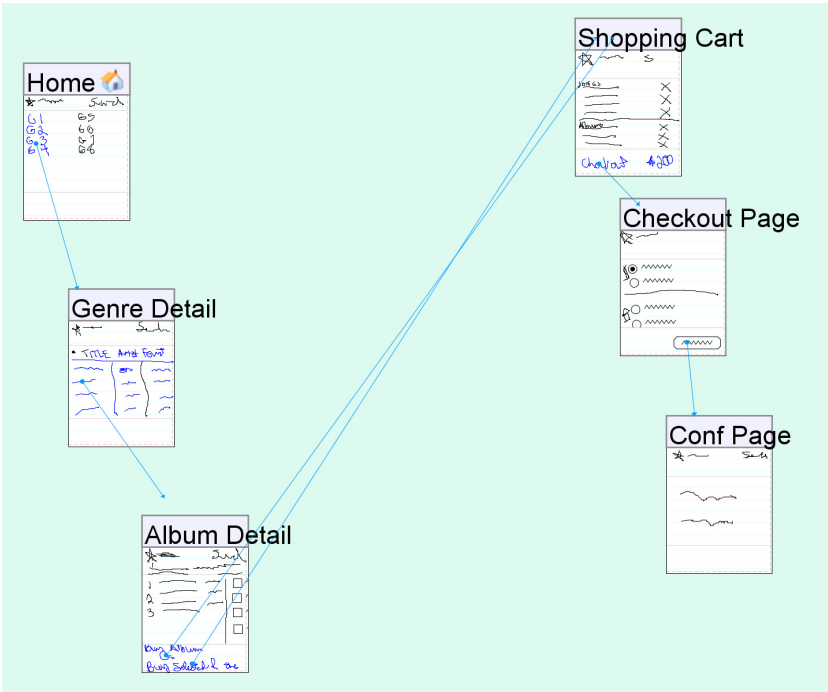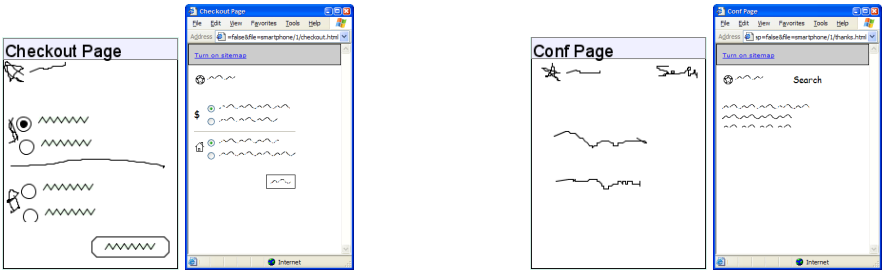
Smartphone
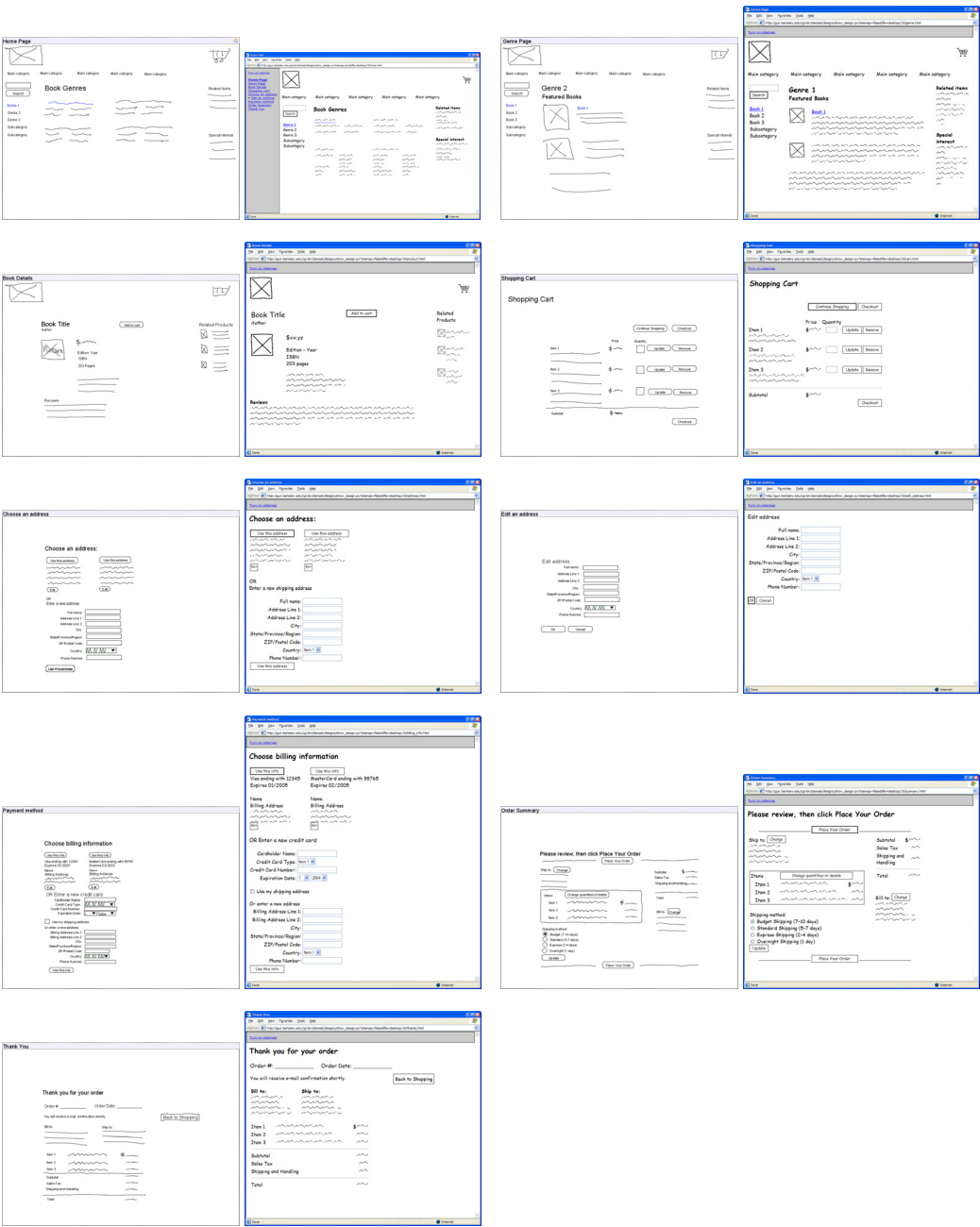
D.2.2 TotalBooks (with layers and patterns)
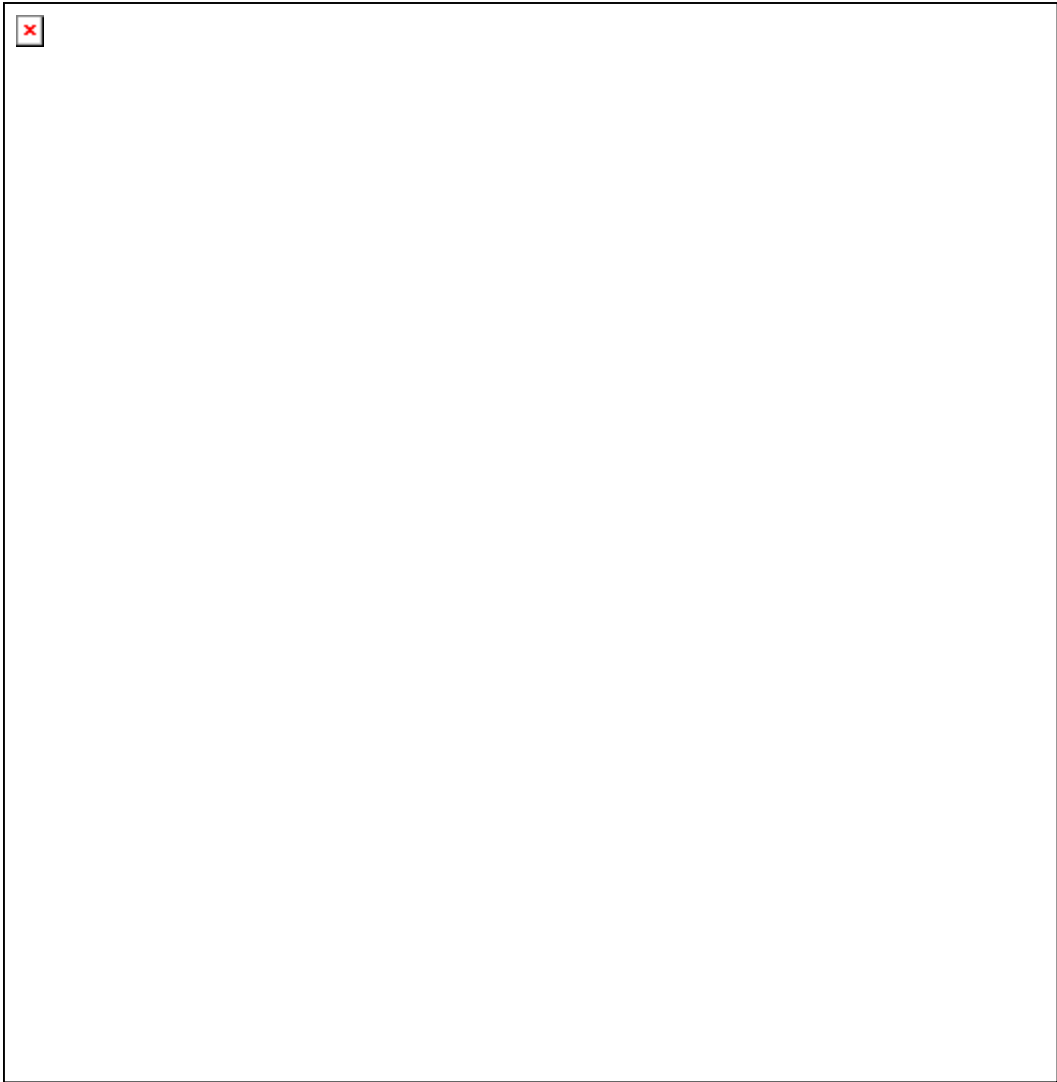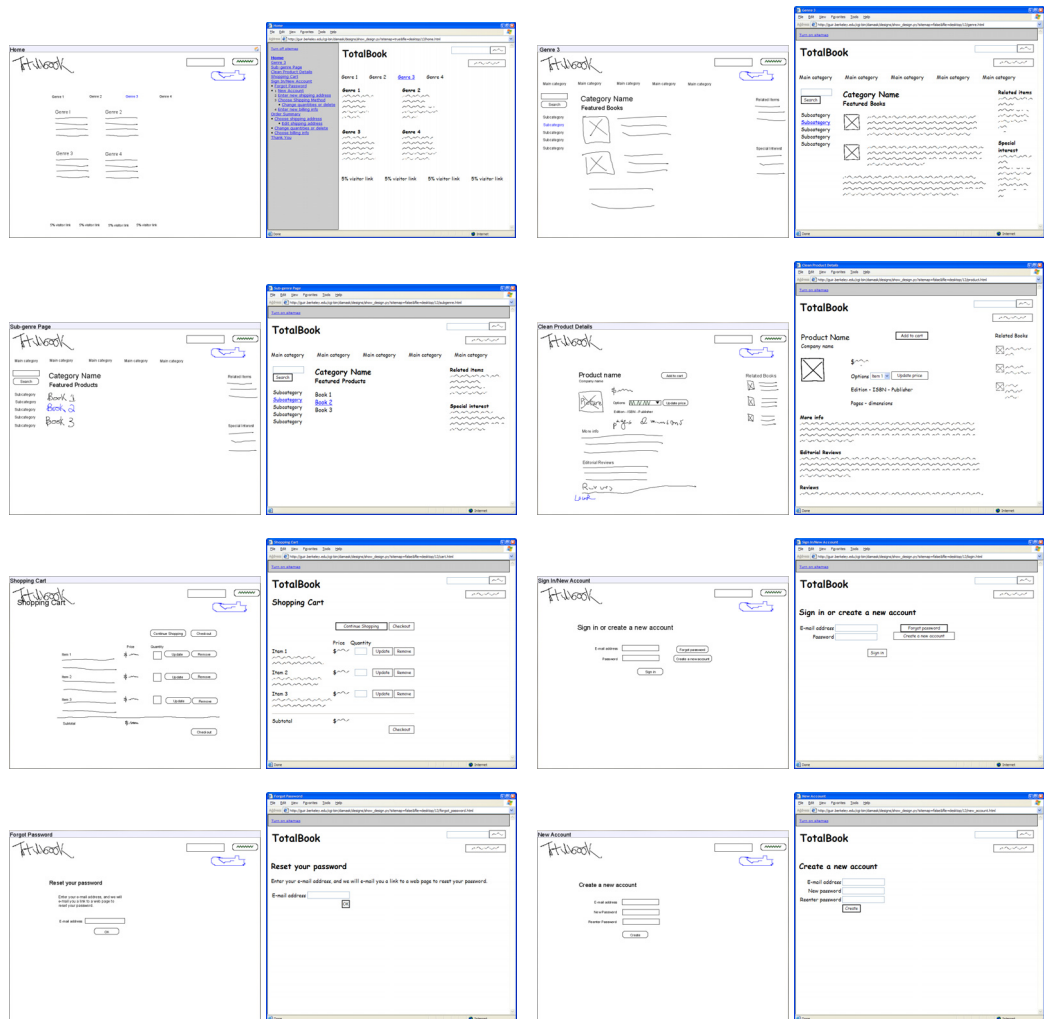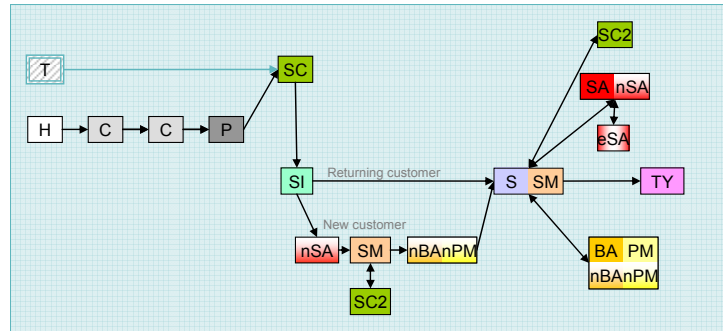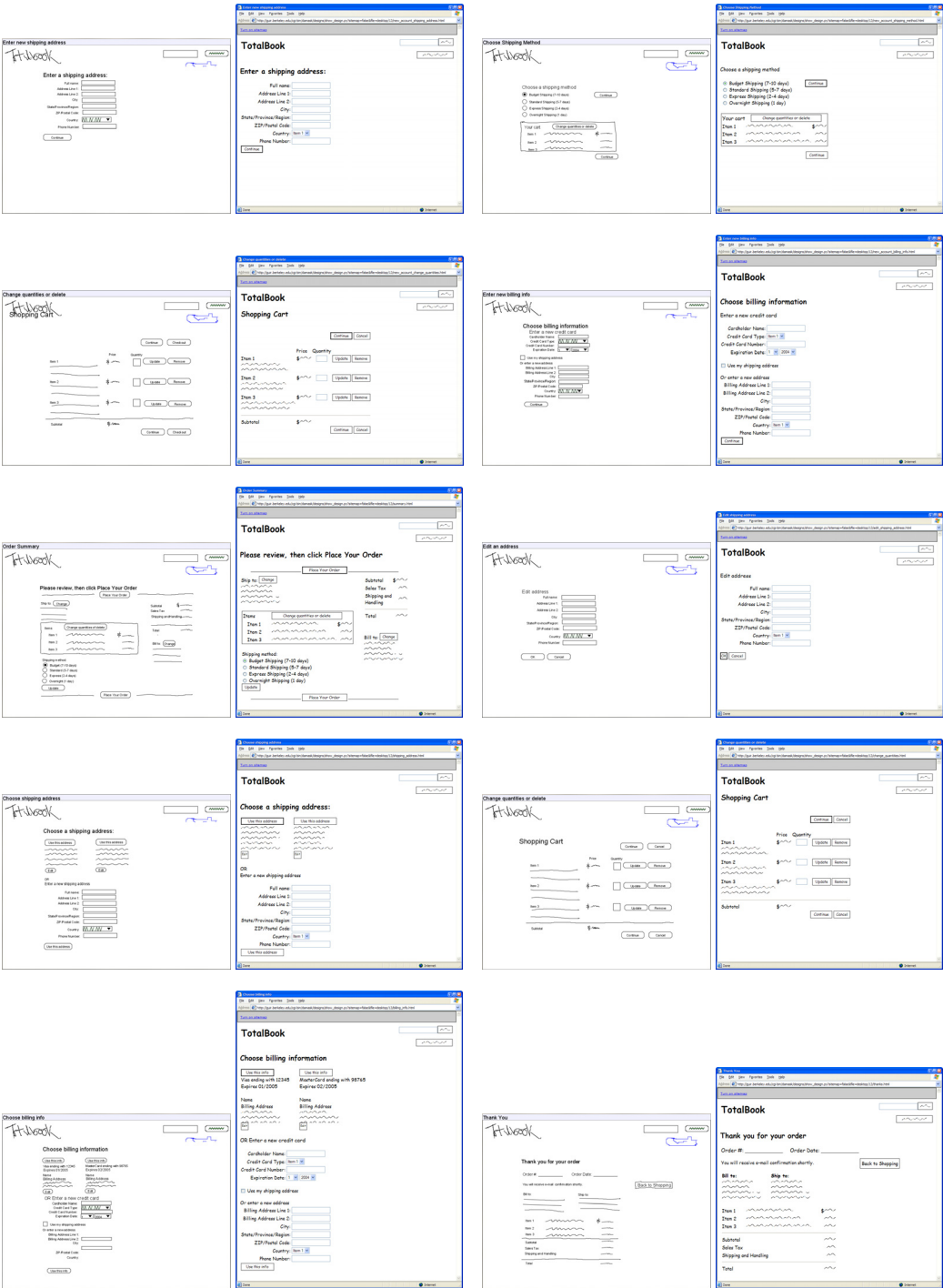
Desktop
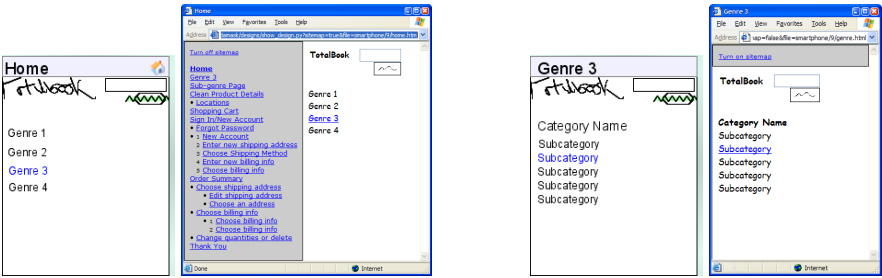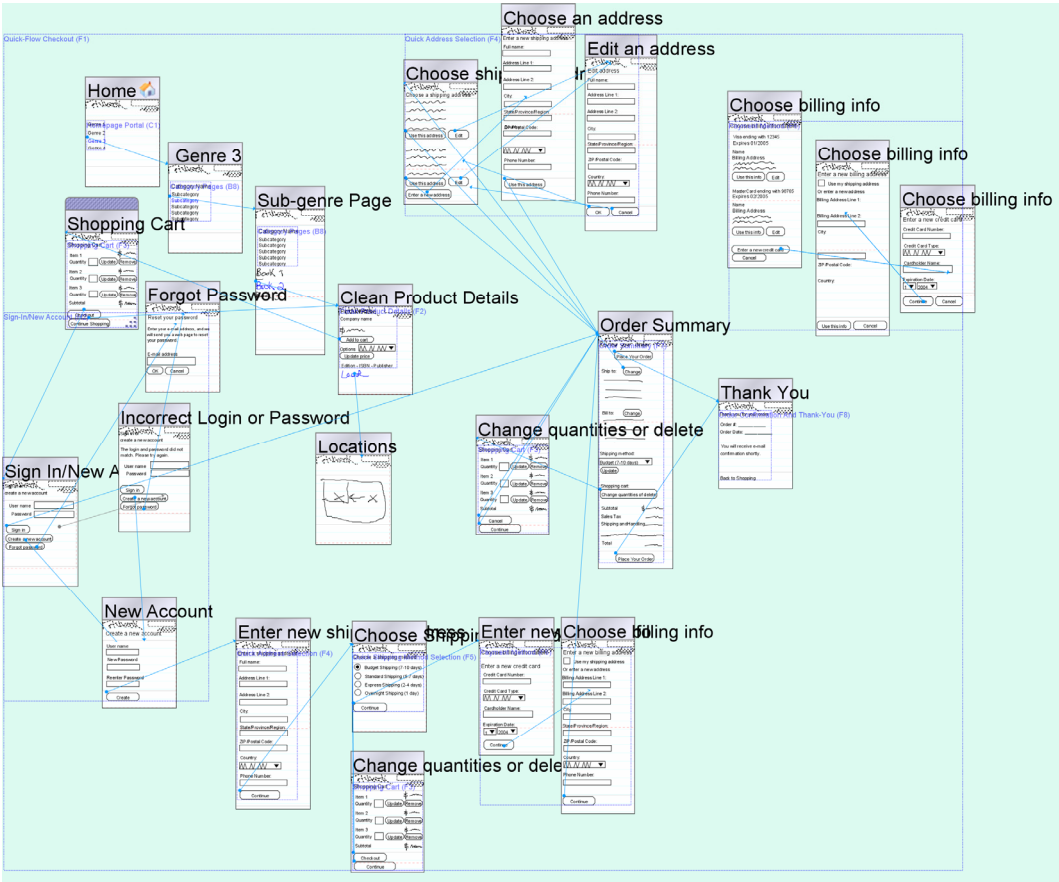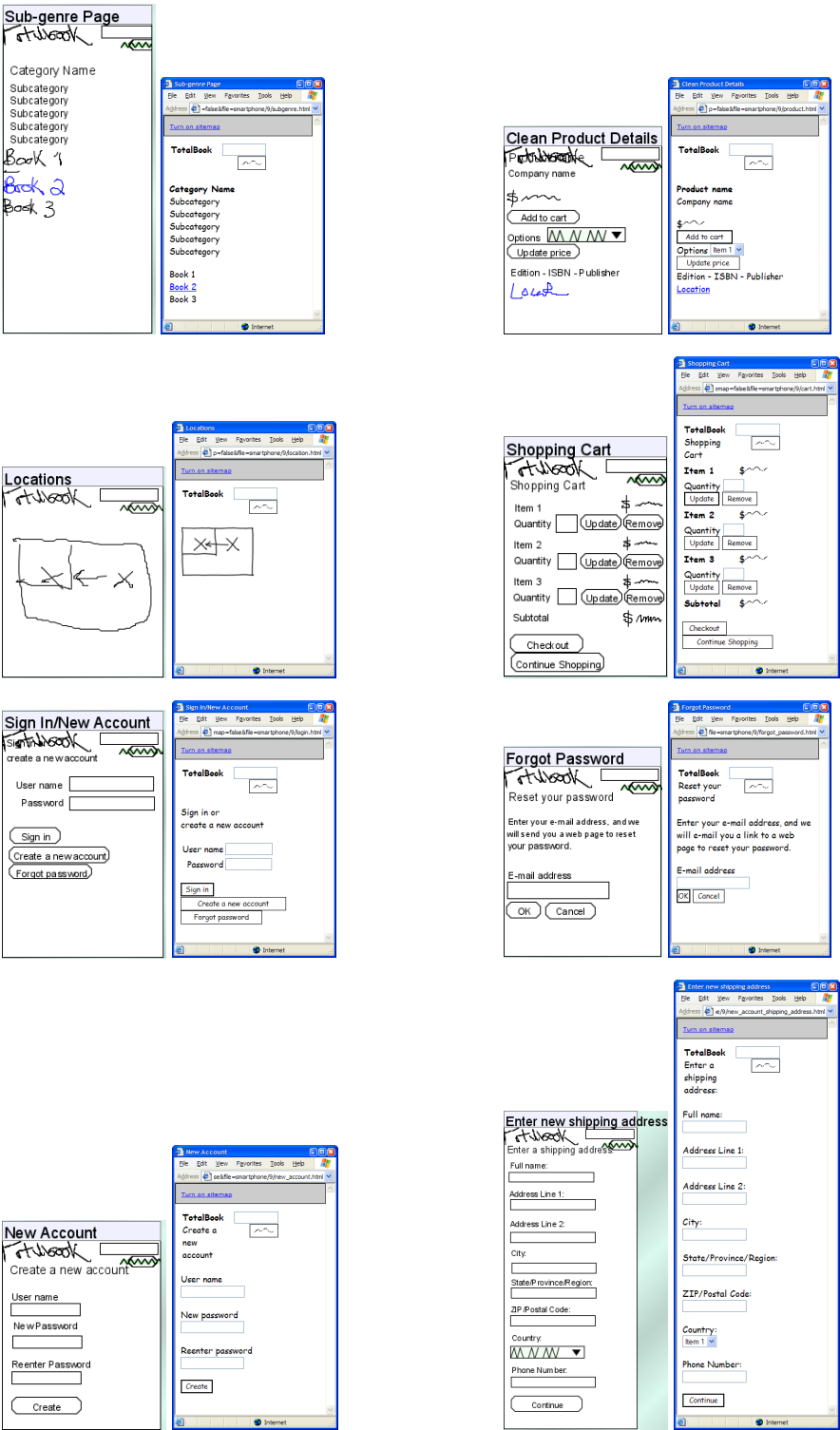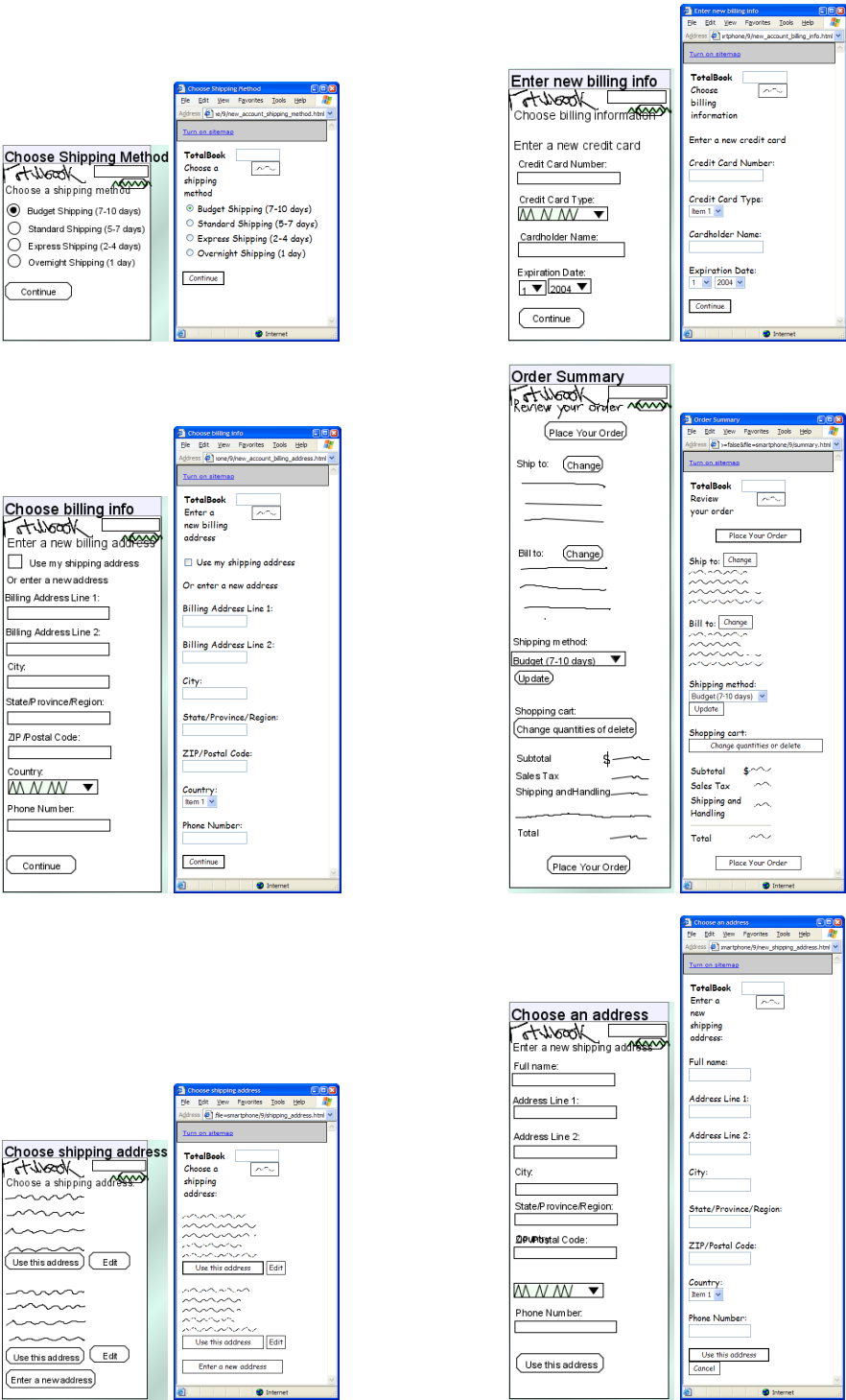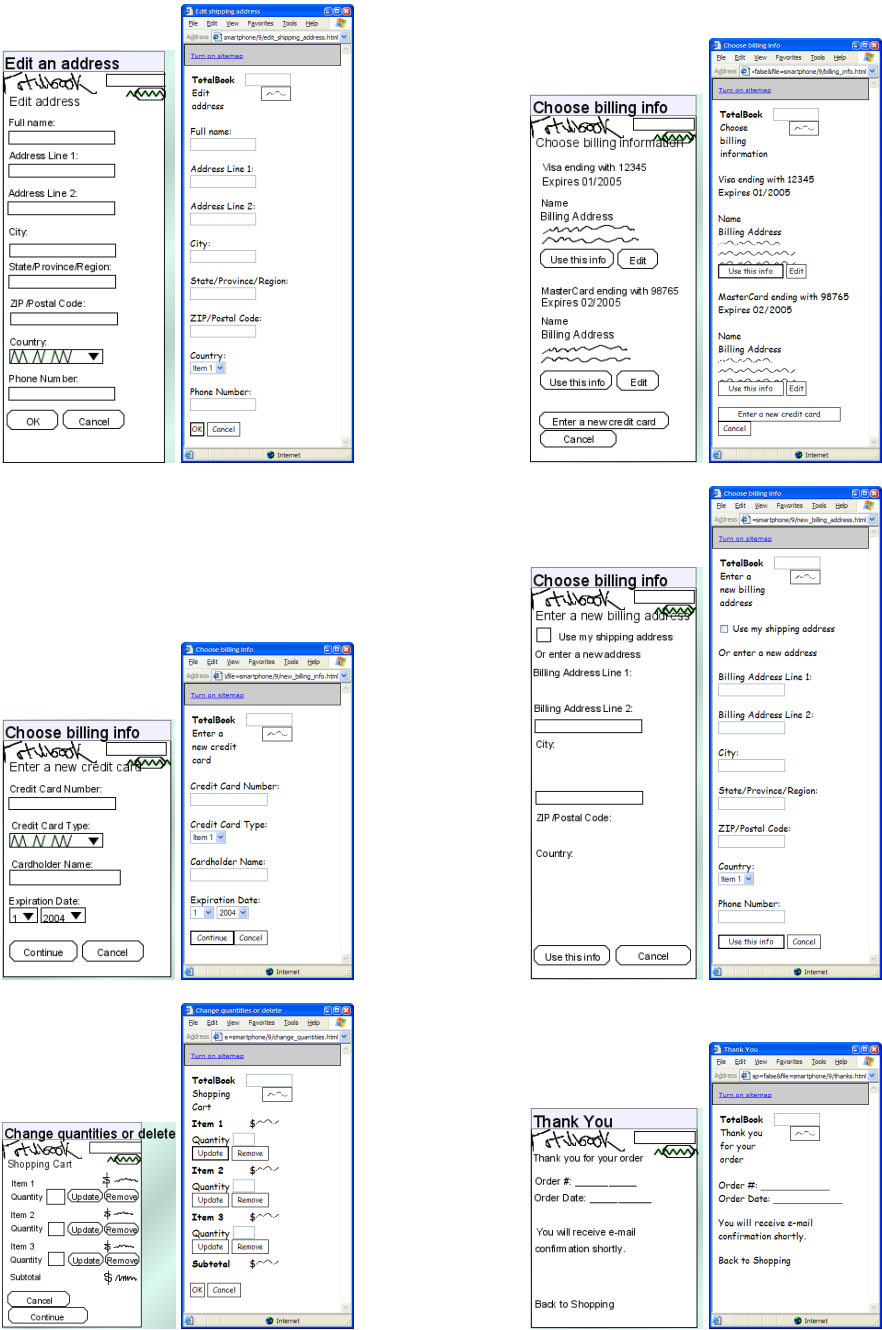
Smartphone

D.3 Designer 5

D.3.1 TotalMusic (no layers or patterns)
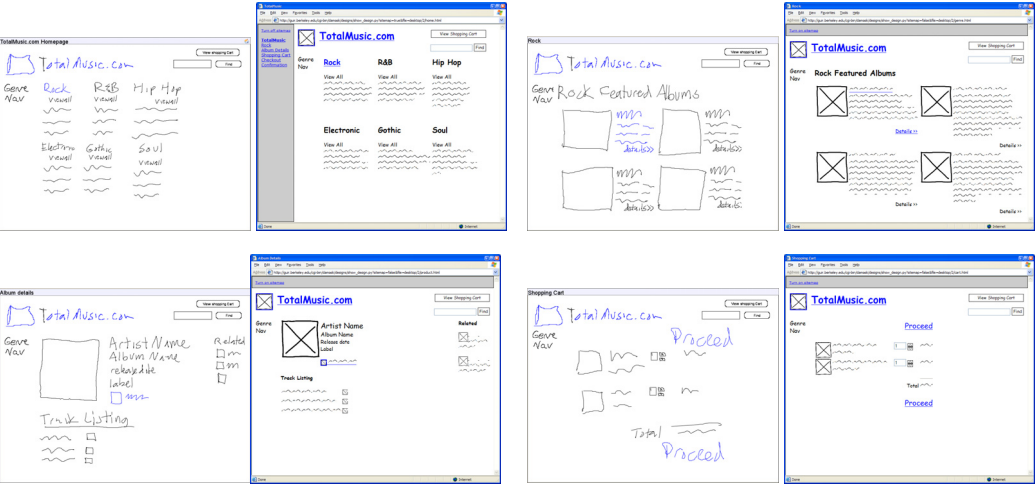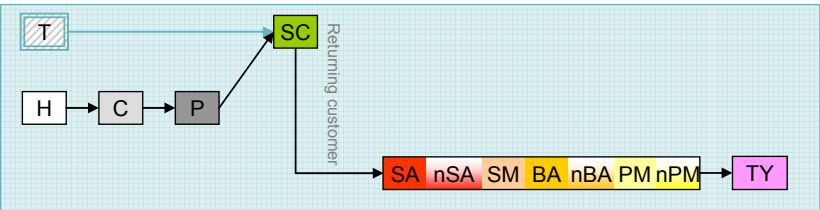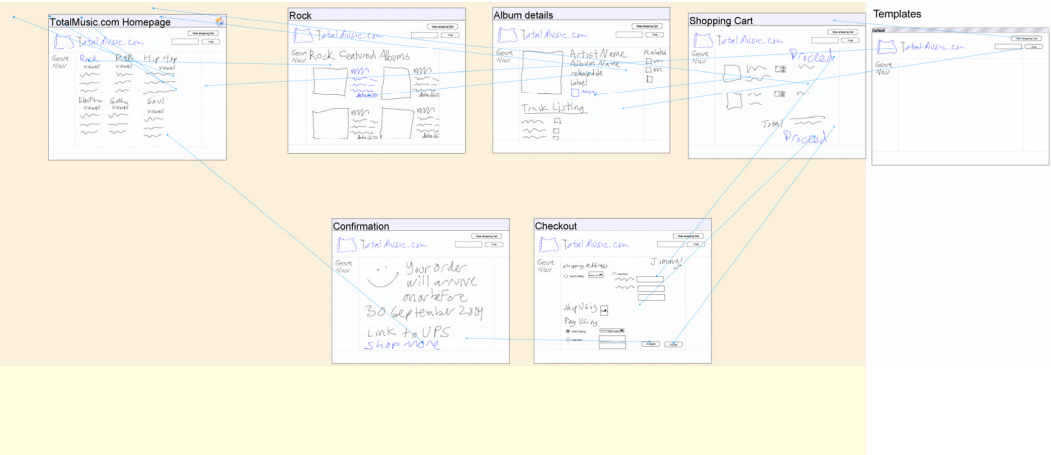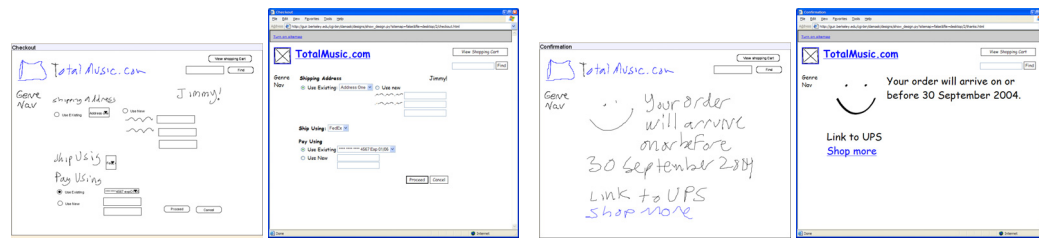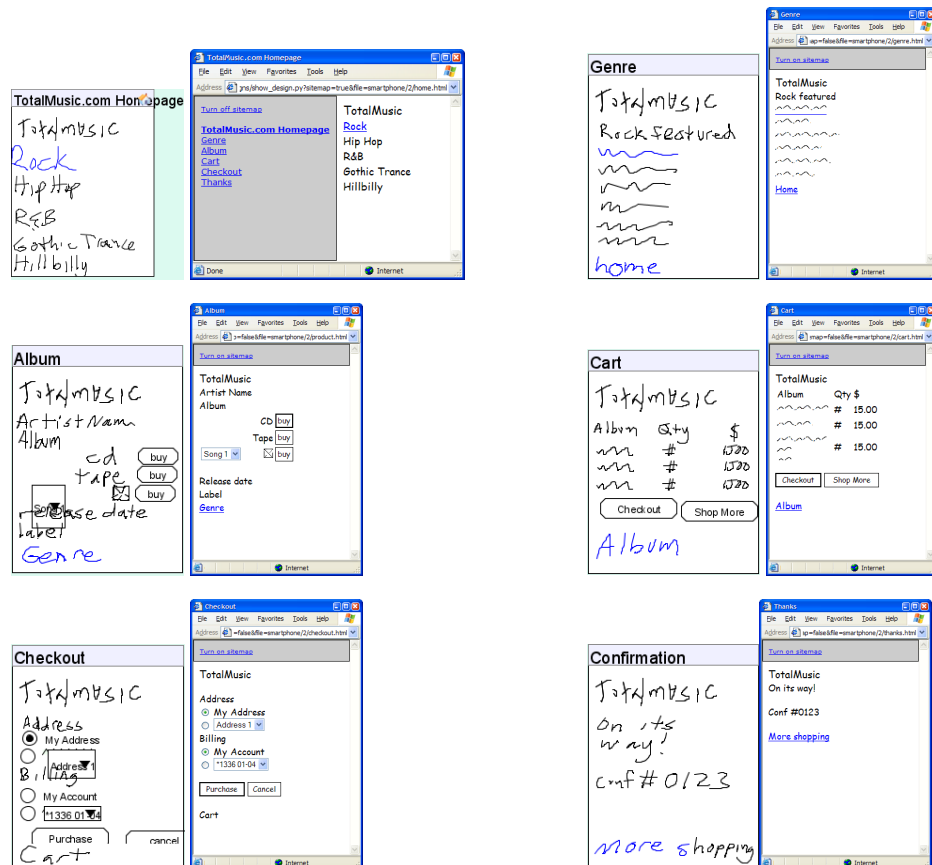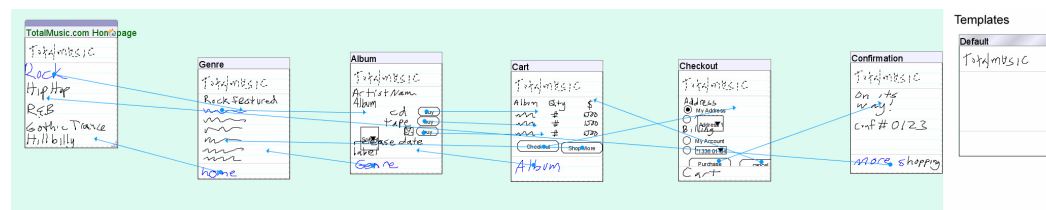
Desktop
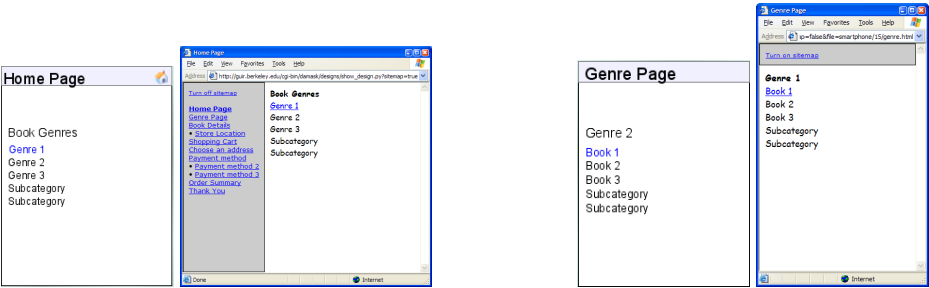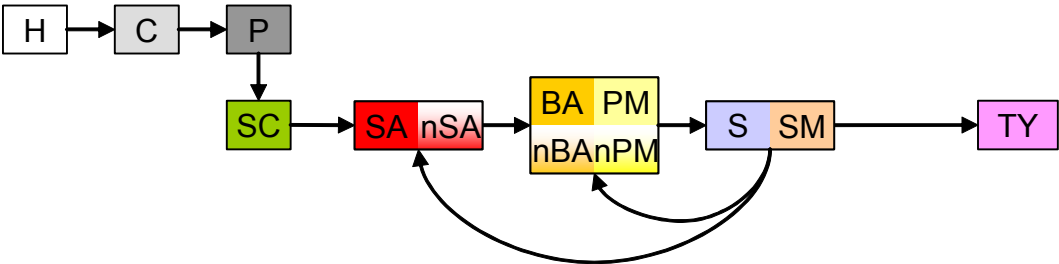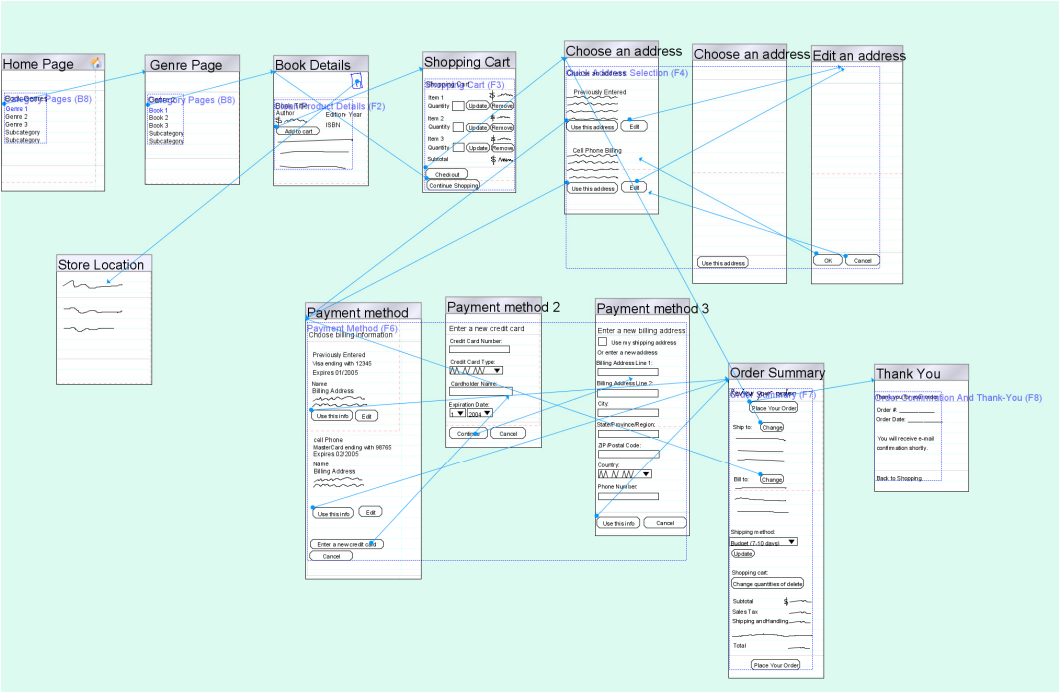
Smartphone

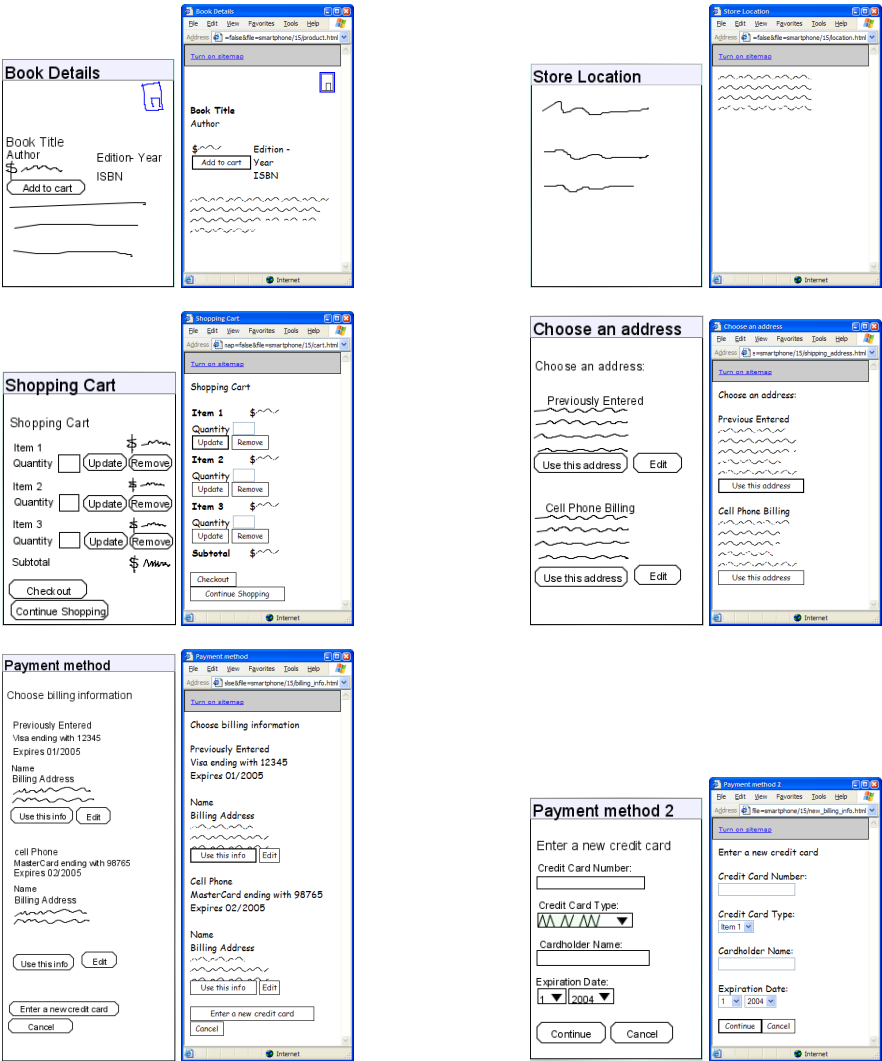## D.3.2 TotalBooks (with layers and patterns)
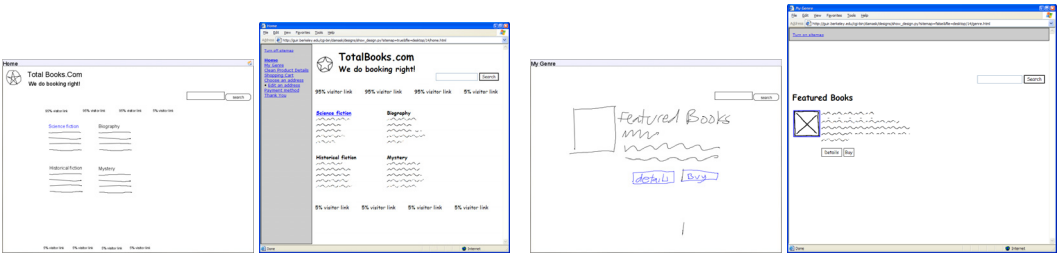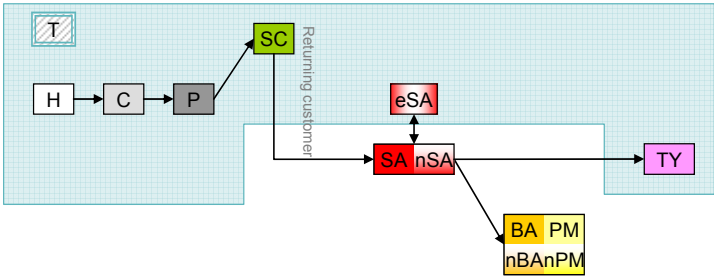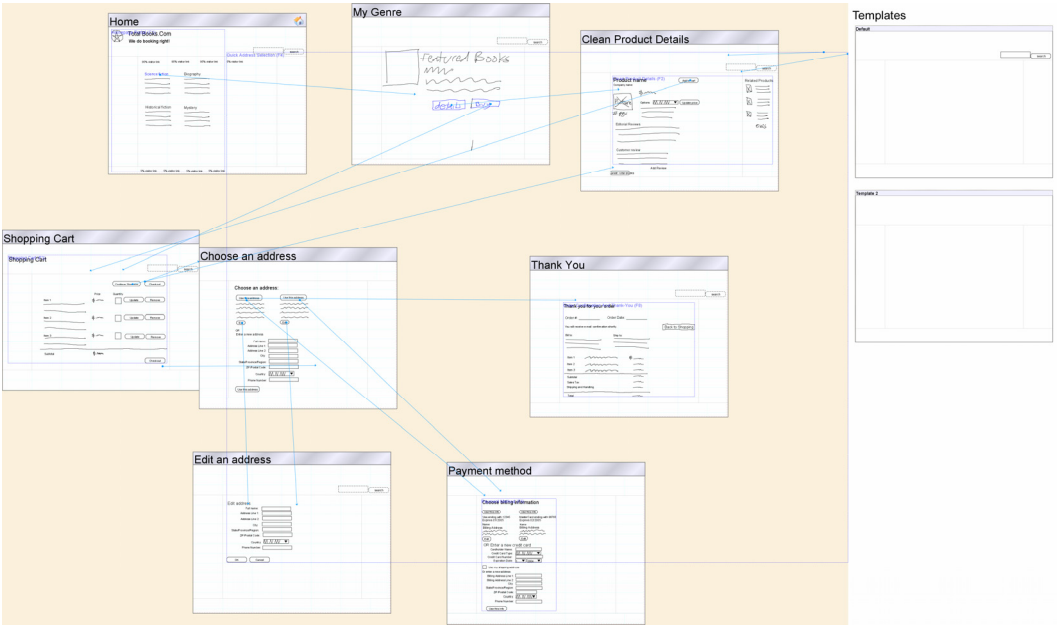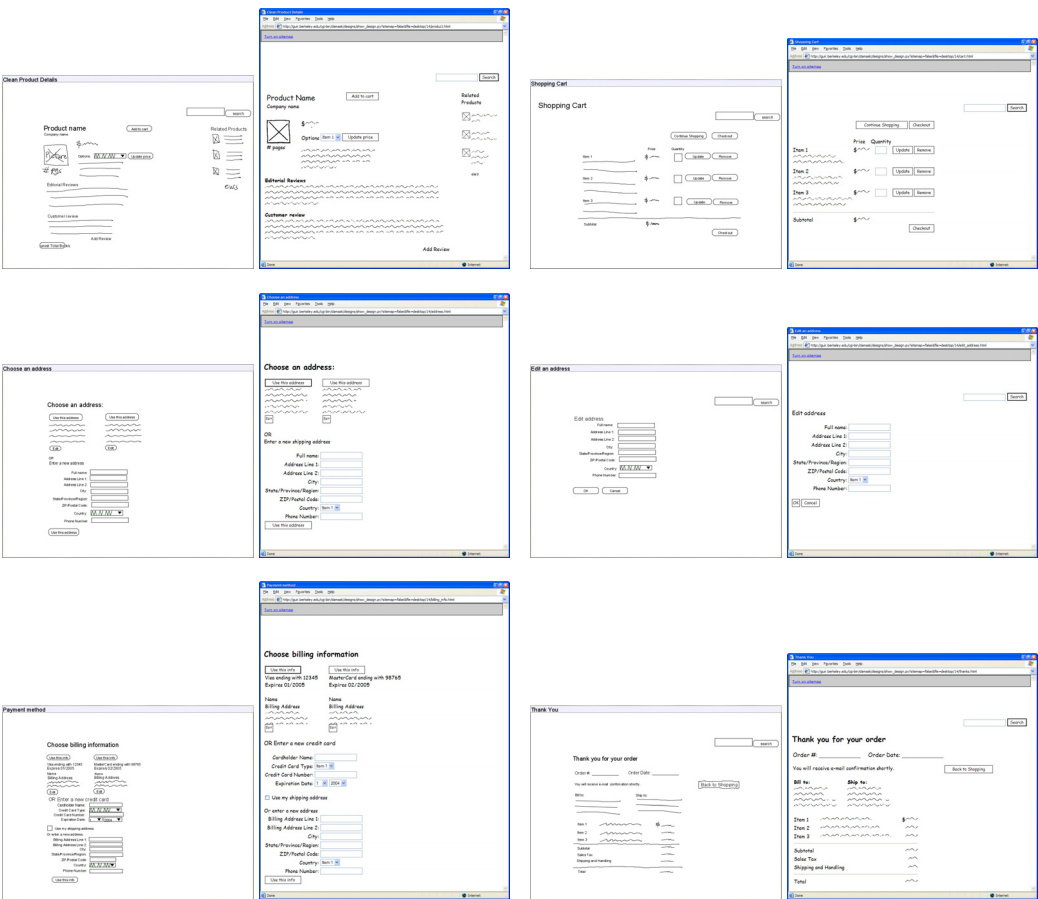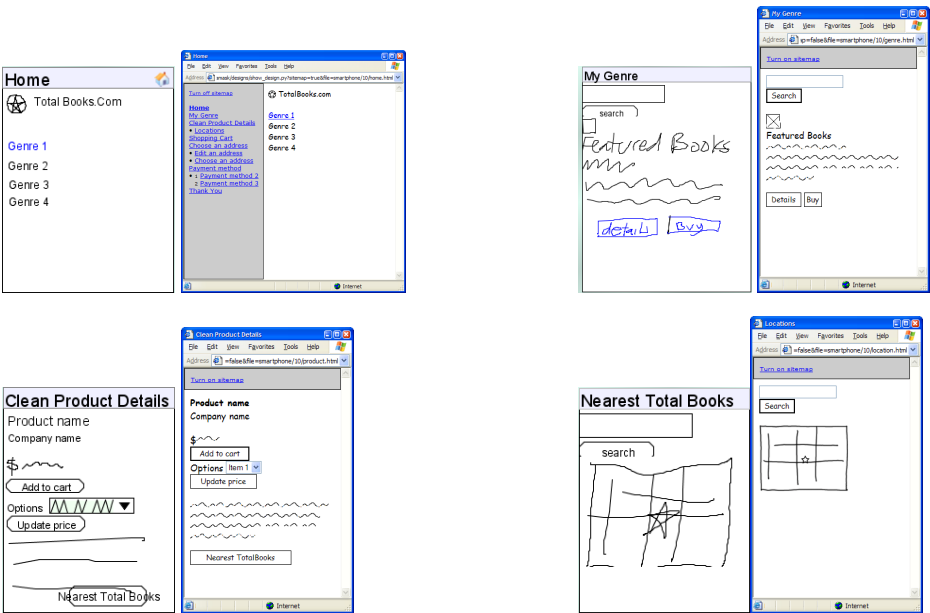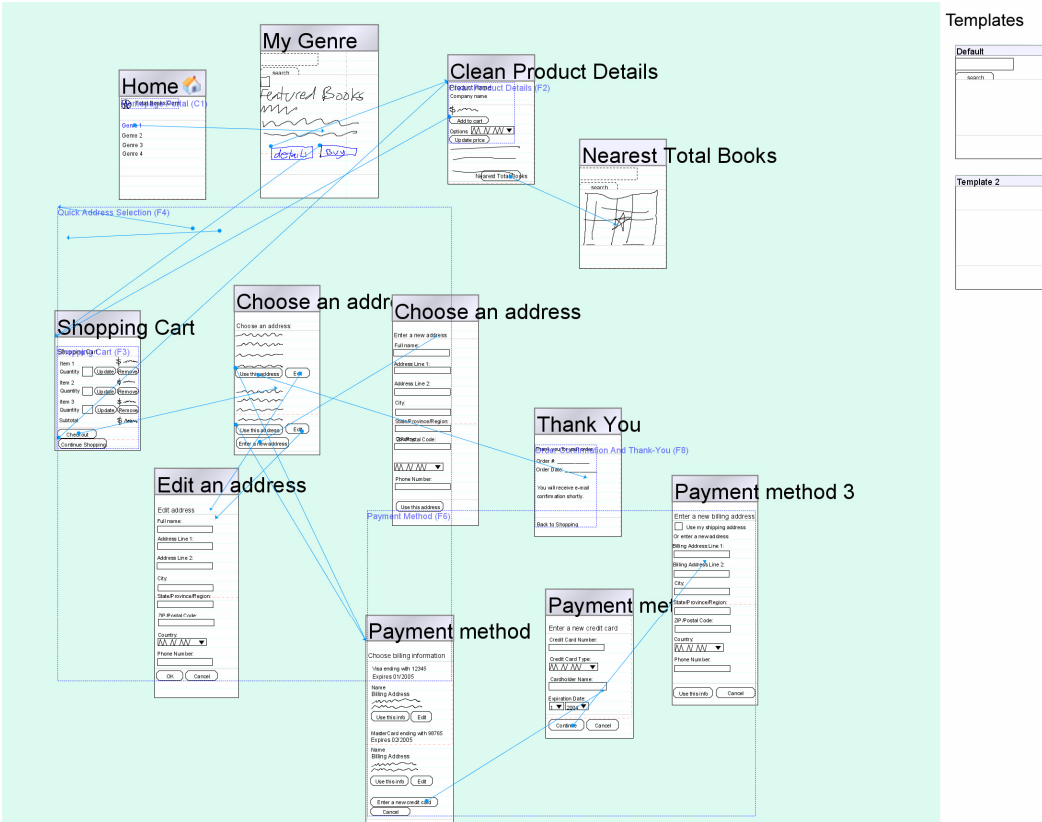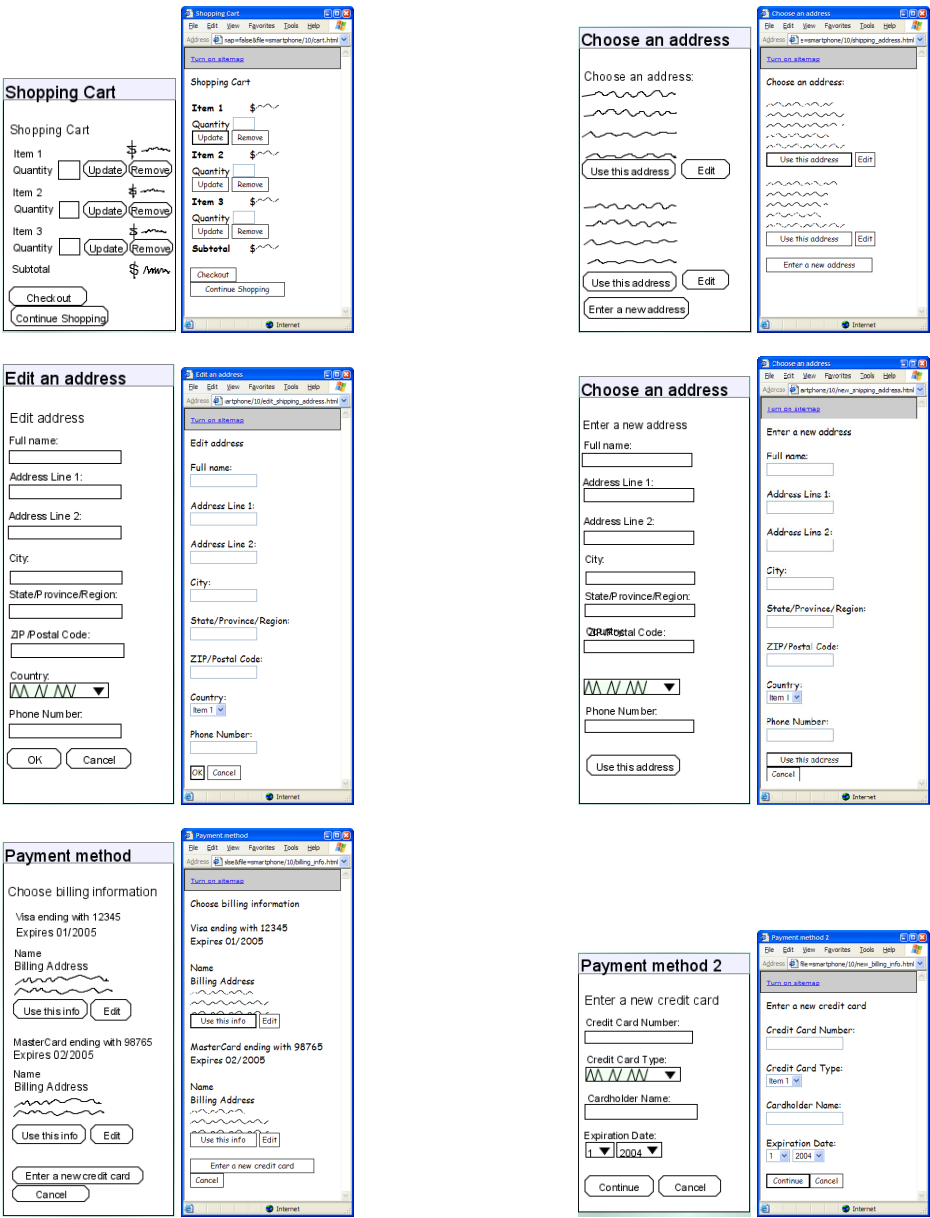
Desktop

Smartphone

Payment method 3

Enter a new billing address

☐ Use my shipping address

Or enter a new address

Billing Address Line 1:

Billing Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Country:

Phone Number:

[Use this info]   [Cancel]

Payment method 3

Address: smartphone/10/new_billing_address.html

Turn on sitemap

Enter a new billing address

☐ Use my shipping address

Or enter a new address

Billing Address Line 1:

Billing Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Country:
Item 1

Phone Number:

[Use this info] [Cancel]

Thank You

Thank you for your order

Order #: _____

Order Date: _____

You will receive e-mail
confirmation shortly.

Back to Shopping

Thank You

Address: j=false&file=smartphone/10/thanks.html

Turn on sitemap

Thank you for your order
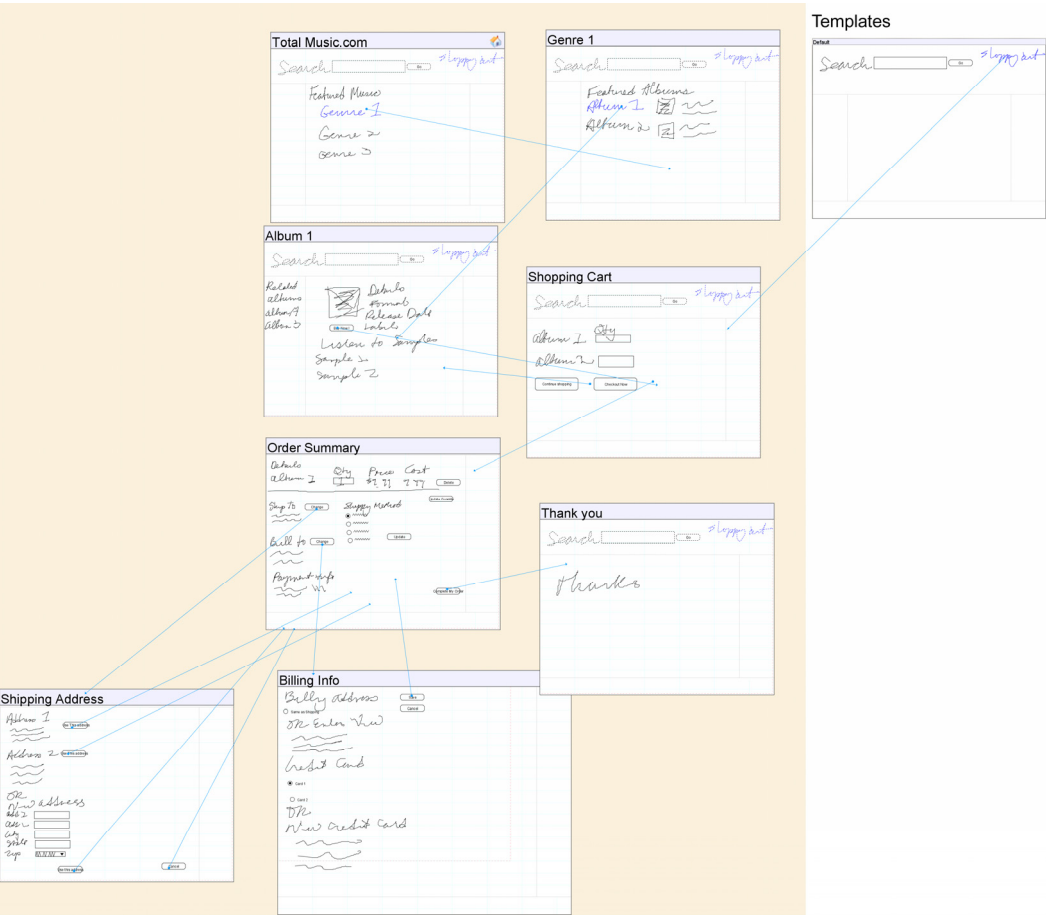
Order #: _____
Order Date: _____

You will receive e-mail
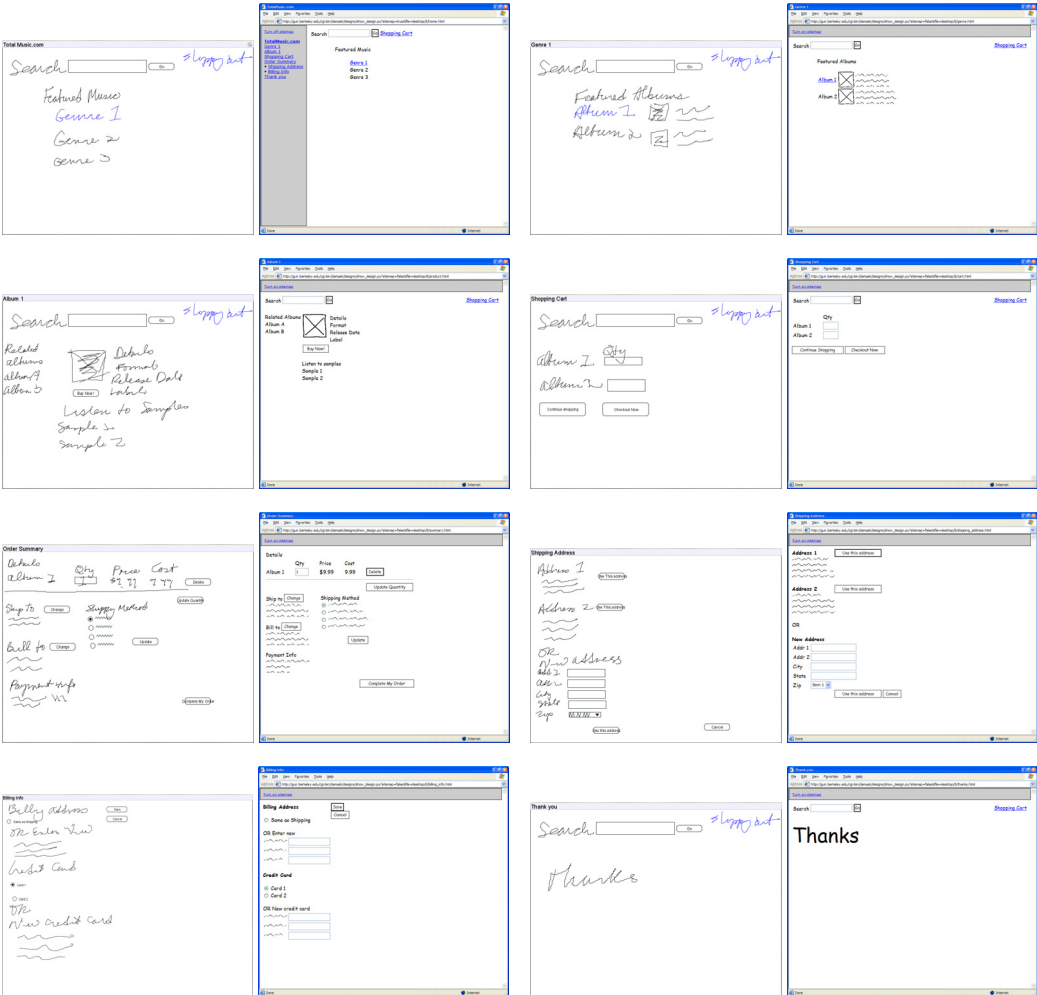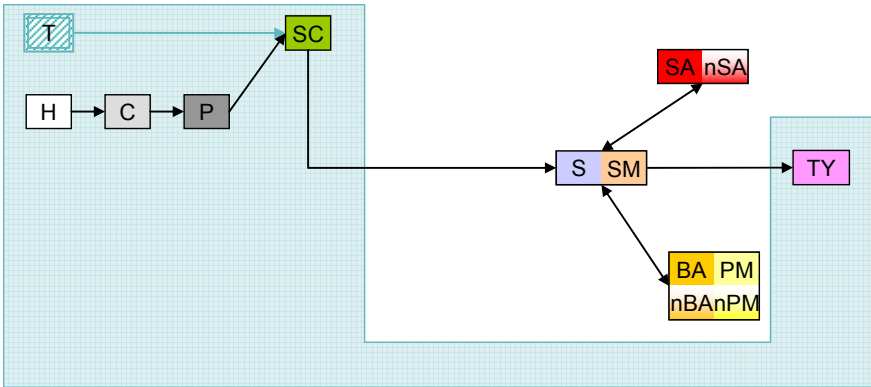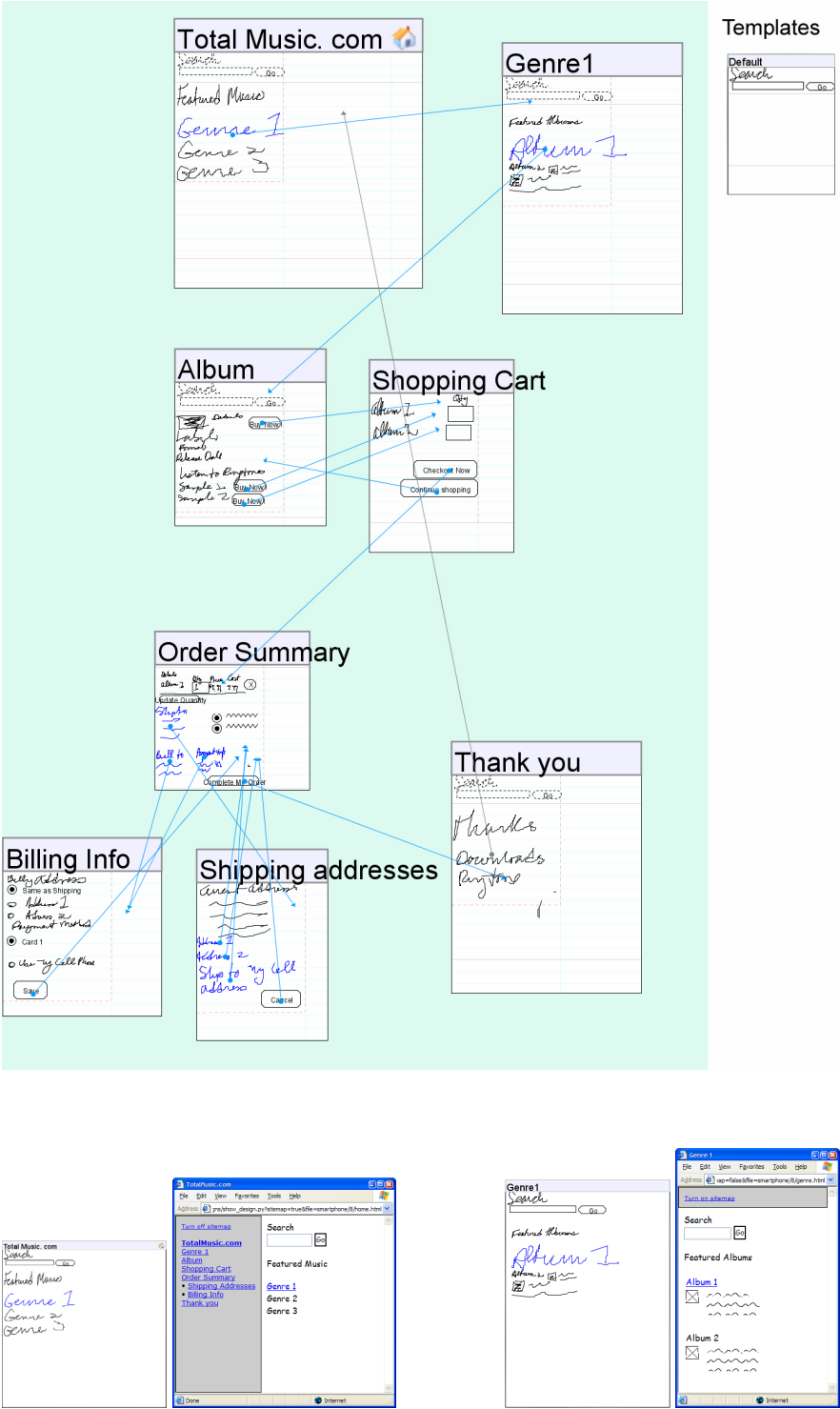confirmation shortly.

Back to Shopping

D.4 Designer 6

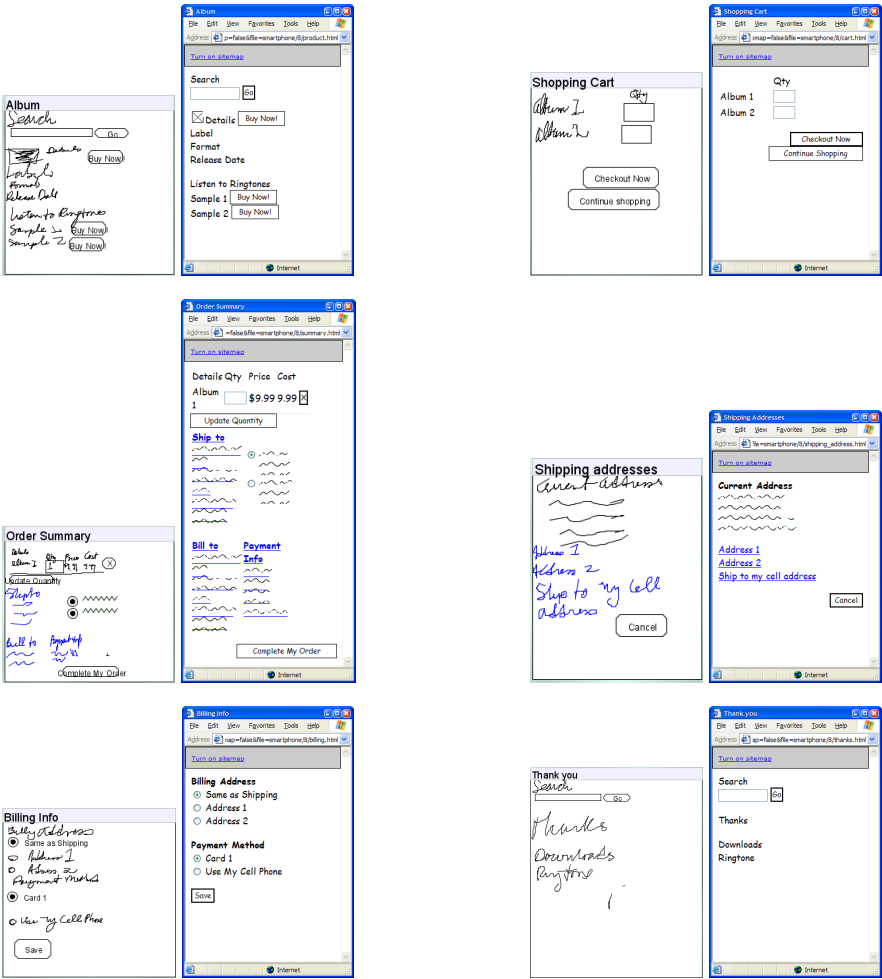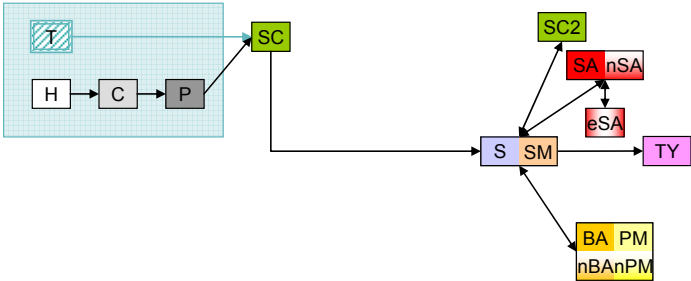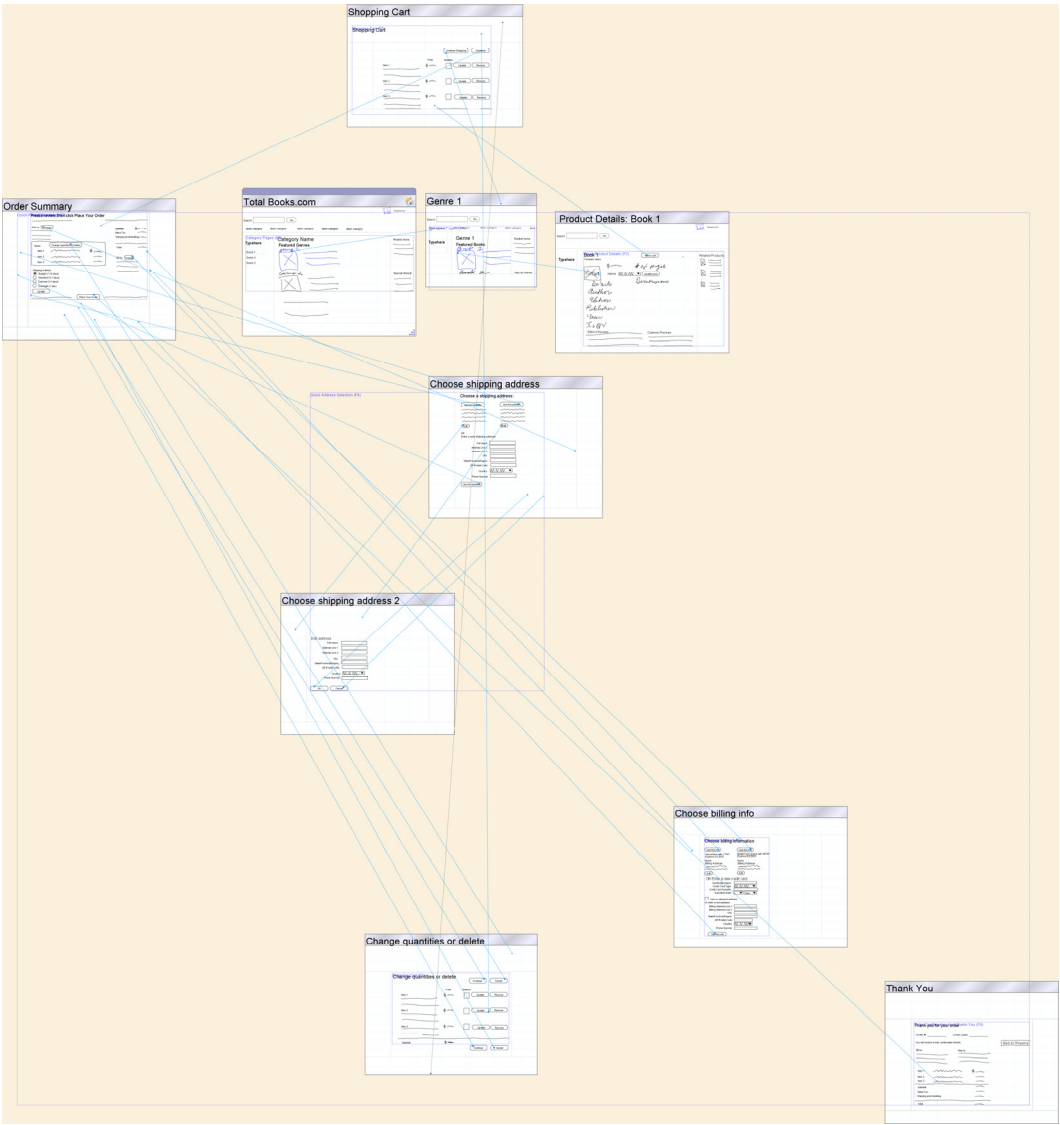### D.4.1 TotalMusic (no layers or patterns)

Desktop

Smartphone

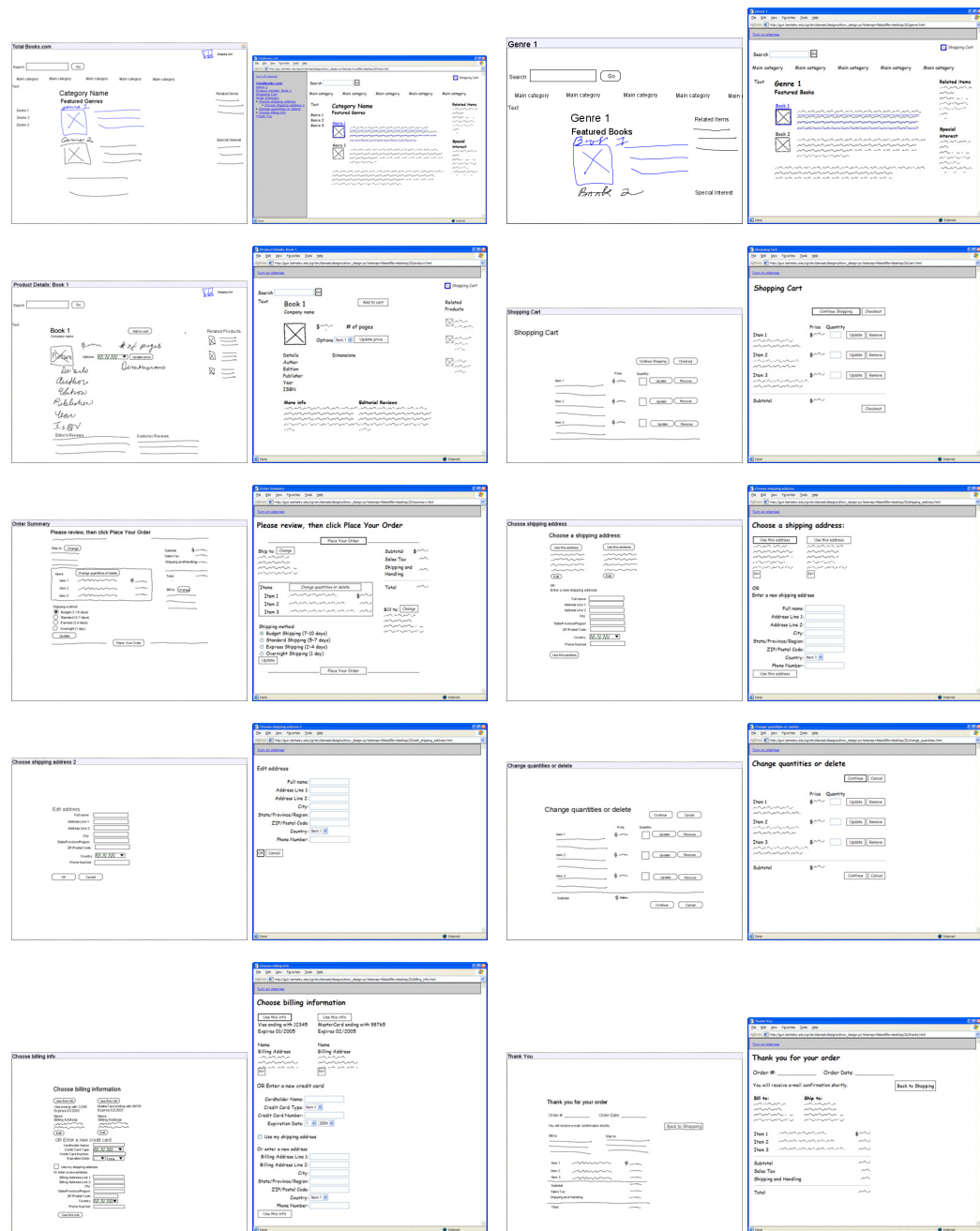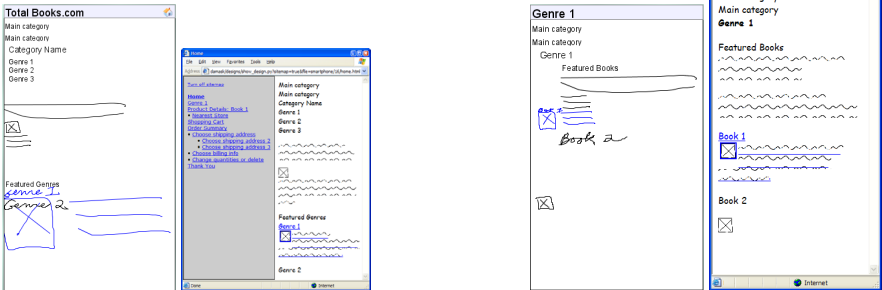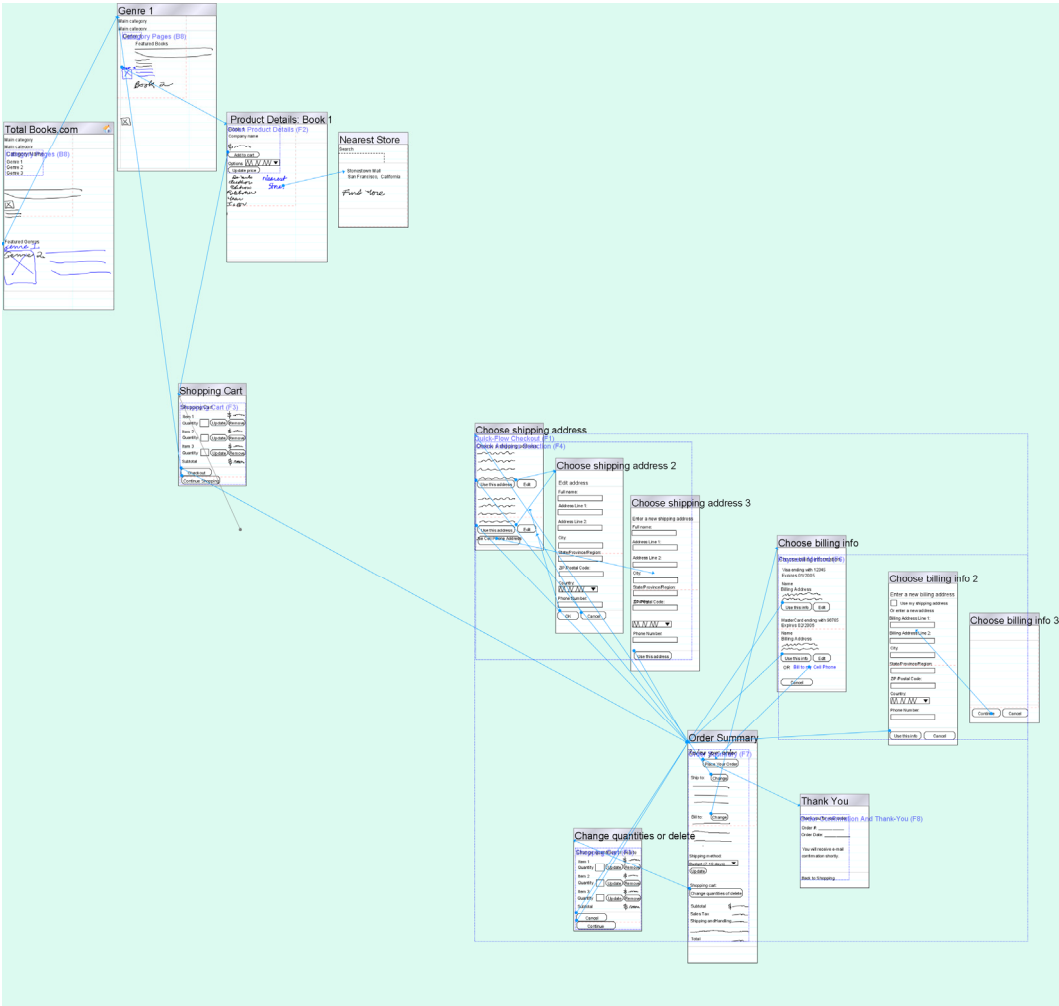## D.4.2 TotalBooks (with layers and patterns)

Desktop

Smartphone
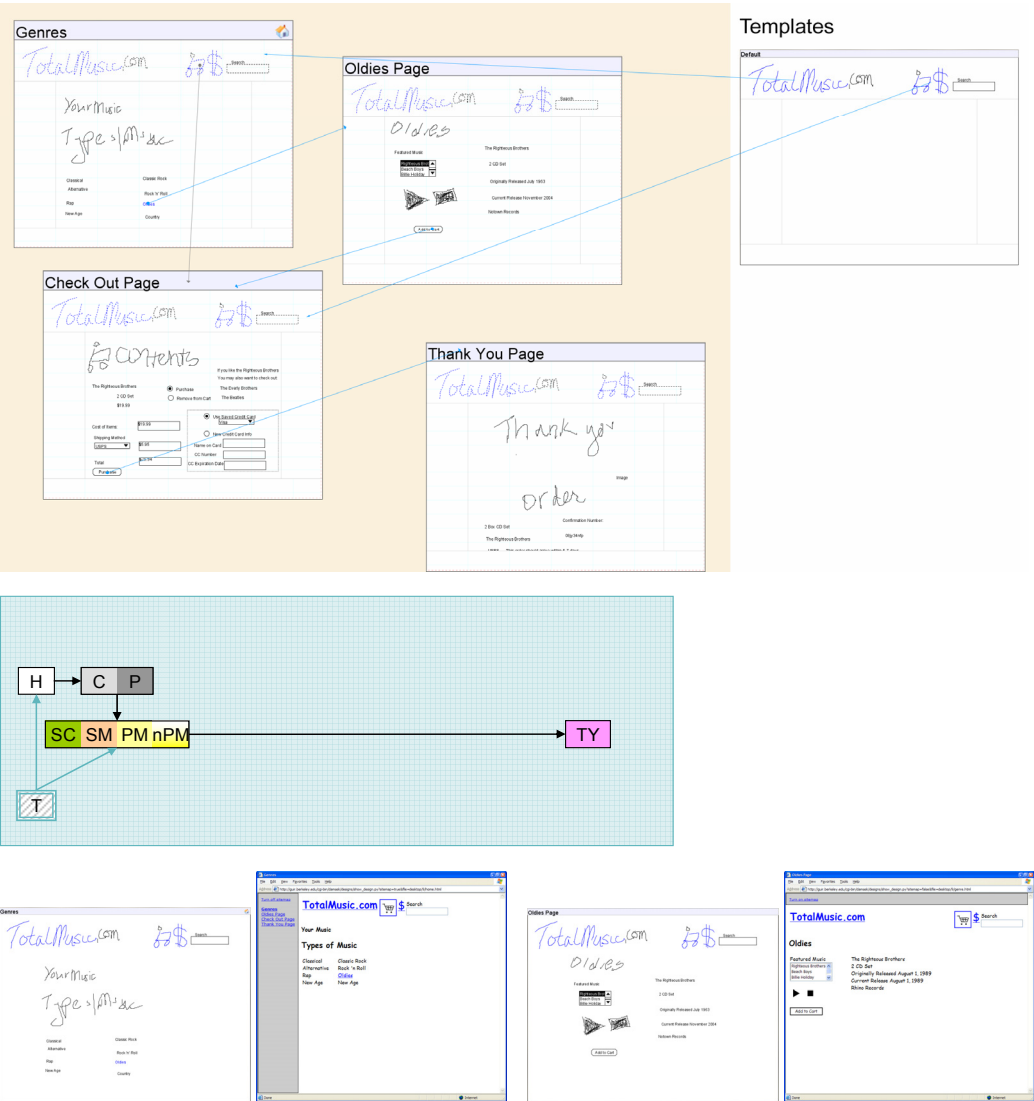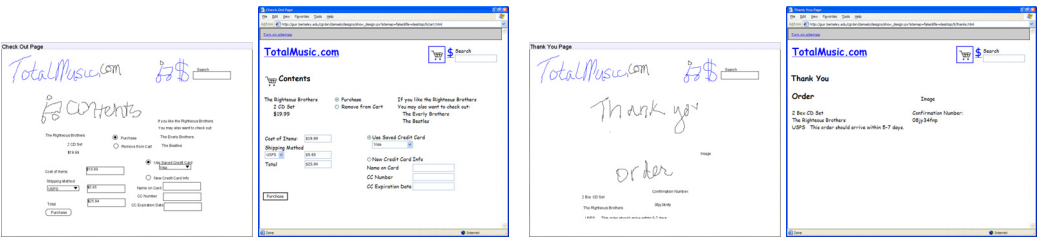
The Big Feeblest

TotalBooks.com
Raymond Chandler

Search

$

Add to cart

Options

Update price

Hardback
Vintage International, 1994
1234-5678-9012

Nearest Store

The Big Sleep

TotalBooks.com

Search

The Big Sleep
Raymond Chandler

$

Add to cart

Options   Item 1

Update price

Paperback
Vintage, 1988
0-394-75828-5

Nearest Store

Nearest Store

TotalBooks.com

Search

Locations

TotalBooks.com

Search

Shopping Cart

TotalBooks.com
Shopping Cart

Item 1 $
Quantity
Update   Remove
Item 2 $
Quantity
Update   Remove
Item 3 $
Quantity
Update   Remove
Subtotal $

Checkout
Continue Shopping

Shopping Cart

TotalBooks.com
Shopping Cart   Search

Item 1 $
Quantity
Update   Remove
Item 2 $
Quantity
Update   Remove
Item 3 $
Quantity
Update   Remove
Subtotal $

Checkout
Continue Shopping

Sign In/New Account

TotalBooks.com
create a new account

User name
Password

Sign in
Create a new account
Forgot password

Sign In/New Account

TotalBooks.com

Search

Sign in or
create a new account

User name
Password

Sign in
Create a new account
Forgot password

Forgot Password

TotalBooks.com
Reset your password

Enter your e-mail address, and we will

E-mail address

OK   Cancel

Forgot Password

TotalBooks.com
Reset your
password   Search

Enter your e-mail address, and we
will e-mail you a link to a web
page to reset your password.

E-mail address

OK   Cancel

New Account

TotalBooks.com
Create a new account

User name

New Password

Reenter Password

Create

New Account

TotalBooks.com
Create a new
account   Search

User name

New password

Reenter password

Create

Enter a shipping address

TotalBooks.com
Enter a shipping address:
Full name:

Address Line 1:

Address Line 2:

City:

State/province/region:

ZIP/Postal Code:

Country:

Phone Number:

Continue

Enter new shipping address

TotalBooks.com
Enter a shipping
address: Search

Full name:

Address Line 1:

Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Country:
Item 1

Phone Number:

Continue

Choose Shipping Method

TotalBooks.com
Choose a shipping method

○ Budget Shipping (7-10 days)
○ Standard Shipping (5-7 days)
○ Express Shipping (2-4 days)
○ Overnight Shipping (1 day)

Continue

Choose Shipping Method

TotalBooks.com
Choose a
shipping method   Search

○ Budget Shipping (7-10 days)
○ Standard Shipping (5-7 days)
○ Express Shipping (2-4 days)
○ Overnight Shipping (1 day)

Continue

Choose billing info

TotalBooks.com
Choose billing information

Visa ending with 12345E xpires 01/2

◉ 〰〰〰
NameBilling Address

〰〰〰〰〰

[Use this info] (Edit)

◯ 〰〰〰
MasterCard ending with 98765E xpir

NameBilling Address

〰〰〰〰

[Use this info] (Edit)

◉ Bill to my cell phone bill

Choose billing info

TotalBooks.com
Choose billing
information   [Search]

◉ Visa ending with 12345
Expires 01/2005

Name
Billing Address
〰〰〰〰
[Use this info][Edit]

◯ MasterCard ending with 98765
Expires 02/2005

Name
Billing Address
〰〰〰〰
[Use this info][Edit]

◯ Bill to my cell phone bill

Shopping Cart

TotalBooks.com
Shopping Cart

Item 1 $ 〰
Quantity [   ] (Update)(Remove)
Item 2 $ 〰
Quantity [   ] (Update)(Remove)
Item 3 $ 〰
Quantity [   ] (Update)(Remove)
Subtotal $ 〰〰
(Cancel)
(Continue)

Change quantities or delete

TotalBooks.com
Shopping Cart   [Search]
Item 1 $〰〰
Quantity
[Update][Remove]
Item 2 $〰〰
Quantity
[Update][Remove]
Item 3 $〰〰
Quantity
[Update][Remove]
Subtotal $〰〰
[OK] [Cancel]

Thank You

TotalBooks.com
Thank you for your order

Order #: _____
Order Date: _____

You will receive e-mail
confirmation shortly.

Back to Shopping

Thank You

TotalBooks.com
Thank you for   [Search]
your order

Order #: _____
Order Date: _____

You will receive e-mail
confirmation shortly.

Back to Shopping

D.5 Designer 7

D.5.1 TotalMusic (no layers or patterns)

Desktop

Smartphone
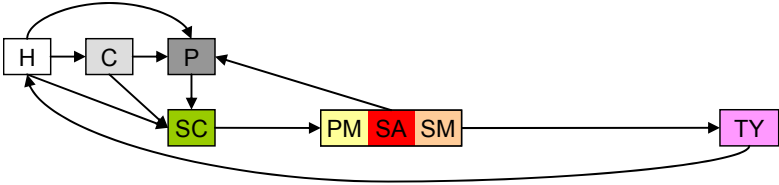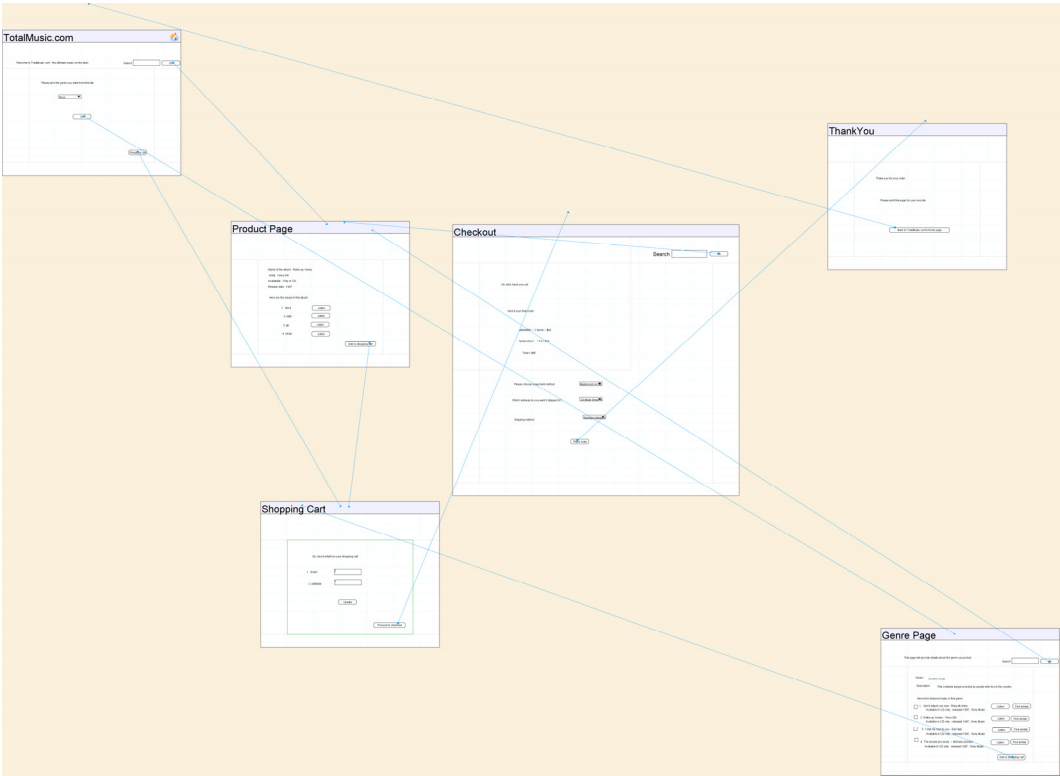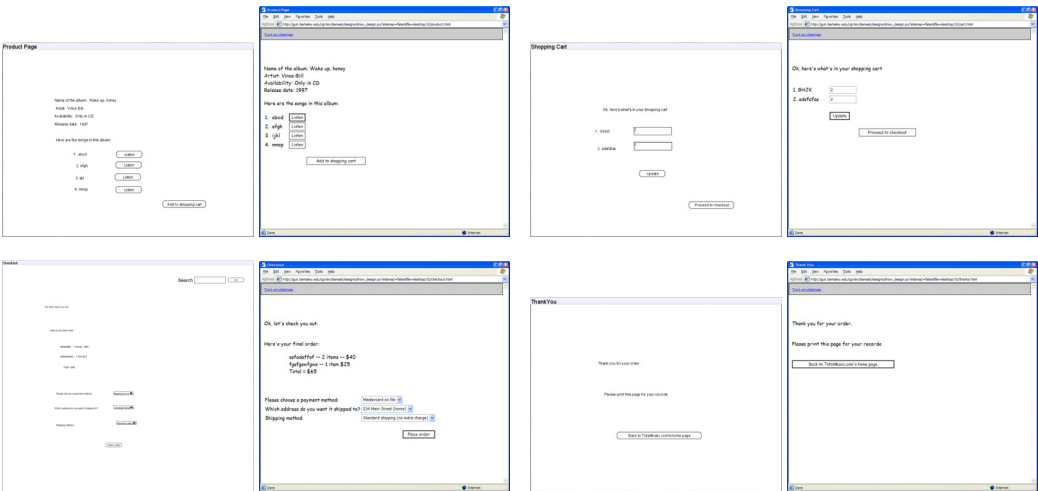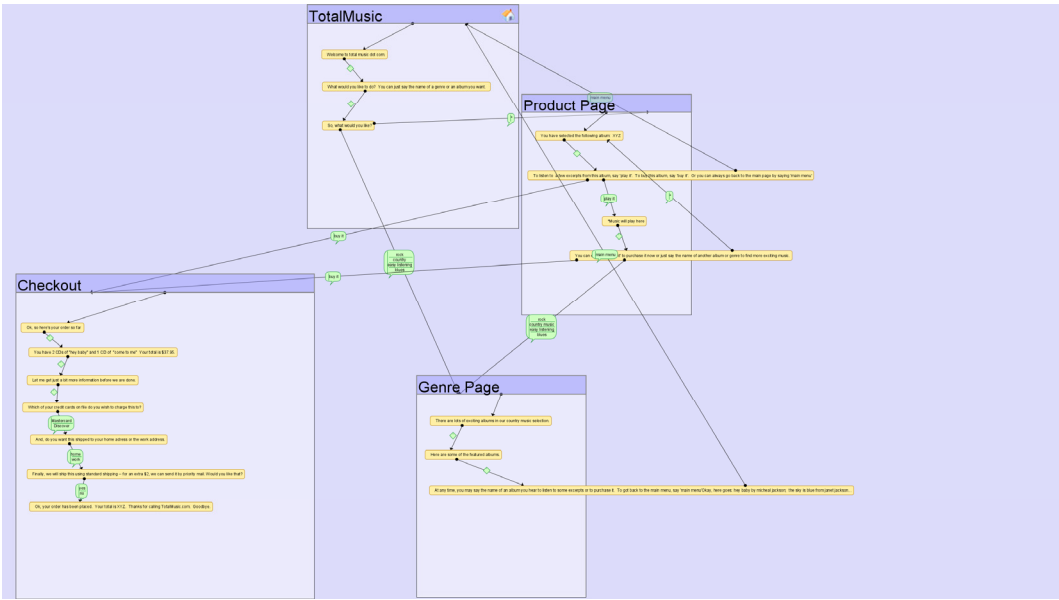

Templates

Album

search

Albums

I. Album I
2. Album 2
3. Album 3

Album (browser)

Turn on sitemap

Search

Albums

1. Album 1
2. Album 2
3. Album 3

Detail

search

Album 3

I. Song 1
2. Song 2
3. Song 3

Detail (browser)

Turn on sitemap

Search

Album 1

1. Song 1
2. Song 2
3. Song 3

Song 1

search

Song 1

I. Listen
2. Buy

Song 1 (browser)

Turn on sitemap

Search

Song 1

1. Listen
2. Buy

Buy

search

Purchase

my Name

I. Choose Address
2. Choose payment
3.Shipping method

Buy (browser)

Turn on sitemap

Search

Purchase

1. Choose address
2. Choose payment
3. Shipping method

Choose Address

search

Choose Address

I. cell phone address
2. Address I
3. Address 2

Choose address (browser)

Turn on sitemap

Search

Choose Address

1. Cell phone address
2. Address 1
3. Address 2

Thank You

search

Thank You

You have purchased

I. Play tune
2.Browse more
3. exit

Thank You (browser)

Turn on sitemap
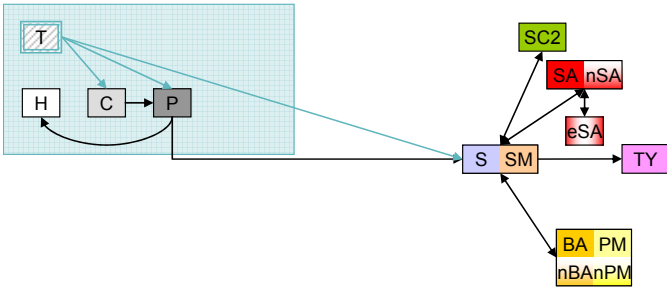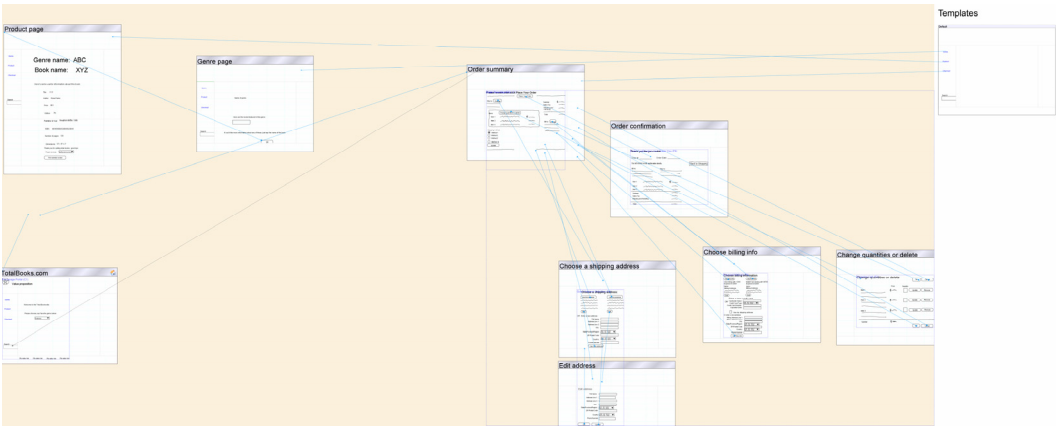
Search

Thank You

You have purchased

1. Play tune
2. Browse more
3. Exit

D.5.2 TotalBooks (with layers and patterns)

Desktop

Smartphone

D.6 Designer 8

D.6.1 *TotalMusic (no layers or patterns)*

Desktop

Smartphone

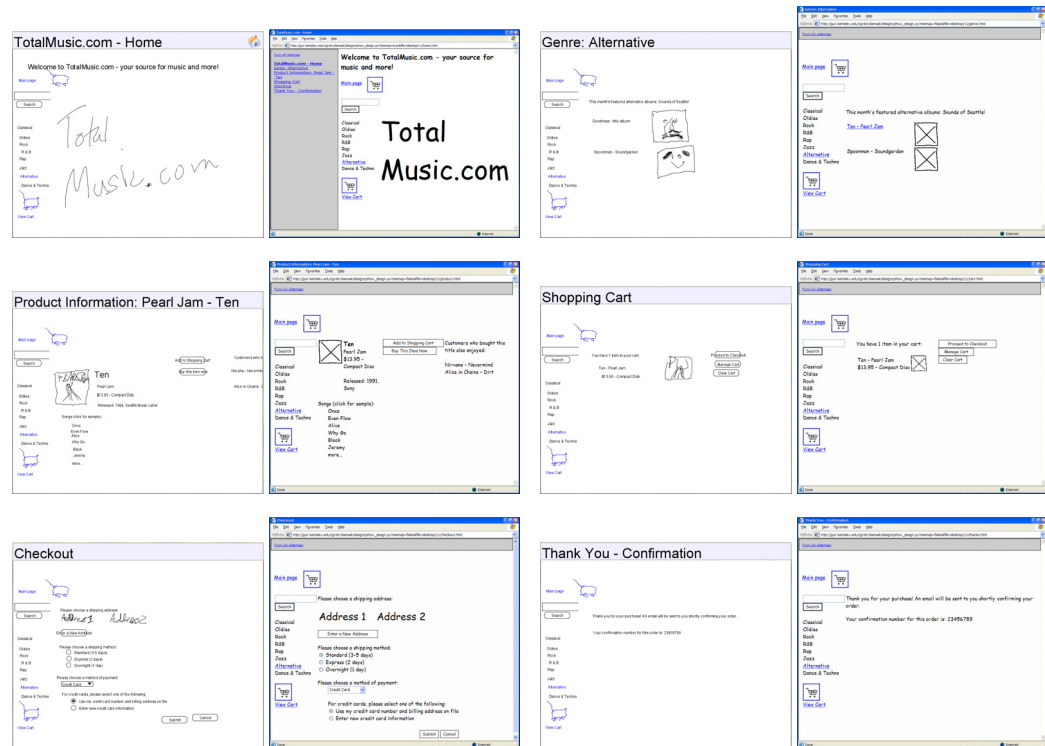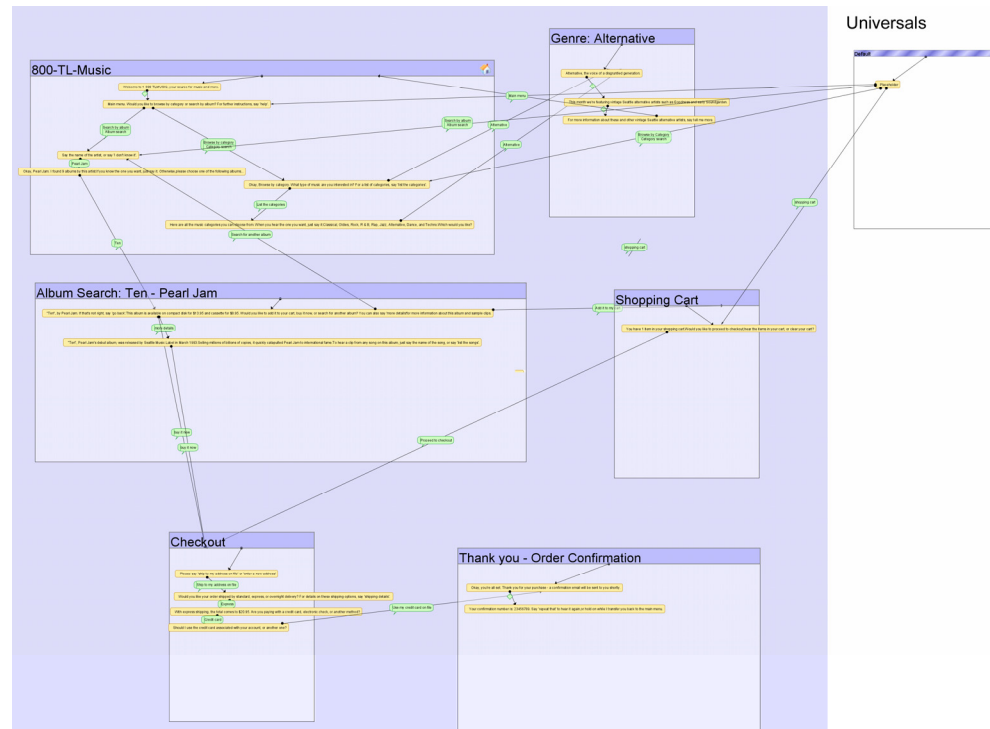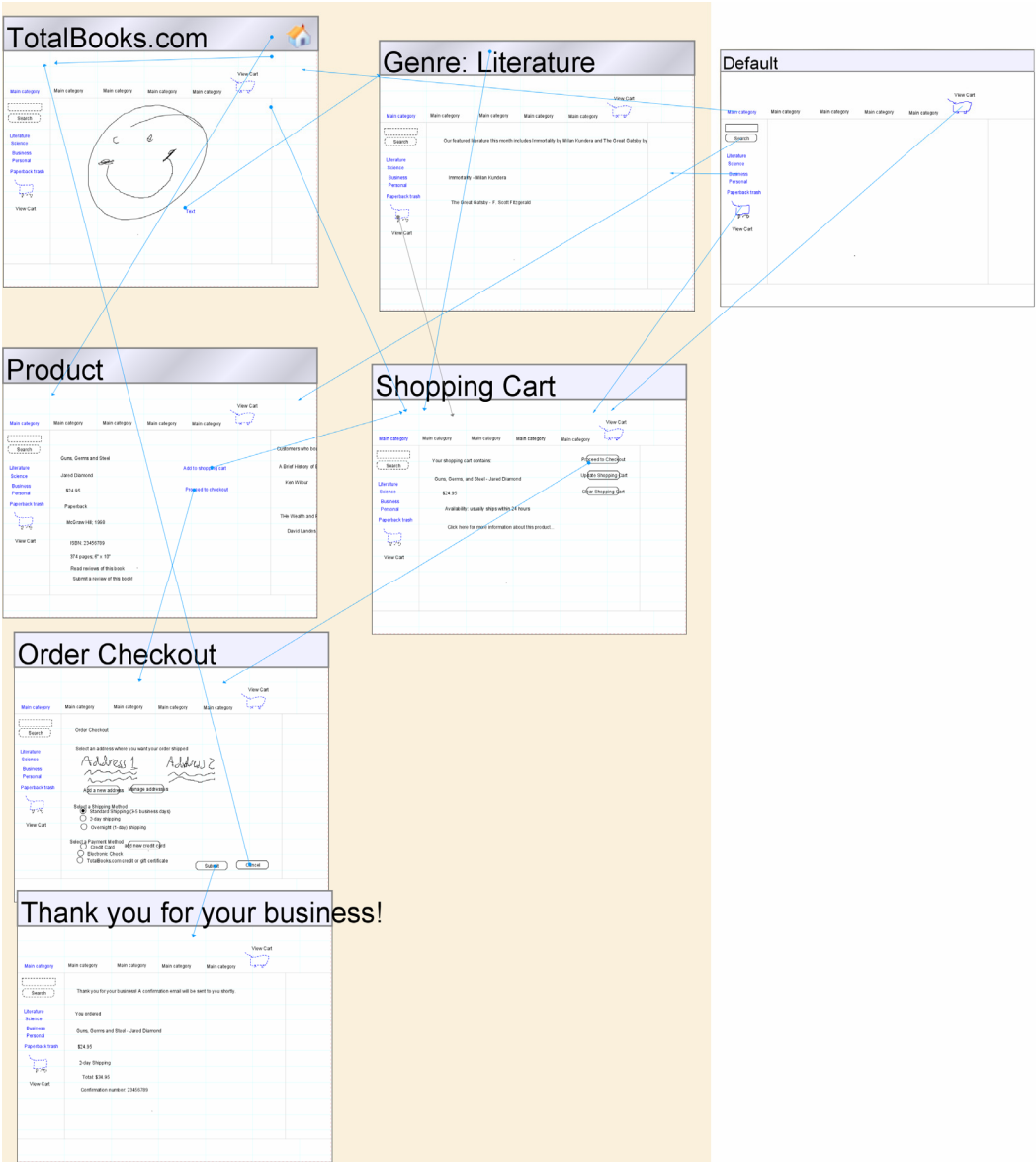## D.6.2 TotalBooks (with layers and patterns)
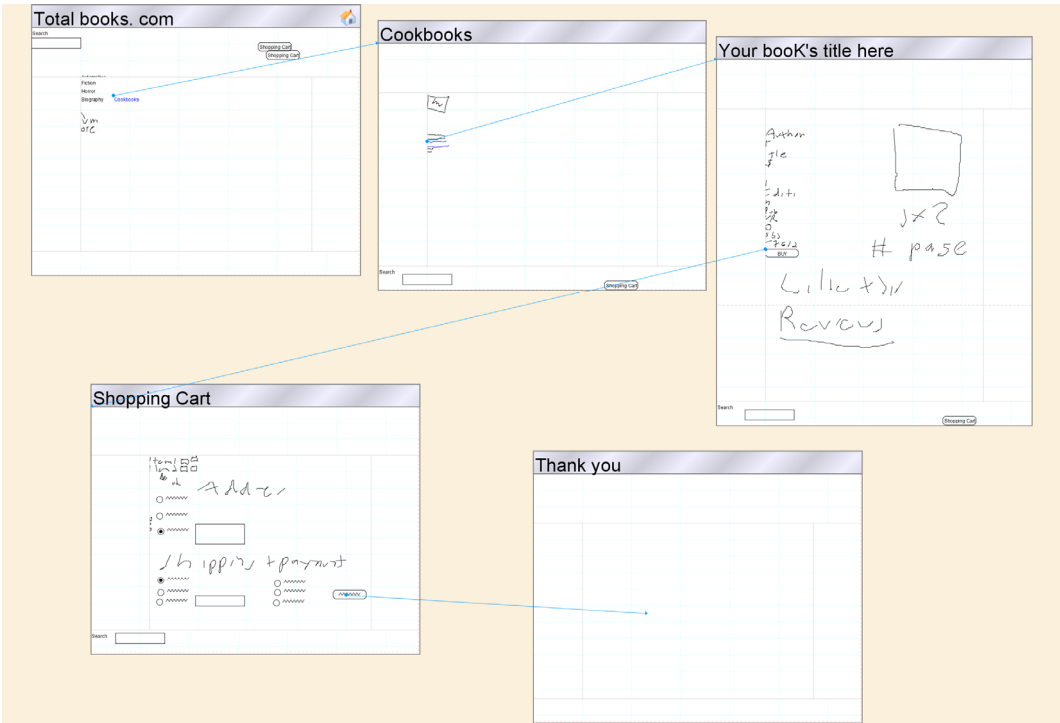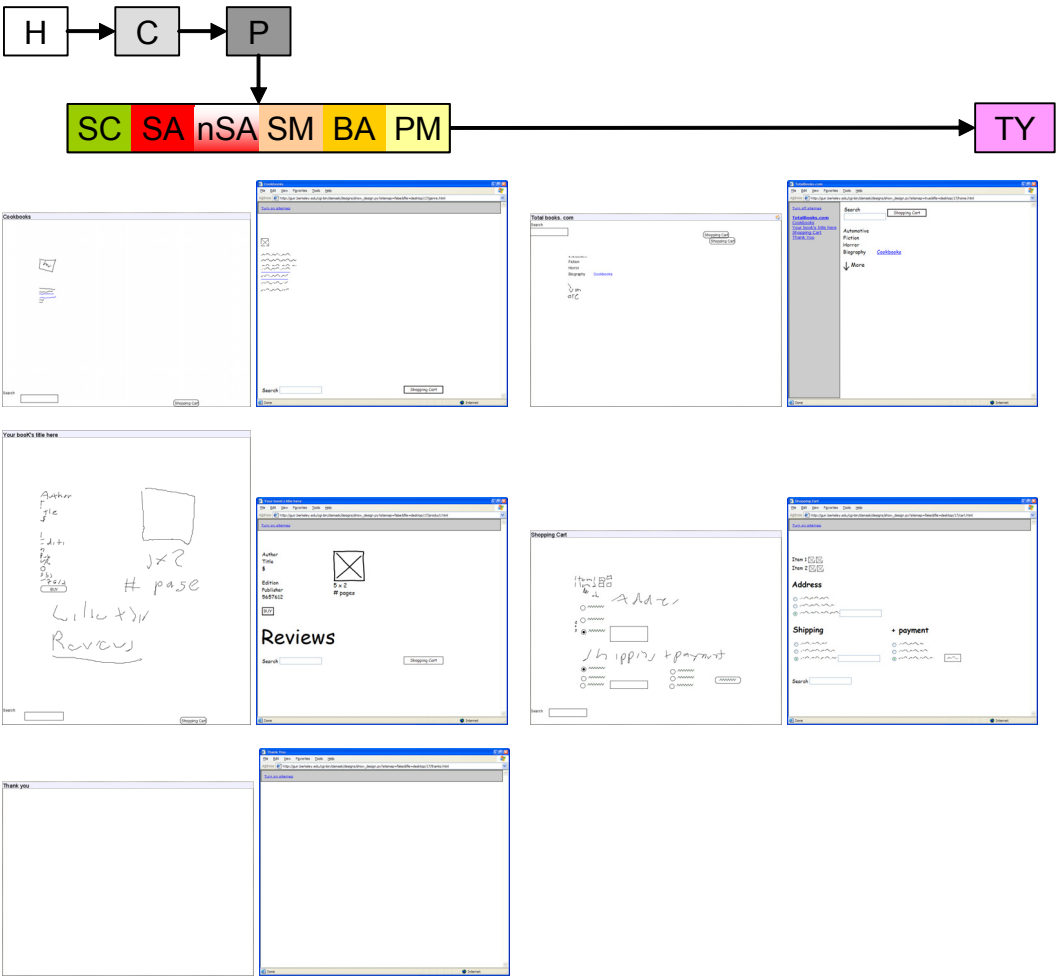
Desktop
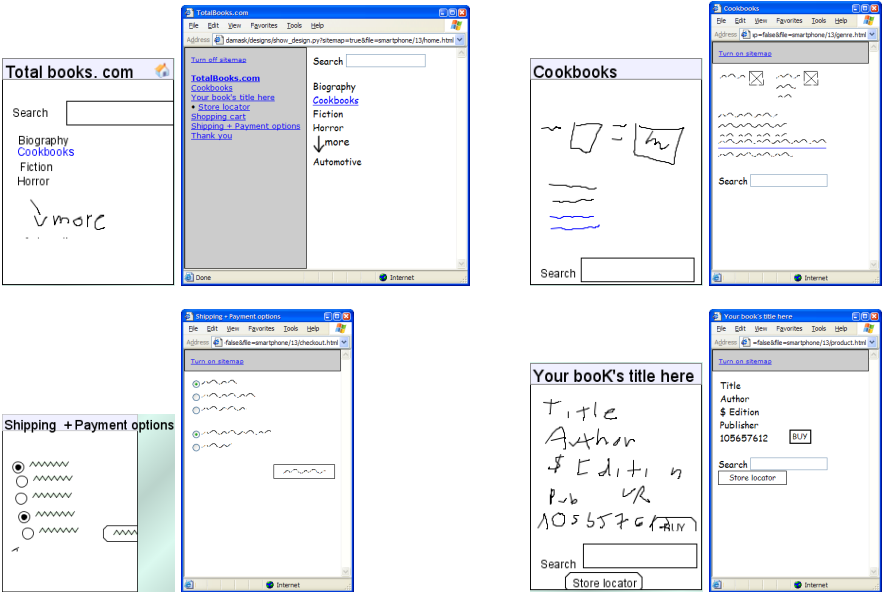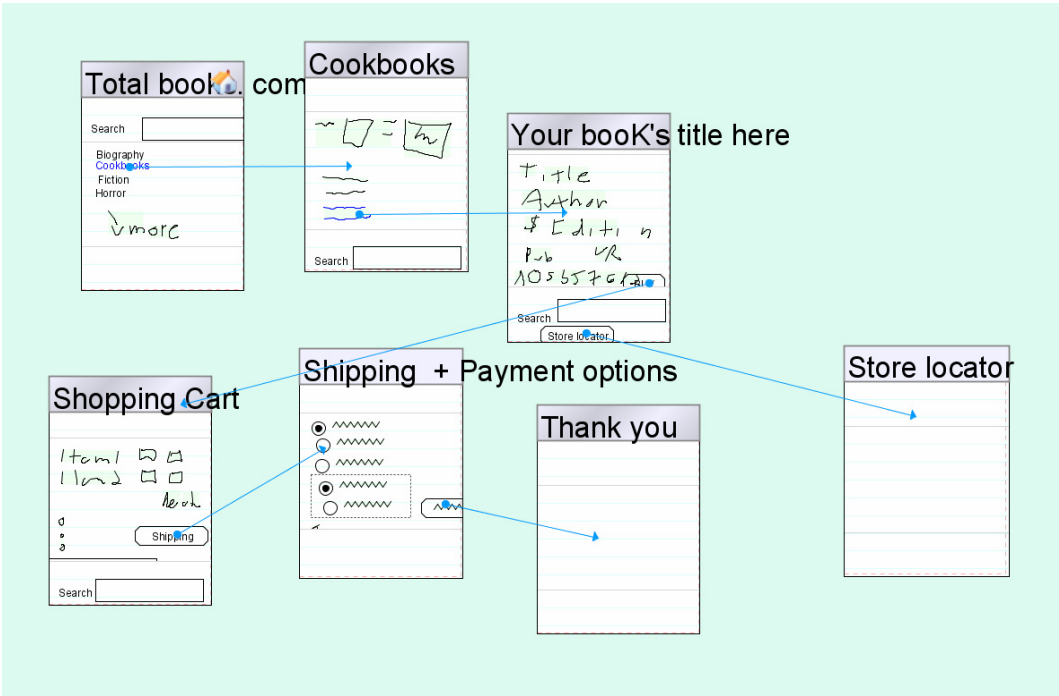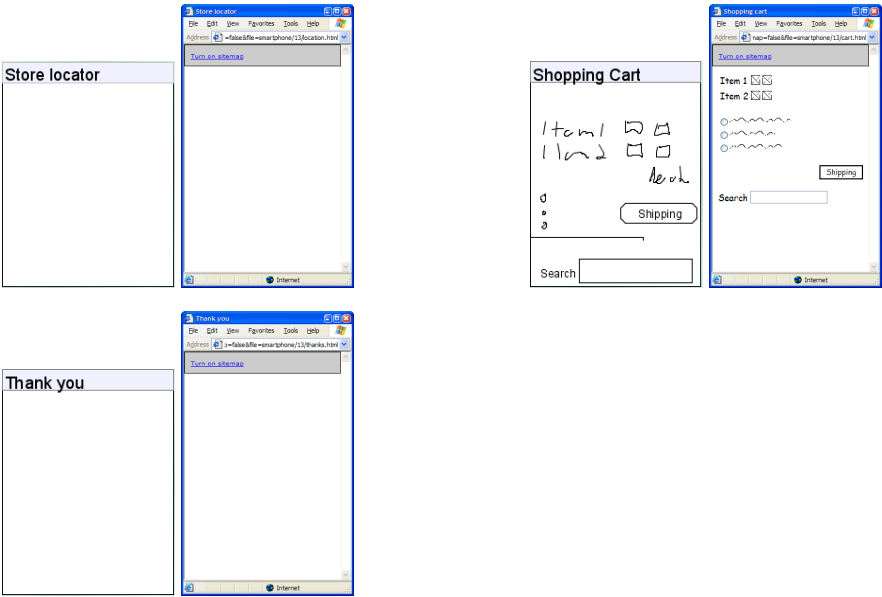
Smartphone

D.7 Designer 9
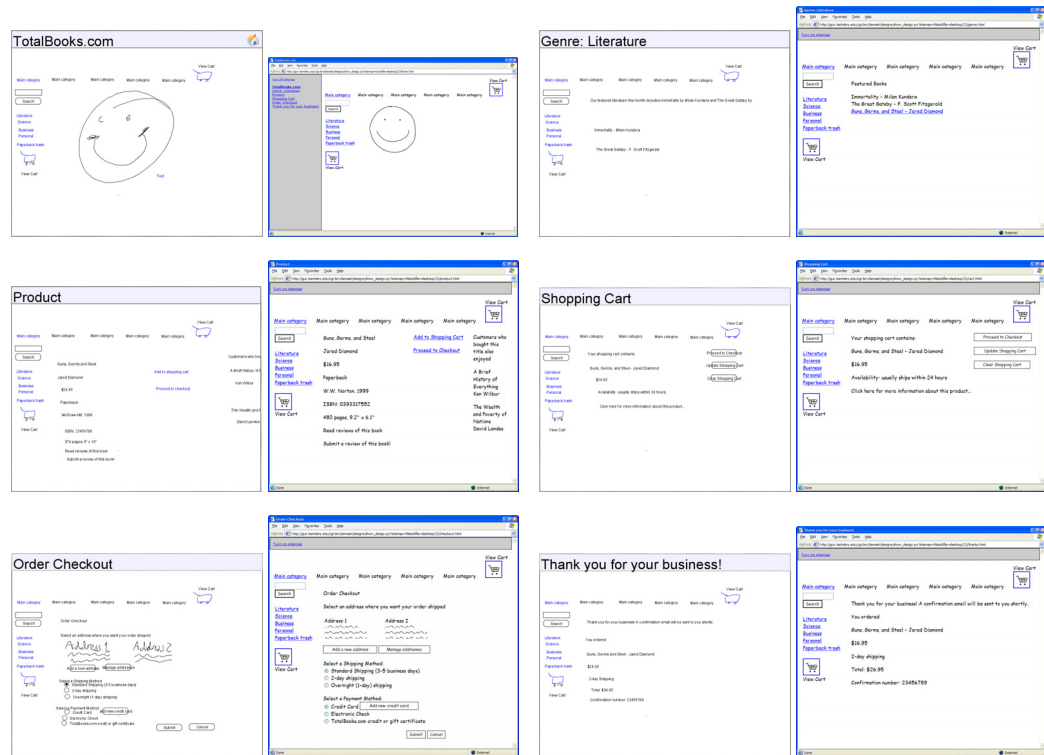
D.7.1 TotalMusic (no layers or patterns)
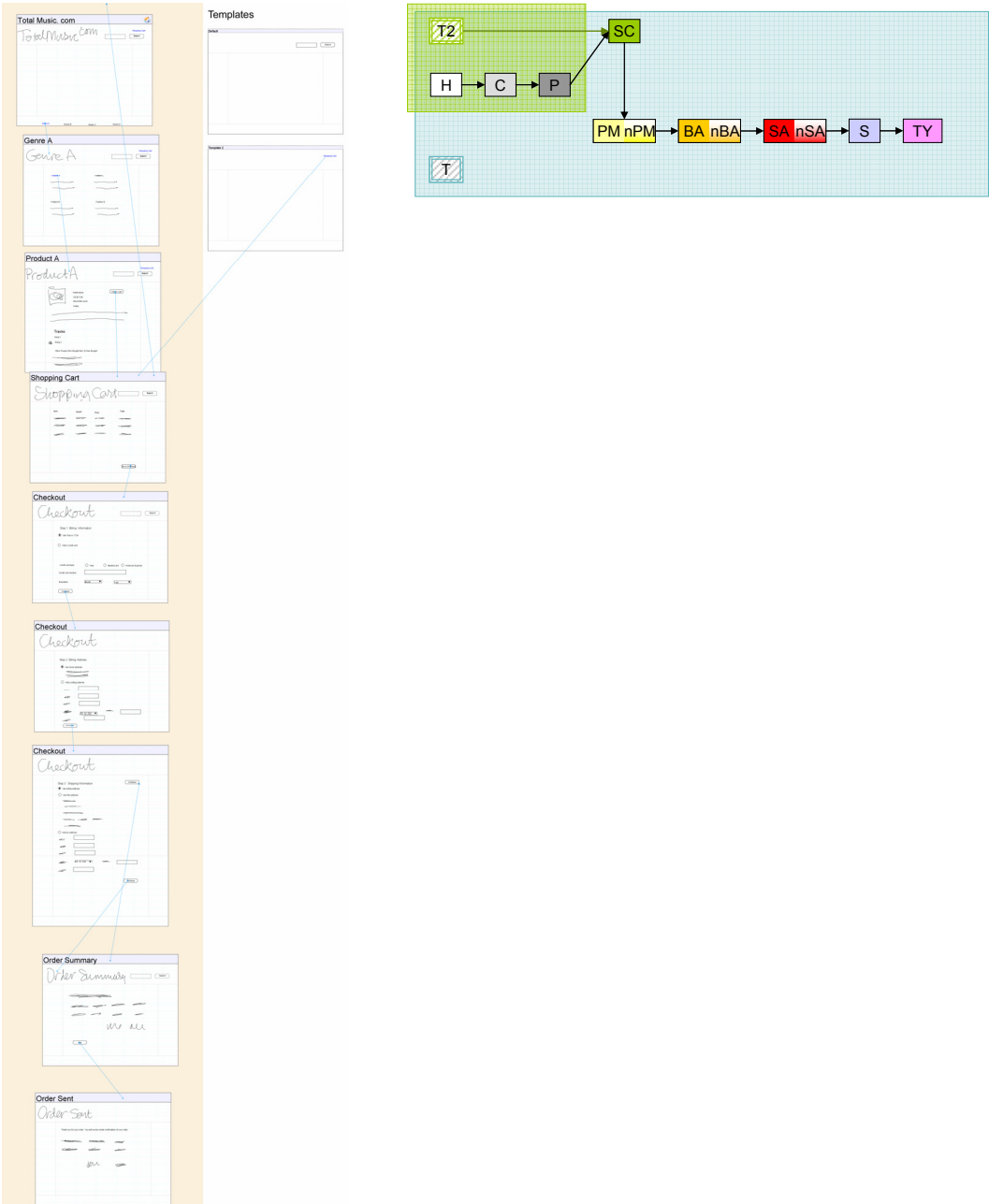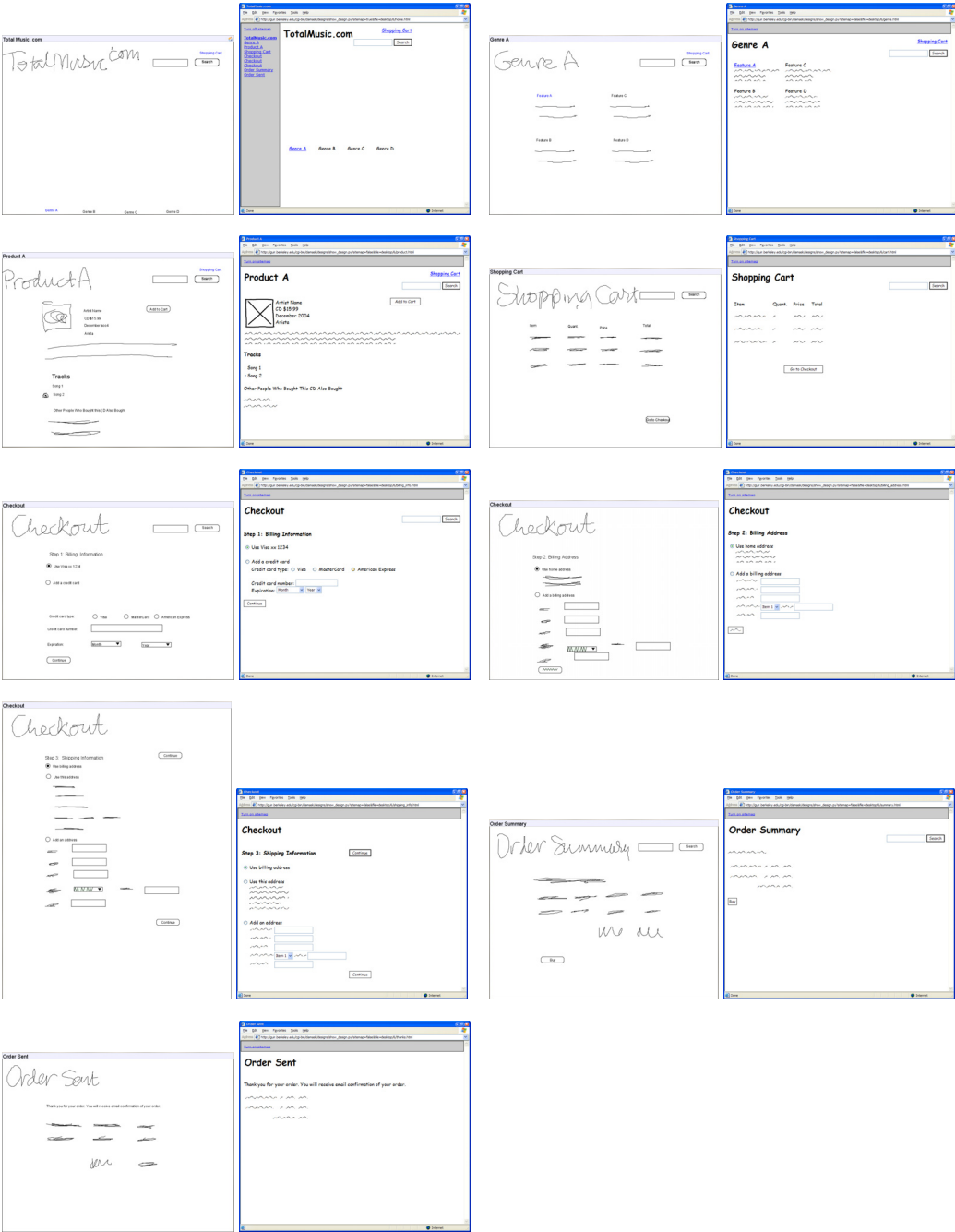
Desktop
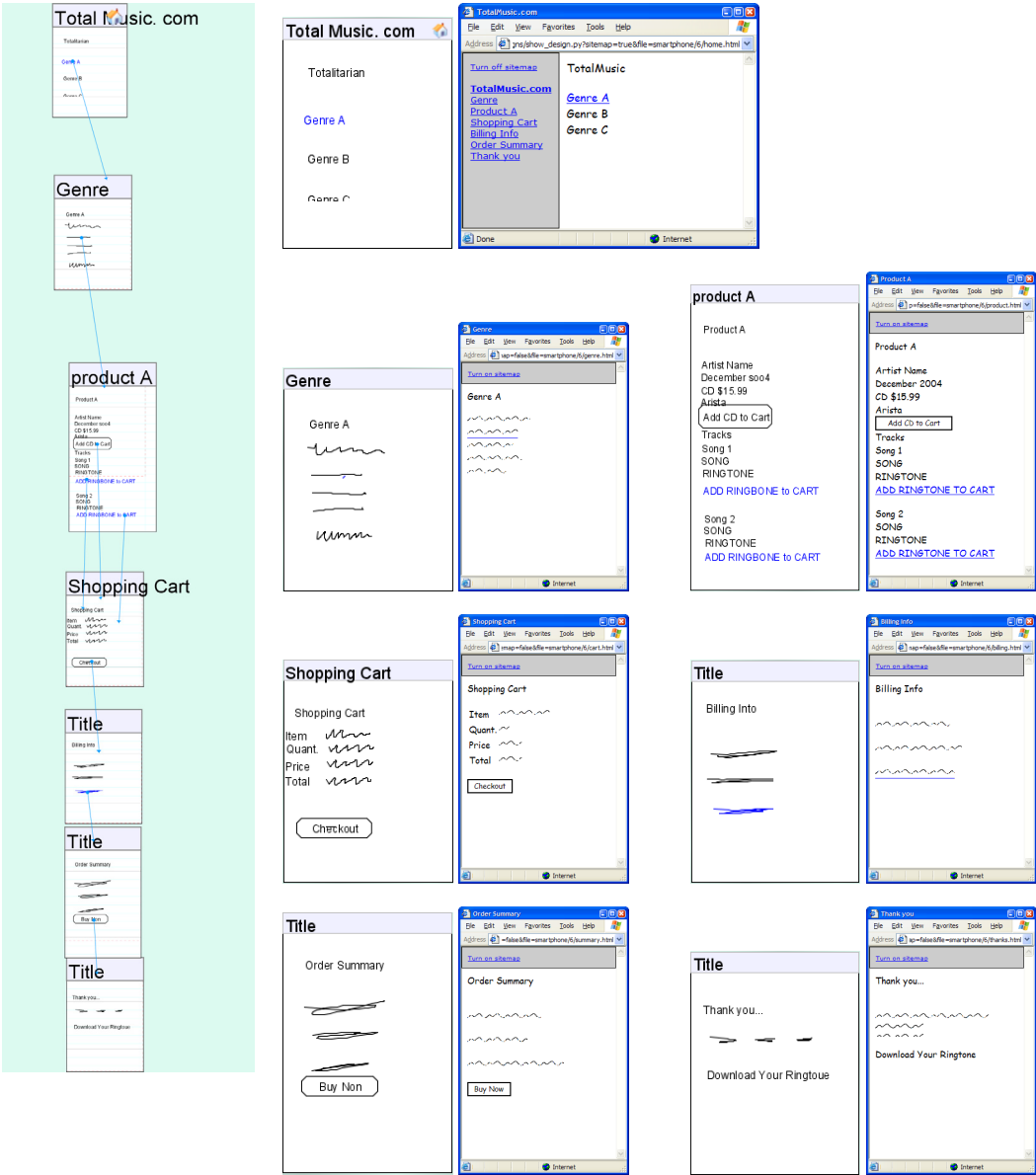
Smartphone

D.7.2 TotalBooks (with layers and patterns)
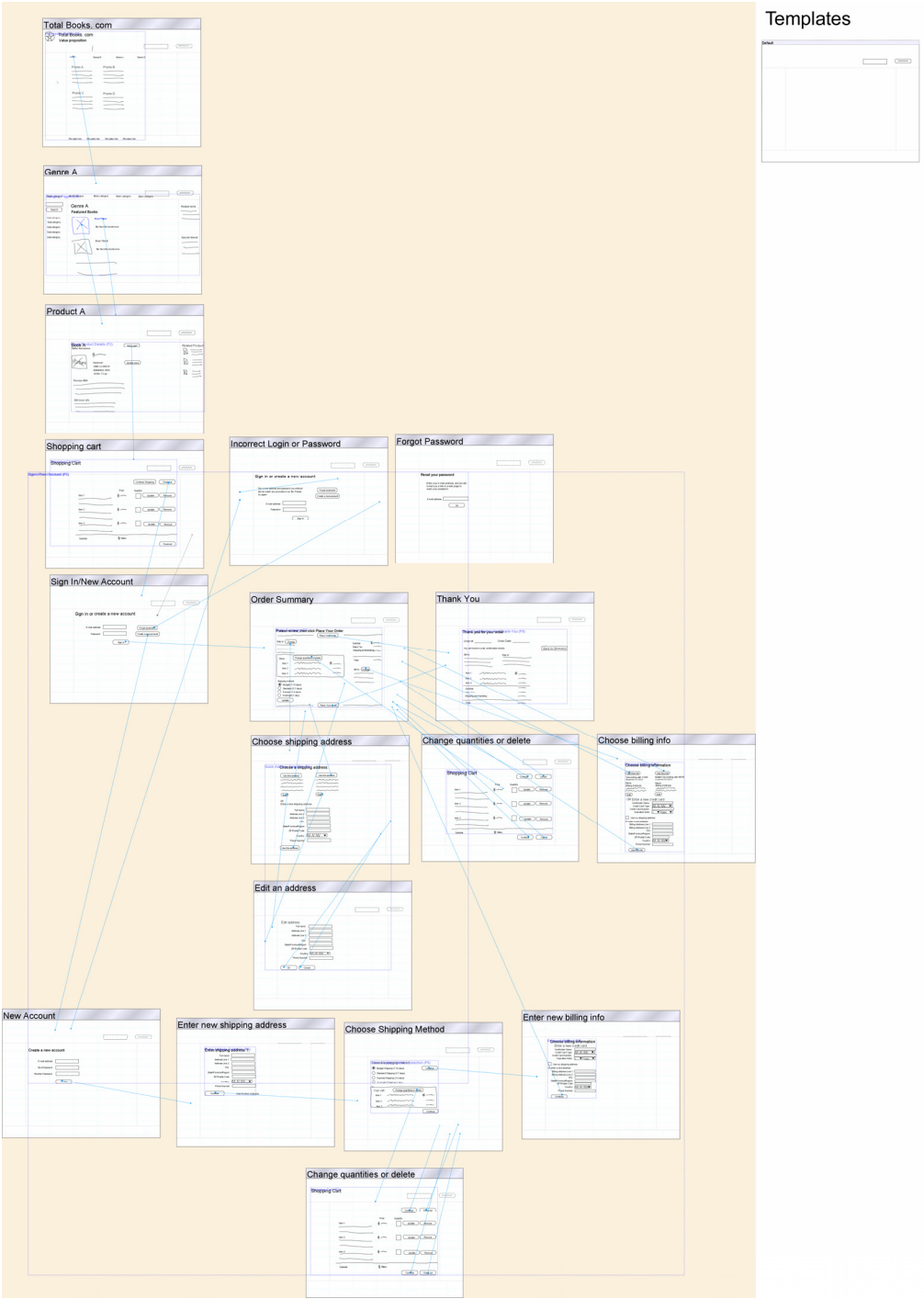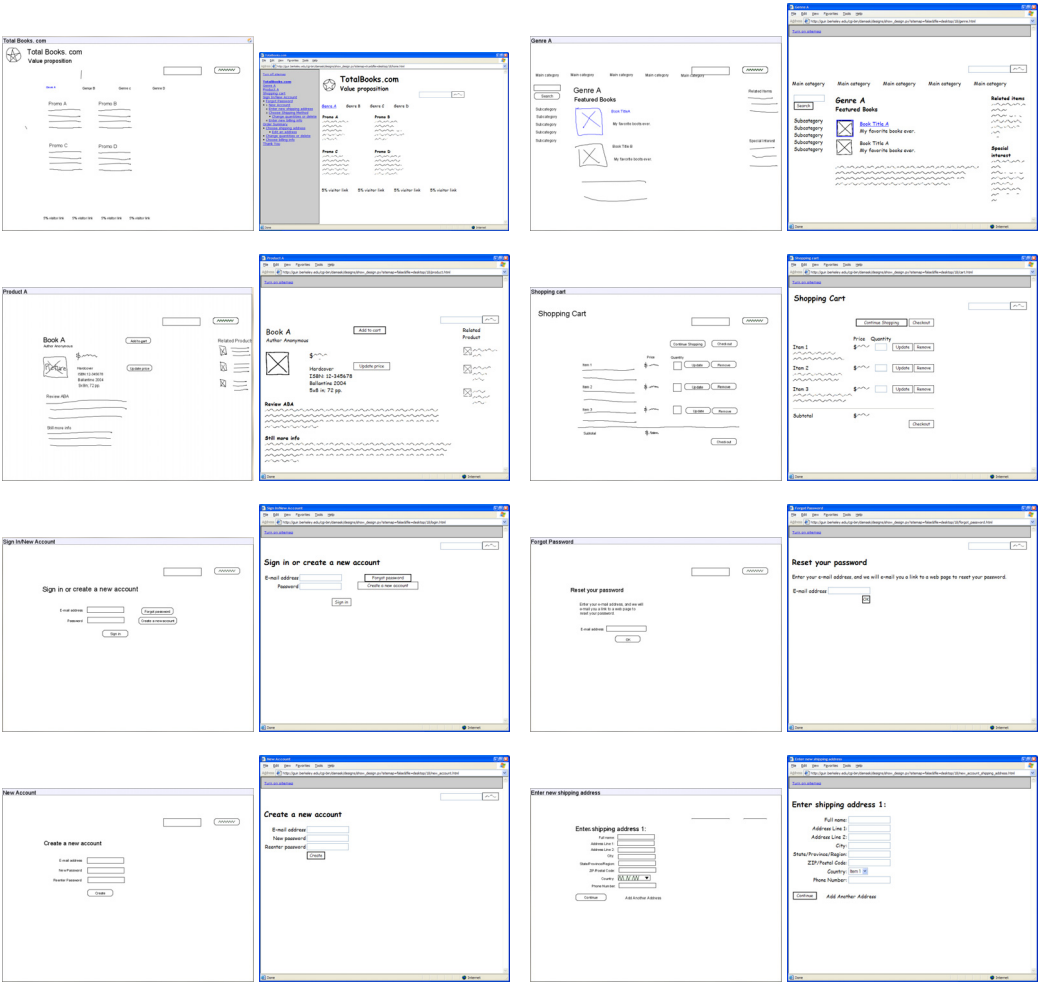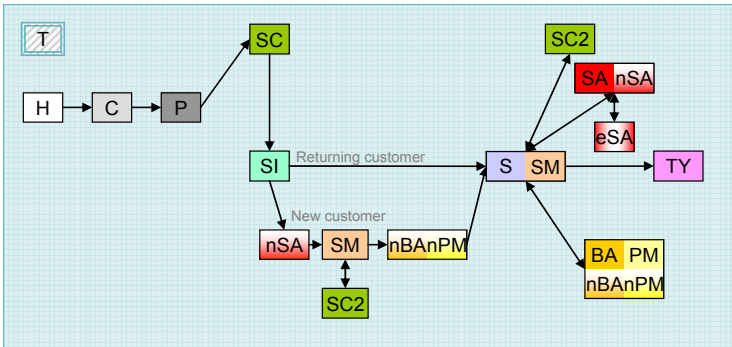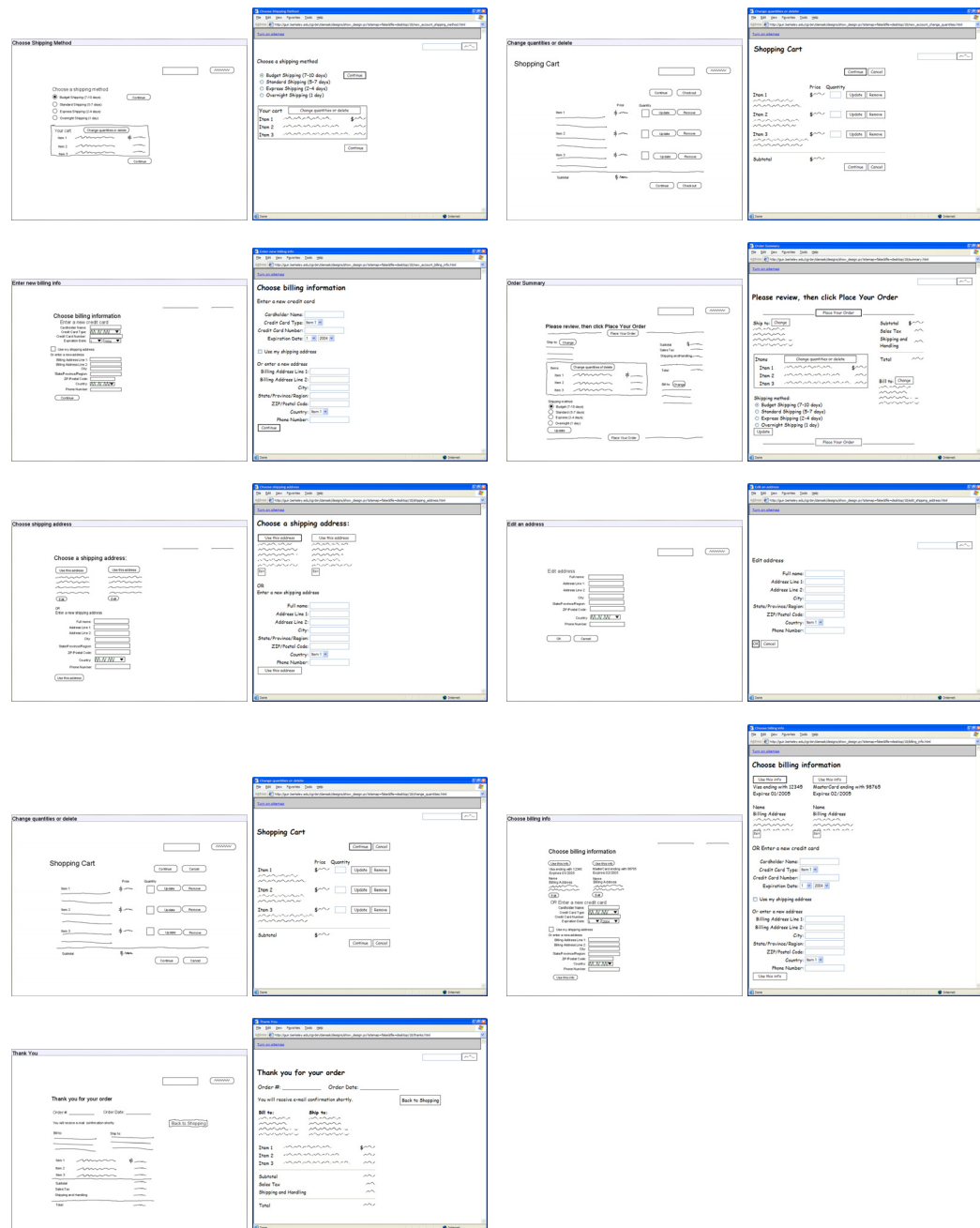
Desktop
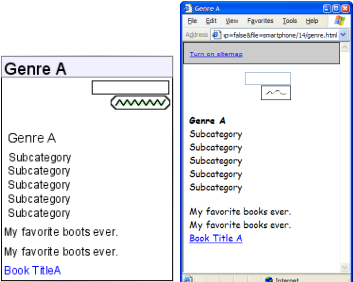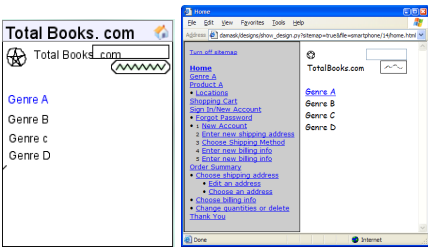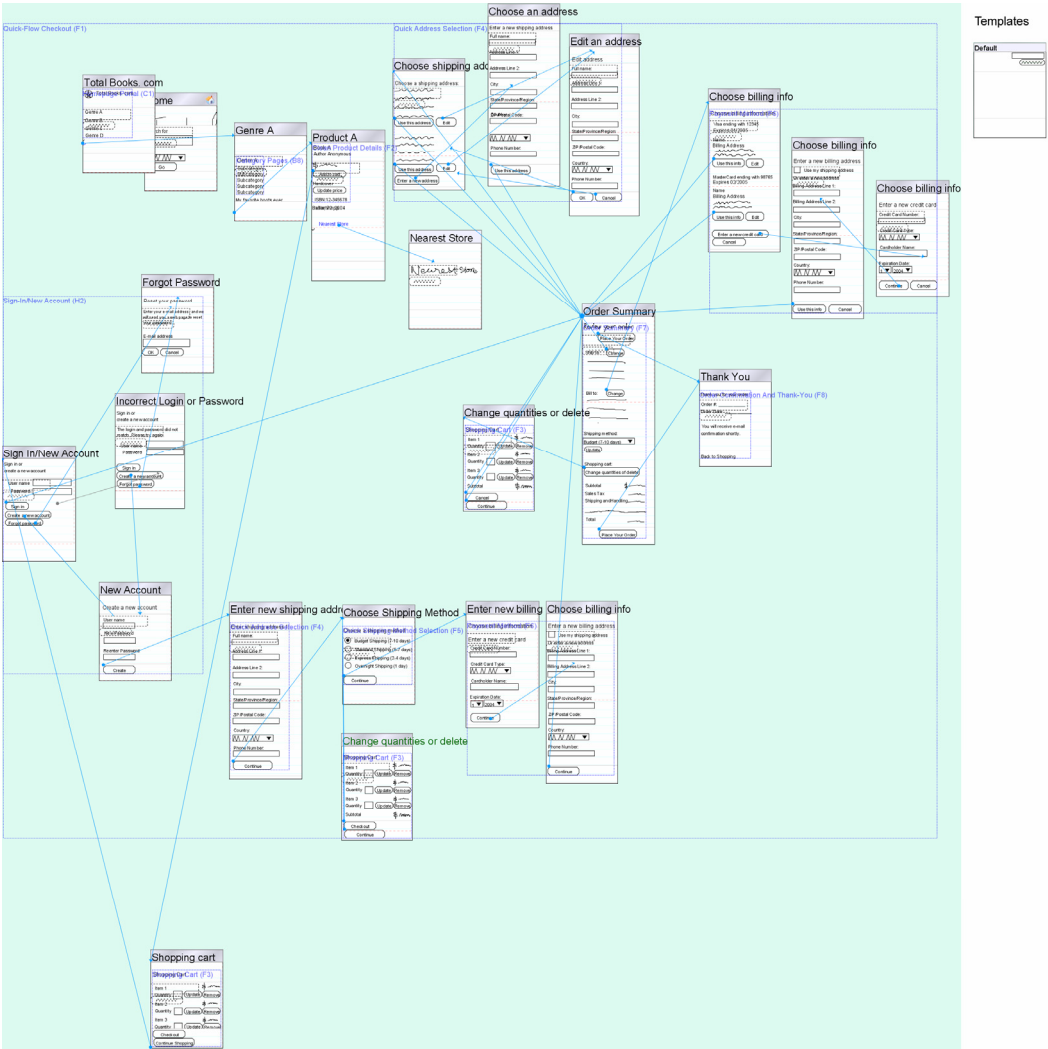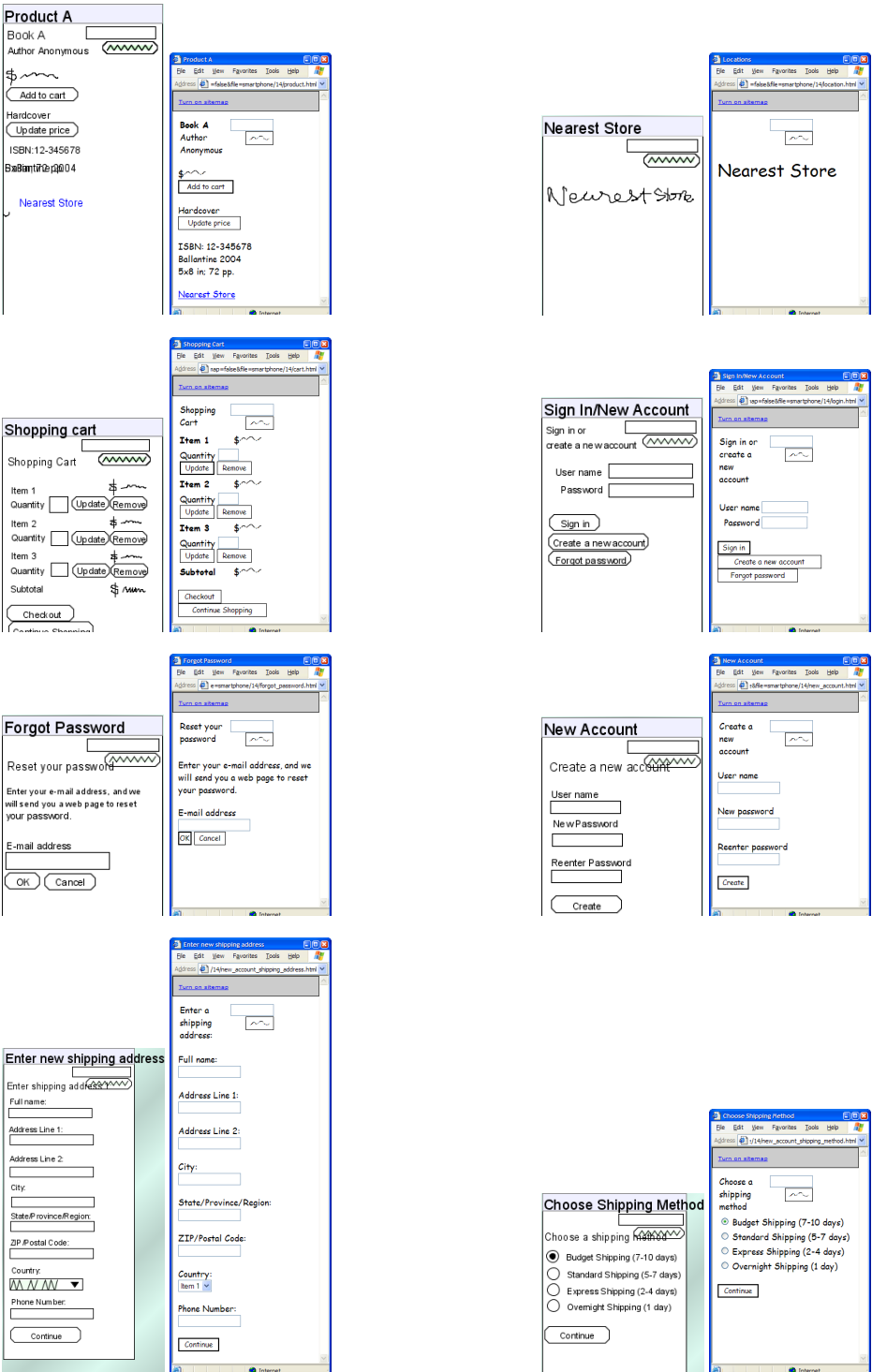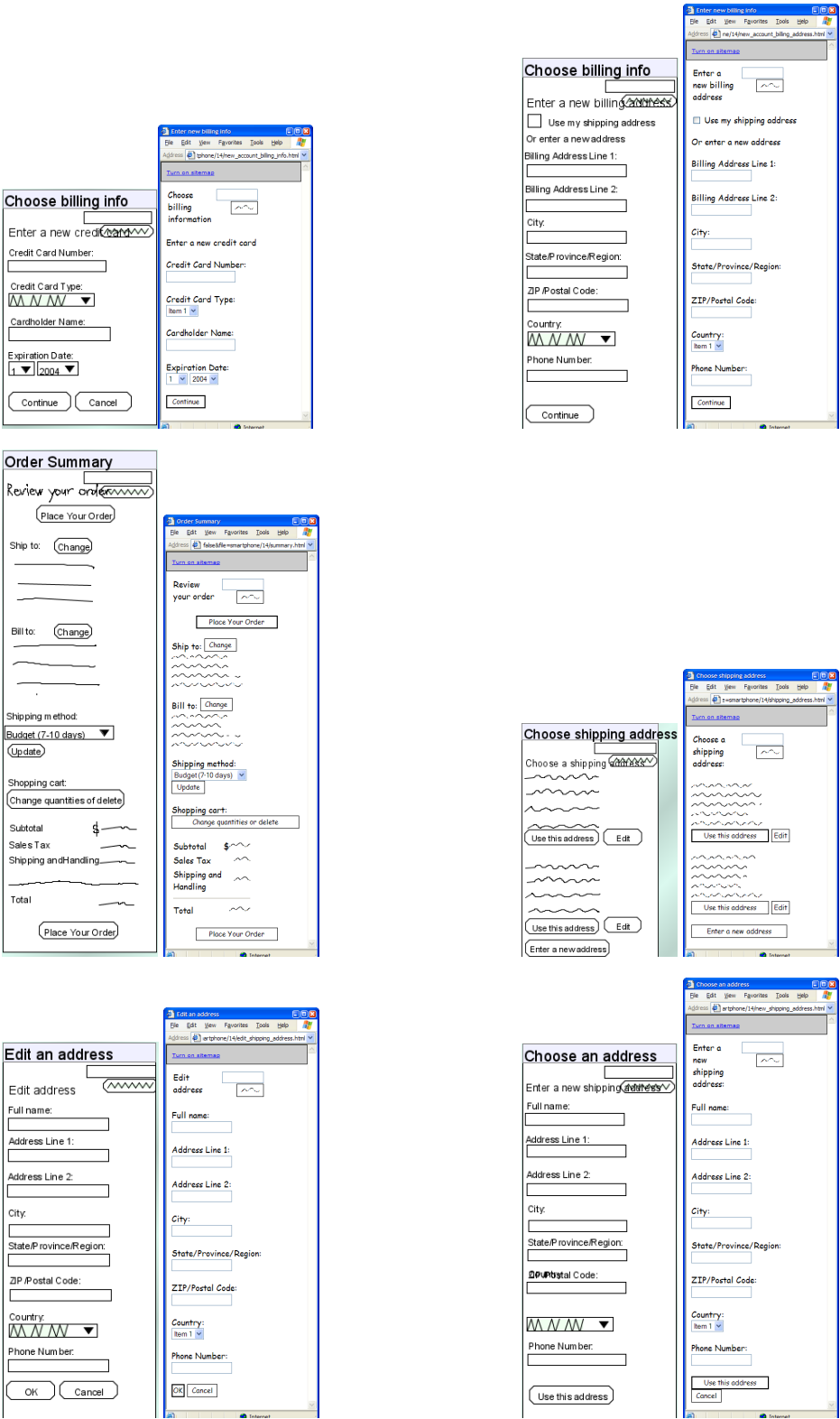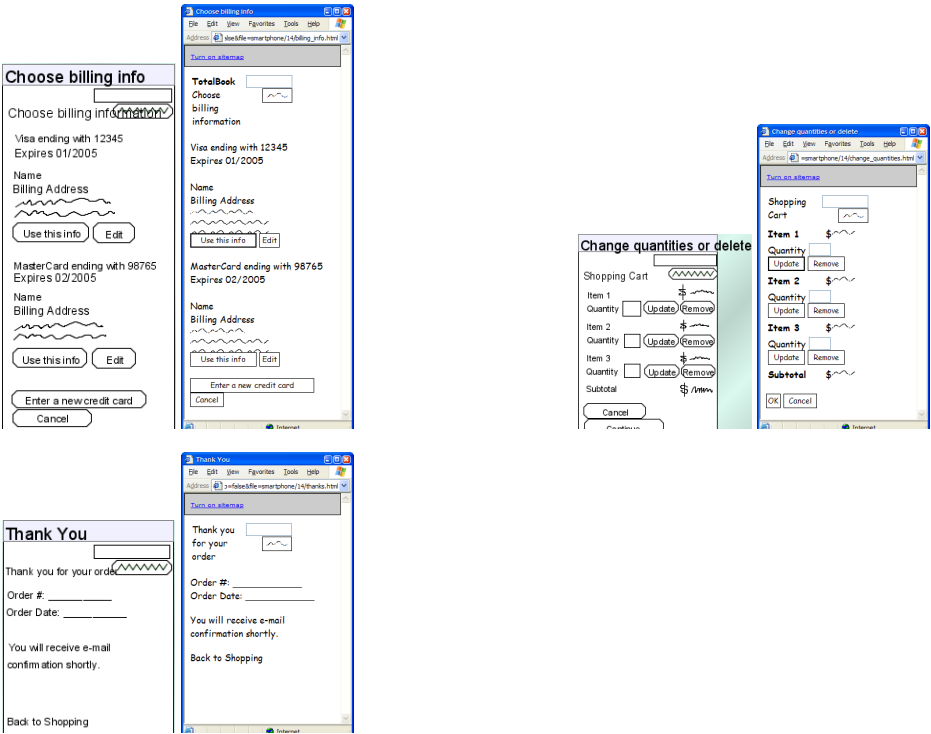
Smartphone

D.8 Designer 10

D.8.1 TotalMusic (no layers or patterns)

Desktop

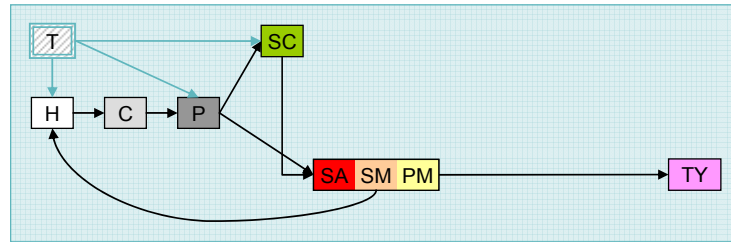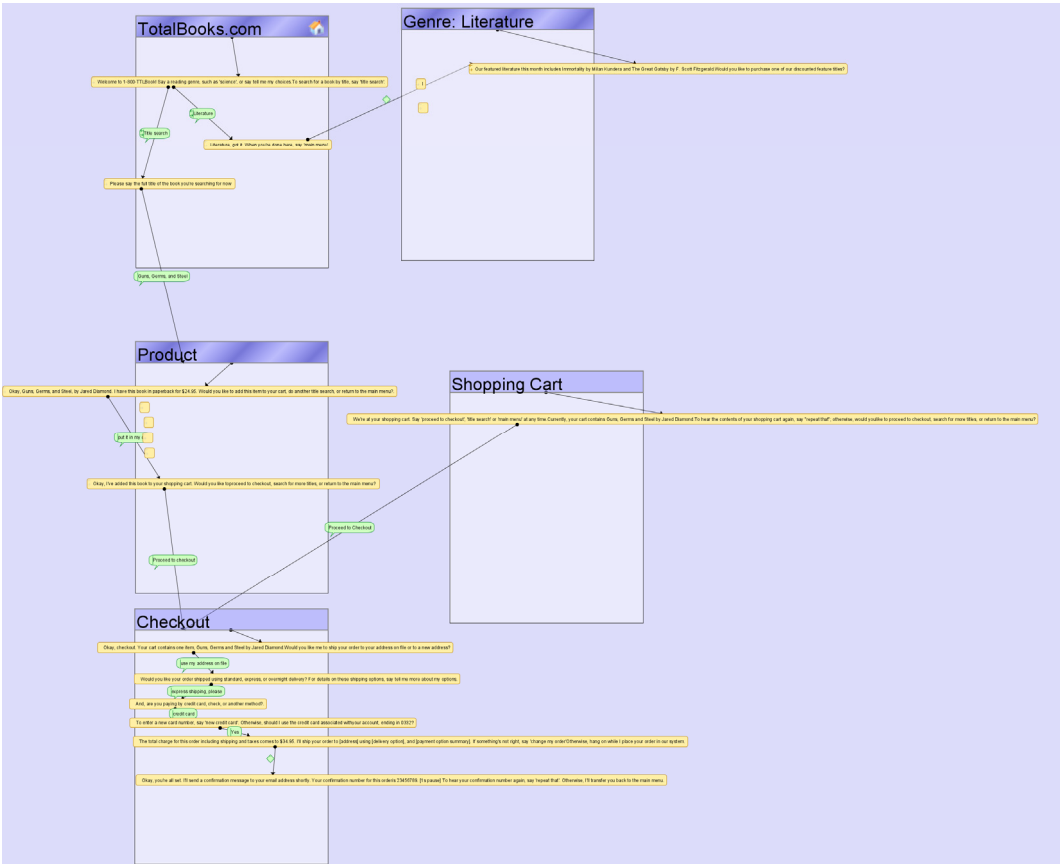Instead of creating an eBA | ePM page, User 10 just linked to eSA as a "good enough" demo
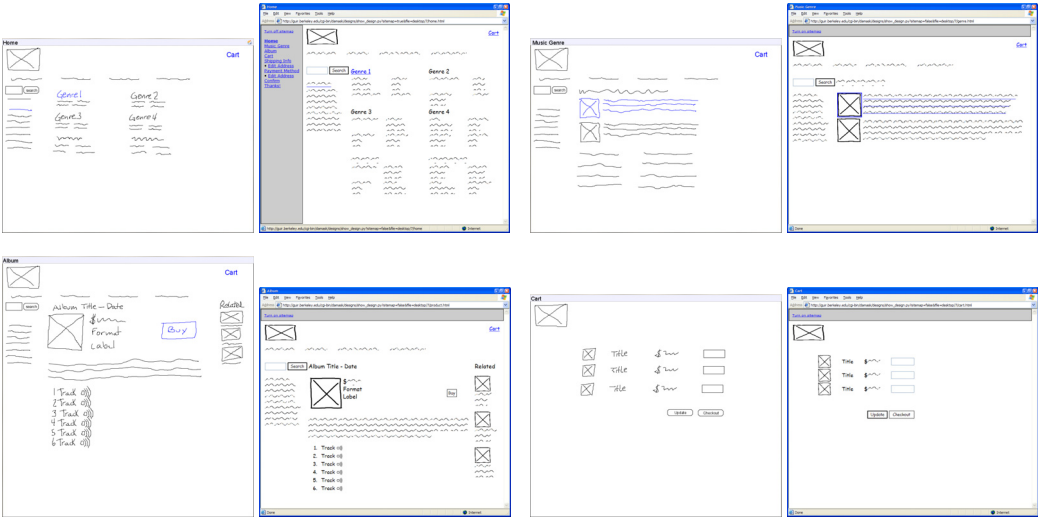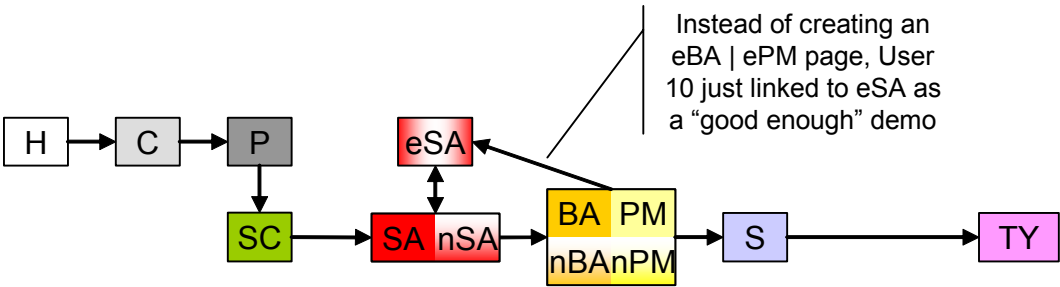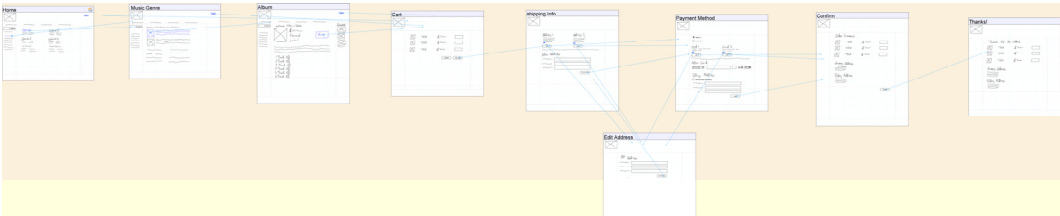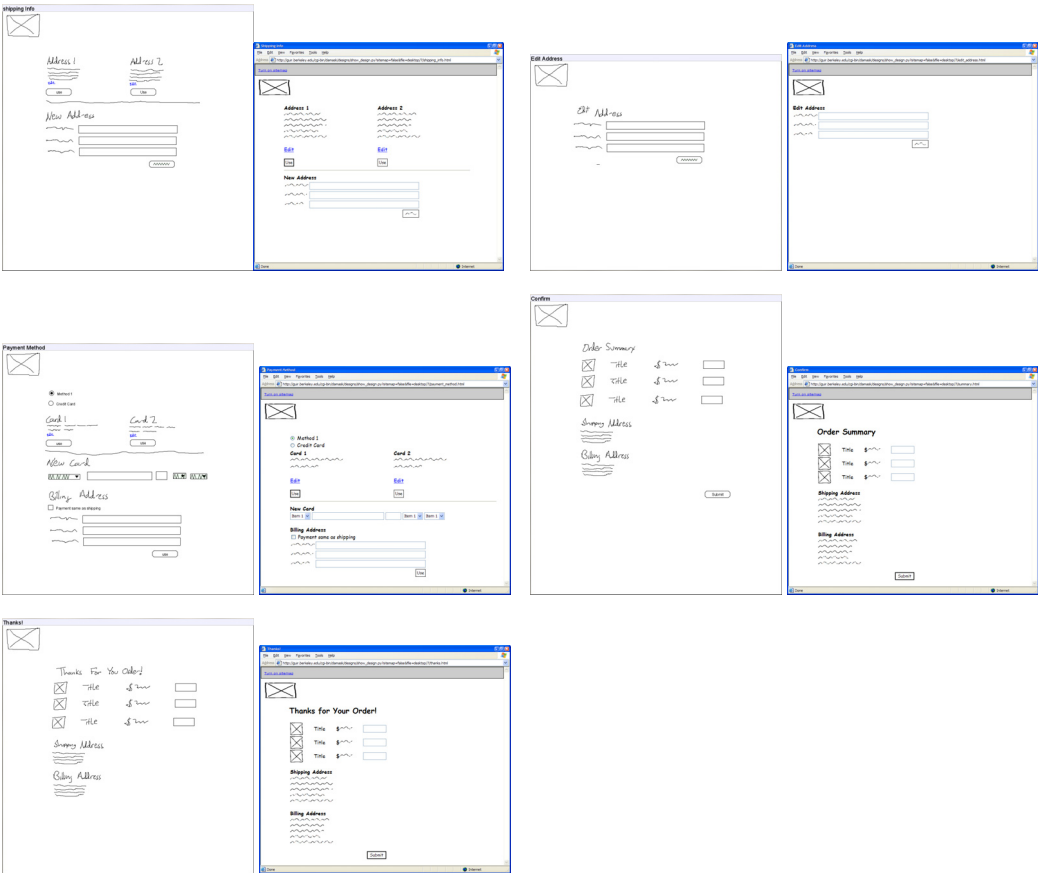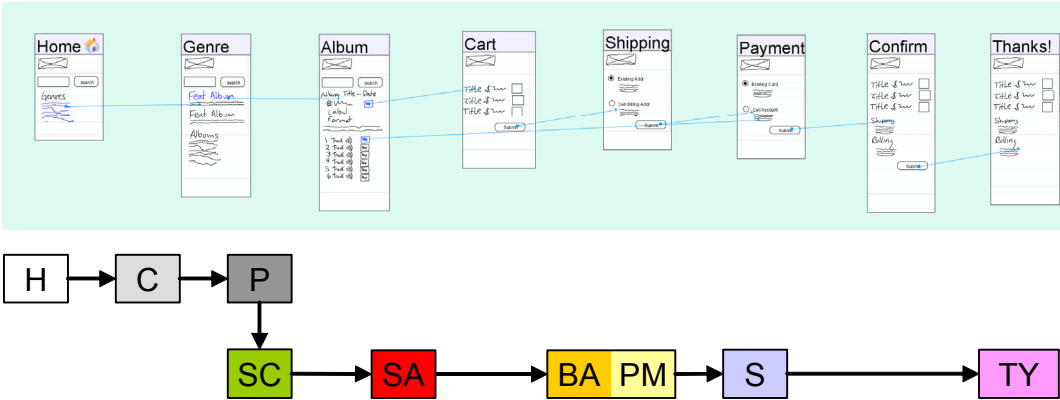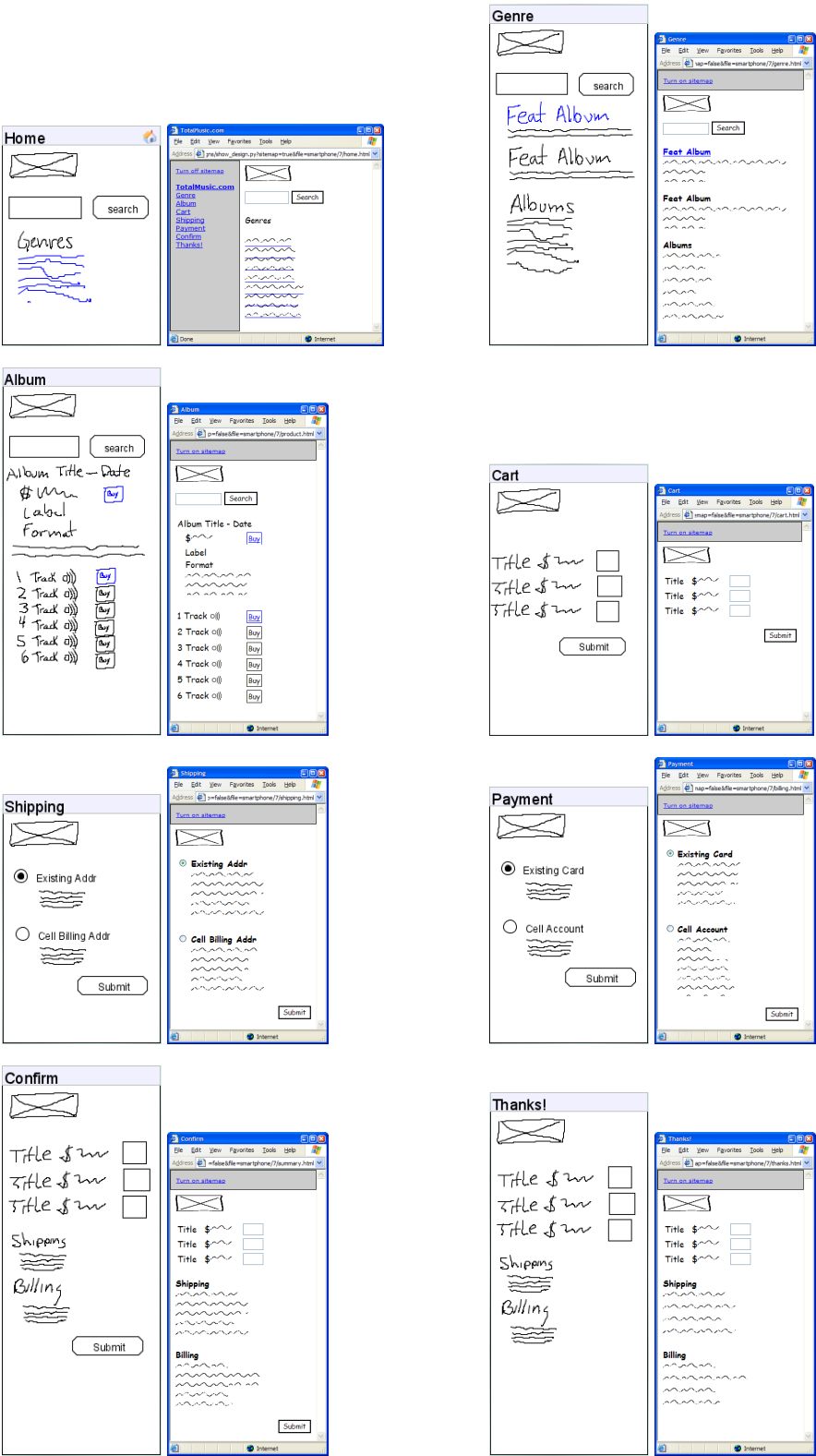
Smartphone
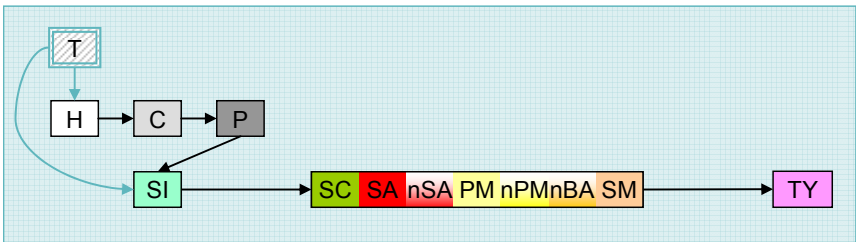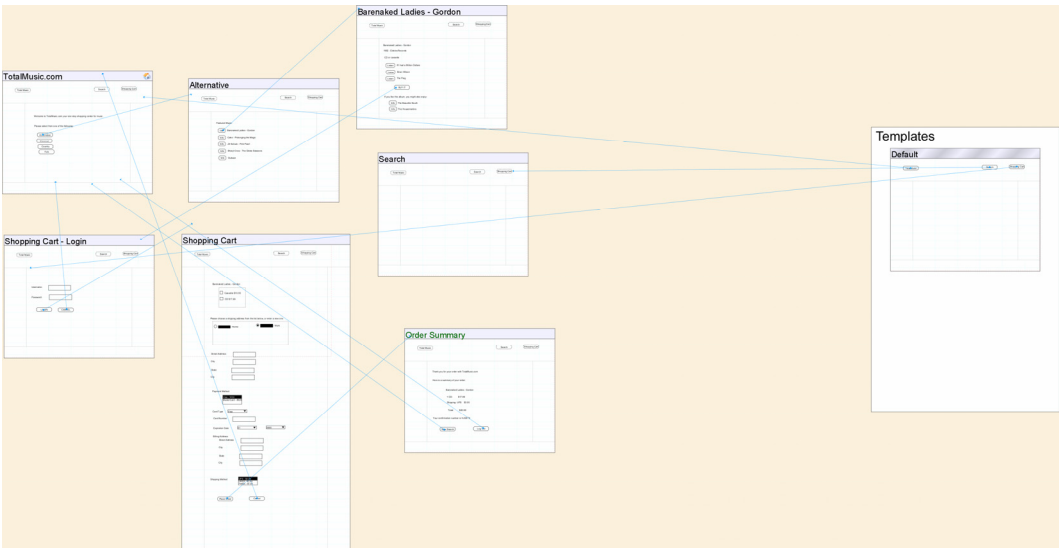
D.8.2 TotalBooks (with layers and patterns)
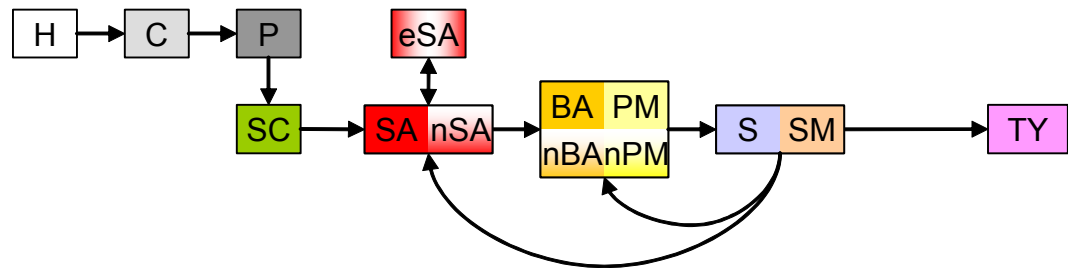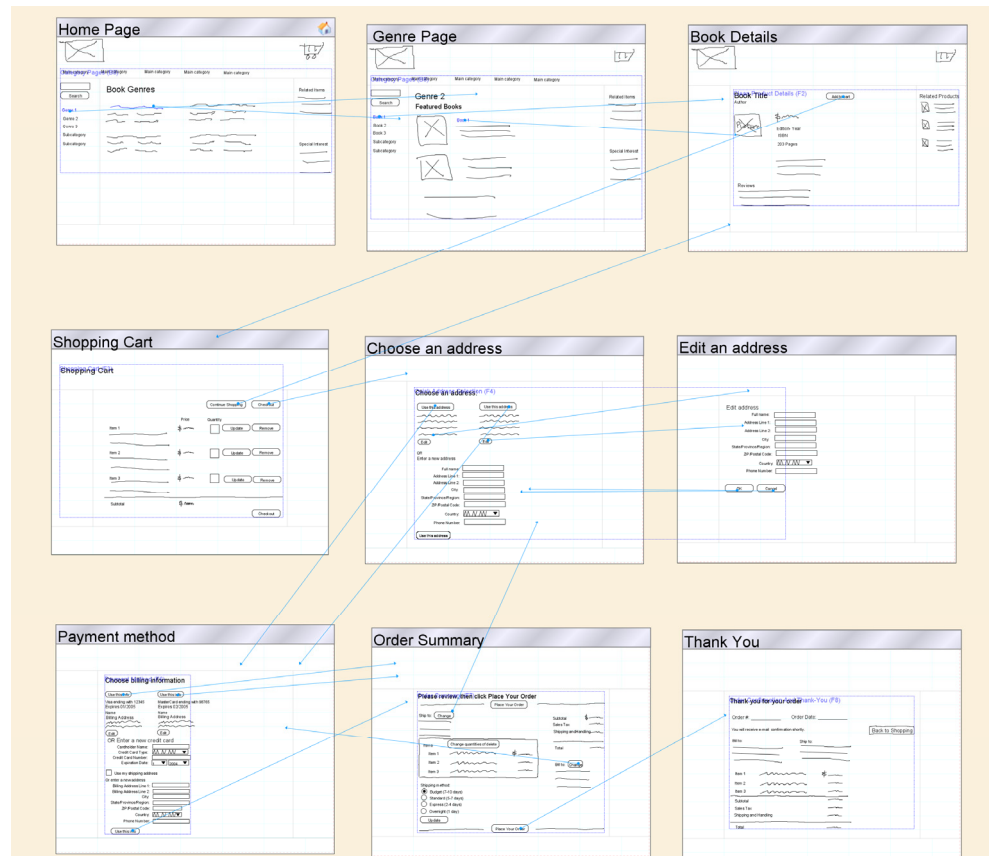
Desktop

Smartphone

Payment method 3

Enter a new billing address

☐ Use my shipping address

Or enter a new address

Billing Address Line 1:

Billing Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Country:

Phone Number:

[Use this info] [Cancel]

Payment method 3

Turn on sitemap

Enter a new billing address

☐ Use my shipping address

Or enter a new address

Billing Address Line 1:

Billing Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Country:
Item 1

Phone Number:

[Use this info] [Cancel]

Order Summary

Review your order

(Place Your Order)

Ship to: (Change)

Bill to: (Change)

Shipping method:
Budget (7-10 days) ▼
(Update)

Shopping cart:
(Change quantities of delete)

Subtotal $
Sales Tax
Shipping and Handling

Total

(Place Your Order)

Order Summary

Turn on sitemap

Review your order

[Place Your Order]

Ship to: [Change]

Bill to: [Change]

Shipping method:
Budget (7-10 days) ▼
[Update]

Shopping cart:
[Change quantities or delete]

Subtotal $
Sales Tax
Shipping and Handling

Total

[Place Your Order]

Thank You

Thank you for your order

Order #: _____
Order Date: _____

You will receive e-mail confirmation shortly.

Back to Shopping

Thank You

Turn on sitemap

Thank you for your order

Order #: _____
Order Date: _____

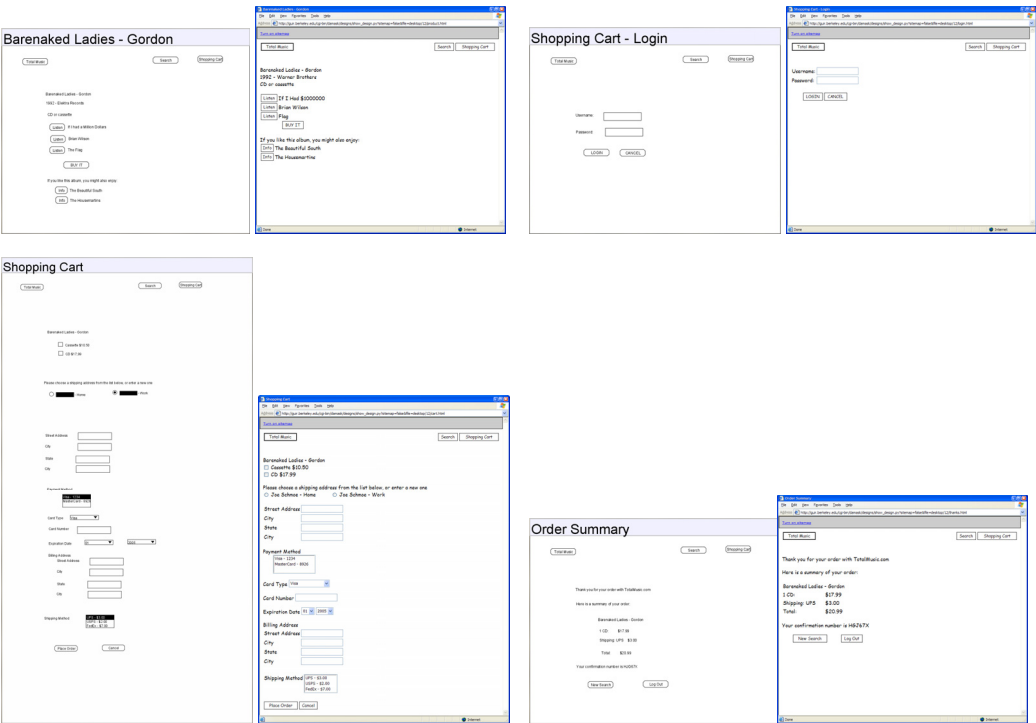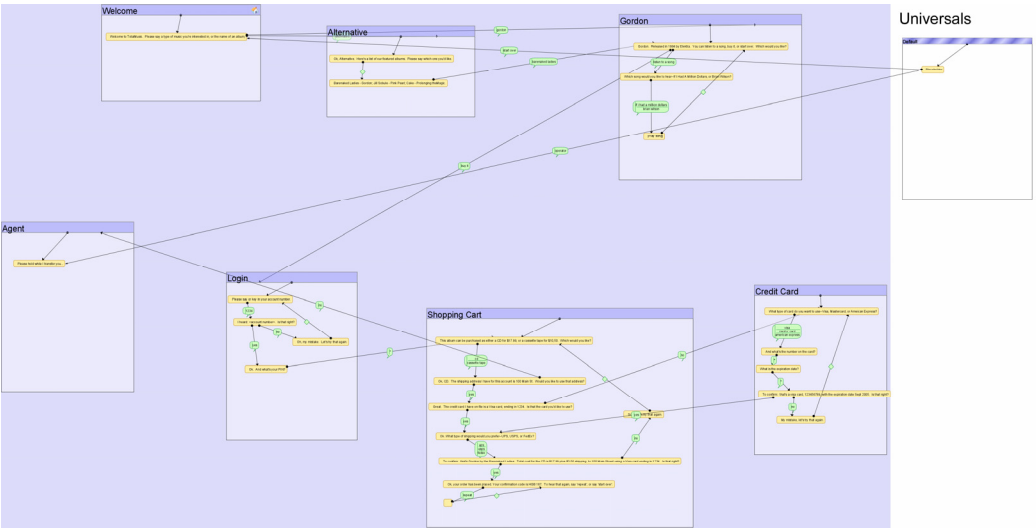You will receive e-mail confirmation shortly.

Back to Shopping

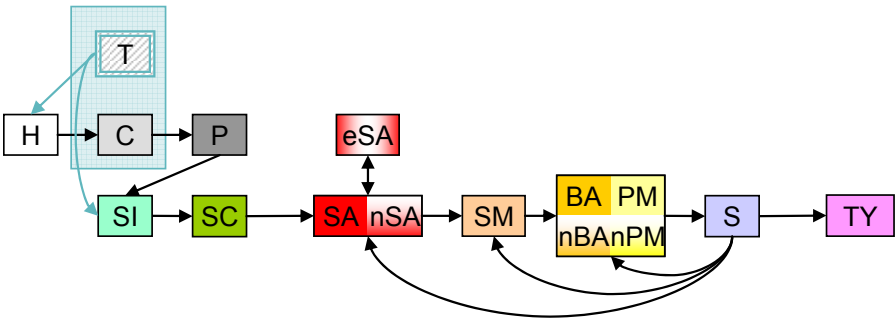## D.9 Designer 11
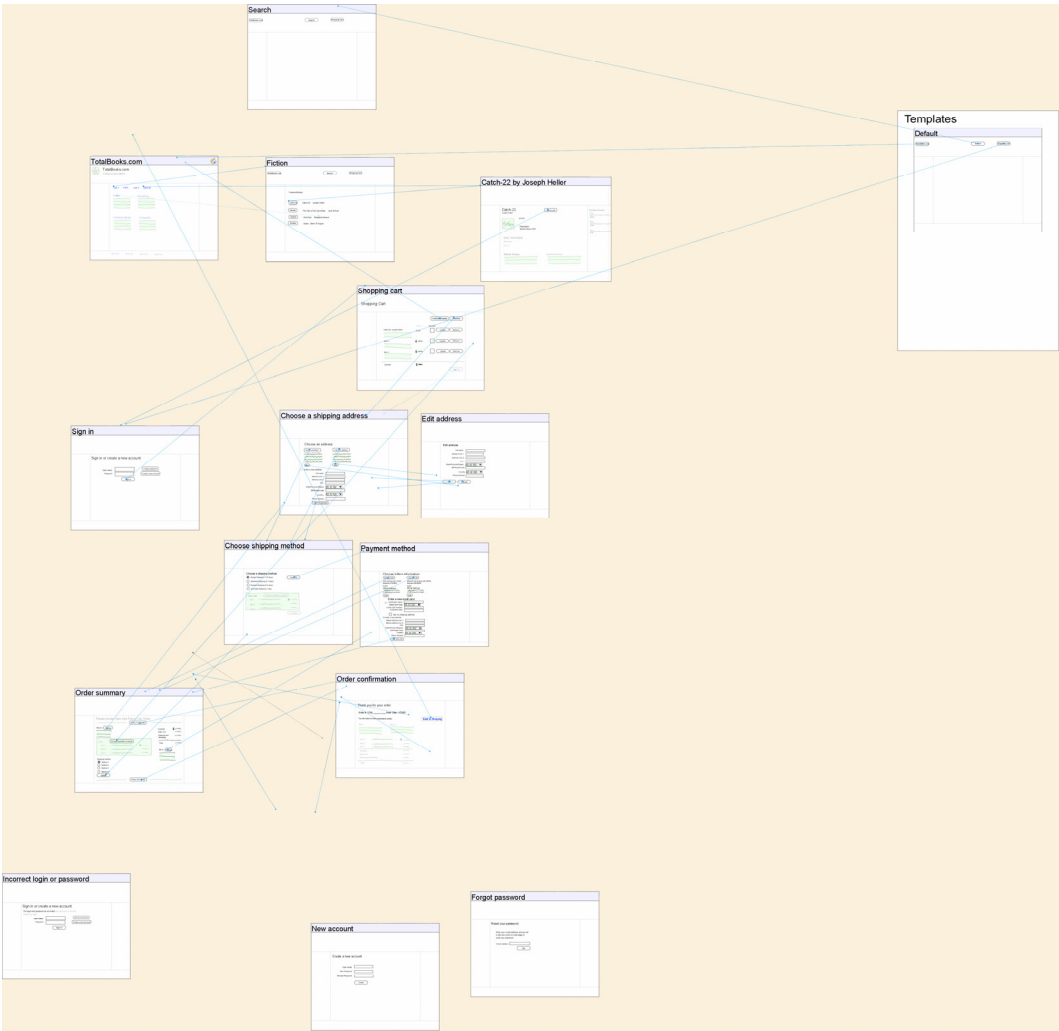
D.9.1 TotalMusic (no layers or patterns)

Desktop

Smartphone

D.9.2 TotalBooks (with layers and patterns)

Desktop

Smartphone

Product Details: Book 1

Book 1
Company name

$

Add to cart

Options

Update price

Nearest Store.

Details
Author
Edition
Publisher
Year
ISBN

Product Details: Book 1

Address =false&file=smartphone/16/product.html

Turn on sitemap

Book 1
Company name

$

Add to cart

Options   Item 1

Update price

Details   Nearest
Author   Store
Edition
Publisher
Year
ISBN

Internet

Nearest Store

Search

Stonestown Mall
San Francisco, California

Find More

Nearest Store

Address =false&file=smartphone/16/location.html

Turn on sitemap

Search

Stonestown Mall
San Francisco, California

Find store

Internet

Order Summary

Review your order

Place Your Order

Ship to: Change

Bill to: Change

Shipping method:

Budget (7-10 days)

Update

Shopping cart:

Change quantities of delete

Subtotal $
Sales Tax
Shipping and Handling

Total

Order Summary

Address =false&file=smartphone/16/summary.html

Turn on sitemap

Review your order

Place Your Order

Ship to: Change

Bill to: Change

Shipping method:
Budget (7-10 days)
Update

Shopping cart:
Change quantities or delete

Subtotal $
Sales Tax
Shipping and
Handling

Total

Internet

Shopping Cart

Shopping Cart

Item 1 $

Quantity   Update Remove

Item 2 $

Quantity   Update Remove

Item 3 $

Quantity   Update Remove

Subtotal $

Checkout

Continue Shopping

Shopping Cart

Address =false&file=smartphone/16/cart.html

Turn on sitemap

Shopping Cart

Item 1 $
Quantity
Update Remove
Item 2 $
Quantity
Update Remove
Item 3 $
Quantity
Update Remove
Subtotal $

Checkout

Continue Shopping

Internet

Choose shipping address

Choose a shipping address:

Use this address   Edit

Use this address   Edit

Use Cell Phone Address

Choose shipping address

Address =smartphone/16/shipping_address.html

Turn on sitemap

Choose a shipping address:

Use this address   Edit

Use this address   Edit

Use Cell Phone Address

Internet

Choose shipping address 2

Edit address

Full name:

Address Line 1:

Address Line 2:

City:

State/Province/Region:

ZIP /Postal Code:

Country:

Phone Number:

OK   Cancel

Choose shipping address 2

Address artphone/16/edit_shipping_address.html

Turn on sitemap

Edit address

Full name:

Address Line 1:

Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Country:
Item 1

Phone Number:

OK Cancel

Internet

Choose shipping address 3

Enter a new shipping address

Full name:

Address Line 1:

Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Phone Number:

Use this address

Choose shipping address 3

Enter a new shipping address

Full name:

Address Line 1:

Address Line 2:

City:

State/Province/Region:

ZIP/Postal Code:

Country:
Item 1

Phone Number:

Use this address

Internet

Choose billing info

Choose billing information

Visa ending with 12345
Expires 01/2005

Name
Billing Address

Use this info   Edit

MasterCard ending with 98765
Expires 02/2005

Name
Billing Address

Use this info   Edit

OR Bill to my Cell Phone

Cancel

Choose billing info

TotalBook   Lorem

Choose billing information

Visa ending with 12345
Expires 01/2005

Name
Billing Address

Use this info   Edit

MasterCard ending with 98765
Expires 02/2005

Name
Billing Address

Use this info   Edit

OR Bill to my Cell Phone

Cancel

Internet

Change quantities or delete

Change quantities or delete

Item 1 $
Quantity   Update Remove

Item 2 $
Quantity   Update Remove

Item 3 $
Quantity   Update Remove

Subtotal $ /mm

Cancel

Continue

Change quantities or delete

Change quantities or delete

Item 1 $
Quantity
Update   Remove

Item 2 $
Quantity
Update   Remove

Item 3 $
Quantity
Update   Remove

Subtotal $

OK Cancel

Internet

Thank You

Thank you for your order

Order #: _____
Order Date: _____

You will receive e-mail
confirmation shortly.

Back to Shopping

Thank You

Thank you for your order

Order #: _____
Order Date: _____

You will receive e-mail
confirmation shortly.

Back to Shopping

Internet

D.10   Designer 13

D.10.1   TotalMusic (no layers or patterns)

Desktop

Voice

D.10.2 TotalBooks (with layers and patterns)

Desktop

Voice

D.11 Designer 15

D.11.1 TotalMusic (no layers or patterns)

Desktop

Voice

D.11.2 TotalBooks (with layers and patterns)

Desktop

Voice

D.12 Designer 16

D.12.1 *TotalMusic (no layers or patterns)*

Desktop

Voice

D.12.2 TotalBooks (with layers and patterns)

Desktop

Voice

TotalBooks.com

Genre: Literature

Welcome to 1-800 TTLBooks! Say a reading genre, such as "science", or say tell me my choices To search for a book by title, say "title search"

Our featured literature this month includes Immortality by Milan Kundera and The Great Gatsby by F. Scott Fitzgerald Would you like to purchase one of our discounted feature titles?

Literature

Title search

Literature, got it When you're done here, say "main menu"

Please say the full title of the book you're searching for now

Guns, Germs, and Steel

Product

Okay, Guns, Germs, and Steel, by Jared Diamond. I have this book in paperback for $24.95. Would you like to add this item to your cart, do another title search, or return to the main menu?

Shopping Cart

We're at your shopping cart. Say "proceed to checkout", "title search" or "main menu" at any time Currently, your cart contains Guns, Germs and Steel by Jared Diamond. To hear the contents of your shopping cart again, say "repeat that", otherwise, would you like to proceed to checkout, search for more titles, or return to the main menu?

put it in my cart

Okay, I've added this book to your shopping cart. Would you like to proceed to checkout, search for more titles, or return to the main menu?

Proceed to Checkout

Proceed to checkout

Checkout

Okay, checkout. Your cart contains one item, Guns, Germs and Steel by Jared Diamond Would you like me to ship your order to your address on file or to a new address?

use my address on file

Would you like your order shipped using standard, express, or overnight delivery? For details on these shipping options, say tell me more about my options.

express shipping, please

And, are you paying by credit card, check, or another method?

credit card

To enter a new card number, say "new credit card". Otherwise, should I use the credit card associated with your account, ending in 0312?

Yes

The total charge for this order including shipping and taxes comes to $34.95. I'll ship your order to [address] using [delivery option], and [payment option summary]. If something's not right, say "change my order"Otherwise, hang on while I place your order in our system

Okay, you're all set. I'll send a confirmation message to your email address shortly. Your confirmation number for this order is 23459786. [1s pause] To hear your confirmation number again, say "repeat that". Otherwise, I'll transfer you back to the main menu.

D.13 Designer 17

D.13.1 TotalMusic (no layers or patterns)

Desktop

Voice

D.13.2 TotalBooks (with layers and patterns)

Desktop

Voice

APPENDIX

E   Designs and Sitemaps of Amazon.com and BarnesAndNoble.com

E.1   Amazon.com — as of April 26, 2005

E.1.1   Sitemap

See Section D.1 for the key to the sitemap.

E.1.2   Pages

Home (H)

Category (C)

Product (P)

Add to Shopping Cart/Cross-Selling (CS)

Shopping Cart (SC)

Sign-In (SI)

New Customer: New Shipping Address (nSA)

New Customer: Shipping Method (SM)

New Customer: New Payment Method (nPM)

New Customer: New Billing Address (nBA)

Order Summary (S | SM)

Change Quantities (SC2)

Shipping Address (SA | nSA)

Edit Shipping Address (eSA)

Payment Method (PM | nPM)

Billing Address (BA | nBA)

Thank You (TY)

E.2 BarnesAndNoble.com — as of April 27, 2005

E.2.1 Sitemap

E.2.2   Pages

Home (H)

Category (C)

Product (P)

Add to Shopping Cart/Cross-Selling (CS)

Shopping Cart (SC)

Sign-In (SI)

New Customer: New Shipping Address (nSA)

New Customer: New Payment Method (nPM)

New Customer: New Billing Address (nBA)

Create account

Order Summary (S)

Shipping Method (SM)

Edit Shipping Address (eSA)

Change Quantities (SC2)

Shipping Address (SA)

New Shipping Address (nSA)

New Billing Address (nBA)

Billing Address (BA)

Edit Billing Address (eBA)

Payment Method (PM$_0$)

Payment Method: Choose Credit Card (PM)

Payment Method: New Credit Card (nPM | BA)

Payment Method: Edit Credit Card (ePM | BA)

F Materials for Judging Damask Desktop and Smartphone User Interfaces

F.1 Consent Form

My name is James Lin. I am a graduate student in Computer Science at uc Berkeley. I would like to invite you to take part in my research. It consists of evaluating user interface designs over the web. The purpose of the study is to learn more about the design of user interfaces.

If you agree to take part in my research, you fill out a questionnaire on the web at the time and location of your choice. There will be one session. I ask that you schedule one hour for this study, though it is possible that you will finish early. The study will consist of looking through and evaluating several user interfaces on the web, and filling out a written questionnaire after each user interface. I would like to emphasize that this experiment should be approached as a fun activity and a contributing effort. It is okay if you do not complete the task. I may ask to contact you by telephone or e-mail if there are any follow-up questions I have after our interviews.

If you agree to participate and finish the questionnaire, you will receive a $50 gift certificate from Amazon.com to thank you for your participation.

There are no known risks to you from taking part in this research, and no foreseeable direct benefit to you either. However, your participation will contribute to my efforts to improve the state of the art in user interface design.

The judging results that you will create will be kept on my secured computer. We will not use any identifying information in any reports of my research. After this research is completed, I may save this data for use in future research by others or myself.

Your participation in this research is voluntary. You are free to refuse to take part. You may refuse to answer any questions and may stop taking part in the study at any time. Whether or not you participate in this research will have no bearing on your job or your relationship with UC Berkeley.

If you have any questions about the research, you may contact me, James Lin, at (408) 927-2687 or jimlin@cs.berkeley.edu. If you agree to take part in the research, please sign the form below. Please keep the other copy of this agreement for your future reference.

If you have any question regarding your treatment or rights as a participant in this research project, please contact UC Berkeley's Committee for the Protection of Human Subjects at (510) 642-7461 or subjects@uclink.berkeley.edu.

I have read this consent form and I agree to take part in this research.

_____   _____   _____

Name (please print)   Signature   Date

F.2 Introduction

Thanks for participating in our study of early-stage UI designs. You will be asked to look at four early-stage UI designs and evaluate them based on several criteria, both freeform questions and ratings. These UI designs were all created in less than 1 hour and 45 minutes, with an average time of 1 hour.

You are to evaluate the designs as if the designer is applying for a job at your firm, and the designs were created as part of the job application process. The designs will look similar to the screenshot below:
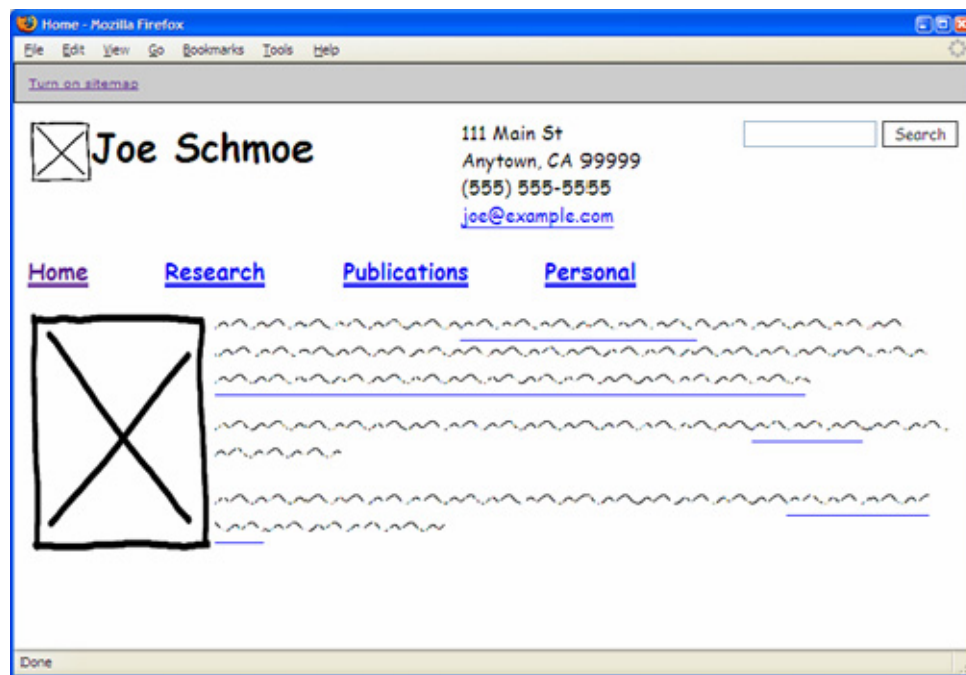
A few things to note:

- A blue line under a squiggle means that it is a link.
- Buttons (like the *Search* button in the upper right-hand corner of the example) may or may not be linked to another page.

- If you get lost, you can click the link labeled "Turn sitemap on" in the upper left-hand corner, which will make the design look like this:
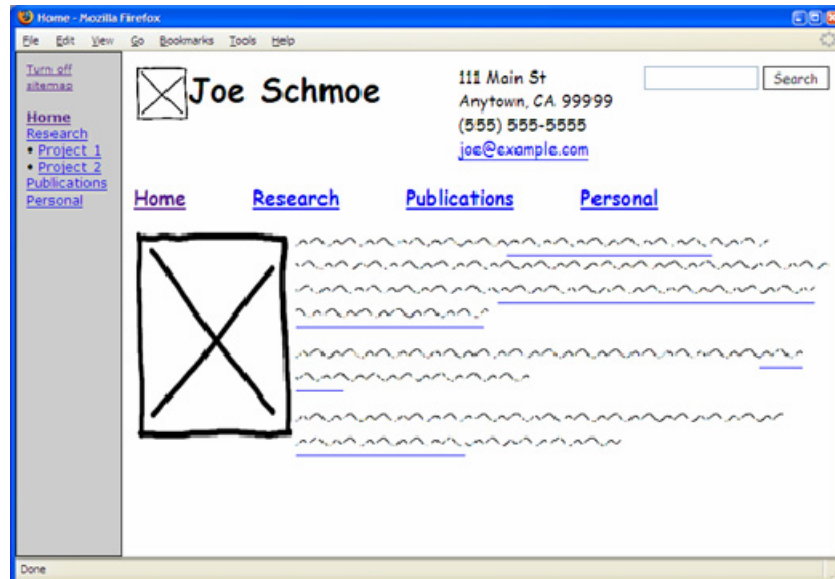
Within the sitemap, the page you are currently viewing is in bold (in this case, *Home*).

Throughout the evaluation form itself, there are buttons labeled Save the whole form as a draft (just in case). This allows you to save your answers so that you can come back later. After saving the form, you can close your browser without losing your answers. To resume evaluating, simply come back to this page and login again.

Before starting, make sure you have **enabled cookies and JavaScript** in your browser.

To begin, please enter the evaluator number and password that you received from us by e-mail.

Evaluator number: ☐

Password: ☐

F.3 Questionnaire

x **out of 4 designs**

Evaluation of Design *y*

A designer is applying for a job at your firm and has been asked to create a preliminary design for a web site for selling books. Here are requirements that were given to the designer, and the designer's design:

- Instructions for design task *(linked to the instructions given to the participants: §C.6.1, Task 2; §C.6.2; or §C.7.6, depending on the design)*
- Design *y (linked to the appropriate design, Appendix D)*

As part of the job application process, you are to evaluate the design and the designer. Please fill out the following form.

Browsing for a (CD | Book)

Page flow

1. Please give a rating for how well the pages for browsing for a (CD | book) were *linked together*: (1 = negative, 5 = positive; evaluator number in parentheses)

Designer	Ratings			
	1	2	3	Average
Desktop—No patterns or layers				
4	(9) 4	(10) 2	(12) 4	3.33
5	(3) 3	(8) 3	(9) 2	2.67
6	(5) 2	(6) 2	(11) 3	2.33
7	(1) 3	(2) 2	(3) 3	2.67

8	(1) 5	(4) 4	(7) 1	3.33
9	(4) 4	(6) 3	(10) 1	2.67
10	(2) 4	(5) 3	(8) 4	3.67
11	(7) 2	(11) 4	(12) 4	3.33
13	(15) 3	(16) 3	(17) 3	3.00
15	(13) 1	(14) 3	(17) 4	2.67
16	(15) 5	(16) 4	(18) 4	4.33
17	(13) 3	(14) 2	(18) 2	2.33

Desktop—Patterns and layers

4	(9) 4	(10) 2	(12) 4	3.33
5	(3) 2	(8) 4	(9) 3	3.00
6	(5) 3	(6) 2	(11) 3	2.67
7	(1) 4	(2) 4	(3) 4	4.00
8	(1) 2	(4) 2	(7) 2	2.00
9	(4) 4	(6) 3	(10) 2	3.00
10	(2) 4	(5) 3	(8) 3	3.33
11	(7) 4	(11) 4	(12) 4	4.00
13	(15) 2	(16) 3	(17) 4	3.00
15	(13) 1	(14) 4	(17) 4	3.00
16	(15) 4	(16) 3	(18) 4	3.67
17	(13) 2	(14) 4	(18) 1	2.33

Smartphone—No patterns or layers

4	(19) 4	(22) 3	(29) 5	4.00
5	(24) 4	(25) 3	(26) 2	3.00

6	(20) 5	(21) 3	(28) 3	3.67
7	(23) 4	(24) 3	(27) 4	3.67
8	(19) 2	(20) 2	(30) 4	2.67
9	(23) 2	(27) 3	(29) 4	3.00
10	(21) 1	(25) 2	(30) 4	2.33
11	(22) 2	(26) 5	(28) 4	3.67
Smartphone—Patterns and layers				
4	(19) 3	(22) 3	(29) 3	3.00
5	(24) 1	(25) 1	(26) 2	1.33
6	(20) 4	(21) 3	(28) 3	3.33
7	(23) 4	(24) 2	(27) 3	3.00
8	(19) 3	(20) 2	(30) 5	3.33
9	(23) 3	(27) 4	(29) 3	3.33
10	(21) 2	(25) 1	(30) 4	2.33
11	(22) 5	(26) 2	(28) 3	3.33

2. Discuss with the designer what you like and do not like about the how the pages for browsing for a (CD | book) were *linked together*.

DESIGNER 4 · DESKTOP · NO PATTERNS OR LAYERS

(9)   I thought it worked fine.

(10)   I like the fact that i have visibility into all genres on the top left nav. I like the use of the horizontal space. All the important information is in my face, i like that.

(12)   Seemed familiar and comparable to other online music seller web sites.

DESIGNER 5 · DESKTOP · NO PATTERNS OR LAYERS

(3)   Some of the language is awkward, such as proceed. I wasn't sure where I was
       goign with this link. I wasn't sure what the link below the album details was for
       (the add to shopping cart). This seems like an odd detail to leave off a design. I
       think the artist name should have been linked to the listing of all their albums.¶I
       like that there is some navigation on the Album page but it still doesn't really
       give much indication of where you currently are in the category structure.

(8)   should have secondary method of interaction menus for users to retrieve
       information. users should be able to directly purchase music instead of looking
       at details, then purchase.

(9)   Ok this was confusing. I click on a "featured album" and I go to an "artist's name"
       type item???? Put an album name item on that first page for each of those
       "featured albums" such that when I click on it, the next page makes better sense.

Designer 6 · desktop · no patterns or layers

(5)   not entirely clear the connection between the main genre page and the
       selection of possible artists. or how this design would support backing up and
       browsing for another selection.

(6)   As with Design 1, the linking from home to genre to CD info is straightforward.
       I'm missing some "scent" trail in the way of page titling - I'm in Alternative, I'm
       looking at the album called Hai! (I think). I like that the genre navigation stays
       with you.

(11)   The flow was fine.

Designer 7 · desktop · no patterns or layers

(1)   no problems
(2)   Can't choose another album or genre easily.
(3)   The flow seems adequate. Main page>genre>album page.

Designer 8 · desktop · no patterns or layers

(1)   No problems, web-standard browse path

(4)   The pages were all linked well. I didn't notice any errors.

(7)   Difficult to navigate bewteen levels

DESIGNER 9 · DESKTOP · NO PATTERNS OR LAYERS

(4)   The pages seemed to link well and I didn't see any broken links.

(6)   Path was pretty direct, information scent is supported through titles. There is a lack of other navigation on the pages, however. Also missing any references to the ringtones - should be creating awareness and telling people how to get it.

(10)   I like the fact that it is simple. ¶Why are the genres at the bottom?¶I do not like the fact that I cannot go back to where I came from without hitting back button several times. How do I go back to the home page?

DESIGNER 10 · DESKTOP · NO PATTERNS OR LAYERS

(2)   I like the shopping cart to be linked on browsing page, so I can always go there to check what is in my cart.¶¶I don't like that the checkout page is totally separate from the CD browsing. What if I want to go back to buy a new CD during the checkout process?

(5)   are breadcrumbs part of this design? if so, these could be more clearly marked in these mockups. would be interested in hearing the rationale behind browsing by genre - are there compelling use cases for this versus say browsing by new releases or top rated?

(8)   Browsing for CDs make sense

DESIGNER 11 · DESKTOP · NO PATTERNS OR LAYERS

(7)   Unable to navigate efficiently between pages

(11)   I like that the user can easily "drill down" to an album by choosing a genre and then selecting an album from a list of albums.¶¶I'd like to see a more creative

way of presenting a "search for a specific album" feature. But doing so wasn't part of the requirements, so I suppose that's fine.

(12)   Interface seemed familiar to me, comparable to other online music sellers.

DESIGNER 13 · DESKTOP · NO PATTERNS OR LAYERS

(15)   Browsing for a CD was possible, but contained errors.¶¶The homepage was successful. The simple genre links from the homepage work fine, because they resemble the very familiar pattern of the categories on a search-enging homepage.¶¶The requirements stated both "a page for one genre of music" and also a "product page." I see a page entitled Oldies, which satisfies the one-genre requirement; however I see no "product" page. Folding the individual products into the same page is a nice way to save a click, and would be worth putting in front of users for their response. However, the big problem here is that the designer assumed a very small data set (the list of featured albums). The designer offered eight genres, yet only four featured albums in one genre. Granted, the requirements should have specified a number range; a stated upper limit of three, 20, or 200 featured albums would make a big difference in the linking to individual albums. But absent that upper limit, the designer should not have assumed just four featured albums and skipped the "product page" requirement.¶¶The requirements did not specify how easy it is to browse from one genre to another. There are real-world reasons why a browser might want to (1) stay highly focused in a genre, or (2) jump among genres. It appears that the designer assumed #1 -- a fair assumption -- by providing only a link to the homepage rather than "sideways" navigation to other genres from the Oldies page.

(16)   It seems to me that this design would work well if there was a very limited inventory of CDs, but that as soon as the number of CDs increased the browse mechanism would fail.

(17)   Clicking from the genre page was easy, but the way to link from music isn't readily understandable.

DESIGNER 15 · DESKTOP · NO PATTERNS OR LAYERS

(13)   A drop down menu is not the best way to start the customer experience, especially when there are only 4 options in that menu. The OK button seems unnecessary, why not just link on select? A simpler UI could be made that requires fewer clicks.¶¶Once a genre has been selected the add to cart functionality should be a priority. Once again by using a form method, you're adding extra work for the customer. Checkboxes and submit also suffer from lack of proximity.¶¶Good that Search is persistant, but results present a different UI.

(14)   it's pretty easy to get around,¶it would be nice if the home page had some features on it

(17)   The pages seem to link well together -- there might be more interactivity on each page (allowing a user to continue shopping after they view their cart, and on an album page, allowing a user to purchase either individual songs or a whole CD).

DESIGNER 16 · DESKTOP · NO PATTERNS OR LAYERS

(15)   Phew, what a relief. I thought I was going crazy.¶¶The hyperlinks are done right, reflecting a hierarchy as specified. They are implemented in global nav plus drilldown. No problems - all the way down to song samples.

(16)   This design seems to have a better flow from genre through album listing through album details to purchase. (I know that I am reacting to the overall similarity to shops like Amazon.com here.)

(18)   Browsing and search both work, there's a clear navigation element to the screen. I know where I am, I can get home, I am an enabled user. The Buy Now accelerator was handy, although personally I don't find myself making use of such things on product websites. (iTunes, on the other hand...)

DESIGNER 17 · DESKTOP · NO PATTERNS OR LAYERS

(13)   Pretty good. Appropriate use of graphical links for each major genre section.¶¶Featured Music is acceptable. Could link text instead of more info button...or perhaps repeat graphical links?¶¶Consistent top navigation is good!

(14)   No links between genres, no way to hyperlink through a lot of stuff at once.

(18)   Access to merchandise is very narrow and constrained, and I feel like I'm doing Big Things when I'm clicking buttons; where are the links?

DESIGNER 4 · DESKTOP · PATTERNS AND LAYERS

(9)   The flow is ok.

(10)   How do I go back?

(12)   Fulfills application spec requirements. I like the ability to change several options, such as billing address, mailing address, and change of order. I also like the option of emailing a password back to customer.

DESIGNER 5 · DESKTOP · PATTERNS AND LAYERS

(3)   I found this very awkward. Do you really have only the one book to purchase for this genre? The pages were linked together adequately, there's just not much there to link. There should be more pages and the navigation should be evident. It's hard to determine how users get around in the site.

(8)   It is linked together in the natural progression of online shopping experience. it is fine, but there are inconsistency in link options and no clear indication on how to "go back."

(9)   What's the difference between BUY and ADD TO CART.¶This isn't very clear. Make the difference between these much bigger or make the PURCHASE command more consistent.¶¶The multiple column format is good vs. forcing user to scroll down. Nice clean spacial organization. I don't understand the "95% visitor link" links - what is this supposed to provide user link to? What is the value of this feature?

DESIGNER 6 · DESKTOP · PATTERNS AND LAYERS

(5)   seems like it works - but i'm not sure how the genre heading connects with the main category sub-header at top?

(6)   The path from the category on the home page to a featured book to book detail is clear. ¶¶What isn't so clear is the navigation in the opposite direction - or navigation if your frst path isn't what you wanted. I felt a little stranded on the book info page with the loss of the navigation. I also didn't feel confident on how to search books that were not featured on the Mystery category page(search function is very basic), or what the main versus sub categories were supposed to be without seeing an example. The two different search fields on the home page and the mystery page also confused me.

(11)   This is fine.

DESIGNER 7 · DESKTOP · PATTERNS AND LAYERS

(1)   Fabulous, although consistent button placement would be an improvement

(2)   Double visitor links are not necessary. And it distract the user. Main category should also show on detailed book page.¶¶It is good to have shopping cart and search box everywhere.

(3)   It would have been nice to provide breadcrumbs to allow quicker navigation out of the page but otherwise I think this was done well. I would also recommend linking author to assist users in finding other books by the same writer. ¶I liked being able to jump quickly to related books from the book page (another reason for breadcrumbs). Otherwise browsing navigation is functional, allows user to view items directly in the direct path as well as branching off to related items.

DESIGNER 8 · DESKTOP · PATTERNS AND LAYERS

(1)   some detail for the destination of each link should be provided¶¶otherwise, fine.

(4)   There were broken links in this process.

(7)   Unable to get to all types of books.¶Deeper pages unable to browse

DESIGNER 9 · DESKTOP · PATTERNS AND LAYERS

(4)   The pages were linked well. No errors or broken links.

(6)   The path down is straightforward, and there is good information scent. The other navigation seems to come in and out though.

(10)   Once I am on Genre A how do I go back to all the Genres? Site map link was too small and not in my visible area so I missed it.

DESIGNER 10 · DESKTOP · PATTERNS AND LAYERS

(2)   I like the horizontal category bar which can bring user's attention.¶¶But on the detail book information page, there is not like to go back to the other books or categories.

(5)   pretty good - but how would the genre page support browsing by any other means that featured books? don't like how i lose my side naviagtion when moving to the product page.

(8)   Order makes sense

DESIGNER 11 · DESKTOP · PATTERNS AND LAYERS

(7)   Design allows more navigation between pages; assume many of these areas are linked.

(11)   The flow was fine.

(12)   Interface seemed familiar to me and comparable to other online book seller web sites.

DESIGNER 13 · DESKTOP · PATTERNS AND LAYERS

(15)   (As an evaluator, I do not understand the relationship between this question and the requirements doc. Actually, same was true for the last design. Are you trying to find out whether the site map is right? Since I don't really understand

what you want, I'll just give you my subjective opinion.)¶¶Links are incomplete. There is no genre page. There are only homepage and product page.¶¶There is no return link to Home, nor for that matter any global nav. "Continue Shopping" button is nonstandard for a product detail page, and insufficient. Aside from the "continue shopping" button, drill-down is a one way trip - oops.

(16)   Difficult to evaluate, because I was dumped in with the 'Da Vinci' code already selected, and didn't get to go through the browsing process. Nonetheless, it seems reasonable enough for the detail that is there.

(17)   The two Da Vinci pages are well done, but almost seem like they should be switched -- The product page has less information than the category page. While offering related and featured items from the product page is not a requirement from the specs, it's a nice addition... knowing when to add (or subtract) a feature also shows critical thought and will let the client know they are very important to the designer.

Designer 15 · desktop · patterns and layers

(13)   Pages are barely linked at all! ¶¶What or where is the submit on the drop-down menu on the homepage? The word "Genre" is linked, and I'd assume that it would show me a list of genres available, not a specific one. What specific genre is it anyway?¶¶Search also has no submit element.

(14)   straightforward + easy to get through, but no way to get back to the home page.. and the "product" link makes no sense, I mean, what product IS it? this page shouldn't be in the navigation like that, you should get to that page by clicking on a particular product, like, once you are inside the genre listing or whatever

(17)   The pages seem to flow logically together.

Designer 16 · desktop · patterns and layers

(15)   The overall hierarchy is correct.¶¶I was a little confused by the multiple "main category" items across the top. What are these supposed to be? If I ignore them entirely, the rest appears correct.

(16)   Seems ok. Fits most of my standard model for how this should work. ¶¶The largest problem is that when I am browsing there seems to be no clear indication of what genre I am currenlty browsing. The 'featured books' header is not precise enough.

(18)   It is fairly intuitive with regards to browsing. I don't have a sense for where I am in the site once I begin to drill down, so a breadcrumb trail of sorts would help.

Designer 17 · desktop · patterns and layers

(13)   Text links on homepage, but now a graphical (button) link on Genre page. Make links consistent. Link title names if using text.¶¶"Catch 22" is not a genre yet exists at same level as Link 1,2,3 at the top of homepage.

(14)   This is a very complete design for browsing for books.. It lets you know what the categories are and lets you drill down through them into book details.. and once you get to a book you can get to other books easily.. it would be good to have navigation from the book detail page to get back to the genre you came from though

(18)   This is utterly foul. You have no sense where you are or where you've been, and you're forced to go one way. I despise it.

Designer 4 · smartphone · no patterns or layers

(19)   Good aspects are that there is consistency in links and navigation, and follows the intuitive way of performing this task. However in case of dozens of genres and in each genres, there can be hudreds of artists, navigation can be a bit problematic. A breadcrumb trail of links would be good (considering that smartphones would have stylus to click the links). Zooming interfaces could be another approach.

(22)   They are linked together just fine, again in a linear fashion. But none of the advanced features you'd like to see were presented, such as featured product, other ways to browse besides genre, etc. If I wanted to find tones by Sinatra, I'd have to figure out what genre that might be, and I might think it's something other than the person who chose it.

(29)   These proceed as I would expect.

Designer 5 · smartphone · no patterns or layers

(24)   Good job in keeping the screen count to a minimum. The flow made sense and it was fast and easy to get where I wanted to.

(25)   - "Home" link below fold¶- Could we save a click by "buy" icon in genre text (so user could chose between getting further album details or starting transaction)¶- CD / Tape should be checkboxes so user can buy tape and cd in one click

(26)   incomplete design. user cannot listen to songs, cannot download to phone, search not available on each page, etc.

Designer 6 · smartphone · no patterns or layers

(20)   The pages browing for a CD were linked together pretty well. I was able to logically navigate to the music, and on this page I see the information that a user would expect to see.

(21)   The pages are clearly linked together and easy to find, though I'm not sure how to get back if I want to see a different genre.

(28)   Linkage and progression were OK. You could have used some additional backlinks at the bottom of each page to allow the user to pop back up to a different level of the site -- just using the back button can get frustrating over a slow connection. Incidentally, I can't really tell when something is a mocked-out hyperlink and when something is just text in your prototype.

Designer 7 · smartphone · no patterns or layers

(23)   Much better than previous flow. Allows me to listen to the tune, which should result in more purchases.

(24)   Although the requirements called for less steps and different interaction, overall the page flow was pretty good. Intuitive to a point. The lack of button labeling was definitely a problem when it came to the genre and product detail pages. What does that button do? Having to click on it to figure it out is not good.¶¶I liked the usage of ordered lists. For smartphone navigation this is a MUST.

(27)   Simple, but not clear how you would handle more than the few options available.

DESIGNER 8 · SMARTPHONE · NO PATTERNS OR LAYERS

(19)   Search is not present. Forward and back button would be helpful. Breadcrumbs would be further helpful. No Link to home page? Interface needs to be a bit more detailed for appropriate evaluation.

(20)   Judging by the 'login' 'logout' experiences at the top, it seems like I have already had to log-in to the site to browse through the content. This shouldn't be the case. ¶¶The pages for getting to a specific piece of music lack titles / explanation. What am I looking at here? Featured artists? Most popular artists? etc It is unclear. ¶¶I am unable to search from each page throughout this experience.

(30)   Pages link together logically.

DESIGNER 9 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   Is it possible to hear samples of songs?¶Liked the ringtone option.¶A bit confused after viewing artist information, how navigate to another artist. Seemed like a deadend.¶This flow doesn't seem as complete as the previous flow.

(27)   Linking was straightforward, but without turning on the sitemap, there wasn't much context.

(29)   These link as I would expect.

DESIGNER 10 · SMARTPHONE · NO PATTERNS OR LAYERS

(21)   I often could not tell where I was, how I got there, or what to do next. The
        buttons did not tell me what would happen when I clicked them, and the links
        were not very descriptive.

(25)   - impossible to assess quality of linking without seeing text on home page¶- no
        back links or way to move laterally¶- do you consider listening to mp3 demo
        part of browsing?

(30)   Standard shopping experience

DESIGNER 11 · SMARTPHONE · NO PATTERNS OR LAYERS

(22)   Only giving me a choice of what was featured in the genre was too limiting.
        What else is there? It's good to show the featured items but I need the big
        picture.

(26)   seems to meet requirements and provide navigation

(28)   Adequate. A link back to the site home would be useful for each page.

DESIGNER 4 · SMARTPHONE · PATTERNS AND LAYERS

(19)   There should be a breadcrumb trail of the links clicked, so that the user could go
        back and precisely know their location. Again, back and forward buttons would
        be helpful.¶¶The user should not be taken to the shopping cart page, unless
        they specifically want to. Clicking on "Add to cart" should be such that the user
        is not taken away from the current page.¶¶Price should be updated
        automatically.¶¶There is no way to go back if you clicked on the link 'location'.
        Instead of a dropdown, 'Shipping Method" can be a radio button.¶¶The 'back to
        shopping' link is not shown as a button. It should be active.

(22)   I was really only given the choice to follow a linear pattern in finding a book. I
        wasn't sure if the box up top was search or not, as it was not labeled. Other than

that, things were linked up fine. There should have been some featured books or some clues to what was popular on the site.

(29)   These proceed as I expect-- general to specific.

DESIGNER 5 · SMARTPHONE · PATTERNS AND LAYERS

(24)   Honestly, I was a bit confused when I clicked on the Genre link. I thought I may have made a mistake and clicked on the wrong item. I went back and forth a couple of times before I noticed that you were using the HTML title element as your sole method of displaying the page title. While that is definitely correct usage, I think people are also used to seeing a visual page title within the view port itself.¶¶On the product detail page, the label "Featured Books" coupled with a single set of "Details" and "Buy" buttons threw me off-track again. The plural "Featured Books" implies more than one. I would expect a "Details" and "Buy" link for each book listed. ¶¶I am not sure what kind of "Options" one would have when purchasing a book, but this set of form controls doesn't make sense and only adds to the confusion.

(25)   How do I buy a non-featured book? ¶How can I move from one genre to the next?¶Can I search for a book on the home page?¶Can I browse by author or title from the home page?

(26)   Does not seem to fit together well¶¶search not available on every page

DESIGNER 6 · SMARTPHONE · PATTERNS AND LAYERS

(20)   The design is simple - which is a good thing for people browsing to a book. I would have expected the list of genre's to be ordered alphabetically, or have an option for this. In general it seemed simple to move from the genre to a specific book.

(21)   The overall hierarchy is fine - browsing the categories makes sense. Once on the detail page of the specific book, where there are multiple actions, the links between pages became less clear. I also need a way to get "home" from anywhere in the site.

(28)   The linking was adequate. I couldn't tell from the prototype how sensibly the link text was chosen for some sections (e.g. the book titles). Generally, in mobile applications that's fairly important, since less context is available on the screen at any given time. ¶¶You probably also want a backlink or toplink at the bottom of each page, so that a user can quickly pop back up to to a higher level of the site.

Designer 7 · smartphone · patterns and layers

(23)   I would like to be able to view Other Books by the author. (I may want to buy more than one, or see what they had written in the past or more recently.)

(24)   I don't like like the fact that scrolling was required to find the link that would take me to the next page. There are too many superfluous links between me and my intended target. Also, your choice of sample text and fake titles aren't the greatest, but I won't hold that against you. ;-)

(27)   I did not see a search function, and did not get a feel for what browsing multiple books would be like. Some context and navigation would help. If customer did not like the featured book, not obvious what I could do next.¶¶Not sure what the 95% user lines are.

Designer 8 · smartphone · patterns and layers

(19)   Position of links is not consistent. There should be 'back' and 'forward' buttons. Some form of hint should be given to user about how many more steps are remaining before the purchase is finalized. Global navigation needs to be improved a lot and should be made consistent.¶¶There are a few blank pages with no links, so the chain of links is broken, and user could not go ahead without using the sitemap.

(20)   I was able to get into the genre of cooking; but I could not understand what the content was supposed to be on the next page. I needed to see some content here. ¶¶Once I found a book, I was given a store locater; however, it would have been preferable to initially tell me my nearest store.

(30)   A basic shopping experience - seems logical. Homepage > category page > product detail page.

DESIGNER 9 · SMARTPHONE · PATTERNS AND LAYERS

(23)   Didn't see two functions in the requirements document: ¶1. When choosing from multiple addresses, users should be able to have it shipped to their cell phone billing address.¶2 When choosing a payment method, users should be able to have their order billed to their cell phone bill.

(27)   The site flow was okay. No real changes to recommend.

(29)   These flow as I would expect.

DESIGNER 10 · SMARTPHONE · PATTERNS AND LAYERS

(21)   The only option was to drill down - there was no way to get back to previous pages.

(25)   cannot realisticaly assess flow and design separately in a mobile device interface. see thoughts below

(30)   Flow seems logical

DESIGNER 11 · SMARTPHONE · PATTERNS AND LAYERS

(22)   Very well done, giving me multiple ways to shop. Can't really find anything negative to say about it.

(26)   users should be able to browse for a book without knowing or following a particular genre. The instructions assume users use genre as a major navigation theme for the website. Even if genre is used as a navigation theme, users should be able to search book titles and authors.

(28)   Adequate. Excess link text in many places. And backlinks / toplinks would've been nice.

Page design and layout

3. Please give a rating for the page *layout and design* for (CD | book) browsing: (1 = negative, 5 = positive)

Designer	Ratings			
	1	2	3	Average
Desktop—No patterns or layers				
4	(9) 2	(10) 2	(12) 3	2.33
5	(3) 3	(8) 4	(9) 3	3.33
6	(5) 2	(6) 2	(11) 2	2.00
7	(1) 3	(2) 3	(3) 3	3.00
8	(1) 2	(4) 3	(7) 2	2.33
9	(4) 4	(6) 3	(10) 1	2.67
10	(2) 3	(5) 3	(8) 4	3.33
11	(7) 2	(11) 3	(12) 4	3.00
13	(15) 2	(16) 2	(17) 2	2.00
15	(13) 1	(14) 3	(17) 3	2.33
16	(15) 4	(16) 4	(18) 4	4.00
17	(13) 3	(14) 2	(18) 2	2.33
Desktop—Patterns and layers				
4	(9) 2	(10) 3	(12) 3	2.67
5	(3) 3	(8) 4	(9) 2	3.00
6	(5) 4	(6) 2	(11) 3	3.00
7	(1) 4	(2) 4	(3) 2	3.33
8	(1) 2	(4) 3	(7) 3	2.67
9	(4) 4	(6) 2	(10) 3	3.00

10	(2) 4	(5) 3	(8) 4	3.67
11	(7) 4	(11) 3	(12) 4	3.67
13	(15) 4	(16) 4	(17) 5	4.33
15	(13) 1	(14) 2	(17) 3	2.00
16	(15) 4	(16) 3	(18) 3	3.33
17	(13) 2	(14) 4	(18) 2	2.67
Smartphone—No patterns or layers				
4	(19) 2	(22) 3	(29) 1	2.00
5	(24) 2	(25) 3	(26) 1	2.00
6	(20) 5	(21) 4	(28) 3	4.00
7	(23) 3	(24) 4	(27) 4	3.67
8	(19) 2	(20) 1	(30) 3	2.00
9	(23) 3	(27) 2	(29) 2	2.33
10	(21) 1	(25) 3	(30) 4	2.67
11	(22) 3	(26) 5	(28) 3	3.67
Smartphone—Patterns and layers				
4	(19) 3	(22) 4	(29) 2	3.00
5	(24) 1	(25) 1	(26) 3	1.67
6	(20) 3	(21) 3	(28) 2	2.67
7	(23) 3	(24) 2	(27) 2	2.33
8	(19) 3	(20) 2	(30) 3	2.67
9	(23) 3	(27) 2	(29) 1	2.00
10	(21) 2	(25) 2	(30) 3	2.33
11	(22) 4	(26) 4	(28) 1	3.00

4. Discuss with the designer what you like and do not like about the *layout and design* of the pages for browsing for a (CD | book).

DESIGNER 4 · DESKTOP · NO PATTERNS OR LAYERS

(9)   The page with the actual title and detail of the title should be much more similar in design than the list of titles on the page before it. The addition of the 3rd column might work IF you can design that 3rd column such that the info in it is much more flush giving it a true simple 3rd columnar feel rather than stuff not quite lining up well enough. That little bit of spacial disorganization could throw a user off thus slowing them down and disrupting their thought process at this point.

(10)   I like that the various items are one below another. Good use of vertical space.

(12)   Seemed familiar and comparable to other online music seller web sites.

DESIGNER 5 · DESKTOP · NO PATTERNS OR LAYERS

(3)   The album page should have had the album title higher than the artist name. I found this a bit odd. Given that this is the primary info on this page. I would also think that the designer would want to provide some review information on this page. Otherwise the browsing is pretty standard.

(8)   no concerns

(9)   There is more of a solid underlying grid in these designs. Still, use of indentation would help dilineate categories of information a little more quickly and easily (ex., indenting 'track listing' items).

DESIGNER 6 · DESKTOP · NO PATTERNS OR LAYERS

(5)   difficult to discern - design could be more complete by showing interesting and possible content areas. the album page shows more detail - which is nice.

(6)   Shopping cart and search are in standard places, which is good.¶¶Home page is very confusing to me. I see a featured album, but not much else. It doesn't appear that I can link to that albumn. I like the way that the link is listed as see

more music in alternative. I would expect at least to see some representation of other albumns and genres, and less copy for each of them. ¶¶I would also expect to see something abaout ringtones, even if I can't get them from the web site, I want to be made aware of them and learn how to download from my phone.¶¶Alternative Category page¶There is not enough sketch here to get a good sense of how this page would work. The top text is going to be too wide...the other columns are probably fine although the first column looks like it is associated with the image above it.¶¶Product page¶I don't see the ability to listen to a track. I feel a little unsettled to see the track info right next to the image of the CD. It occurs to me now that the scribbling on top might be the page title, but I think in these kinds of sketches it is worth spelling that out.¶The layout doesn't feel as tight as it could - not sure about the decision to put the price/buy button to the right. There's no quantity.¶There is a missed oppty to fufil the cross sell requirement - other albumns by this band or others in this genre.

(11)   I don't see related albums offered to me when I'm looking at a specific album, only when I check out. This seems to me to only speak to one use case -- that of the buyer -- rather than multiple use cases (e.g. the buyer and the browser). I'd rather have related albums offered to me before I decide to buy a particular album.¶¶Everything else was fine.

Designer 7 · desktop · no patterns or layers

(1)   standard stuff

(2)   I like this simple and clean layout and it bring attention to user what they are doing. But it is not easy to start a new album or go to homepage or go to shopping cart.

(3)   The first page needs more detail to convey the concept. I wasn't sure what was linked (why didn't the designer take the extra minute to add the genre for the link?).¶The picture element on the main page seem to large for albums, so I'm not sure what they are intended to represent. Also there's no textual

information to provide detail. On the genre page, there's no easy navigation (shortcuts) to the promoted items except the one featured which lacks title and artist to provide links. ¶Also, the A-Z navigation is understandable it's hard to understand how the titles are organized underneath. Am I looking at all the titles, only the A's? ¶The album page is nice, I like how this is laid out. I would provide some genre indicator and/or navigation on this page back to the higher sections in the site map.

Designer 8 · desktop · no patterns or layers

(1)   too vertical, could have made better use of the horizontal space.¶¶inconsistent shopping cart placement, log in/out placement, search placement, awkward product page layout¶¶no indication the user is logged in

(4)   This design seemed a little cluttered. Was not as predictable or easy to interpret as I would like.

(7)   Unable to understand some of the info; [pages look confusing

Designer 9 · desktop · no patterns or layers

(4)   The main page seemed a little bland with not much info. Overall the layout seemed predictable if not innovative.

(6)   I don't understand what is happening with the home page, and why the links are at the bottom of the page. ¶Shopping cart and search are in common places.¶¶The category page is pretty minimal - no issues with the layout but it is lacking additional information and browsing functionality.¶¶¶Same comments on the others as far as the text column being too wide on the product page, and that secondary info (e.g., * of pages) is in prime sselling real estate. The add to cart button is in an odd place, outside the eyeflow. Tracks are in a better position than the other designs, but there is no indication that you can listen to the tracks.

(10) I would prefer to have the results be displayed neatly in a table. I would prefer it to be a vertical display rather than horizontal display. If there are several results,

there would be too much horizontal scrolling to do. I do not mind vertical scrolling but I mind the horizontal scrolling.

DESIGNER 10 · DESKTOP · NO PATTERNS OR LAYERS

(2)   Nothing dramatic. It is a common layout. ¶¶One thing I don't like is the search box is not big enough. Search is so important these days. User likes to find what they need by search. Also there is no histories about the CDs I browsed before.

(5)   i liked the layout. seems to leverage well established conventions.

(8)   centralized area for buttons and links.

DESIGNER 11 · DESKTOP · NO PATTERNS OR LAYERS

(7)   Easy to get to genre, find checkout and search¶¶Difficult to move between pages

(11)   The layout and design are very functional but not particularly creative. You could, for example, offer a description of the genre next to each genre type, which would allow the user to make a more informed decision about genre selection. I think it's safe to assume that different people might think a record falls into different genres.

(12)   Content categories were clearly apparent and choices can be easily made.

DESIGNER 13 · DESKTOP · NO PATTERNS OR LAYERS

(15)   The home page is fine.¶¶Continuing the comments in question #2 regarding the absence of a "product page." Even if we were to assume a maximum of four Featured Albums, the Select box was unnecessarily small, hiding the fourth album. There is plenty of room on a browser screen to show five or ten albums at a time.¶¶Minor issue: I see "The Righteous Brothers" details prefilled on the right. Here I would ask the designer for their intention. Is this the initial state of the screen (defaulting to the first item in the list), or the state after the user has clicked an item? If the latter, there is no problem. However, if the former, we

would do better with a drill-down. When there is no intrinsically best item in the selection list, there should be no default; this further helps guide the user's attention toward learning that they must click the selection list.¶¶Minor issue: The requirement stated a list of "featured albums." The designer changed the words to "featured music." I tend to favor the more specific, tangible "albums," but we can leave that question for testing.¶¶Final observation: although question #4 asks only about browsing for a CD, it's worth noting that the design completely missed the requirement to "listen to a sample of each song in the album." Design #9 *[i.e., this design]* looks like a great way to play whole albums, but offers no way to play sample of each song in an album. A list of songs must appear somewhere.

(16) Generally speaking, the layout has a good flow from heading of the site down. Two items, however, seem to be misplaced: the 'play' and 'stop' buttons (presumably for starting and stopping playback of sample tracks) and the 'add to cart' button appear below the list of albums, not below the album listing itself.¶¶Also, I don't think a combo-box is the best selection method for albums. This might work when the inventory is small, but it will not scale well to a large number of albums.

(17) The scroll-down menu hides products from the visitor: users with basic internet experience might not ever know the Beatles were on the list... for a retail site, it's important to make purchasing a product as easy as possible for the end user. There doesn't seem to be a reasonable association between the link in the menu and the play and stop buttons below.

Designer 15 · desktop · no patterns or layers

(13) Again a poor choice to use forms in this instance. Too many clicks for the user. Page should have consistent header where Search, Cart, root navigation could live. ¶¶Search runs into body text on Genre page. ¶¶Lack of consistency.

(14) The search was not on every page.¶¶there's no way to get back to the home page from the cart, or add anything else to the cart

(17)   On the Genre: Country music page, it's not readily apparent that a user needs to click the box on the left and then add to cart... it'd be simpler to have the 'add to cart' button next to each song, and eliminate the checkboxes on that page.¶¶Product page is easy to understand and offers a clear and logical flow of information. ¶¶The checkout page should offer, instead of 2 items, the unit price for each item and then a total in line.¶¶The landing page might offer content, and a help button sh/could be utilized here.

DESIGNER 16 · DESKTOP · NO PATTERNS OR LAYERS

(15)   The homepage is hard to take in. What is the priority? -- I get that the huge text would be rendered attractively. But that leaves the nav so small and squished as to be an afterthought. This is a shopping site; shopping needs to be easy as pie.¶¶It gets better in the detail pages. Pages appear information -rich and sensible. I like the eye for conciseness, e.g. folding release date and label into one line.¶¶It's not beautiful - but heck it was done in under two hours and meets the requirements.

(16)   Much better than the previous design *[Designer 13, no patterns or layers, desktop]*. Overall, the ordering of items seems much better, and matches my expectations. Of course, the layout is still only very rough and a lot of tuning is needed, but most stuff seems to be where it needs to be.

(18)   It's your standard L-shaped web layout with product drilldown, but it works. Why mess with something that works?

DESIGNER 17 · DESKTOP · NO PATTERNS OR LAYERS

(13)   Layout seems pretty good. Clean and simple, links appear in front of items.¶¶What Outkast album are you selling exactly?¶¶Top nav is shifting around... try to lock each element in place across all pages.¶¶CD or Cassette is shown but no place to make a choice between formats on this page.

(14)   There should be pictures of the album art. It doesn't tell me how much an item costs before clicking on buy. Recommnendations links are well placed.

(18)   The page size is woefully underused. Everything is compressed together, nothing breathes and the feeling of constriction the browsing provides is amplified by the various actions being so close to together, e.g. Info, Buy It, Listen. It's all linear, and no thought was given to how the page might be broken up by feature or functionality.

DESIGNER 4 · DESKTOP · PATTERNS AND LAYERS

(9)   Grid used here is a hell of a lot better than the other designs. The page design still could be better organized, though. RELATED BOOKS is placed on the page in a spot which suggests it is equally as important as the book that was selected and equally as important as THEE most important command/feature on the page which is the ADD TO CART button. Organize the info on the page such that that IMPORTANT "finalization" command is ALWAYS in the same place on each page and design that space so that NOTHING else distracts from its importance. CHECKOUT button is another "finalization" type command and should be placed in same place on page where ADD TO CART was on previous pages (or any other 'finalization' type command button was).

(10)   I dont like the navigation on the first page with genres on the top and their description in columnar fashion.

(12)   Layout seemed familiar and comparative to other online book sellers.

DESIGNER 5 · DESKTOP · PATTERNS AND LAYERS

(3)   I like the layout for the book page on this design. It's easier to read the way the information is chunked together. But I'm not sure where the book description would belong. There should be more detailed information for the book, data like author, format, etc.

(8)   layout using hierarchies such as font size, style, and location is used properly. However, there should be more clear separations using other visual clues. a

good example is the layout for address change, i feel there should be a distinct separation of addresses.

(9)   The multiple column format is good vs. forcing user to scroll down. Nice clean spacial organization. I don't understand the "95% visitor link" links - what is this supposed to provide user link to? Search mechanism needs MUCH more prominent and thoughtful placement, though. Since the SEARCH command will likely be the most used feature.

Designer 6 · desktop · patterns and layers

(5)   very nice. i like the idea of featured books, the side options of special interests makes sense. and i like the thought put into the possible content sections of the actual book page.

(6)   Home¶The page misses an opportunity to market specific titles - this isn't a req but the page is very open and feels incomplete. It needs some sort of titling.¶¶The shopping cart link is in a non-standard position on the pages.¶¶Mystery¶I would guess that the text column is too wide for good readability. Aside from the search functions mentioned earlier, and the fact that we've lost the shopping cart, this is probably the most successful page layout wise. I would suggest exploring the alignment of the top nav coming in to be flush with the body copy.¶¶I would also suggest that the link should not be an entire paragraph.¶¶Page detail¶I've lost the navigation; The big hole left on the right side of the book info is distracting and will make your visual designer smack you :-) It also pushes the related books beyond the attention of the user.¶¶I don't understand why you would update the price on this page - the price is set for the book, and I would expect to see that type of functionality in the cart. I think users might confuse this with add to cart.¶¶The add to cart should not be on top of the information - it should be grouped with the quantity selection.¶¶Even though the reqs said to include the information to the right of the book image, it seems relatively unimportant for the position it is getting on the page - that area could be some selling text and the other

information could be listed as facts either to the right of that or below. The genral layout of the book info in the main body is fine (e.g., where the book title is, the book image, etc.)¶¶Shopping cart link is missing from the mystery category page

(11)   Why is the edition dropdown menu labeled "option"? It should be labled "edition," and the appropriate values displayed for selection (hardback, paperback).

Designer 7 · desktop · patterns and layers

(1)   Nice work

(2)   Add to shopping card button should not bring user to the order summary page. Most cases, user want to shop for another book.¶¶The left side search box is not necessary.

(3)   I found the layout on the book page a bit difficult to read - the grouping of information chunks in a column next to reviews was a bit awkward and distracting.¶The sketch for the Genre was incomplete. It only showed the featured books and lacked an indication of where the bulk of the listings would appear.

Designer 8 · desktop · patterns and layers

(1)   inconsistent placement of global elements

(4)   The layout wasn't very intuitive. the main page was very sparse.

(7)   Unclear place on interface¶Unclear where navigation goes¶Unable to navigate back to referreing page

Designer 9 · desktop · patterns and layers

(4)   The design was interesting with lots of info on each page. It was easy to follow the process of browsing for a book.

(6)   Similar to one of the earlier designs - width of text column can be too wide. Not sure what the two different search mechanisms are; some space could be better utilized (e.g., to the right of the featured books). Also suffers from some problems in the placement of the Add to Cart button, and has an update price control (which doesn't make sense in this context) instead of quantity. On the book page, again the most prminent place for text is being used for secondary info. There's a large white space hole in the upper right.

(10)   I like the related items and special links on the right. Information is easy to read.

DESIGNER 10 · DESKTOP · PATTERNS AND LAYERS

(2)   The search bar should be on every page, a heavy search user want to search at any time.

(5)   layout seems fine - but would be interested in seeing more ideas about content sections of the pages. would anything else be on the product page besides reviews?

(8)   more links to move from one category to another. easier to link up with other sections. Side navigation menu helps users find necessary information if the main content area becomes too overwhelming.

DESIGNER 11 · DESKTOP · PATTERNS AND LAYERS

(7)   Easy to see where you are; good labels and lots of detail

(11)   I don't like that the genres and the books look exactly alike, at least from a rough sketch perspective. These should be visually different.¶¶The related books should be presented more aggressively on the page. They need to somehow -look- related, rather than just be listed way over on the right-hand side of the page.

(12)   Interface seemed familiar to me and comparable to other online book seller web sites.

DESIGNER 13 · DESKTOP · PATTERNS AND LAYERS

(15)   The layout of homepage and book product page have good layout reflecting the requirements. Title is prominent above details. Details are grouped conceptually.¶¶The homepage has an error. Two images appear below the words "Featured Books" yet there is an extraneous hyperlink to the words "The Da Vinci Code." The text and image below should be hyperlinked. A simple error, easily fixed.

(16)   The layout and design here work quite well. The general areas for information work much better. ¶¶In the actual details page, I would put the book info (ISBN, etc.) before the reviews. This is important information!¶¶(Note as well that the design representation - the 'greeking' helps a better focus on the high level organization over the details.)

(17)   There's clearly been a lot of thought here, and the designer has tried to implement items that work successfully from other e-commerce sites. The layout and design offer a logical arrangement of information, allowing the user to navigate the site effectively.

DESIGNER 15 · DESKTOP · PATTERNS AND LAYERS

(13)   Bad. Weird changes in Font sizes on product page. Lack of a consistent navigation type. ¶¶No add to cart? How do I buy? ¶¶Looks like absolutely no thought was put into this part of the site.

(14)   I don't really see good navigation for browsing books. There is a link that says "Genre" and that's it. There should be a list of books inside here, a way to navigate and narrow down the list. So this feels very incomplete to me. Also the requirement for linking to similar books is not displayed on these mockups

(17)   A couple of issues stand out -- the product page offers drop down menus for reviews and a button for finding similar items... "flattening" the site a bit (reducing buttons, adding content), and offering some sample similar items as a "teaser" element might have been a more effective strategy. The layout and design are clean, although the heirarchy of information on the product page is a

little confusing (why is the genre page as large as the product text, when the user is on the product page and not on the genre page)

DESIGNER 16 · DESKTOP · PATTERNS AND LAYERS

(15)   The layout is very spare. The list of recommended books appears run together. The product page has the "add to cart" link far separated from the book description - an unnecessary disconnect.¶¶The designer punted on some layout choices, but no biggie, all easily fixed in graphic design.

(16)   Good, but nothing too stellar. Missing is an indication that there will be pictures of the book available, etc. and it is overall unclear how graphic elements are going to be incorporated into this page.

(18)   Why are there several Main Categories across the top of the page? For a site that just sells books, I would expect the Main Categories to be types of books. Of course, given the scale, maybe it would be the most popular types of book categories? Or maybe there would be no Main Categories at all, instead, save the screen real estate.

DESIGNER 17 · DESKTOP · PATTERNS AND LAYERS

(13)   Genres in right hand column too far out. Tighten layout.¶¶Logo changed on Genre page. Should remain consistent across all pages, at least in design if not size as well. No logo at all on Detail page.¶¶Again content too widely dispersed on Detail page. Tighten design.

(14)   Makes sense. But the "search" is nonexistent from the home page, and also from the book detail page... and when it is present, why is it a button -- might as well just stick the form on the page & make it that much easier for people to actually search

(18)   The front page is not the worst thing in the world (it is the second worst thing); it reminds me of a portal though, so it's misused here.

DESIGNER 4 · SMARTPHONE · NO PATTERNS OR LAYERS

(19) Good thing is that the page is designed in a way which is literally like buying the song or album like in a store. However this entire experience can be designed to be more computer imaginative. Search can be elaborated more. There can be multiple columns depending upon the genres of the song or album. Sorting according to names, generes, artist etc. should be allowed.

(22) Almost too simple - there are bound to be tens or hundreds of genres and thousands and thousands of artists. I need more ways of finding information. What's there is clear, but the user needs more help.

(29) Is the Search feature on the home page a link to a separate page? Why can't this be a properly labeled form?¶¶Why are the Genre names on the Home page duplicated? If the links are labeled unambiguously, I'll know which Genre pages I'll access by clicking on them.¶¶I need more contextual cues-- when I navigate to a Genre page, please restate that Genre atop the results. I can't tell from the Site Map where I am, since the link for a certain page stays active even when I'm on that page.¶¶I think re-ordering the Genre results as Artist, Title, Format will honor more user expectations than the current arrangement.¶¶I don't see the Featured Albums on the Genre page. ¶¶How can I listen to a music sample from the Product page? This doesn't seem possible.

DESIGNER 5 · SMARTPHONE · NO PATTERNS OR LAYERS

(24) The home and genre pages were simple and to the point. ¶¶The layout and design of the product detail pages were not the most intuitive. I was confused by the usage of a drop-down menu for the songs.¶¶The Search function, which was the number one requirement, is nowhere to be found. Also, the ability to listen to a sample of each song is missing along with the ability to download a ringtone directly to the phone.

(25) not much to say as there isn't really a browse mechanism

(26)   poor, incomplete layout and design

DESIGNER 6 · SMARTPHONE · NO PATTERNS OR LAYERS

(20)   The layout seems appropriate for a mobile product. Neat efficient, and providing all the necessary details. I can see that I can buy either the album, in a variety of media formats, or buy ringtones for each song.

(21)   The information is very clearly presented, although it's hard to tell which Genre page I'm on. The elements of the album page take up a lot of space vertically, so the user has to scroll a lot. This may become a problem if there are many songs on the album.

(28)   Pretty decent. The lack of a button to execute a search may be confusing for some users. Also, it would be appropriate to include a header or description of some kind for the genre listing on the front page. Also, how will you deal with the different prices for CD, cassette and Vinyl in the product page?

DESIGNER 7 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   Good use of language. Uses current ecommerce standards.

(24)   I liked the layout and design of each page. Simple and effective. The page titles were clear as were the menu items. ¶¶You are obviously aware of basic smartphone UI.

(27)   Clean design. Liked the use of numbered choices, and assume they could be activated from the keypad. There did not appear to be the option to download the ringtone.

DESIGNER 8 · SMARTPHONE · NO PATTERNS OR LAYERS

(19)   Pages of genres or artists may be designed in a better way. Maybe according to alphabets (as it can become very crowded later on, with thousands of artists and generes). Page layout Okay and standard. Not much innovativeness. There are many opportunities to design it well.

(20)   When I get to 'Satchmo - Hits', the user experience is confusing. All the options are gathered together. As a user I wouod not be sure of the difference between 'buy' and 'buy and download'. If I choose to listen, what is it that I am listening to? (the beginning of the album?). Also, At this point I'm not sure what I'd be searching on, since I've just been offered the option. May of the options here should not be clustered as different buttons. Search for example, should be a text input field. Listen should be able t be done from this page, rather than having to move to another.

(30)   Didn't see a search function on each page - only on the product detail page. And I feel the function would be more usable if it were a field instead of a button.¶¶What would the "Listen" button do? On the product detail page, i would insert an album title.

DESIGNER 9 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   I had problems with the flow, not the design or content.

(27)   Shouldn't the user have some option to navigate the available albums/genres? Prev/Next would have been useful. What happens when there are 20 tracks, not 2.¶¶I did not see a listen to a track option, nor did I see the search (which was to be available on all pages).

(29)   I don't find the Featured Albums on the Genre page, nor the Search function on any pages.

DESIGNER 10 · SMARTPHONE · NO PATTERNS OR LAYERS

(21)   I can't figure out that I'm on the Genre page - it doesn't say what genre it is or how I got there. I also can't get back.¶¶On the album page, there are multiple "buy" links but I can't tell what the difference is. Is one for buying the album and the other for buying a song? I only see one sample icon for each song - is that for both the song and the ringtone?

(25)   - layout gives a feeling of richness and depth of choice¶- no spacial awareness (menu bar etc)¶- when does browse end and shopping cart begin?¶- does IA

assume a given artist will appear only in one genre?¶- is the 'radiant' icon a link to listen to demo of track?

(30)   Good layout. I like the Buy button next to price. Would like to see a price next to the tracks,

Designer 11 · smartphone · no patterns or layers

(22)   Nice to show related ringtones on the page. I wanted more info about the product I chose however.

(26)   simple, well-designed layout

(28)   Good. Thumbnails are a nice touch, although I doubt they'll show up well on smaller screens. I would've liked to see the greek as actual text, just so I could tell if the wrapping would be ugly. ¶¶Ditto with the CD product page. Where would the "Buy Now" button end up if the title of the CD was 120 characters long? The text on the "Buy Now!" button could be clearer when it's next to the ringtone - what am I buying when I click on that? And where's the link to listen to the ringtone sample? ¶¶Finally, where's the site logo? It'd be nice to know I'm on TotalMusic.com.

Designer 4 · smartphone · patterns and layers

(19)   Mostly OK, few times the page becomes too large. At places, the process can be easily broken up into different steps.¶¶The search button should be in line with the search field.¶¶Order of "OK" & "Cancel" should be reversed. As usually a stylus is used by right hand (and considering that tab key won't be pressed to go to next field), its usually easier, if the OK button is on the right and cancel button on left.

(22)   The pages presented were easy to understand and not too busy. Some more thought could be put into labeling and clarifying the function of each element on the page.

(29)   I like the persistent "TotalBook" branding! I don't need the ".com," just the

company name, to tell me where I am.¶¶Please label the Search input with a

text label ("Search" or "find" or something). I want to know what that text input

does.¶¶Where are the Featured Titles?¶¶When I'm on a Sub-genre page, I'm less

interested in the other sub-genres. Maybe place the links to these below the

book titles. Or, better, place a breadcrumb (Home>Genre>Sub-genre) so that I

can back up to Genre. Yes, this is redundant with the Site Map, but gives me

one-click access to a level just one higher in the hierarchy.¶¶The Product Details

page confuses me greatly. I'm not sure from context alone what "Options" are,

so label these more clearly. Place product details such as Edition, ISBN, and the

link to Location. with other non-form elements such as Title and Author. Why

can't I Update Price before I Add to Cart? Place "Add to Cart" below all

elements-- this is a final step, so place it last on the page.

DESIGNER 5 · SMARTPHONE · PATTERNS AND LAYERS

(24)   I found the layout and design inconsistent and counter-intuitive.¶¶The

requirement calls for making the search function available on every page,

however it is only included on the Genre page and the "Nearest Totalbooks"

page. Further, the labeling for the Search box is not clear so its inclusion on the

"Nearest Totalbooks" page is confusing and brings up the question of what we

would be searching for; store or book?

(25)   - no use of max-width attribute¶- no recuring button bar (see Nokia / Opera

design guidelines)¶- button destinations unclear

(26)   missing content¶- home page has no information and details on genres¶- book

page does not display book information

DESIGNER 6 · SMARTPHONE · PATTERNS AND LAYERS

(20)   On the page featuring a single genre, I liked how the subcategories were

organized at the top; but there was still ample room to display the featured

books well. ¶¶In the page featuring a single book, information about things in

my shopping basket need not be here, for example, the ability to up-date the price is not necessary on this screen.

(21)   I don't really understand the "options" selection where you choose item 1-3 and update the price. Maybe it's because the text is generic and I can't see examples? I'm also not sure how the Update Price button interacts with or affects the Add to Cart.¶¶I would like to see how you get back to higher categories once you've drilled down.

(28)   Layout and design was OK. You really need a section header or title of some kind for the genre listing. And a problem on the book page -- you do not want to force the user to have another round trip (over a painfully slow GPRS network) just to update the price when choosing an option. A better solution would be to put the option and the price in a single combo box entry, and do away with the update price button. It would depend on how long the option text is. Just what are those options supposed to be, anyway?

DESIGNER 7 · SMARTPHONE · PATTERNS AND LAYERS

(23)   Clear and concise. Although I wasn't sure what ¶"95% visitor link¶95% visitor link¶95% visitor link¶5% visitor link"¶¶represented.

(24)   There are missing elements. Namely the Search function, which was the number one requirement.¶¶While the layout is simple, from a hierarchical standpoint it is neither intuitive nor consistent. For example, on the Genre sub page, the heading for Featured Books has the same weight as the page title.

(27)   I don't find sufficient context and navigation. Browsing tends would imply ease of movement and awareness of context. Don't see that in this work.

DESIGNER 8 · SMARTPHONE · PATTERNS AND LAYERS

(19)   Not many comments as the overall layout and design need to be more detailed. However there is much scope for improvement. The position of "Search" field needs to be consistent throughout the design. Interface should give more

feedback about in what stage the transaction is.¶¶Prices of items in shopping cart needs to be shown clearly.

(20)   Search was always at the bottom. While this is good on consistency, it is poor on famiiarity, as typically customers are used to finding search at the top of a screen. ¶¶While the screen on a single book was easy to understand, there was missing information, such as the year published. ¶¶Additonally, it would have been preferable to allow the user to add the item to their shopping cart, rather than simply opt to 'buy'.

(30)   This is fine, considering the tiny amount of real estate present on cellphones. Super simple pages are necessary. Shows an understanding of the limitations of cellphones.¶¶Could've added some more detail on the comps, such as book titles, or some ideas for the store locator page.

DESIGNER 9 · SMARTPHONE · PATTERNS AND LAYERS

(23)   1. The linking and organization of screens almost meet all the functional requirments.[Postive]¶2. User can become "lost" in the process, so we need to establish a mechanism for giving user a context of their place in the process. (I wasn't clear if sitemap functionality was actually part of the design, or just part of the evaluation.) [Negative]¶3. Content was clear and intuitive. [Positive]¶4. No method for seeking help, either through a call or email. This could result is lost sales. [Negative]¶5. Do users use the phone's buttons to go forward and move back in the flow? (Perhaps I missed something in the instructions?)¶6. After clicking on Nearest Store, I move forward to a screen with Nearest Store, but no text is mocked up below to suggest 1. an address 2. a link to a map¶7. Friendly wording/content.

(27)   Did not like the placement of the seach (I assume it was search). Without some other kind of visual differentiation, it was visually confusing.

(29)   Please give a text label to the Search input-- it will improve accessibility, and will also separate the form visually from the logo.¶¶What are the items on "my favorite books?" If this is the Featured Books list, label it so, with something like

a <dl><dt> construct.¶¶I suggest placing featured books beneath individual book titles-- I'm more interested in finding (buying) exact matches to my search, and don't make me scroll to find them.¶¶The TotalBooks logo disappears from interior pages. I won't find this useful on a phone screen, which won't be displaying the URL to remind me where I am. ¶¶Give me back to top/skip to main content links, so I can navigate the page without my phone's tiny scrolling mechanism.

Designer 10 · smartphone · patterns and layers

(21)   On any given page, I had no way of knowing where I was in the site. There were no navigational elements to show what I was looking at.¶¶I also did not notice the "store location" icon in the corner. Once I saw it, I had no idea what it was or what it did, without clicking on it first (at which point I had no way to get back).

(25)   - what is a genre, what is a subcat?¶- why book list and subcat list displayed at same level?¶- are subcats nested?¶- why no bread-crumb?¶- what is box in top-right corner that links to a paragraph of text?

(30)   Good thought to include subcategories, but i wasn't clear how they were related to the items in the list. ¶¶Didn't like the product detail page - wouldve preferrred the edition/year/isbn to be under the book title/author, and the price and add to cart button under everything else. Perhaps you were trying to ensure the add to cart button is visble w/o scrolling.

Designer 11 · smartphone · patterns and layers

(22)   Well ordered information makes the pages easy to skim and understand. Lots of information for me to make my decision, including a store locator in case I want to drop in and pick it up.

(26)   straightforward navigation and design

(28)   Awful. Was this design randomly generated? ¶¶1) Unnecessary text everywhere. Nobody cares about your explanation of the genre, especially when it adds download time. ¶2) Why are there repeated titles (e.g. Main category / Main

category)? ¶3) What is "Company name" on the book detail page? Our company? ¶4) Buttons on detail page are shmooshed together - bad spacing / layout. ¶5) It's unnecessary to force another round trip to update the price based on options. For that matter, the label "Options" is meaningless. I KNOW it's a set of options. The text in the dropdown should be self-explanatory. ¶6) Layout is incomplete on the Detail Page. "Details" will be a blob of text, and the layout should reflect that. Author should be up at the top next to the title. "Nearest Store" is a good thing to have near the top, but it should be below the details section.¶7) What does the "Find Store" link do on the store page?¶8) Failed to meet requirements: search function is not on every page.

Shopping Cart/Checkout

Page flow

5. Please give a rating for how well the pages for shopping cart and checkout were *linked together*: (1 = negative, 5 = positive)

Designer	Ratings			
	1	2	3	Average
Desktop—No patterns or layers				
4	(9) 4	(10) 2	(12) 3	3.00
5	(3) 2	(8) 3	(9) 4	3.00
6	(5) 4	(6) 3	(11) 4	3.67
7	(1) 3	(2) 4	(3) 2	3.00
8	(1) 4	(4) 4	(7) 2	3.33
9	(4) 4	(6) 3	(10) 2	3.00
10	(2) 3	(5) 4	(8) 3	3.33
11	(7) 3	(11) 5	(12) 4	4.00

13	(15) 5	(16) 1	(17) 2	2.67
15	(13) 3	(14) 3	(17) 3	3.00
16	(15) 3	(16) 4	(18) 5	4.00
17	(13) 3	(14) 1	(18) 1	1.67
Desktop—Patterns and layers				
4	(9) 3	(10) 3	(12) 4	3.33
5	(3) 2	(8) 4	(9) 4	3.33
6	(5) 4	(6) 2	(11) 2	2.67
7	(1) 4	(2) 5	(3) 4	4.33
8	(1) 3	(4) 2	(7) 2	2.33
9	(4) 4	(6) 2	(10) 3	3.00
10	(2) 4	(5) 3	(8) 3	3.33
11	(7) 4	(11) 2	(12) 4	3.33
13	(15) 5	(16) 4	(17) 5	4.67
15	(13) 4	(14) 4	(17) 4	4.00
16	(15) 4	(16) 4	(18) 4	4.00
17	(13) 2	(14) 2	(18) 2	2.00
Smartphone—No patterns or layers				
4	(19) 2	(22) 4	(29) 4	3.33
5	(24) 4	(25) 3	(26) 2	3.00
6	(20) 3	(21) 3	(28) 2	2.67
7	(23) 4	(24) 1	(27) 4	3.00
8	(19) 3	(20) 1	(30) 4	2.67
9	(23) 2	(27) 3	(29) 2	2.33

10	(21) 2	(25) 2	(30) 5	3.00
11	(22) 4	(26) 4	(28) 4	4.00
Smartphone—Patterns and layers				
4	(19) 3	(22) 4	(29) 4	3.67
5	(24) 1	(25) 3	(26) 4	2.67
6	(20) 4	(21) 4	(28) 4	4.00
7	(23) 3	(24) 1	(27) 3	2.33
8	(19) 3	(20) 1	(30) 4	2.67
9	(23) 4	(27) 4	(29) 5	4.33
10	(21) 3	(25) 1	(30) 4	2.67
11	(22) 5	(26) 4	(28) 4	4.33

6. Discuss with the designer what you like and do not like about the how the pages for shopping cart and checkout were *linked together*.

DESIGNER 4 · DESKTOP · NO PATTERNS OR LAYERS

(9)   I think it's fine.

(10)   Well linked compared to previous layout *[Designer 9, desktop, no patterns or layers]*.

(12)   I think the 'checkout' link should be below or next to the total price amount ($2.00)

DESIGNER 5 · DESKTOP · NO PATTERNS OR LAYERS

(3)   I'm not sure why the browsing navigation (genre nav) is showing on this page. It seems out of place. Is this sitewide navigation because it's not appearing consistently on other pages. ¶This design makes the assumption that you are a known users. You should provide an easy out for other users to create a new

account. Something like Jimmy! (not you). ¶And there's recalculation for the total with shipping cost. It's really disconcerting to suddenly jump into the receipt after providing address and payment method.¶Why is there a continue shopping link on the receipt page but not on the total with items page? This would be a more logical location to nudge the user to add to their total rather than after they've gone through the payment process.

(8)   it's good to give users less pages to click through, however, there needs to be clear feedback.

(9)   Flow was ok.

DESIGNER 6 · DESKTOP · NO PATTERNS OR LAYERS

(5)   nice process for indicating progression of ordering/checkout process (shipping payment confirm steps)

(6)   Designer going the right way with the progress bar. I also don't mind having more shorter steps, this seems to test better than fewer more complicated pages (even though you have to fight with the old "the fewer clicks the better" belief of your clients). One thing that is missing is an overal review page of all the info before you buy.¶¶The button on the payment page doesn't give you the sense that you are about to commit yourself to the purchase. Payment also needs to collect the billing address if different from the shipping address.

(11)   The workflow was fine.

DESIGNER 7 · DESKTOP · NO PATTERNS OR LAYERS

(1)   better, more prominent/consisten buttons needed. buy button miles away from product being purchased

(2)   The checkout process is simple, one click done. But user can't easily add another item or change the cart. ¶¶The best of all, user doesn't need to go to separate page to enter the address and credit card information.

(3)   This lacks a page showing a total and giving the user feedback on what they are purchasing. The final page should act as a receipt and it too is lacking

information.¶For the shipping info, *'m not sure what the item 1, etc. information is intended to convey. Is this stored info? and if so what's supposed to go in the text fields below it? And how do you add a new address, new user?

DESIGNER 8 · DESKTOP · NO PATTERNS OR LAYERS

(1)   standard, no problems

(4)   The pages were linked fine. No errors or broken links.

(7)   They don't seem to be well linked together

DESIGNER 9 · DESKTOP · NO PATTERNS OR LAYERS

(4)   The pages were linked together well. No errors.

(6)   Has a standard request-review-confirm structure, which is good. The steps don't tell you how many steps to expect. Payment method and billing address could be combined. Lacks other navigation.

(10)   I like the continue button, I like the layout with radio buttons. I do not like that I do not have the back button.

DESIGNER 10 · DESKTOP · NO PATTERNS OR LAYERS

(2)   The thing I don't like is that user have to select the address and credit to finish the transaction. For most users, they never changed the address and credit card information. The order summary page should perform the address and credit card selection funtion. So user can save at least two cliks.¶¶Also there is no link for the shopping cart on the address or credit card page .

(5)   i like it. simple - click checkout and move to shipping address page. i might want to know more about what other navigation is on this page for error correction - or if the idea were to get someone "locked" into the process flow.

(8)   there is also no method for me to correct my mistakes. such as a method for me to go "back." can we combine address and credit card change into the same page rather than 2 separate pages.

DESIGNER 11 · DESKTOP · NO PATTERNS OR LAYERS

(7)   Not bad, hard to tell in shopping cart on the checkout.

(11)   The division of tasks among the various pages was clear and fairly standard.

(12)   Seemless linkage. If I wanted my music right now, I would have been successful.

DESIGNER 13 · DESKTOP · NO PATTERNS OR LAYERS

(15)   No problems linking to the checkout.

(16)   The transition from shopping cart to fully purchased material was too quick. I would think (though this might need to be confirmed via testing) that most users would be accustomed to the following:¶¶1. View cart; indicate you want to purchase.¶2. Review account information, shipping address, etc.¶3. Confirm payment information.¶4. Feedback that purchase is complete.¶¶If this flow is chosen, a message is needed on the page to the effect that, "To complete your purchase, press the Purchase button below. Your credit card will be charged xxx".¶¶I think what's going on here is a misread of the shopping cart metaphor. One action is to put items in your cart; another is to review your cart; another is to commit to purchasing all of the items in your cart; finally, another is to pay for those items. By calling the shopping cart page 'checkout' the flow has been too abbreviated.¶¶Also, I missed any information about a shipping address. I would expect that the system can store multiple shipping addresses for my account, and I would want to be able to review / select / correct a shipping address.

(17)   The user, when they add an item to the cart, is presented with a cart and a checkout window. This will scare the user if they're not ready to buy -- the checkout information should be on a separate page, giving users the control when they're ready to buy.

DESIGNER 15 · DESKTOP · NO PATTERNS OR LAYERS

(13)   relatively straight forward, price confirmation at the Cart level would be helpful. Remove button might be more logical for a user than to have to change

quantity to "0" and click update.¶¶On checkout page a back to Cart button would be good to have.   The use of credit cards on file is worrisome. No security mechanism here? ¶¶Otherwise flow is good and follows a logical path. ¶Friendly language is nice for customers. Seems personable.

(14)   there's no way to get back to the home page¶there's no way to remove items¶there's no way to get to the cart unless i add something

(17)   While the shopping cart gave the user a clear way to check out and fulfills the requirements of the instructions, a couple of items can help the end user browse and purchase more effectively. Shopping cart might offer an option to remove items from cart, rather than set quantity to 0. CSS technology can allow the user not to leave the page and just click 'add to cart' to toggle a desired item (similar to the way a Netflix user reviews movies). The shopping cart should let the user know where they are in the process, and the design seems to achieve this.

Designer 16 · desktop · no patterns or layers

(15)   "Add to shopping cart" combined with "Buy this item now" is incorrect. There should be just one link, not two. After all, what would happen if I first did an "add" followed by a "buy now"? Wouldn't make sense. You'll always want to review your cart.¶¶A minor issue: Next, looking at the links from cart to checkout. Forget about "clear cart" - it's an edge case. Just build "manage" functionality right into the ¶¶I'm marking down significantly (3 instead of 4) because simple "buy this item" and "proceed to checkout" links would have been the obvious slam dunk.

(16)   Again, this matches my model much more closely. It's a rip off of Amazon.com, but who isn't doing that?!

(18)   It's easy enough to get to checkout: one click from the shopping cart, and an accelerator from any product page.

Designer 17 · desktop · no patterns or layers

(13)   Although the assumption is that the customer is already signed in, good to see login page.¶¶Consider seperating the Cart and finalize order (payment, address) on diffrent pages.

(14)   Really dislike this. ¶1) I shouldn't be asked to log in where I am.. it's a huge setback. Let me add stuff to my cart@¶2) is there even a cart? when i say i want to buy something it sends me straight to checkout. this makes no sense.¶3) Sloppy. City/State/City labels in the form? it says "joe work" and "joe home" but there's no way to label a new addreses like that.¶4) let me confirm the total and everything before placing the order!

(18)   Given that the shopping cart is the checkout page, should the rating asymptotically approach 5 as convergence approaches 1? ¶It completely stinks that the only access to your shopping cart is via BUY IT. It is also bizarre that you choose the media in the shopping cart, rather than when you choose to BUY IT.

Designer 4 · desktop · patterns and layers

(9)   Flow is ok.

(10)   Why is the continue shopping button not repeated at the bottom just as checkout button has been?¶¶Why is sign in in the middle of the process..i wud expect sign in early in the process.

(12)   Fulfills application spec requirements. I like the ability to change several options, such as billing address, mailing address, and change of order. I also like the option of emailing a password back to customer. I like its flexibility.

Designer 5 · desktop · patterns and layers

(3)   The designer should have provided easier access to the checkout flow. The only way into it, is by choosing to buy a book.¶I'm a new user, how do I create a new account (the system is 'recognizing me' but I've never previously used this site. This is consistent on the pages that follow such as credit card. The design would work better if there were two flows, one for registered users and one for new.

(8)   Shopping cart and check out makes a lot of sense.

(9)   It seems fairly logical.

Designer 6 · desktop · patterns and layers

(5)   seems fine. the continue shopping works. straight forward.

(6)   Flow is straightforward, even though the button placement is bouncing around. It has a standard request-verify-confirm sequence. I have an issue with the no navigation here as well, though the designer may have been instructed to tunnel the user in the cart, so I didn't mark off for that.

(11)   I'm being asked to log in to check out. One of the assumptions is that the user is logged in. This was a requirement for the design.¶¶Why are the order number and order date fields on the thank you page shown as lines? Wouldn't they be filled in with information by the back-end?

Designer 7 · desktop · patterns and layers

(1)   well done. might think about pervasive account controls

(2)   Very good check out process. Can change the address and credit card in one page. Can navigate to continue shopping.

(3)   This is pretty much to industry standard. I found the 'Place order button' across the top of the Place Order page a little disconcerting. I think the treatment on this page makes the button too primary. You really want the user to go to review the order and then commit. I don't see a need for two buttons here. Otherwise, the way the pages are put together are good. You've allowed for plenty of shortcuts and opportunities to recover from errors (except for the button placement mentioned above).

Designer 8 · desktop · patterns and layers

(1)   standard

(4)   There were broken links. I could not complete the checkout process since the
        button on the shopping cart was non funtional.

(7)   Shopping cart not persisten so it's not linked together thorugh the desing

DESIGNER 9 · DESKTOP · PATTERNS AND LAYERS

(4)   No errors. All links worked.

(6)   See comments from first design *[Designer 6, desktop, patterns and layers]*

(10)   They are linked well. How do I go back though? By hitting the back button on
        browser?? Is that my only option?

DESIGNER 10 · DESKTOP · PATTERNS AND LAYERS

(2)   It is good to have the continue shopping button. But if the book genre or
        categories can be shown, it will help user link to a specific place.¶¶The address
        and credit card choose page should be optional.

(5)   nice - everything seems well connected. fairly conventional

(8)   too many buttons everywhere. lack consistency with other pages. why is "place
        your order" on the top of the page?

DESIGNER 11 · DESKTOP · PATTERNS AND LAYERS

(7)   Easier to navigate between sections of site

(11)   I don't like that when I put a book in my shopping cart, and choose to continue
        shopping, I'm thrown back to the list of books for the genre I chose earlier. I'd
        rather go to the book I was just looking at. Otherwise it seems like I was
        dropped somewhere at random while I was off trying to buy a specific book ...

(12)   Shopping cart seemed familiar and comparable to other online book seller web
        sites.

DESIGNER 13 · DESKTOP · PATTERNS AND LAYERS

(15)   Impressive, but excessive. Instructions stated to assume the user is already logged in.¶¶If I ignore the login screen (which is not a design error, just a reading-the-instructions error), then the links to Shopping Cart and Checkout are good, as expected. I like the duplicate links at top and bottom.

(16)   I like this flow. The only thing lacking is that I should be able to add items to my shopping cart without having to view my cart every time. Some feedback at the top of the page that the item has been added would be sufficient.¶¶On reflection, this design shows that there is a much better way to manage cart items than does the previous design.

(17)   Again, a logical flow of items. The user is constantly aware of where they are in the process.

DESIGNER 15 · DESKTOP · PATTERNS AND LAYERS

(13)   Aside from not finding any way to actual add items to a cart this process looks pretty good. More thought here than in the browse pages.

(14)   this is the most complete string of pages. It makes sense, and meets the requirements

(17)   The pages link logically, although the change quantities or delete might be more effective if there's the ability to do that within that page.

DESIGNER 16 · DESKTOP · PATTERNS AND LAYERS

(15)   Minor issue: I would skip the "proceed to checkout" link from the product page. What is this meant to do - add the product and then buy the whole cart? Confusing. Just omit this particular link.¶¶"Proceed to checkout" works fine. Again, I would demote or omit those other two links (update, clear).

(16)   Seems OK. The necessity to go to a secondary page to add another shipping address or credit card could be a problem, though.¶¶On this design (and on the others) there were also no elements to tell the user up front what the steps of the ordering process are. This could be a problem.

(18)   Checking out is an action, and the metaphor is upheld by the use of a button.

DESIGNER 17 · DESKTOP · PATTERNS AND LAYERS

(13)   Login is nice and simple, however 'Create a new account' is a high level feature, right now it seems grouped with the login for an existing account. Seperate.¶¶'Forgot Password' button show line up with the password field, not the e-mail field as they're related.¶¶Cart looks good. Consider putting a continue shopping button along with the bottom Checkout button for consistency and accessability.

(14)   the buttons through the checkout are inconsistently labelled. sometims you click on "continue" or "use this address" lots of different words for "move to the next step" it could be more clear. also there are too many pages. it could be a shorter, cleaner more straighfroward process. And aren't i supposed to be logged in already?

(18)   You can only get to the shopping cart by adding something to it, and you have to login to get to it. I've used sites like this (X10.com). I dislike them intensely. From shopping cart to checkout isn't terrible, it's still an action button. It's annoying that checkout is a multi-step process from review, address, shipping... and then it blows up on the payment page. Too many disparate pieces of information, especially since the user's expectation has been set to deal with them separately. (Why is the shipping address selection not on the shipping type page?)

DESIGNER 4 · SMARTPHONE · NO PATTERNS OR LAYERS

(19)   Link to the checkout page is obvious, however it can be more efficient. Making '$200' a link does not make much sense. There is no way or link to go back an change anything in checkout page. There should be 'back' and 'forward' buttons on all pages. Again there should be a 'Save Cart' feature.¶¶The checkout page has a button which takes to the next page, however this button is not found anywhere else. This is a good feature but needs to be consistent.

(22)   Once I had what I want the buy process was quick and painless, giving me the
          option to bill and ship to different places.

(29)   These proceed as I expect, except for the absence of Change Quantity/Delete
          Item options.

DESIGNER 5 · SMARTPHONE · NO PATTERNS OR LAYERS

(24)   Again, as with the previous section, the pages flowed nicely from one to the
          next. I never had the sense of being lost. The one thing that is missing is the
          ability to select a shipping method.

(25)   see above

(26)   incomplete, inaccurate design

DESIGNER 6 · SMARTPHONE · NO PATTERNS OR LAYERS

(20)   The good user experience breaks-down when it comes to the shipping cart /
          checkout experience. There is a problem with purchasing ringtones - since the
          UI details that I am also purchasing the album, even if I did not intend to do so.
          ¶¶While the ordering of the experience in terms of the site map seems
          reasonable, unfortunately the content is not in-line with this and the whole
          experience for the user is very confusing.

(21)   Why does the Shop More button take you back to the Genre page? Shouldn't it
          go Home?¶¶There's no way to get back if I change my mind on one of the
          options during checkout.

(28)   No back button for the checkout process.¶The "Shop More" button in the cart is
          great.¶¶Ugh! No confirmation page for the order. How do I know my order was
          placed?

DESIGNER 7 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   Good. Complete and clear.

(24)   The fact that a shopping cart page doesn't exist is obviously a problem. The payment selection and shipping method pages don't exist either. I got stuck in an endless loop because, again, the button wasn't labeled.

(27)   Had no problem with this flow.

Designer 8 · smartphone · no patterns or layers

(19)   There should be back and forward buttons during checkout. Also user should be provided information about how many more steps remain before final purchase.

(20)   The checkout procedure is not is a logical / desirable order. For example, the user should not be providing billing information after they have been through a page entitled 'checkout'. ¶¶In this design, confirming shipping information is an optional procedure from the shopping cart page. The user is not taken through the essential steps sequentially, and this is problematic.

(30)   Interesting choice of having the billing method pre-selected with a "change billing method" button. At first i was put off by this but i think it's ok as long as some research was done as to the preferred default billing method.

Designer 9 · smartphone · no patterns or layers

(23)   No way to navigate from the buying a CD screen back to the browsing function. How can I buy more CDs, either by this artist or others?

(27)   Would the user be able to "continue shopping"? I did not see that capability. How would the user remove an item from the cart? Why are some things buttons and some links?

(29)   I think "usual requirements," as specified in the Instructions, includes delete/change quantity functions. I suggest placing these functions on an prototype Order Summary page, which could precede the Billing Info page.

Designer 10 · smartphone · no patterns or layers

(21)   I was never given a chance when buying this album to enter my shipping

address, but I did when I bought a particular song. (I think that's what I was

doing - couldn't tell from the layout of the page.)¶¶Not sure what I would do if I

wanted to add multiple items to my cart. There's no way to continue shopping.

(25)   - distinction between buying track and album is unclear¶- unclear what text

input box is for (if to change quantity then were is the 'update' button?)

(30)   Seems to make sense.

DESIGNER 11 · SMARTPHONE · NO PATTERNS OR LAYERS

(22)   The process was linked up fine, giving me many options to adjust billing,

address and shipping info, as well as quantity control and item removal.

(26)   seems to meet requirements

(28)   Adequate. A backlink at the bottom of each page would've been nice.

DESIGNER 4 · SMARTPHONE · PATTERNS AND LAYERS

(19)   Its very cluttered. Space could have been efficiently utilized. There should be no

need of the update button.

(22)   At this point it made perfect sense how you walked through the process, and

here I wanted a linear process. Being able to change items, addresses, etc was

good.

(29)   Few surprises, which is good for online purchasing.¶¶The position of Sign In is

problematic-- I'd prefer it somewhere before Checkout, of course, but want also

to be able to view an order's total (subtotal + shipping) without a login screen

between display of the subtotal and final totals. I'm not sure what to

recommend, however.

DESIGNER 5 · SMARTPHONE · PATTERNS AND LAYERS

(24)   After clicking a button that says Checkout, I would expect the next page to be more instructional and descriptive when asking me to select an address. What kind of address? Billing, Shipping? There is no way to tell. ¶¶On the next page, we're asked to choose billing information. This is much better than the previous page. I would encourage the use of this page as a template for the shipping page. ¶¶I have a question about the Cancel button. What are we canceling? The billing page, the order process? It's the first time we're presented with such a button.¶¶After choosing the billing information and clicking "Use this info", I was shocked to be taken to the "Thank You" page. I think a confirmation screen with a summary of choices and links to change those choices would be more appropriate.

(25)   - Checkout works well¶¶- Could user link back to shopping once past the "checkout" link?¶¶- Could addresses be given labels to allow choice without scrolling through them? (select, multiple-coice list or other form widget)¶¶- Same question with card/billing details

(26)   Seems too linear

DESIGNER 6 · SMARTPHONE · PATTERNS AND LAYERS

(20)   In general I liked the flow of the pages as it built upon previous experiences that customers may have - utilizing familiarity. It only took 4 screens to purchase the book, including signing in, so this seems efficient.

(21)   The general page flow seems to make sense. I like that there is a link to the Shopping Cart on the Review Order page, but I would rather just see the itemized list on the page.¶¶I thought the requirement was not to include the Sign In flow in this case? Even so, the flow for creating an account and adding all of the information that would have otherwise been saved is clean. My only suggestion is that the order in which shipping address, billing address, and shipping option are presented be consistent between the account creation flow and the review order page.

(28)   Adequately. It would've been nice to have a backlink at the bottom.

DESIGNER 7 · SMARTPHONE · PATTERNS AND LAYERS

(23)   When I add to the cart, many items are added. I'm confused. Otherwise, this seems to follow current ecommerce standards.

(24)   In the list of requirements it is clearly stated that "You can assume users are already logged into their account.", so I am a bit perplexed as to why you included a login failure redirect page. If it were removed from the flow, it wouldn't be a bad transition. Digging deeper it appears that you spent a lot of time on the account and password management pages. It would have better to spend that time on actual requirements.

(27)   I found it straightforward. The process for creating a new account was okay, but more used to seeing billing before shipping address.

DESIGNER 8 · SMARTPHONE · PATTERNS AND LAYERS

(19)   The Shopping Cart and Checkout pages could be linked more tightly. Maybe even combined together to some extent. Overall the linking is quite generic and straightforward.

(20)   There was a huge amount of missing information in the shopping cart experience, the user familiar with online shopping would feel dis-concerted that the typical procedures were not attended to. ¶¶Additionally the verb used 'shipping', is not what the customer does, and should not have been used for the button. 'Continue' or 'add to' or 'use' etc... are all better verbs that mean something to the consumer.

(30)   seems logical. Could've used a bit more detail.

DESIGNER 9 · SMARTPHONE · PATTERNS AND LAYERS

(23)   Unclear what was the funciton of the Update Price button before I add the book to my shopping cart. (The default view.) This is usually associated with selecting the quantity of a product, but I hadn't gotten to that stage of the process. [Negative]

(27)   Check out flow was good.

(29)   These work as I would expect.¶¶I know it isn't in the Instructions, but is there really no way to display the Nearest Store data on the Product page, and not force the user to leave the shopping process to find a store?

Designer 10 · smartphone · patterns and layers

(21)   The order of actions in the checkout flow is logical. However, there was no sense of status - I didn't know where I was in the process, what to expect next, and how to go back.

(25)   see 7 below

(30)   Worked great - though I think the "Continue Shopping" button should return user to last genre page or home page, not the product detail page.

Designer 11 · smartphone · patterns and layers

(22)   Linked up just right, giving me the option to go back and change things when I need to, go back and shop if I need to.

(26)   "Place Your Order" button should be at the top and bottom of the page.

(28)   Partitioning of functionality among several pages was OK. I'm concerned about the number of round trips required, but it might be OK. It covers the default case quite well, at the expense of making it harder for customers to alter their order.

Page design and layout

7.   Please give a rating for the page *layout and design* for shopping cart and checkout: (1 = negative, 5 = positive)

Designer	Ratings			
	1	2	3	Average
Desktop—No patterns or layers				

4	(9) 2	(10) 3	(12) 3	2.67
5	(3) 2	(8) 4	(9) 2	2.67
6	(5) 4	(6) 3	(11) 3	3.33
7	(1) 3	(2) 3	(3) 1	2.33
8	(1) 3	(4) 3	(7) 1	2.33
9	(4) 4	(6) 2	(10) 2	2.67
10	(2) 3	(5) 2	(8) 3	2.67
11	(7) 3	(11) 1	(12) 1	1.67
13	(15) 2	(16) 1	(17) 2	1.67
15	(13) 1	(14) 3	(17) 4	2.67
16	(15) 3	(16) 4	(18) 4	3.67
17	(13) 4	(14) 1	(18) 1	2.00
Desktop—Patterns and layers				
4	(9) 2	(10) 2	(12) 4	2.67
5	(3) 2	(8) 3	(9) 2	2.33
6	(5) 4	(6) 2	(11) 2	2.67
7	(1) 4	(2) 5	(3) 4	4.33
8	(1) 1	(4) 3	(7) 3	2.33
9	(4) 4	(6) 2	(10) 3	3.00
10	(2) 4	(5) 4	(8) 4	4.00
11	(7) 4	(11) 3	(12) 3	3.33
13	(15) 4	(16) 5	(17) 5	4.67
15	(13) 3	(14) 4	(17) 3	3.33
16	(15) 3	(16) 3	(18) 4	3.33

17	(13) 3	(14) 3	(18) 2	2.67
Smartphone—No patterns or layers				
4	(19) 3	(22) 3	(29) 1	2.33
5	(24) 3	(25) 3	(26) 1	2.33
6	(20) 1	(21) 2	(28) 1	1.33
7	(23) 4	(24) 3	(27) 4	3.67
8	(19) 4	(20) 1	(30) 3	2.67
9	(23) 2	(27) 3	(29) 2	2.33
10	(21) 1	(25) 2	(30) 4	2.33
11	(22) 3	(26) 5	(28) 1	3.00
Smartphone—Patterns and layers				
4	(19) 3	(22) 4	(29) 3	3.33
5	(24) 2	(25) 3	(26) 3	2.67
6	(20) 4	(21) 4	(28) 2	3.33
7	(23) 4	(24) 4	(27) 3	3.67
8	(19) 2	(20) 1	(30) 3	2.00
9	(23) 3	(27) 2	(29) 2	2.33
10	(21) 4	(25) 4	(30) 5	4.33
11	(22) 5	(26) 4	(28) 2	3.67

8. Discuss with the designer what you like and do not like about the *layout and design* of the pages for shopping cart and checkout.

Designer 4 · desktop · no patterns or layers

(9)   The grid beneath ALL pages needs to be worked out and use a standard grid -
       not this tiny column on the left huge column in the middle and medium and

sometimes tiny column on the right. GET A BASIC GRID that you can use for the ENTIRE site. The inconsistency of the column widths looks AND feels disorganized. ¶Also, place important commands and features like CHECKOUT over on the right (that's the last and most important critical command on the page; it should echo the 'period' in an English sentence).

(10)   I like the return link. ¶I like the fact that I can add another card I am still missing a confrmation age.¶I like the fact that the shopping cart button does not disappear.

(12)   The only suggestion I would make is: I think the 'checkout' link should be below or next to the total price amount ($2.00)

Designer 5 · desktop · no patterns or layers

(3)   I found some of the language ('Proceed') a bit awkward and non-standard. I think it's best to use common language like continue or checkout.¶The address and payment method page is oddly organized with the user's name on the same level as the shipping address this should be integrated into the flow of the information preferably above the address. Also, why is this not a consistent element on all the pages? The navigation on the left seems inconsistent across the pages and out of place on this page. The last page, with the receipt, doesn't provide any information except the approximate arrival date and access to UPS (and the continue shopping link, see above comment). I would expect this page to be more formal, providing a total (and detailed information on the items in the order) for the order and allowing the user to print it or somehow retain for their records.

(8)   combo box is a nice way to for mouse interaction only. that is nice, but i believe you are not giving users a method to go back if there are errors. the

(9)   The underlying grid got trampled on here. PROCEED buttons/commands need to be organized into an area/column which is consistent in ALL pages of the site for 'finalization' type commands. Right now it is neither here or there. Shipping

page info needs better cleaner organization. Again, stick to a well designed underlying grid and better dilineate logical groups of items.

DESIGNER 6 · DESKTOP · NO PATTERNS OR LAYERS

(5)   layout is solid. i like the content areas for other albums below - i'd be interested to hear what design elements would be included to distinguish these albums from the ones in the user's cart.

(6)   I'm not sure what the new address and new payment headings are supposed to be doing. I would expect the drop down to change the current address in the same space.¶¶I'm not sure that the cart is the best cross-sell placement. I think that would be up for testing.¶¶¶Overall the layout seems pretty straightforward, the buttons are in the expected places, and having real info would make a difference.

(11)   I didn't like that the shopping cart was embedded in a page similar to the one I had arrived from (i.e. with a left hand nav). I'd rather have a simplified interface for a shopping cart, where the user is conscious of leaving the browsing portion of the site to move into buying mode. Otherwise the user might unconsciously assume that there is a shopping cart content area similar to a genre content area. Also, the user could click on a link on the left hand nav and accidentally leave the buying workflow. We don't want this to happen.¶¶I really like the tabular layout for the shopping cart, though. Very nice.¶¶The shipping page is a little confusing. I don't like "Method" as a shipping method label. It sounds very developer-y, like jargon. I don't understand why "New Address" is hanging out on the right-hand side seemingly attached to nothing on the page. What's it for? Also, the left-hand nav is on this page ... it shouldn't be, unless we want to encourage users to leave the buying workflow. Same goes for the "shopping cart" link. Aren't we in the cart, sort of? I know that being able to access the shopping cart from every page was a requirement, but this seems redundant when the user is essentially in the cart already.¶¶The progress bar on the shipping page is nice.¶¶The confirm page seems a little weird. I expected to see

information that I could confirm before finalizing my order. Instead, I see that this has already been done and that I've submitted my order. Maybe the button on the previous page should have been labeled "submit order."

DESIGNER 7 · DESKTOP · NO PATTERNS OR LAYERS

(1)   2-cloumn grid is fine, but inconsistently used

(2)   Put order summary and checkout information on the same page is good. And it needs

(3)   I like that the user shows the album with the price but I'd rather have this on a separate page, one that shows the total cost outlined (in other words, the albums plus tax and shipping).¶The final page is very abrupt, I wasn't expecting the process to be finalized. I'm not sure what the images and text are intended to be on this page. The bottom one links back to the purchased album which makes some sense but I'm not sure what the context is.¶Also, there's no link to allow users to step out and continue with their shopping.

DESIGNER 8 · DESKTOP · NO PATTERNS OR LAYERS

(1)   ok, could have used horizontal space better. should/could assume/show multiple shipping addresses on one page, as with payment methods

(4)   The shopping cart and checkout seemed cluttered and not as intuitive to use as I would expect.

(7)   Some order of operations are confusing

DESIGNER 9 · DESKTOP · NO PATTERNS OR LAYERS

(4)   Again, the layout was simple and predictable. I was confused by the checkout page, which didn't have a clear submit button at the bottom.

(6)   Cart has no controls for updating the cart, and doesn't have a total for all items. Also missing navigation to continue shopping.¶¶Payment methods don't supply the ability to select among more than one previously saved. Copy could

be made clearer but there aren't any other major layout issues.¶¶The other address pages have the same problem. I'm not sure what the drop-down control is for.¶¶The pages get really sketchy after this point. The order summary should have a link back to edit the information in addition to the buy button.¶¶The shipping info page has an extra continue btn that the others don't have.

(10)   Why does the shopping cart link disappear? How do I select the item to put in the shopping cart? When I want to checkout I want to confirm first what I need to get, not give my visa information immediately.

DESIGNER 10 · DESKTOP · NO PATTERNS OR LAYERS

(2)   1) No total amount and shipping fee information¶2) if the use button is right beside of address label, user don't need to move the mouse too much. Otherwise, they may accidently click the wrong button.

(5)   again - appealing to well established conventions seems more important than anything else on these pages. if business case supports upsells during the process, i'd like to see these represented in the layout. had you considered putting the update button under the edit fields? what about any summary line? or option to add more? what made you decide to use large action buttons for the addresses instead of radio buttons?

(8)   no clear indicaation of where users are.looks like order summary, users can still change order settings. should it allow users to do that?

DESIGNER 11 · DESKTOP · NO PATTERNS OR LAYERS

(7)   Checkout is too far right, hard to see.

(11)   I would like the shopping cart to be prepopulated with a quantity of "1" for the album I'm viewing when I click "buy now." ¶¶Why are the "continue shopping" and "checkout now" buttons next to each other? They are not equivalent actions ... I'd rather see the continue shopping action presented as a link below the form.¶¶When I change my shipping address, the save and cancel buttons

appear at the top of the form (perhaps this is a Firefox issue). This is confusing.¶¶The "thanks" page did not contain an order summary. Also, it should contain information telling the user what to expect from totalmusic.com. I was suprprised to not see it (even dummied up) in this design. A giant "Thanks" isn't helpful to the user at all, except to tell them that the process has ended.

(12)   Did not like the 'Thanks' at end of online transaction. I felt like somebody just took my money and ran.

DESIGNER 13 · DESKTOP · NO PATTERNS OR LAYERS

(15)   Good features...¶- The product listing (Righteous Brother) was prominent and clear.¶- The "also want to check out" thing is a nice touch, and cognitively consistent when placed next to the product listing and above the interactive form features.¶- Credit card (saved/new) looks fine.¶¶Needs work...¶- Missing features: new shipping address, and saved shipping addresses.¶- The shipping cost and total cost should not appear editable.¶- There was no update button to submit the "remove from cart" radio button. There should be a separate "update" and "purchase" buttons.

(16)   The ordering of items on the page doesn't seem to work that well. Especially the 'related purchases' information should be linked differently (perhaps this is a flaw related to having the shopping cart fully integrated with the purchase action).¶¶Also, there shouldn't be option buttons for 'purchase' and 'remove from cart'. Remove from cart should be a link, not an option button, and the purchase option isn't needed (the stuff is in your shopping cart; you already know that you want to purchase it).¶¶There is no good title on the shopping cart page.¶¶The items to indicate how much you are going to pay shouldn't be text fields, but should rather just be standard HTML text. They aren't user editable, and they shouldn't look like they are.¶¶The shipping options could possibly be a set of option buttons.¶¶The saved credit card information should give some indication of the selected account number (last four digits?); as is, if a

person has more than one MasterCard, it is difficult to know which one is linked to this application.

(17)   The layout here seems confusing, as noted above, with shopping cart and checkout knocked together in one page. The layout feels crowded, and having suggestions in the cart seems strange -- it seems logical to have them on a product page, and not an account page. Purchase and remove from cart buttons don't seem like they associate with the product they identify with

Designer 15 · desktop · no patterns or layers

(13)   Mostly good.¶¶Confused as to how the "New Credit Card" or "New Address" field is acted upon? On select? when customer clicks Place order? Consider taking this out of the drop down and making it a text link.¶¶Shipping method is missing the colon.

(14)   it doesnt tell me how much each thing costs¶it doesnt tell me how far through the process i am

(17)   As this is a skeletal structure, this offers a clear way to browse items, with the commentary above. There's clearly been some research into the way a user purchases items, and in a way that a user is familiar with.

Designer 16 · desktop · no patterns or layers

(15)   Does the job. Changing addresses is a bit confused. The words "Please choose" are unnecessary and add clutter.¶¶Ouch - very important, you don't just drop a "submit" button on the final page. Should at least say "purchase now!" or similarly final-sounding language. Much better: provide an order summary prior to final order placement, rather than this form page.

(16)   Some items are rough (notably the Submit button at the end of the purchase chain; some more action oriented text like "Complete Purchase" would be better) but overall it looks like things are in place for a good design.

(18)   How do I select an address (maybe this isn't a valid point?)? Address 1 and 2 are listed, but no selector is provided for either of them. I would also find it more

intuitive for the on-file credit cards to provide some sort of up front information so I could identify which one of my cards I have daringly allowed the site to memorize for perpetuity. The "Enter New..." address and card buttons didn't do anything, but that might also be unimportant in the demo.

DESIGNER 17 · DESKTOP · NO PATTERNS OR LAYERS

(13)   Easy to read and clear to follow. ¶¶City is repeated in the Address sections. Replace with ZIP.¶¶Manual address entry needs a radio button of its own so we'll know if they're using address on file on new one. Also show existing address in full so customer knows right away what addresses are already on file so they don't enter one again.¶¶Payment method needs something like a radio button to specify whether or not customer is using on file card or entering new.

(14)   The payment method select box combined with the card type/entry fields make no sense. How is this supposed to work? ¶¶Why am I being asked format at the top of the checkout pages? I should be asked format before placing something in the cart. and this should show me what's in the cart maybe. And why is format tick boxes anyway. ¶¶Where IS the cart? I can't seem to buy more than one thing at a time. ¶¶I want to be able to make billing+shipping the same withot having to retype.

(18)   Everything is on one page. They get one point for having all the things on the page, but it's terrible. There is no segmentation, no process, nothing. Only someone who creates web pages for a living might have hope of getting through it.

DESIGNER 4 · DESKTOP · PATTERNS AND LAYERS

(9)   Better than the book description but SUBTOTAL needs to be distinguished from another 'item' in the 'item' column (i.e., indent it like traditional invoices). Place 'finalization' type buttons/commands in a different column of the underlying grid than the information for items that command will affect (i.e., place those

'finalization' command/buttons on the right in the 3rd column of your

underlying design grid).

(10)   Inconsistency in update price or update??¶¶Liked the forgot password and

create a new account. Would have preferred them to be links rather than

buttons.¶¶Like the place your order links at top as well as bottom.¶¶Dont like

the use of two similar terms change and update.¶¶What if I want to cancel at

any point and want to go back to the previous screen?¶¶Why are change

quantities and delete a single button?

(12)   The steps in the online transaction appeared to work seemlessly.

DESIGNER 5 · DESKTOP · PATTERNS AND LAYERS

(3)   For each of the data pages, address and payment method, it would be better

(for registered users) to provide the existing information and have a link to

allow users to add a new address or credit card. There's no reason to take up so

much space allowing users to add the new info if it's not necessary. Also, the

mixing of the billing address and the credit card info is confusing. I think there's

a fairly well established industry standard that allows users to enter a billing

address and then specify a shipping address if necessary.

(8)   interaction buttons are located all over the page. the overall layout doesn't have

a sense of stability.

(9)   Buttons/commands for very important things like CHECK OUT and BUY and

anything that's got a feel of "finalization" should be in pretty much the same

place on each page. SUBTOTAL label needs to be indented - to echo a more

traditional invoice format (which will enable the user to differentiate subtotal

from another list item more quickly).

DESIGNER 6 · DESKTOP · PATTERNS AND LAYERS

(5)   layout's nice. fairly conventional - i'd want to ask the designer why he/she chose

to have an update button next to each item instead of at the end of the entire

column.

(6)   Button placement moving around¶Buttons at the top of the info instead of at the bottom¶Different strategies on repeating the cart navigation on top and bottom¶Overall navigation/search placement aplies throughout here as well.¶¶Cart page¶Probably the most succesful page. Aside from the navigation/button issues, the body is fairly easy to read and understand. Using buttons for update and remove is something I would discuss based on the user group/technology resources. Here I expect the continue shopping to be down by the checkout button.¶¶Sign in¶Should be some instructional copy here. ¶The forgot password should be grouped with the log in¶Don't like the two buttons centered and different sizes¶Probably needs more separation between returning and new users¶I would not recommend making the user create an account in order to buy a book.¶The reqs probably imply you would bypass this page altogether.¶¶Review page¶Very hard to scan the information here. More grouping problems include items and totals.. also not sure about how the shipping and billing addresses and the shipping method are placed.¶There's no way to select payment, which was in the reqs¶The selection of another shipping address would work but is unsophisticated...and you have to assume that the linked page will do what the reqs are asking.¶Navigation back to the cart is a little fuzzy - assuming it is the button above the items.¶¶Confirmation page¶This one is layed out better than the previous - I see the address info together and the items and total. The back to shopping link is misplaced

(11)   The order summary (not the one on the "thank you" page, the one before that) isn't organized in an intuitive fashion. It seems like the information is just displayed willy-nilly. ¶¶The "checkout" button on the order summary page looked like a graphic title, not a button. I didn't like the placement. Very atypical for a form button. I clicked it accidentally.

DESIGNER 7 · DESKTOP · PATTERNS AND LAYERS

(1)   nice. 3-column grid is good.

(2)   Excellent. It will be great for the thank you page to display something other than order summary.

(3)   The pages flow nicely and the layout is easy to read and navigate. For the most part, it's easy to understand where you are and where you have left to go but I'd still add a progress bar for the registration process.

Designer 8 · desktop · patterns and layers

(1)   inconsistent layout, incomplete labeling

(4)   The layout was sparse in some areas and not very easy to understand.

(7)   Easy to find on first page¶inconsistent location - needs to be consistent

Designer 9 · desktop · patterns and layers

(4)   The design seemed very complete. It was easy to follow the process to completion.

(6)   See comments from first design *[Designer 6, desktop, patterns and layers]*

(10)   What is update price? How do I find out more about something I do not understand on first glance? I like that the links are in my face.

Designer 10 · desktop · patterns and layers

(2)   I like the remove button, so user don't need to enter 0 and click a link to get rid of the item. And it is good to have address button is on the top.¶¶Using my shipping address can be default for the new credit card information page. And it can be automatically unchecked when user starts input the new address.

(5)   much more complete than some of the browsing pages - but perhaps only so for filling in the names of the fiedls (which are common in any case)

(8)   layout is nice. it is placed in different groups and most of it is on the top page. it's easier to view the bill.

Designer 11 · desktop · patterns and layers

(7)   Good labels, easier to navigate, more valuable details

(11)   The order summary (not the one on the "thank you" page, the one before that) isn't organized in an intuitive fashion. It seems like the information is just displayed willy-nilly. I want to see the billing and shipping addresses next to each other.¶¶The "checkout" button on the order summary page looked like a graphic title, not a button. I didn't like the placement. Very atypical for a form button.

(12)   It's really hard to say without any visuals. I've been long accustomed to see form buttons and I sort of automatically fill in the gaps (gestalt) on what to do next.

DESIGNER 13 · DESKTOP · PATTERNS AND LAYERS

(15)   Pretty good. They have all the right information.¶¶Shopping cart page is perfect - well grouped and presented.¶¶The checkout page could be improved by¶- placing the order total below the item total.¶- placing the ship-to address adjacent to the bill-to address

(16)   This is really good. The flow is sensible, and the final invoice-like form that you accept works really well. It would seem this design has done a better job at understanding the details of information flow on a page.¶¶(Again, the improved design representation might be somehow biasing my reaction - if the other designs had used greeking like this one I might have been better able to see the forest instead of the trees.)

(17)   Having charge information on the right hand side of the page allows a user to be constantly aware of charges and items. The update and remove buttons are a clearly thought-out feature and easy to understand.

DESIGNER 15 · DESKTOP · PATTERNS AND LAYERS

(13)   Pretty good. I would challenge the designer to thinkn of a way to combine the confirmation and edit pages together. Feels like a lot of extra page types needed for something that perhaps could exist together.¶¶Confirmation and Order summary are both well made with nice divisions between sections.

(14)   Overall it makes sense but I think that the ship to and bill to should be next to each other.

(17)   The thank you screen is logically arranged, but the order summary page separates bill to and ship to information, making it a bit scattered.

DESIGNER 16 · DESKTOP · PATTERNS AND LAYERS

(15)   Cart page is barebones (underdeveloped) but can't complain.¶¶Checkout page lacks any confirmation function. "Submit" is insufficient for a final purchase click.

(16)   Ok, but not stellar. Need to know more about how it is all going to come together.

(18)   Clear Shopping Cart is a dangerous button. If there is no confirmation, it should not be present.

DESIGNER 17 · DESKTOP · PATTERNS AND LAYERS

(13)   Checkout process seems good (after cart). All relevant fields are there, in a sensible order, and submit/edit buttons are all in appropriate places.¶¶Also we wanted a link to cart on all pages. Please add to homepage.

(14)   Some of the pages are clean and make sense but some of them are very jumbled and it's difficult to tell what i am supposed to be looking at. There are a lot of links on some of these pages with little indiciation of where they will take me or what i will do.

(18)   If I have two addresses on file, I don't think half the page should be wasted on input of a new one in checkout. Likewise with the credit card page. Again, I can't stand the multi step checkout process, it should be reduced to fewer steps.

DESIGNER 4 · SMARTPHONE · NO PATTERNS OR LAYERS

(19)   The layout and design is quite average (nothing special or helpful about it). It should be easy to use as it follows old conventions. Categorization into 'Songs'

and 'Albums' is okay, but even individual songs belong to some album. So categorization needs to improve.¶¶The checkout page brings in a button to go to the next page, and this convention was not followed elsewhere. There should be consistency in design.¶¶Why is the search feature there on the confirmation page? The last thing that a site would want is to push the customer away from the page, just when they are about to make a purchase.

(22) Again, clear and concise. Seems to tell me exactly what I chose and what the cost is before making me press the pay button. There was no way to adjust quantity however, or any way to buy related items.

(29) What is this "$200" to the right of the Checkout submit button on the Shopping Cart page? Is this the total? Why not label it so? It should be separated visually from both the list of items in the Shopping Cart, and the Checkout element.¶¶How can I add or delete to the Shopping Cart? Why not enclose this info in a form with Change/Delete checkboxes, and have "Checkout" as the text on its submit button?¶ ¶There's nothing technically wrong with having "Checkout" as a mere text link if there's no form on this page, but it suggests lack of functionality to me-- I suspect that my Shopping Cart will not be saved, and I won't be able to complete my purchase.¶¶How can I download a ringtone as a Shipping option? This doesn't seem possible.

DESIGNER 5 · SMARTPHONE · NO PATTERNS OR LAYERS

(24) I liked the layout and design of the shopping cart. The checkout page wasn't bad, but it didn't include the ability to choose a shipping method. The Thank-you page didn't inlude an order summary.

(25) track and delivery mechanism page is confusing

(26) does not meet UI requirements

DESIGNER 6 · SMARTPHONE · NO PATTERNS OR LAYERS

(20) There is a problem with purchasing ringtones - since the UI details that I am also purchasing the album, even if I did not intend to do so. ¶¶I am unable to update

the shipping address. Additionally on this page, it is unclear why there is a drop-down list for the phone billing address.¶¶Moving on to payment, it still provides the title 'ship album(s) to', which is inappropriate on this page. Again, I am unable to change billing information, and the user experience on this page in not at all clear, with the combination of text and drop-down field list that appears here. ¶¶Finally, the 'thanks' page is more of a summary. It's certainly not clearly a 'thanks' page, and a user would be left wondering whether they really had purchased anything.

(21)   I don't really understand the layout of the two "Ship Items to" pages. Is the one displayed the one that's selected? Are the items in the dropdown the alternate options? I can't tell what I'm selecting here.¶¶The "Thanks" page doesn't tell me that I've purchased. In fact, nothing told me that I was confirming the transaction - the button just said "Continue." This is unnerving when a credit card is being charged.

(28)   A few important things missing from the prototype. ¶¶What is that dropdown in the ship-to page? What happens when I select a different address? Does it refresh the page? Does it confirm that I selected a new address when I hit "continue"? ¶¶On the payment page, the header is incorrect (should be "Bill Order To" or somesuch). Same problem as the ship-to page -- how can I confirm the credit card information? Also, NEVER NEVER NEVER display the customer's credit card information and expiration date unless you're in a secure browser -- X-out the last eight digits. ¶¶What I *think* is the confirmation page doesn't really confirm anything. It just displays some items without telling me what really happened.

DESIGNER 7 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   Works for me.

(24)   The pages that were created in the "Shopping Cart/Checkout" section show the same thoughful layout and design as the other section. They definitely are a bit sparse though.

(27)   Frequent users would like the

DESIGNER 8 · SMARTPHONE · NO PATTERNS OR LAYERS

(19)   There should be individual pricing listed as well. Overall layout and design is

standatd. But interface can be improved overall. Placement of interface

elements is not the best.

(20)   The shopping cart page is confusing. It provides the user with too many options.

They need to work through this sequentially. ¶On the 'shipping' page (which is

really about shipping addresses not shipping methods), the user is not given

the option of providing new billing or shipping information - though it is at this

point that they would recognise that they would want and need the option for

that. ¶¶When the user is given the option to change the billing address, they are

then taken to an additional screen - which is unnecessary.

(30)   Need more info on the Thank you page. What happens to my ringtone? is it

automatically installed? It should tell me where to go or what to do to activate it.

¶¶In the Shopping cart. The "Delete Checked" seems to encourage deleting of

product out of the cart - i wouldn't have included that functionality at all. ¶¶In

Shopping Cart: i like that you included Shipping Cost up front.

DESIGNER 9 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   Again, didn't seem as complete as the previous product.¶I can't choose my

mailing address. This part of the flow wasn't as rich as previous flow.

(27)   Given the intended platform is the smartphone, the layout seems reasonable.

However, I am concerned about the overall lack of navigation.

(29)   I don't see a form which permits the user to change the billing information, such

as shipping address or payment method.

DESIGNER 10 · SMARTPHONE · NO PATTERNS OR LAYERS

(21)   I have no idea whether I've bought or not. I'm not clear on the layout of the checkout page - what are the text fields supposed to be for? They are still there on the "thanks" page.

(25)   - this layout would certainly require lots of scrolling on my euro smart-phone (Symbian OS 192x192pixels)¶- no visual cueue as to where one is in checkout process¶- no back or lateral links

(30)   Not necessary to have quantity control on the thank you page, and I would consider removing it from the confirmation page.¶¶The "thank you" page seemed lacking - could have some instructions here.

DESIGNER 11 · SMARTPHONE · NO PATTERNS OR LAYERS

(22)   While I liked the options on the second screen, and the ability to adjust quantities, I found it odd that I had to enter a quantity when first adding the album to the cart. Why do I want more than one album? 99.9% of the time I won't. You're making me do more work than I need to.

(26)   well laid out billing and shipping pages

(28)   Yow! What is going on in the order page?!?!?¶¶1) Too much stuff crowded in horizontally. Everywhere. I can barely read the little table in there.¶¶2) The greek makes it even more incomprehensible. No idea what the radio buttons do. Why is the entire greeked address hyperlinked? It is a mystery.¶¶3) I would make quantity a dropdown box. Two operations to update quantity makes no sense. ¶¶4) what does the [x] button do? Delete, I guess, but that's pretty unclear. ¶¶5) TY page should confirm what I ordered and the billing / shipping methods. What do the "Downloads" and "Ringtone" links do?

DESIGNER 4 · SMARTPHONE · PATTERNS AND LAYERS

(19)   Page design is constrained by the small screen size. However, a progress bar showing the state of transaction would be useful. The order confirmation should tell the books bought as well.

(22)   Well done, easy to understand. I'd like a little less scrolling if possible on the

longer pages, but I'm thinking that won't be a problem on the actual pages

when implemented.

(29)   I'm glad to see the page headings ("Shopping Cart," "Thank you for your order");

on a small screen it's easy for me to lose track of where I am on a site.¶¶Again, I

think the Update/Remove options on the Shopping Cart page could be

streamlined with just one checkbox for Remove, and one submit button

sufficing to send the revision on.¶¶The Subtotal on the Shopping Cart page

needs to be distinguished more, such as by margins.

DESIGNER 5 · SMARTPHONE · PATTERNS AND LAYERS

(24)   Aside from the Shopping Cart page, the layout and design leaves much to be

desired for the same reasons that are outlined above in the responses to the

flow questions.

(25)   see comments on links and avoidance of excesive scrolling above

(26)   seems OK. Not all page elements are visible - no Search

DESIGNER 6 · SMARTPHONE · PATTERNS AND LAYERS

(20)   The information was clear and concise. The information was layed out well for

mobile use.

(21)   For the returning customer, it is not clear (because of the use of squiggly lines)

that "bill to" contains saved credit card information also. I expected to have to

enter my credit card information at some point and never did.¶¶Otherwise, the

layout is pretty clear, considering everything is in static text with plain buttons.

I would recommend using some lines or formatting to emphasize the calls to

action over the peripheral actions.

(28)   Unfortunately, some poor choices here. ¶¶1) The Update Quantity button

requires a round trip for every minor edit the user wants to make to the cart.

Depending on the platform, either a dropdown (with quantity in it) or

Javascript-enabled +/- buttons would be preferable for quantity.¶¶2) Also,

crowding the title of the section in the corner between the page header and the search button is a poor choice. You really want to visually distinguish the title a bit more -- either with positioning or fontage. ¶¶3) Does someone neeed to enter a username and password in order to press the "Create a New Account" button? It sure looks that way -- those choices are hidden below the fold of your screen. But then you force the user to re-enter the username and password on the next screen. Not great when all you have to work with is Multitap. ¶¶4) Same "Update Price" round-trip problem on the shopping cart page. ¶¶5) Where does "Back to Shopping" on the TY page go to?¶¶6) TY page should echo back the email address to which the confirmation was sent.

DESIGNER 7 · SMARTPHONE · PATTERNS AND LAYERS

(23)   Develop to cross promote authors' other books within the user's current view of a book.

(24)   I like the layout for the Shopping Cart. You limit each Product to three lines in a concise and clear manner and the organization of each element makes good sense. ¶¶Again, I do take issue with your font-weighting choices which are not consistent from page to page.¶¶On the Order Summary page, you separate shipping methods from shipping address. They should probably go together. There is a lot of scrolling on this page and it's confusing to have so many buttons on such a critical page. Perhaps the buttons to "Change" should be changed to linked text instead. Food for thought.¶¶In the list of requirements you are asked to provide a thank-you page with an order summary. While there is a thank-you page, the order summary is lacking.

(27)   Overall, I found the shopping cart and checkout usable.

DESIGNER 8 · SMARTPHONE · PATTERNS AND LAYERS

(19)   Information is not presented where it should be. Gestalt principle of space and closure violated. It is not quite evident, which piece of information to read first,

and what all information is associated. There should be clear headings on top of the page to let the users know clearly, which page are they in currently.

(20)   Agai, I have no idea what most of the content was supposed to be. Not enough text is included to tell what's happening. On one page check-boxes are bring used next to the item; but I have no idea what for. ¶¶While I acknowledge that shipping and payment options have been included, as has an summary of the order, it is necessary for the user to have more input, for example, to specify a new shipping address, change billing etc...

(30)   I'm a bit confused by the shopping cart page - why two graphics for each item, and what do the radio buttons represent? Same for the Shipping & Payemnt options - not clear what the radio buttons represent.¶¶Should've had an "add to cart" button present on the product detail page, since there are two items in your cart.

DESIGNER 9 · SMARTPHONE · PATTERNS AND LAYERS

(23)   1. What is the function of the box on the opening screen? I was unclear. [Negative]¶2. Would be helpful to have a progression model. I'm in step 3 of six, for example.¶3. The flow related to user name and account were clear to me, and seem to offer the current standards.¶4. Suggest explicitly telling user the Order number and other details will be sent in the email confirmation. (Some people print these out; other save them on their hard drive.)

(27)   I have the same comment on the search intruding upon the main role of the page. I think this would be simple to correct.

(29)   Group the book's details on the Product page together, and the form elements together. For instance, the ISBN and publisher info belongs with the other book details, such as Author.¶¶What does the "Update price" form submit do? Is this really an auction? I'm leery of buying, then.¶¶I like the columnar layout on the Shopping Cart page. I'm convinced it can be streamlined, though-- instead of three separate form submits, why not use a checkbox on each item to indicate

deletion, and one big Update Quantity submit button, before displaying a Checkout submit.

Designer 10 · smartphone · patterns and layers

(21)   I liked the layout on the shipping and billing pages. Showing the known information and then having a "use this address/info" button is clearer than having a selection interaction followed by a "Next" button.¶¶I'm not sure why "use this info" had an edit button but "use this address" did not. That would have been helpful.

(25)   - "continue shopping" link is useful¶- "update" is expected functionality¶- "use this address" is nicer than radio-button+select link as it cuts out a link and user knows what to expect¶- this cart works well

(30)   Very thorough and well thought out. Impressed that you were able to create detailed designs for all pages, including billing information, enter new credit card (even though it wasn't in the requirements), order summary, and thank you page.

Designer 11 · smartphone · patterns and layers

(22)   The only odd thing I found was the complete order button at the top of the page only - it should be on the bottom as well. I had to search for a moment to find it. Everything else is just as it should be.

(26)   simple and straighforward

(28)   Again, bad. ¶¶"Place your Order" should be further down the page. Nobody's going to click on it without reviewing the information. ¶¶"Ship To" is OK. ¶¶"Bill To" conflates the credit card and billing address information. The layout is confusing, and lo! there's the Search box specified in the requirements. No reason at all to show a separate billing address for each card. ¶¶At least we finally see a decent TY page.

Overall

9. Please give an overall rating: (1 = negative, 5 = positive)

Designer	Ratings			
	1	2	3	Average
Desktop—No patterns or layers				
4	(9) 3	(10) 3	(12) 3	3.00
5	(3) 2	(8) 4	(9) 3	3.00
6	(5) 3	(6) 3	(11) 2	2.67
7	(1) 3	(2) 3	(3) 2	2.67
8	(1) 3	(4) 3	(7) 2	2.67
9	(4) 4	(6) 3	(10) 2	3.00
10	(2) 3	(5) 3	(8) 3	3.00
11	(7) 3	(11) 3	(12) 3	3.00
13	(15) 3	(16) 1	(17) 2	2.00
15	(13) 2	(14) 3	(17) 4	3.00
16	(15) 4	(16) 4	(18) 5	4.33
17	(13) 4	(14) 1	(18) 1	2.00
Desktop—Patterns and layers				
4	(9) 3	(10) 3	(12) 4	3.33
5	(3) 2	(8) 4	(9) 4	3.33
6	(5) 4	(6) 2	(11) 2	2.67
7	(1) 4	(2) 5	(3) 4	4.33
8	(1) 2	(4) 3	(7) 2	2.33
9	(4) 4	(6) 2	(10) 2	2.67
10	(2) 4	(5) 3	(8) 4	3.67

11	(7) 4	(11) 3	(12) 4	3.67
13	(15) 5	(16) 4	(17) 5	4.67
15	(13) 3	(14) 3	(17) 3	3.00
16	(15) 4	(16) 4	(18) 4	4.00
17	(13) 2	(14) 4	(18) 1	2.33
Smartphone—No patterns or layers				
4	(19) 2	(22) 3	(29) 2	2.33
5	(24) 3	(25) 4	(26) 1	2.67
6	(20) 2	(21) 4	(28) 2	2.67
7	(23) 4	(24) 3	(27) 4	3.67
8	(19) 3	(20) 1	(30) 4	2.67
9	(23) 1	(27) 3	(29) 2	2.00
10	(21) 1	(25) 2	(30) 4	2.33
11	(22) 3	(26) 5	(28) 3	3.67
Smartphone—Patterns and layers				
4	(19) 3	(22) 4	(29) 4	3.67
5	(24) 1	(25) 3	(26) 3	2.33
6	(20) 4	(21) 3	(28) 3	3.33
7	(23) 4	(24) 2	(27) 3	3.00
8	(19) 2	(20) 2	(30) 3	2.33
9	(23) 4	(27) 4	(29) 2	3.33
10	(21) 3	(25) 3	(30) 5	3.67
11	(22) 5	(26) 4	(28) 2	3.67

10. How complete do you consider this design to be? (1 = not complete, 5 = complete)

Designer	Ratings			
	1	2	3	Average
Desktop—No patterns or layers				
4	(9) 2	(10) 2	(12) 3	2.33
5	(3) 3	(8) 3	(9) 2	2.67
6	(5) 3	(6) 3	(11) 3	3.00
7	(1) 3	(2) 3	(3) 1	2.33
8	(1) 2	(4) 4	(7) 2	2.67
9	(4) 4	(6) 1	(10) 1	2.00
10	(2) 4	(5) 3	(8) 3	3.33
11	(7) 3	(11) 2	(12) 2	2.33
13	(15) 2	(16) 1	(17) 2	1.67
15	(13) 1	(14) 2	(17) 3	2.00
16	(15) 3	(16) 3	(18) 4	3.33
17	(13) 3	(14) 1	(18) 1	1.67
Desktop—Patterns and layers				
4	(9) 2	(10) 3	(12) 3	2.67
5	(3) 2	(8) 5	(9) 3	3.33
6	(5) 4	(6) 2	(11) 2	2.67
7	(1) 4	(2) 4	(3) 3	3.67
8	(1) 1	(4) 3	(7) 2	2.00
9	(4) 4	(6) 2	(10) 2	2.67

10	(2) 4	(5) 3	(8) 4	3.67
11	(7) 4	(11) 4	(12) 4	4.00
13	(15) 4	(16) 4	(17) 4	4.00
15	(13) 2	(14) 3	(17) 3	2.67
16	(15) 3	(16) 3	(18) 3	3.00
17	(13) 1	(14) 4	(18) 2	2.33
Smartphone—No patterns or layers				
4	(19) 1	(22) 3	(29) 2	2.00
5	(24) 2	(25) 2	(26) 1	1.67
6	(20) 1	(21) 3	(28) 2	2.00
7	(23) 3	(24) 2	(27) 3	2.67
8	(19) 2	(20) 1	(30) 3	2.00
9	(23) 1	(27) 1	(29) 1	1.00
10	(21) 1	(25) 1	(30) 4	2.00
11	(22) 3	(26) 5	(28) 3	3.67
Smartphone—Patterns and layers				
4	(19) 4	(22) 2	(29) 4	3.33
5	(24) 2	(25) 1	(26) 3	2.00
6	(20) 2	(21) 4	(28) 4	3.33
7	(23) 4	(24) 2	(27) 3	3.00
8	(19) 1	(20) 1	(30) 3	1.67
9	(23) 3	(27) 4	(29) 1	2.67
10	(21) 2	(25) 3	(30) 4	3.00
11	(22) 4	(26) 4	(28) 2	3.33

11. How skilled do you think this designer is? (1 = not skilled, 5 = very skilled)

Designer	Ratings			
	1	2	3	Average
Desktop—No patterns or layers				
4	(9) 2	(10) 3	(12) 3	2.67
5	(3) 3	(8) 4	(9) 2	3.00
6	(5) 3	(6) 3	(11) 3	3.00
7	(1) 3	(2) 4	(3) 2	3.00
8	(1) 3	(4) 3	(7) 2	2.67
9	(4) 3	(6) 2	(10) 1	2.00
10	(2) 3	(5) 3	(8) 3	3.00
11	(7) 3	(11) 3	(12) 3	3.00
13	(15) 3	(16) 1	(17) 2	2.00
15	(13) 2	(14) 2	(17) 4	2.67
16	(15) 3	(16) 3	(18) 4	3.33
17	(13) 4	(14) 1	(18) 1	2.00
Desktop—Patterns and layers				
4	(9) 2	(10) 3	(12) 3	2.67
5	(3) 2	(8) 3	(9) 2	2.33
6	(5) 4	(6) 1	(11) 2	2.33
7	(1) 4	(2) 5	(3) 3	4.00
8	(1) 1	(4) 2	(7) 2	1.67
9	(4) 5	(6) 2	(10) 2	3.00
10	(2) 4	(5) 3	(8) 4	3.67

11	(7) 4	(11) 3	(12) 3	3.33
13	(15) 4	(16) 5	(17) 5	4.67
15	(13) 3	(14) 3	(17) 4	3.33
16	(15) 3	(16) 3	(18) 4	3.33
17	(13) 1	(14) 3	(18) 2	2.00
Smartphone—No patterns or layers				
4	(19) 2	(22) 3	(29) 3	2.67
5	(24) 3	(25) 3	(26) 1	2.33
6	(20) 1	(21) 4	(28) 3	2.67
7	(23) 4	(24) 4	(27) 4	4.00
8	(19) 3	(20) 1	(30) 4	2.67
9	(23) 1	(27) 2	(29) 2	1.67
10	(21) 1	(25) 1	(30) 4	2.00
11	(22) 3	(26) 5	(28) 3	3.67
Smartphone—Patterns and layers				
4	(19) 3	(22) 3	(29) 3	3.00
5	(24) 1	(25) 3	(26) 3	2.33
6	(20) 3	(21) 3	(28) 4	3.33
7	(23) 3	(24) 2	(27) 3	2.67
8	(19) 2	(20) 1	(30) 4	2.33
9	(23) 3	(27) 4	(29) 2	3.00
10	(21) 3	(25) 3	(30) 5	3.67
11	(22) 4	(26) 3	(28) 2	3.00

12. Is there anything more you would like to add? *(optional)*

DESIGNER 4 · DESKTOP · NO PATTERNS OR LAYERS

(9)   You need to work with a good professional GRAPHIC designer as well as a usability engineer type. This design feels like the designer has more of a background in "web design" vs. either usability engineering OR graphic and visual design.

(10)   *[blank]*

(12)   *[blank]*

DESIGNER 5 · DESKTOP · NO PATTERNS OR LAYERS

(3)   On most of the browse pages the designer seems to be close to on target but they really fall down in the checkout flow. The page with the shipping address is really nice and compact but there's the odd user id shoved in there.

(8)   *[blank]*

(9)   See #12 on last design *[Designer 4, desktop, patterns and layers]*.

DESIGNER 6 · DESKTOP · NO PATTERNS OR LAYERS

(5)   browsing pages were weaker and less complete than the checkout process - which seemed well thought through.

(6)   *[blank]*

(11)   The designer took the requirements very literally. The designer seems somewhat creative (i.e. tabular layout for the shopping cart) but not very sensitive to usability issues, or even the best interests of the business (i.e. not pushing users out of buying mode).

DESIGNER 7 · DESKTOP · NO PATTERNS OR LAYERS

(1)   *[blank]*

(2)   *[blank]*

(3)   I don't feel that the designer put much effort or thought into this design. Many of these interactions are fairly standard throughout the web so I don't feel that the designer has much experience.

DESIGNER 8 · DESKTOP · NO PATTERNS OR LAYERS

(1)   even given the limited time allowed, I would expect much more attention to detail

(4)   *[blank]*

(7)   *[blank]*

DESIGNER 9 · DESKTOP · NO PATTERNS OR LAYERS

(4)   *[blank]*

(6)   *[blank]*

(10)   Perhaps it is because these are representative mockups, they seem very incomplete. Not illustrative of the designer's skills.

DESIGNER 10 · DESKTOP · NO PATTERNS OR LAYERS

(2)   Summary page is pretty much same as the Thanks page. It is redundant. If a thanks page is needed, it should display something else instead of the order information.

(5)   *[blank]*

(8)   *[blank]*

DESIGNER 11 · DESKTOP · NO PATTERNS OR LAYERS

(7)   *[blank]*

(11)   *[blank]*

(12)   *[blank]*

DESIGNER 13 · DESKTOP · NO PATTERNS OR LAYERS

(15)   Under the time constraints, not too shabby.¶¶As an evaluator, it was very challenging for me to evaluate this design, because I was trying to comprehend the requirements at the same time!¶¶I actually have one big gripe about the requirements themselves. They throw around hierarchical terms (home, genre, product/album, song) without quite specifying the relationship among them. I can infer that hierarchy that I just listed, but that's asking a lot of a designer with just 1:45 start to finish!

(16)   For a 1.45 hour design project, it seems that the designer has gotten a little bit too detailed. The details seems to have been dealt with first, instead of taking a deeper look at flow and ordering of information.

(17)   While it's admirable to try new metaphors to purchase, it can be done if (a) users aren't alienated from the purchasing process (especially those with basic skill -- and many music purchasers can fall into this category) and (b) a clear and logical layout doesn't confuse viewing with purchasing (mixed shopping cart and checkout).

DESIGNER 15 · DESKTOP · NO PATTERNS OR LAYERS

(13)   Would be nice to be able to see some more thought process going on with this design. Designing for a scalable system and imaging how it can be technically implemented should show in the design. Designer needs to consider each page element and where it is coming from. Does the design scale? ¶¶Some big errors in this design exist, like not helping the user with calling out the primary action and not thinking ahead to the next step.

(14)   *[blank]*

(17)   As a rule of thumb, it's a good idea to let the user know at all times where they are in a process -- it provides them with the interactivity they need to allow them and is helpful to retain the user as a future visitor.

DESIGNER 16 · DESKTOP · NO PATTERNS OR LAYERS

(15)   Not bad. The overall architecture is correct. The few glaring errors are easy to fix.

(16)   Difficult to rate the skill of the designer. The ability to copy a model like
        Amazon's is really determined by your ability to get the fine details right;
        copying at the coarse level of this design is easy.

(18)   *[blank]*

DESIGNER 17 · DESKTOP · NO PATTERNS OR LAYERS

(13)   *[blank]*

(14)   *[blank]*

(18)   An engineer must have made this.

DESIGNER 4 · DESKTOP · PATTERNS AND LAYERS

(9)   No.

(10)   *[blank]*

(12)   *[blank]*

DESIGNER 5 · DESKTOP · PATTERNS AND LAYERS

(3)   There are a lot of details missing from these pages and a lot of ideas that aren't
        using well established industry formats. I think this designer needs to spend
        more time exploring other sites and develop a better understanding of best
        practices.

(8)   this is very similar to amazon's shopping experience. a wizard would also be
        very helpful during shopping designs.

(9)   No.

DESIGNER 6 · DESKTOP · PATTERNS AND LAYERS

(5)   *[blank]*

(6)   The designer seems to not be familiar with shopping cart patterns and grammer.

(11)   *[blank]*

Designer 7 · desktop · patterns and layers

(1)   *[blank]*

(2)   *[blank]*

(3)   This is a pretty easy concept to design and I think it's fairly complete. I really wish that the designer had provided a search results page and I was curious to see what the subcategory looked like (I assume it's basically the genre page but what about the left nav? Also, what's the difference between a genre and a main category (and a subcategory).¶I liked the consistent placement of the shopping cart but some recognition of the user would be valuable, especially for users that share a computer. ¶There's also no main navigation (header) and footer indicated on the designs so I'm not entirely sure how the primary navigation would work.

Designer 8 · desktop · patterns and layers

(1)   added reviews but missed other req's

(4)   *[blank]*

(7)   *[blank]*

Designer 9 · desktop · patterns and layers

(4)   *[blank]*

(6)   I hope you can see what I commented on in the first design *[Designer 6, desktop, patterns and layers]* - not sure how random this is.

(10)   *[blank]*

Designer 10 · desktop · patterns and layers

(2)   Back to shopping on the thank you page is good. But the order summary on this page is redundant. Put something new.

(5)   *[blank]*

(8)   design is more comprehensive than previous version *[Designer 5, desktop, patterns and layers]*.

DESIGNER 11 · DESKTOP · PATTERNS AND LAYERS

(7)   *[blank]*

(11)   *[blank]*

(12)   *[blank]*

DESIGNER 13 · DESKTOP · PATTERNS AND LAYERS

(15)   This designer knows shopping carts inside and out, and showed off his/her skills there. Short changed the product browsing, though.

(16)   *[blank]*

(17)   The designer really thought this through and took some insight into how a user navigates a site. The site requirements specified that it was assumed the user was already logged in, but adding a new account item in the design structure filled in a blank that was necessary to communicate complete account functionality.

DESIGNER 15 · DESKTOP · PATTERNS AND LAYERS

(13)   The browse pages had no thought put into them at all... Disappointed in that regard. The cart and checkout process are pretty good however. Did the designer just need some more time?

(14)   *[blank]*

(17)   While there was limited time requirement for the site design, it seemed like some pages (genre) could have been flushed out a bit more. The designer has a few quirks to work out with the shopping cart order summary design. A good way to think about it is, "how can I achieve a result with as few clicks as possible?"

DESIGNER 16 · DESKTOP · PATTERNS AND LAYERS

(15)   Numberous small errors.

(16)   *[blank]*

(18)   *[blank]*

DESIGNER 17 · DESKTOP · PATTERNS AND LAYERS

(13)   This design obviously needs a lot of polish. Some good starting ideas, but need to see next step. I think something more impressive could be done in 1 hour 45 minutes.¶¶Search only exists on Genre page. Needs to be on all pages.

(14)   *[blank]*

(18)   It's a crap design, but it's "complete" in that it's been completely thought through and that person wouldn't be working with me.

DESIGNER 4 · SMARTPHONE · NO PATTERNS OR LAYERS

(19)   Some more detail in the design and layout would have helped. It is not clear if the Sitemap feature is part of the design by the applicant? A left navigation panel is not the best navigation method for such sites.

(22)   *[blank]*

(29)   *[blank]*

DESIGNER 5 · SMARTPHONE · NO PATTERNS OR LAYERS

(24)   Overall, the flow was definitely better than the design. Skipping the number one requirement is troubling.

(25)   stab in the dark, I wouldn't hire this designer based on this wireframe

(26)   poor, unusable design

DESIGNER 6 · SMARTPHONE · NO PATTERNS OR LAYERS

(20)   *[blank]*

(21)   *[blank]*

(28)   The designer understands some of the basic issues, but simply designed to requirements instead of putting thought into the design.

DESIGNER 7 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   *[blank]*

(24)   It is obvious that you ran out of time. You made some good design choices. On the other hand, you added some uneccesary steps and ignored some of the requirements. I would defintely like to see how you would flesh-out these pages and complete the interaction flow if given more time.

(27)   *[blank]*

DESIGNER 8 · SMARTPHONE · NO PATTERNS OR LAYERS

(19)   Design needs to be more detailed, and overall navigation needs to be improved.

(20)   The designer does not understand the user, and their wants needs, and aquired experiences. In addition the designer has not met a number of requirements of the project, such as providing the user with the option of different media formats. The sequencing of procedures is confused from beginning to end, and the use of interaction methods for changing data and providing input is often not appropriate. For example, buttons for downloading music, or changing addresses, taking the user on to different screens creates unnecessary interactions.

(30)   Shows some good thinking and attention to common shopping issues (e.g. shipping cost), but also left out specific requirements though (e.g. search function). Difficult to rate this disigner.

DESIGNER 9 · SMARTPHONE · NO PATTERNS OR LAYERS

(23)   Half-baked.

(27)   *[blank]*

(29)   *[blank]*

DESIGNER 10 · SMARTPHONE · NO PATTERNS OR LAYERS

(21)   *[blank]*

(25)   - nicer 'feel'¶- too incomplete to rationally assess¶- this has to be a crap way of hiring a designer!

(30)   Seems to understand the basics of ecommerce design and the basics of cellphone UI.¶¶Some pages could've used more thought, but it may be due to the time constraints.

DESIGNER 11 · SMARTPHONE · NO PATTERNS OR LAYERS

(22)   *[blank]*

(26)   best design

(28)   Again, skilled designer who made some pretty awful choices for a mobile platform.

DESIGNER 4 · SMARTPHONE · PATTERNS AND LAYERS

(19)   Design is pretty well formed, except some problems with usability. Things like breadcrumbs and progress bars, and less cluttered spaces would make a good interface.

(22)   *[blank]*

(29)   I still really want in-page links (back to top, etc.) on the non-form pages, such as Genre lists-- these have the potential to grow very long.

DESIGNER 5 · SMARTPHONE · PATTERNS AND LAYERS

(24)   I found myself wondering whether or not the designer has a good command of the english language. The decision not to label the Shipping page as such has a lot to with it. Some requirements were completely over looked as well. Namely the last two of being able to choose a previously stored shipping address or

payment method or using their cell phone billing address and billing to thier cell phone account.

(25)   impossible to completely assess information-design skill from this wireframe demo

(26)   *[blank]*

DESIGNER 6 · SMARTPHONE · PATTERNS AND LAYERS

(20)   This is a conventional design. It is well done in that it is simple, easy to follow, and builds upon users previous experience with online commerce; while bring designed with the constraints of mobile devices in mind. The design does not bring a new paradigm to shopping online by mobile device.

(21)   This design follows many of the conventions of other online shopping sites. Because it is consistent, customers will be able to figure it out, and any usability issues will be more annoyances than serious problems.

(28)   Clearly skilled, but needs more experience with mobile application design.

DESIGNER 7 · SMARTPHONE · PATTERNS AND LAYERS

(23)   *[blank]*

(24)   Overall, I think the main problem is the failure to understand a simple set of requirements.

(27)   *[blank]*

DESIGNER 8 · SMARTPHONE · PATTERNS AND LAYERS

(19)   More details needs to be added in the page, and layout and structure should be a bit tighter and coupled with the interface as a whole.

(20)   *[blank]*

(30)   Considering the requirements, the limited time available, and the limitations of screen real estate on smartphones, i would say this designer has had some experience with both ecommerce and cellphone design, or is skilled enough to

figure out shopping UI problems quickly. ¶¶Would've appreciated a bit more detail.

DESIGNER 9 · SMARTPHONE · PATTERNS AND LAYERS

(23)   Strong start. Good use of language. For the most part, seemed to follow current convention in ecommerce. So, this will be familiar to end user.

(27)   I want to give this a good rating. The design was nearly complete and the flow was effective. My low marks on layout stem from the search function (again that is an assumption), as it dominates the limited screen real estate by including a search button and entry field. Would recommend putting a link to a search page.

(29)   This design still shows bias towards computer screen, not mobile device, usage-- there needs to be stronger branding (TotalBooks) on each page, as well as in-page links to help users on smaller screens navigate the site.

DESIGNER 10 · SMARTPHONE · PATTERNS AND LAYERS

(21)   I liked the checkout interaction much more than the browsing interaction on this design. I also did not see a "search" functionality on every page, as specified in the requirements.¶¶I think the user would have some problems using this site, mostly because of an overall lack in navigation and status information.

(25)   - again, impossible to properly assess designer skill.¶¶- also, mobile apps don't really present themselves as linked pages, more 'states' of a given system so hard to assess IA in terms of boxes and arrows. Main thing about this last example is that user doesn't get as lost as in the previous examples.¶¶- user unlikely to shop for books or music using this app. User might buy tracks for use on iPod or similar...

(30)   This designer has extensive experience in ecommerce - very well thought out pages and attention to detail. This designer was able to create a thorough

shopping experience in a short amount of time, with only minor ui issues¶¶Did not have a search function on every page.

Designer 11 · smartphone · patterns and layers

(22)   *[blank]*

(26)   basic, simplistic design. Not elegant or unique.

(28)   Bonus points for a good TY page, otherwise this is pretty bad.

Demographics

Desktop evaluators are represented with outlined squares, smartphone evaluators with solid squares.

13. What is your gender?

Male ☐1 ☐2 ☐4 ☐5 ☐8 ☐12 ☐13 ☐15 ☐16 ☐17 ☐18 ■19 ■22 ■24 ■25 ■26 ■27 ■28 ■30

Female ☐3 ☐6 ☐7 ☐9 ☐10 ☐11 ☐14 ■20 ■21 ■23 ■29

14. What is your age?

19 and under

20–29 ☐2 ☐8 ☐13 ☐14 ☐18 ■19 ■21 ■28

30–39 ☐1 ☐3 ☐4 ☐5 ☐6 ☐10 ☐11 ☐12 ☐15 ☐16 ☐17 ■20 ■22 ■24 ■29 ■30

40–49 ☐7 ■23 ■25 ■27

50 or above ☐9 ■26

15. How many years of design experience do you have?

1 ☐1 ☐2

2 ☐3

4 ☐5

5 ☐10

6 ☐13 ☐16 ☐18 ■21 ■28

7 ☐11 ☐15 ■19 ■29

9 8 12

10 14 20 23

11 4 6

12 22

13 24

16 17 30

17 7

20 25 26 27

25 9

(Comments)

2 1–2 years
3 2.5 years
5 4+ years
19 6 years educational and 1.5 yrs professional
27 20+ years

16. How many years of *web* design experience do you have?

1 1 2 20

2 3 5 19 28

4 10 16

5 8

6 11 12 18 21 30

7 15 29

8 6 9 13

9 4 22 25

10 7 14 17 23 24 26 27

(Comments)

2 1–2 years
3 2.5 years
5 2–3 years

20 >1 year

17. *(smartphone evaluators only)* How many years of *mobile phone or PDA* UI design experience do you have?

1 20 21 22 23 28 30

2 19 26 29

3 24

6 25 27

(Comments)

20 >1 year
22 1–2 years

18. What devices have you designed user interfaces for?

GUIs	1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17 18 19 20 21 22 24 25 26 27 28
Web on a personal computer	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
PDA or mobile phone	7 9 10 17 19 21 22 24 25 27 28 29 30
Voice	5 19 21 25 27 29
Other:	
Point-of-sale interfaces	4
Businesses, products, services	6
Exercise machine visual displays	9
Cockpits, electronic flight displays, etc.	16 27
Kiosks	27
ATM-style and touch screen interfaces for gas station pumps	30

19. How many e-commerce web sites have you designed?

0   12 16 **20**

1   4 **23** **28** **29**

2   2 3 15

3   1 8 9 10 13 18 **19** **27** **30**

4   **24**

5   6 14 **22**

6   11

7   7 **21**

8   17

10   5 **25** **26**

(Comments)

1   several large ones - macys, beyond, currently walmart
5   10? *(sic)*
9   3–4
17   about 8
22   around 5

20. If you have designed e-commerce web sites, what devices were they target at?

Web on a personal computer   1 2 3 4 5 6 7 8 9 10 11 13 14 15 17 18 **19** **21** **22** **23** **24** **25** **26** **27** **28** **29** **30**

PDA or mobile phone   7 9 10 18 **21** **24** **25** **30**

Voice   5 **19**

Other:

Windows Media Player on a PC   1

software to manage industrial sites   8

(Comments)

⬛23   For the web, but selling mobile phones and plans

21. What is your primary job responsibility?

Information architecture   ⬜10 ⬜11 ⬜12 ⬜14 ⬛21

Graphic design   ⬜8 ⬜17

Web design   ⬜1 ⬜3 ⬜13 ⬜15 ⬜18 ⬛22 ⬛24 ⬛29 ⬛30

GUI design (the overall interaction   ⬜2 ⬜4 ⬛26
for desktop applications)

Mobile phone UI design

Voice UI design   ⬜5

Other:

Design management   ⬜6 ⬜7 ⬛23 ⬛25

Everything   ⬜9

Human factors engineering   ⬜16

User experience design   ⬛19

User research/usability testing   ⬛20

Information accessibility design   ⬛27
(for people with disabilities)

Design and rapid prototyping   ⬛28

(Comments)

⬜1   interaction design for the web

⬜6   Team lead/creative direction/management

⬜9   soup to nuts: IA, design, usability eng, proj mgmt, marketing, doc, edit writing,

support

⬜16   Human Factors Engineering (like GUI design, but broader with much more

analysis responsibilities)

⬛23   Online community manager, including IA, proj. management, UI design

⬛25   UX consultancy, research and management

22. Please check the kinds of design in which you feel you are knowledgeable.

Information architecture 1 2 3 4 5 6 7 8 9 10 11 12 14 15 16 17 18 **19 20 21 22 23 24 25 27 29 30**

Graphic design 1 4 6 8 9 11 12 13 14 17 **19 22 25 28 30**

Web design 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 **19 21 22 23 24 25 26 27 28 29 30**

GUI design (the overall interaction for desktop applications) 2 4 5 6 7 8 9 10 11 13 15 16 17 18 **19 20 21 22 26 27 28**

Mobile phone UI design 5 7 10 **19 25 29 30**

Voice UI design 5 **19 21 27**

Other:

Physical/hardware design 6 16

Design for people with disabilities **27**

(Comments)

6 General interaction design, also with physical products
16 Hardware design

23. How many times have you bought anything online in the past 12 months?

Never

1–3 times

4–6 times 4 8 10 12 13 **20 30**

7–11 times 1 2 3 14 16 **26 28**

At least 12 times 5 6 7 9 11 15 17 18 **19 21 22 23 24 25 27 29**

24. If you have, how did you buy those items?

Through the web on a personal computer 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 **19 20 21 22 23 24 25 26 27 28 29 30**

Through a mobile phone 1 **25 27**

display

Through an automated voice system over the phone 5 9 **19 22 25**

Other:

Called 1-800 number 12

25. How many times have you bought books online in the past 12 months?

Never

1–3 times 2 4 7 8 10 14 15 16 **21 23 25 26 30**

4–6 times 1 3 5 9 11 12 13 **20 22 27 28 29**

7–11 times 6

At least 12 times 17 18 **19 24**

26. If you have, how did you buy those books?

Through the web on a personal computer 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 **19 20 21 22 23 24 25 26 27 28 29 30**

Through a mobile phone display

Through an automated voice system over the phone

Other:

Called 1-800 number 12

27. How many times have you bought music albums online in the past 12 months?

Never 2 4 5 8 10 12 15 **19 21 26**

1–3 times 3 7 9 16 17 18 **20 22 27 30**

4–6 times 11 13 14 **25 28 29**

7–11 times   6 23

At least 12 times   1 24

28. If you have, how did you buy those albums?

Through the web on a   1 3 6 7 9 11 13 14 16 17 18 20 22 23 24 27 28 29 30
personal computer

Through a mobile phone   25
display

Through an automated
voice system over the
phone

Other:

Desktop application   13 23 25 30

(Comments)

6   Digital music service (desktop app)
23 25 30   iTunes

29. *(smartphone evaluators only)* How many times have you bought ringtones
online in the past 12 months?

Never   19 20 22 23 26 29 30

1–3 times   21 24 27 28

4–6 times   25

7–11 times

At least 12 times

30. *(smartphone evaluators only)* If you have, how did you buy those ringtones?

Through the web on a personal computer
<kbd>21</kbd> <kbd>24</kbd> <kbd>25</kbd> <kbd>27</kbd>

Through a mobile phone display
<kbd>21</kbd> <kbd>24</kbd> <kbd>25</kbd> <kbd>27</kbd> <kbd>28</kbd>

Through an automated voice system over the phone

Other:

APPENDIX

G Materials for Judging Damask Voice User Interfaces

G.1 Consent Form

My name is James Lin. I am a graduate student in Computer Science at UC Berkeley. I would like to invite you to take part in my research. It consists of performing tasks by using a phone-based system. The purpose of the study is to learn more about the design of voice user interfaces.

If you agree to take part in my research, I will conduct a study with you at the time and location of your choice. There will be one session. I ask that you schedule one hour for this study, though it is possible that you will finish early. The study will consist of using several voice user interfaces to perform tasks, and filling out a written questionnaire after each user interface. I would like to emphasize that this experiment should be approached as a fun activity and a contributing effort. It is okay if you do not complete the task. I may ask to contact you by telephone or e-mail if there are any follow-up questions I have after our interviews.

If you agree to participate, you will receive a $20 gift certificate from Amazon.com to thank you for your participation.

There are no known risks to you from taking part in this research, and no foreseeable direct benefit to you either. However, your participation will contribute to my efforts to improve the state of the art in user interface design.

The judging results that you will create will be kept on my secured computer. We will not use any identifying information in any reports of my research. After this research is completed, I may save this data for use in future research by others or myself.

Your participation in this research is voluntary. You are free to refuse to take part. You may refuse to answer any questions and may stop taking part in the study at any time. Whether or not you participate in this research will have no bearing on your job or your relationship with UC Berkeley. If you decide to stop in the middle of the session for any reason, you will still receive the $20 gift certificate as a sign of our appreciation for your effort.

If you have any questions about the research, you may contact me, James Lin, at (408) 927-2687 or jimlin@cs.berkeley.edu. If you agree to take part in the research, please sign the form below. Please keep the other copy of this agreement for your future reference.

If you have any question regarding your treatment or rights as a participant in this research project, please contact UC Berkeley's Committee for the Protection of Human Subjects at (510) 642-7461 or subjects@uclink.berkeley.edu.

I have read this consent form and I agree to take part in this research.

_____   _____   _____

Name (please print)   Signature   Date

G.2 Directions

You are about to go on a spending spree for books and music. You will do eight shopping tasks, four for books and four for music, using the phone. Each task comes with an instruction sheet. For each task, order the item on the instruction using any other information on that sheet, such as the "account number." Write down the confirmation number and the total amount of the order. Then fill out the questionnaire after each task.

G.3 Tasks

Buy the item as quickly as possible. You can hang up immediately after you have completed your order. *(The designer numbers were not included in the actual materials.)*

Design 1 (TotalMusic) *[Designer 13]*

Buy *The White Album.*

Use the following information to check out:

- account number: **1234567**

- PIN: **9876**

- Payment method: **credit card stored in profile**

- Shipping address: **address stored in profile**

- Shipping method: **stored in profile**

- Billing address zip code: **94720**

Design 2 (TotalBooks) *[Designer 13]*

Buy *The Da Vinci Code* by Dan Brown.

Use the following information to check out:

- account number: **1234567**

- PIN: **9876**

- Payment method: **credit card stored in profile**

- Shipping address: **address stored in profile**

- Shipping method: **stored in profile**

Design 3 (TotalBooks) *[Designer 15]*

Buy the book *Life of Pi* by Yann Martel.

Use the following information to check out:

- account number: **1234567**

- PIN: **9876**

- Payment method: **credit card stored in profile**

- Shipping address: **address stored in profile**

- Shipping method: **stored in profile**

Design 4 (TotalMusic) *[Designer 15]*

Buy the album *OK Computer* by Radiohead.

Use the following information to check out:

- Credit card: **MasterCard**

- Shipping address: **home**

- Shipping method: **standard**

Design 5 (TotalBooks) *[Designer 16]*

Buy *Guns, Germs, and Steel* by Jared Diamond.

Use the following information to check out:

- Shipping address: **use address on file**

- Shipping method: **express**

- Payment method: **use credit card associated with the account**

Design 6 (TotalMusic) *[Designer 16]*

Buy *Ten* by Pearl Jam.

Use the following information to check out:

- Shipping address: **address on file**

- Shipping method: **express**

- Payment method: **credit card on file**

Design 7 (TotalMusic) *[Designer 17]*

Buy *Gordon* by Barenaked Ladies.

Use the following information to check out:

- account number: **1234567**

- PIN: **9876**

- CD or cassette: **CD**

- Shipping address: **100 Main Street**

- Payment method: **Visa ending in 1234**

- Shipping method: **USPS**

Design 8 (TotalBooks) *[Designer 17]*

Buy *Catch-22* by Joseph Heller.

Use the following information to check out:

- account number: **1234567**

- PIN: **9876**

- Shipping address: **100 Main Street, Anywhere, USA**

- Shipping method: **budget**

- Payment method: **Visa ending in 12345**

G.4 Questionnaire

G.4.1 Questions

1. What is the confirmation number?

    ○ The confirmation number is ➔

    ○ There is a confirmation number, but I didn't catch it.

    ○ There is no confirmation number.

    ○ I don't know if there is a confirmation number or not.

2. What is the total?

    ➔

3. What did you like about this interface?

    ➔

4. What did you not like about this interface?

    ➔

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?

    ➔

G.4.2 Design 1: TotalMusic (Designer 13, no patterns or layers)

1. What is the confirmation number?

    ❶ 342897

    ❷ 342897

    ❸ 342847

    ❹ 342897

2. What is the total?

    ❶ $26.00

- ❷ $26.00
- ❸ $26.00
- ❹ $19.99

3. What did you like about this interface?

- ❶ It said "goodbye" (i.e. I knew when the transaction was over and I could hang up). It asked for billing address zip code, so I had more confidence that the info contained in my profile was correct. Compared to some other interfaces, when I had to speak a selection, the words I needed to speak seemed to be clearer.
- ❷ It was fast and easy to use. It also appended the artist's name to the album even though I didn't supply that information. That is useful for error avoidance (purchasing the wrong album).
- ❸ Was pretty efficient, and the default task (shipping using my credit card, address, and method stored in my profile) was the first choice
- ❹ most was fast, professional, good trust

4. What did you not like about this interface?

- ❶ After selecting the album, I had to say "continue shopping" before I could get to "checkout". Would have preferred to be able to go directly to "checkout"
- ❷ Computerized voice-inflection was sometimes off.
- ❸ Had no problems with it, but I would wonder how hard it is to do non-default tasks.
- ❹ forced me to listen confirmation repeat
  Forced me to confirm white album

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?

```
                    ❶   ❷
                    ❹   ❸
    1   2   3   4   5   6   7
```
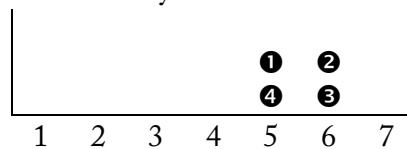
mean = 5.5, median = 5.5, std dev = 0.58

G.4.3 Design 2: TotalBooks (Designer 13, with patterns and layers)
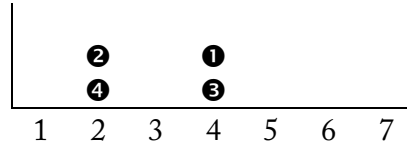
1. What is the confirmation number?

❶ 351918

❷ 351918

❸ 351918

❹ 351918

2. What is the total?

❶ $29.50

❷ $29.50

❸ $29.50

❹ $29.50

3. What did you like about this interface?

❶ (blank)

❷ Nothing

❸ I felt secure that this order was done correctly, given the amount of repetition and confirmation steps

❹ (blank)

4. What did you not like about this interface?

❶ Didn't like hearing about "featured" book (at least when I know exactly what I want, and I just want to buy it. However, it was a nice coincidence that the featured book was the exact one I wanted to buy). Didn't like hearing a bunch of options before selecting "checkout". Didn't like not being able to confirm payment/address/ship method (because it used what was in my profile). No "goodbye"

❷ The computerized voice was very difficult to understand. The voice inflection was incorrect in many places, which meant the words did not sound as they should. I could not understand much of the system and had to guess and hope I guessed right. Led to a fear of getting lost inside the system.

❸ Provided lots of detail, and seemed to repeat info excessively. Also, there was an extra "Place Order" step that I didn't think was necessary

❹ The initial prompt only allowed you to say a topic or the featured book

Repeated cart contents twice

I wanted Checkout, was 5th item in list

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?

mean = 3, median = 3, std dev = 1.15

G.4.4 Design 3: TotalBooks (Designer 15, with patterns and layers)

1. What is the confirmation number?

❶ 364386

❷ 364386

❸ 364386

❹ 364386

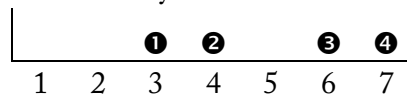2. What is the total?

❶ $17.00

❷ $17.00

❸ $17.00

❹ $17.00

3. What did you like about this interface?

❶ Quick to tell me I could say the title. Liked that it gave me the price of the book before I placed the order. Was OK that it gave info about the book, but I prefer a minimum of info (title/author/price) and if I need more info, I'll ask for it.

❷ It was fairly fast and simple to use, aside from the uncertainty concerns mentioned below.

❸ Pretty efficient, used defaults sensibly, but maybe not completely sure of where this book is being sent to (didn't confirm shipping address, just used implied defaults)

❹ really fast

4. What did you not like about this interface?

❶ Didn't ask for billing info. (implication is that it will use info on profile, but I would prefer confirmation of that). No "goodbye".

❷ There was some level of uncertainty about whether I was confirming the order vs. placing another order.

❸ Did not appear to let me interrupt. Did not explicitly tell me when we were done (just ended, so lacked closure)
Question voice prompted to say "Place Your order", but as a human, I want to say "Place My order". The voice prompt wasn't worded correctly.

❹ what if I didn't want 1-click?. Surprising
Ready to be annoyed about "here's some useful info" Assumed would be irrelevant

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?

mean = 5, median = 5, std dev = 1.83

G.4.5 Design 4: TotalMusic (Designer 15, no patterns or layers)

1. What is the confirmation number?

❶ There is no confirmation number

❷ There is no confirmation number

❸ There is no confirmation number

❹ There is no confirmation number

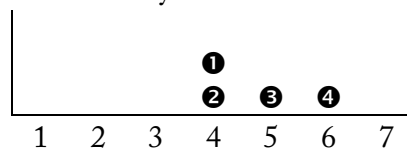2. What is the total?

❶ $17.98

❷ $17.98

❸ $17.98

❹ $17.98

3. What did you like about this interface?

❶ That it asked if I'd like it sent to "home" or "work". Speeds up interaction. Same goes for "which credit card".

❷ It was fast to use.

❸ Pretty efficient. I liked that it could simply allow me to speak an album title, rather than having to declare what "search mechanism" I wanted to use first (smart anticipation of default approach)

❹ very fast, I trusted it

   1-click

4. What did you not like about this interface?

❶ Ambiguity of how to respond to "You can do A or you can do B. Would you like to do that?" No confirmation #. No email confirmation. No "goodbye".

❷ There didn't appear to be a way to confirm that the album I purchased was the correct one, as the system never mentioned the artist.

❸ There were a couple questions where I couldn't anticipate how to interrupt to give the right voice command to make my selection. (like, "I have your standard shipping method, but for $2 extra…, do you want me to use this, yes or no?)

   Didn't provide enough confirmation to know that I bought the right album and would send it to the right "home"

   Also, I was a little surprised that it didn't tell me which credit card options I had, and just expected me to say which card I wanted to use

❹ no shipping charge and tax

   I think it repeated my cart items

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?

```
              ❶
              ❷   ❸   ❹
      1   2   3   4   5   6   7
```

mean = 4.75, median = 4.5, std dev = 0.96

G.4.6   Design 5: TotalBooks (Designer 16, with patterns and layers)

1. What is the confirmation number?
   - ❶ 767152
   - ❷ 767152
   - ❸ 767152
   - ❹ 767152

2. What is the total?
   - ❶ $34.95
   - ❷ $34.95
   - ❸ $34.95
   - ❹ $34.95

3. What did you like about this interface?
   - ❶ Liked that selection process was fast because I could select "address on file"/"credit card on file" but the specific info was read back to me for confirmation. Liked getting email confirmation.
   - ❷ It was very fast to use, while still allowing some measure of control over where the user is in the system.
   - ❸ It worked, reasonably efficiently
   - ❹ liked it the most
     Great summary of defaults

4. What did you not like about this interface?
   - ❶ Didn't like that "say title of book" wasn't given as my first option. No "goodbye" (but at least "I'll transfer you back to the main menu" basically hints that the transaction is over)
   - ❷ I didn't have any complaints about this interface.
   - ❸ I didn't appear to be able to interrupt it. Wasn't clear if it responded to "yes" as it was listing through the choices. Plus, sometimes the answer was "yes" and sometimes the answer was to repeat a key phrase (at least according to the prompting
   - ❹ did not accept a book title in the first prompt. Had to say "title", then the book title

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?
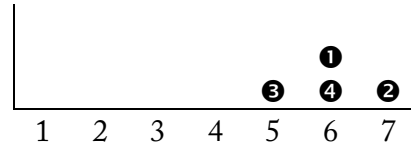
mean = 6, median = 6, std dev = 0.82

G.4.7 Design 6: TotalMusic (Designer 16, no patterns or layers)

1. What is the confirmation number?

   ❶ 415453

   ❷ 415453

   ❸ 415453

   ❹ I don't know—I hung up too soon

2. What is the total?

   ❶ $20.95

   ❷ $20.95

   ❸ $20.95

   ❹ $20.95

3. What did you like about this interface?

   ❶ (blank)

   ❷ It was easy to use and fairly efficient. I liked the fact that it always left a reference to a main menu in case I got "lost". I had more control as a user than in the previous two systems.

   ❸ OK, allowed interruption, I did like the "But it Now" option

   ❹ very fast – can answer without waiting for full list

4. What did you not like about this interface?

   ❶ Didn't like the "ad" at the beginning (prefer that it just state the name of the business then proceed). Didn't like that I had to first state whether I wanted to search by category vs album (prefer that I just say the name of the album up front). Didn't like not knowing the price of the album before ordering. Didn't like not knowing the

breakdown between album/shipping. Would have preferred a confirmation of the address/credit card on file before going ahead. No "goodbye"

❷ It was a little slow, but that was tempered by the fact that mechanisms to go back to a main menu were provided.

❸ Seemed a little inefficient, and didn't like being forced to say the artist first.

Did not confirm shipping location (just using standard profile without confirming could be dangerous)

No closure, just sends back to main menu (although that's better than saying nothing at all)

❹ it said "thank you", but it wasn't done, since it had not said the conf. # yet

Bug? Didn't ask if I wanted cd

This is the first one with real problems

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?
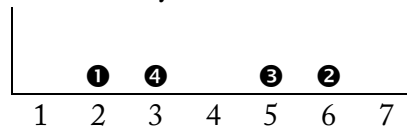
mean = 4, median = 4, std dev = 1.83

G.4.8 Design 7: TotalMusic (Designer 17, no patterns or layers)

1. What is the confirmation number?

❶ 937758

❷ 937758

❸ 937758

❹ 937758

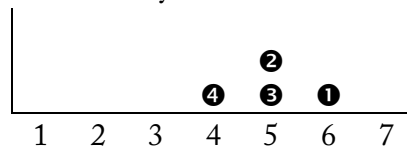2. What is the total?

❶ $20.99

❷ $20.99

❸ $20.99

❹ $20.99

3. What did you like about this interface?

❶ Summarization of order before final submit of order.

❷ It was fast and easy to use.

❸ I liked that it asked to confirm some info. Also explicitly gave me a choice on format (CD or cassette), which in real life, I might be more concerned about

❹ I trust it more than others, because of repetition

4. What did you not like about this interface?

❶ That after selecting the album, it said "you selected Gordon by Warner" where Warner is the producer, not the artist. I was expecting the artist. This interface is confusing. No "goodbye". No summing of order+shipping. Using account info on file (address/payment) and confirming it before going ahead.

❷ It didn't give me a full total, but a partial one for the cd and then another for s&h. I had to add them up separately.

❸ Did not completely let me know when the transaction was completely finished (ended on repeat or start over, but I wanted to end)
Also, did not give calculated total, had to infer it from total + shipping amounts
Asked me to confirm a number that I typed in (rather than spoke), which I find irritatingly inefficient and slow (that's why I type in numbers)

❹ during the product info, it didn't say Barenaked Ladies, it just said Warner Bros
after the product info, I heard an option for Listen, but not for order. I just said order and it happened to work.
Repeated acct #. Prefer my name
Repeated 100 main in summary, no ambiguity

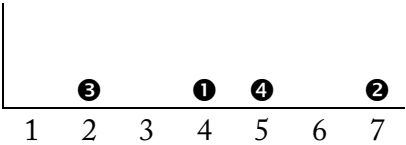5. How much did you like this interface (1 = did not like, 7 = liked a lot)?

mean = 5, median = 5, std dev = 0.82

G.4.9 Design 8: TotalBooks (Designer 17, with patterns and layers)

1. What is the confirmation number?

   ❶ 473522

   ❷ 473522

   ❸ 473522

   ❹ 473522

2. What is the total?

   ❶ $18.50

   ❷ $18.50

   ❸ $18.50

   ❹ got confused, went by too fast, forgot to write down: $15 + $1.50 + something = ~$18

3. What did you like about this interface?

   ❶ Liked that it asked for the name of book first (so I felt freer to say the name as soon as possible). Liked that it would send email confirmation. Liked that it gave info about number of days for each shipping option

   ❷ It was the fastest one to use.

   ❸ I was aware of all possible options (address, shipping method, credit card), but had to sit through a lot of vocalization to wade through it

   ❹ Very fast – didn't have to wait while it repeated what I said.
   But after acct #, should have told me my name
   shipping method "budget": I said that without listening to list and it worked.

4. What did you not like about this interface?

   ❶ Didn't like that it wanted to read through every single address. Would prefer it picked the most likely then confirm w/ me or give me the option to change it. Didn't say "goodbye".

   ❷ The confirmation number came too quickly after the prompt. I almost wasn't ready for it. Since the machine generated 'four' came quickly after the machine generated 'for', I had a momentary bit of confusion.

❸ "Too inefficient, the ordering of presenting commands didn't put the "Default" (in my opinion) first. Also, it seemed rather late in the process to hear how much it cost (sort of after I bought it, not when I was first selecting it, which is where it should be).

Also, did not appear to pause to listen before going through the whole list of choices, and I wasn't able to easily interrupt.

no closure at the end, voice prompt was ambiguous about "Place Your order" command"

❹ Told me catch22 again, after shipping info

Too fast: I said shipping address, when giving list of 5 – it didn't give me the list.

5. How much did you like this interface (1 = did not like, 7 = liked a lot)?

mean = 4.5, median = 4.5, std dev = 2.08