Different strokes for different folks: A fluid toolbelt of paper, walls, and electronic sketching

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INTRODUCTION

In our studies of web site design practice, we observed that designers employ multiple representations of web sites as they progress through the design process, including sitemaps, storyboards, and schematics. These representations allow designers to focus on different aspects of the design [4]. Designers also employ multiple tools during the course of a project, including software for graphic design, web development, presentation, and word processing, as well as plain pen and paper. Our observation of a toolbelt development process echoes findings by Sumner and Stolze [6].

These tools and artifacts are produced and consumed by a diverse group of individuals and communities. We can think about these prototypes in terms of the extent they are authored physically or electronically; as an object of reflection for the designer or as a mechanism for discussing ideas with colleagues or clients; and by individuals or by groups.

RESEARCH TOOLS: OUTPOST AND DENIM

A main focus of our research group is informal user interfaces for early stage design. In our studies into web design [4], we found that pens, whiteboards, paper, walls, and tables were the primary tools used for explaining, developing, and communicating ideas during the early phases of design. Later stage design, where detailed page mockups are generated, occurs mostly on the computer. This finding is not surprising, and is consistent with work practice studies across many design and engineering domains. As an outgrowth of this study, our research group is building two informal web design tools that we hope will match up well with current design practice: The Designers' Outpost [2] and DENIM [3].

The Designers' Outpost is a tangible user interface that combines the affordances of paper and a large physical workspace with the advantages of electronic media to support collaborative information design for the web (see Figure 1). It is implemented by extending a rear projection SMART Board with a computer vision system that tracks and captures paper artifacts on the board.

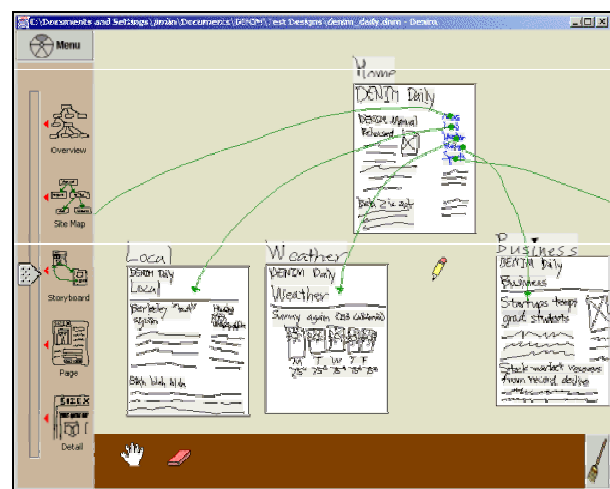**Figure 1.** The Designers' Outpost, tangible web site design.

Figure 2. DENIM, a sketch-based web design tool.

In one common early-phase practice, designers collect ideas about what should be in a web site onto Post-it notes, and arrange them on the wall into categories. This technique, often called affinity diagramming, is a form of collaborative sketching used to determine the site structure.

The large workspace offers several clear benefits for the task. In contrast with the heavyweight, formal operations of the computer, it is relatively easy to fill a wall with pieces of paper and move them around to suggest different associations. It also permits the representation of large, complex information spaces without the loss of contextual, peripheral information. Collaboration is aided both by the persistence of the artifact, which supports asynchronous collaboration and constant awareness of the state of the project, as well as by the greater-than-human-sized space allowing multiple people to simultaneously view, discuss, and modify the artifact.

While Outpost is aimed at collaborative creation of sitemaps, DENIM is a sketch-based web site design tool aimed at the early stages of information, navigation, and interaction design (Figure 2). DENIM allows designers to quickly sketch web pages, create links among them, and interact with them in a run mode. The different ways of viewing a web site, from site map to storyboard to individual pages, are integrated through the use of zooming.

OUTPOST DESIGN STUDY

After building an early software prototype of Outpost, we conducted a design study to get feedback from web designers on the prototype, and the directions the system could head in. We ran five design sessions with between two and five designers per session, for a total of fifteen participants. In four of the design sessions, the designers were colleagues at the same company; the fifth session mixed designers from two companies. Two of the five groups were composed of information architects, two groups were visual designers, and one group had individuals performing both roles. Each session lasted roughly two hours. We began the sessions with a high-level overview of the project and a brief demo of the existing prototype. We gave the designers a mock information architecture design task to work out with their team using the prototype. Our findings from this participatory design study offer insight into the designers' collaborative work process and suggest an appropriate interactivity model.

Every participant currently works with groups on whiteboards early in the site design process. The information architects all said they currently create sitemaps by placing Post-it notes on the board, while the visual designers talked about sketching page designs directly on the board. Whiteboard meeting capture was highly valued by all five teams.

We observed the groups going through three general phases of design when using the interactive prototype. In the first phase, brainstorming, the goal of is to quickly put a large number of concepts on the board. Clients, marketing representatives, and engineers often attend key brainstorming meetings. The designers were adamant about not wanting any system feedback during this phase. "We didn't do anything here that we couldn't do on a normal whiteboard." One team actually turned off the board.

In second phase, designers created a top-level information architecture, migrating from a loose federation of notes on the board to a high level information architecture by clustering related information into groups, pruning unnecessary concepts, and linking notes together. The tool support in the interactive prototype was well suited to this phase.

In the third phase, designers annotated the artifact with freeform ink, and began drilling down, dealing with page level issues for key areas. The key design implication from this phase is the ability to associate freeform ink with individual notes. The visual designers wanted to sketch the design details, and the information architects wanted to add annotations or properties. For example, one information architect said, "I'd like to be able to attach design rationale."

AN INFORMAL TOOLBELT

Our findings in these studies indicate the need for a more seamless integration of authoring tools. In our current research efforts, we are attempting to integrate DENIM with Outpost. The main advantages that we see to this integration are: 1) Remote participants will be able to participate in design meetings, whether they are a group working with Outpost at another SMART Board, or a manager or client working on a laptop and using DENIM as a view to the board. 2) The artifact can remain fresh. By having one model of the information architecture, the wall-scale Outpost view can automatically remain fresh as designers flesh out the site in DENIM. 3) Awareness is improved. We envision that the board can include visual awareness clues as to when designers are working on a site, and what part of the site they are working on. 4) Audio capture is essential. Our study found that in early-phase design, there is a lot of verbal activity that never becomes realized in a physical artifact. Inspired by the work on meeting audio capture systems, we believe that audio capture, indexed by actions on the board (such as adding moving, or gesturing at a note) can provide value for designers as they flesh out the site. They hopefully will be better able to include the insights of all design attendees in their work, and better understand why decisions were made.

In order to facilitate interoperation, we have re-built Outpost on top of SATIN [1], a framework for designing informal applications that DENIM is built on top of. Our research efforts in this direction have shown that SATIN matches up very well, but that some extensions to the framework were necessary. For example, our vision system captures images of physical artifacts. While Outpost is very image-centric, the original intent of SATIN was ink centric applications. We are beginning to look at both internal software representations and end user interaction techniques that allow images and ink to interoperate more fluidly. One direction that we believe will be promising is to adopt a multi-valent documents approach [5].

CONCLUSION

Through our design studies and system building, we have begun to understand the need for better web design tools, particularly at the early stages. We have made DENIM available to the design and research communities at http://guir.berkeley.edu/denim, and it has had over 1000 downloads to date. Our group is currently pursuing a more robust prototype of the Designers' Outpost, and we plan to evaluate both of the tools in a design firm over an extended period of time to better get a sense of how design tools change practice.

AUTHORS BIOS

Scott Klemmer is a doctoral student in computer science at the University of California, Berkeley, specializing in human-computer interaction. He has a dual undergraduate degree from Brown University, completing programs in Computer Science and Art-Semiotics at Brown and the Rhode Island School of Design. As an undergraduate, he created applications to teach computer graphics concepts to art and computer science undergraduates. At Berkeley he has worked on tangible interfaces, speech interface design tools, handheld educational technology, and a location-aware computing infrastructure.

James Landay is an Assistant Professor of Computer Science at the University of California, Berkeley. He is also the CTO and co-founder of NetRaker, a leader in the web experience evaluation business. He received his B.S. in electrical engineering and computer science from Berkeley in 1990 and his M.S. and Ph.D. from Carnegie Mellon University in 1993 and 1996 respectively. His Ph.D. dissertation was the first to demonstrate the use of sketching in user interface design tools. He has published extensively in the area of user interfaces, including articles on user interface design tools, gesture recognition, pen-based user interfaces, mobile computing, and visual languages.

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