WOZ Pro: A Pen-Based Low Fidelity Prototyping Environment to Support Wizard of Oz Studies

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Abstract

Because they are easy to create and modify, low fidelity prototypes are commonly used in early evaluations of user interface designs. Designers typically use either pen-and-paper or various computer-based tools to create and test low fidelity prototypes; however, our informal analyses of these existing technologies indicate that they do not optimally support the two key, complementary tasks of (a) prototype creation and (b) wizard of oz testing. To address this problem, we have been developing WOZ Pro (Wizard of Oz Prototyper), a pen-based software environment for the quick and easy creation and testing of low fidelity user interface prototypes. We are designing WOZ Pro to be as easy to use as pen-and-paper, but to hold key advantages over pen-and-paper and existing computer-based tools. When designing interface screens in WOZ Pro, designers can easily (a) propagate a design change to other related screens, and (b) specify the set of screens that are reachable from a given screen. In a wizard of oz test, WOZ Pro reduces the cognitive load on the wizard by allowing navigation only to those next screens that are valid. We are planning a controlled experiment to compare WOZ Pro against paper-and-pencil and Powerpoint® along several measures in a set of prototype creation and evaluation tasks.

Keywords
Low fidelity prototypes, wizard of oz studies, pen-based software, user-centered design, usability testing

ACM Classification Keywords
H.5.2. User Interfaces—Prototyping, User-centered design; D.2.2 Design tools and techniques—User interfaces.

Introduction

Central to the user-centered design process is the iterative design and evaluation of user interface prototypes. Such prototypes are typically created at various levels of *fidelity*, which refers to how well the prototype reflects the functionality, completeness, and polish of the final product. Because they are easy and cheap to create and modify, *low fidelity* prototypes can help designers to obtain invaluable design feedback on early user interface designs. In fact, empirical research has shown that low fidelity prototypes can uncover just as many usability problems as high fidelity prototypes [9, 10]—a result that suggests their potential value in the later stages of user interface development as well.

User interface designers typically construct low fidelity prototypes using one of three technologies:

- *simple art supplies* (e.g., pen, paper, and scissors);
- *general-purpose graphics and presentation software* not specifically designed for low fidelity prototyping (e.g., PowerPoint® [5], Photoshop® [1], SMART® Notebook [7]); and
- *custom software* specifically designed for low fidelity prototype creation (e.g., SILK [3], DENIM [4], and PatchWork [8]).

In our own experiences with developing low fidelity prototypes with these existing technologies, we have observed that none of them appears to be optimized for the key, complementary activities of (a) rapidly creating a user interface prototype, and (b) running wizard of oz tests in which a human "wizard" simulates the user interface prototype as test users interact with it. With respect to these existing technologies, two problems in particular stand out:

1. *Design change propagation is cumbersome*. When iteratively designing low fidelity screen sketches, designers often need to go back and make design changes that impact multiple screens. With art supplies, this requires the designer either to erase and redraw elements on multiple screens, or to recreate the screens altogether. With general-purpose graphics and presentation software like PowerPoint®, designers can avoid some of this repetitive work by exploiting the *master slide* feature. However, in order to take advantage of it, designers need to be aware of the *master slide* feature from the start. Moreover, in our experience, the master slide feature does not make it easy to quickly apply design changes to only a subset of the screens that compose a prototype.

2. *Running wizard of oz studies incurs a potentially high cognitive load.* When developing a new user interface, designers typically run wizard of oz studies on prototypes with dozens, and sometimes hundreds, of screens. In order to be responsive to a test user's actions, human wizards not only have to have a solid understanding of the user interface they are simulating; they must also have a good organizational scheme, so that they can quickly navigate to the correct screen in response to the test user's actions. Tools like SILK [3]

and DENIM [4] aim to shift this burden from the human wizard to the computer by allowing test users to interact directly with low fidelity prototypes; in so doing, they do not technically support wizard of oz studies. In contrast, art supplies, along with tools like PowerPoint® and SMART® Notebook, do not support features specifically geared toward assisting human wizards in navigating from screen to screen. This places on human wizards a potentially high cognitive load, which can be eased only through the use of *ad hoc* screen labeling or hyperlinking schemes.

Within the context of our development of a new studio-based curriculum for an undergraduate course on human-computer interaction design [2], we are addressing the problems cited above through the development of a computer-based wizard of oz prototyping tool. While specifically targeted at college students who are first learning about interaction design, the pen-based software environment we are developing, WOZ Pro (Wizard of Oz Prototyper), would appear to be suitable for any interaction designer who engages in the common tasks of (a) iteratively designing low fidelity user interface prototypes and then (b) subjecting them to wizard of oz testing. In the remainder of this paper, we describe the early design studies on which WOZ Pro is based, present the WOZ Pro interface through an example usage scenario, and finally describe our plans for an experimental evaluation of tool in the spring of 2007.

Early Design Studies

Since the summer of 2006, we have been developing the WOZ Pro tool through an iterative, user-centered design process (see, e.g., [6]). After reviewing existing tools and reflecting on our own experiences with low fidelity prototyping, we created a low fidelity prototype of a preliminary design using the SMART® Notebook whiteboarding software [7] developed for the SMARTBoard® electronic whiteboard. Using a SMARTBoard®, we then iterated through two rounds of wizard of oz testing, each involving 3 participants. In these tests, participants were tasked with (a) designing a low fidelity prototype of a website according to specifications we provided, and then (b) running a wizard of oz study on the prototype.

Running wizard of oz studies in which participants themselves ran wizard of oz studies posed two notable challenges. First, participants were initially confused about which tool to use to develop and test their prototypes—SMART® Notebook, or our low fidelity prototype developed in SMART® Notebook. To resolve this issue, we resorted to draping a towel over all interface of components of the SMART® Notebook software, leaving in view only the screens that composed our prototype. Second, when it came time for participants to run a wizard of oz study on their prototypes, they initially became confused about their role as wizard—a role that we (as the researchers) had been playing for the first part of the study. We therefore had to take care, in our instructions, to explain that their job in the second part of the study was to run a study on their prototype with us (the researchers) as test users. Once we refined our explanation of this, participants caught on quickly.

WOZ Pro Interface

After two design iterations of our low fidelity prototype, we converged upon a stable design, which we implemented as a high fidelity prototype. Developed for the Tablet PC® using the Microsoft .NET® 2.0

framework and the Tablet PC® SDK, our high fidelity prototype of WOZ Pro contains three main modes that are clearly denoted by the tabs at the bottom of the interface (see Fig. 1a):

1. *Design Mode* allows the user to create and edit individual interface screens by (a) sketching with the pen, and (b) inserting image files as interface elements. To support the rapid creation and modification of screens, WOZ Pro contains a novel "propagate last change" feature, which allows the user to apply the last change (or arbitrarily long sequence of changes) to a selected subset of screens (see Fig. 1b).

2. *Edit Screen Transitions Mode* allows the user to edit a state-transition network (STN) of their screen sketches, which specifies the set of screens that are reachable from each screen.

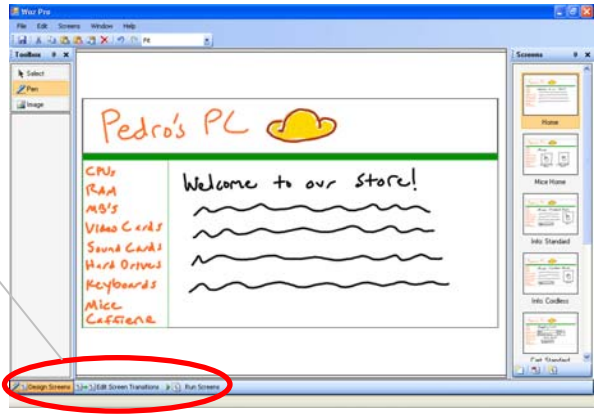
3. *Run Mode* allows the user to run a wizard of oz study by presenting screen sketches to a test user, and navigating screen sketches in response to the test user's actions. Unlike presentation tools like PowerPoint®, WOZ Pro constrains the choice of next possible screens to only those that are valid according to the STN defined by the user.

To illustrate how the WOZ Pro interface supports the iterative design and testing of low fidelity prototypes, we now walk through an example usage scenario in which we design and test a prototype website for Pedro's PC—a fictional online store that sells computer hardware. The first step is to sketch out the eight screens of the website. Since all of the screens have a similar appearance, we can make judicious use of the "clone screen" feature; we create each subsequent screen by modifying a clone of the previous screen. Suppose that, after creating all eight screens, we realize that we have made a mistake: Pedro's PC does not sell CPUs, so we need to remove that item from the navigation bar on the left. Rather than having to remove that element from all eight screens, we can instead remove it from any one of the screens, and then choose "Propagate last change(s)…" from the "Edit" menu. This brings up a list of the last changes we have made, along with a list of screens to which we can apply the change (see Fig. 1b). We choose the most recent change—a deletion action—and select all screens as the target of the change. After clicking on "OK," WOZ Pro automatically applies the change to all of the screens, saving us the work of deleting the "CPUs" element from each individual screen.

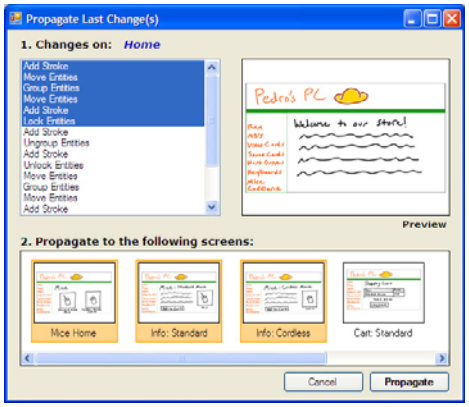
We are now in a position to define the transitions between screens. We first switch to "Edit Screen Transitions" mode by clicking on the corresponding tab (see encircled area of Fig. 1a). We are presented with a state transition network of our prototype; by default, screen transitions (represented as lines) are defined between each pair of screens that were created in sequence. However, in our Pedro's PC website, navigation is more complex. To bring the STN into accordance with the Pedro's PC website, we first select and delete invalid transitions. Choosing the "transition" tool, we then drag out transitions between appropriate screens, yielding the STN shown in Fig. 1c.

In the final step, we run a wizard of oz test on our prototype. Clicking on the "Run Screens" tab (see encircled area of Fig. 1a), we enter a mode similar to "presentation" mode in PowerPoint®. The key difference is that the set of next possible screens from any given screen is constrained, reflecting the

Tabs at bottom of interface allow user to switch between three modes: *Design Screens*, *Edit Screens*, and *Run Screens*

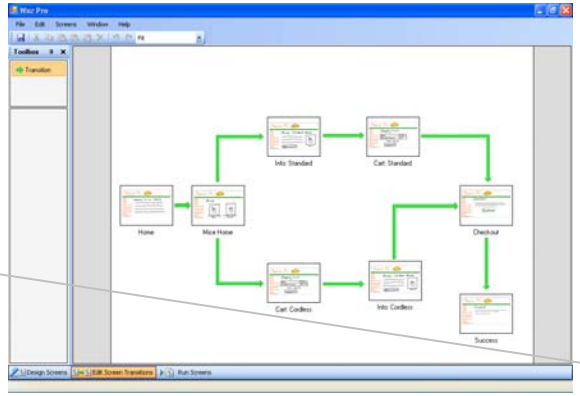


(a) WOZ Pro interface

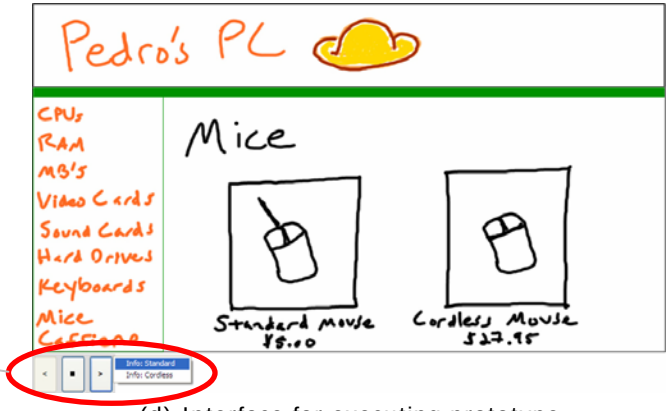


(b) Interface for propagating last change(s)

Pop-up menu constrains possibilities to only valid next screens, thus reducing cognitive load on human wizard



(c) Interface for defining state transition network



(d) Interface for executing prototype

Figure 1. Screen Shots of the WOZ Pro Interface

transitions we defined in the previous step. In particular, navigating to a screen in response to a test user's actions merely requires us to click on the navigation menu in the lower-left portion of the screen, and then to select the next screen from a constrained list of choices (see encircled area of Fig. 1f). Thus, in contrast to art supplies and other computer-based tools, a human wizard using WOZ Pro does not have to struggle to remember, and then navigate to, valid choices; instead, the navigation menu in WOZ Pro contains only those screens that can be reached from a given screen, easing the cognitive load on the wizard.

Status and Future Work

After two recent rounds of usability testing, our WOZ Pro high-fidelity prototype is now ready for more formal studies to determine its effectiveness in supporting the construction and testing of low-fidelity prototypes. Two research questions are of particular interest:

1. Will WOZ Pro support faster and more accurate prototype construction, and faster and more accurate prototype execution in a wizard of oz study, as compared to art supplies and existing computer-based tools?
2. Will WOZ Pro support richer design dialog and increased detection of usability problems, as compared to art supplies and existing computer-based tools?

To address these questions, we will conduct an experimental study within the context of the spring, 2007 offering of Human-Computer Interaction at Washington State University. Our study will adopt a within-subjects design with three treatments corresponding to three low fidelity prototyping tools: 1) art supplies; 2) PowerPoint®; and 3) WOZ Pro. Participants will implement and test low fidelity prototypes for three isomorphic website designs, each of which will be seeded with an equivalent set of usability problems.

To compare the effectiveness of the three prototyping tools, our study will adopt the following dependent measures: (1) time to construct prototype; (2) accuracy of constructed prototype; (3) average delay between screen transitions in wizard of oz study; (4) average number of screen transition errors; (5) number of test user design feedback episodes; and (6) number of usability problems identified by designer. We look forward to reporting our results in future publications.

Acknowledgements

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