HCI in Practice: Teaching Students to Prepare Interactive Mockups of a User Interface for Ticket Vending Machines

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Abstract:
This paper is a case study of teaching the usability of interfaces. The students of the computer science learn how to design a prototype of an interface for ticket vending machines. Paper prototyping is used as a tool to prepare a mockup prototype. The prototype is tested according to several scenarios of usage. Finally, working interactive digital prototypes are built using dedicated software and hardware tools. Students work in teams in all stages of these projects. As a result, the computer science students develop practical skills in general designing of interfaces, teamwork, and creative use of analog techniques for fast development of interactive front panels.

Keywords-component; usability of interfaces; paper mockups; prototyping

I. INTRODUCTION

Human-computer interaction is based on appropriately designed interfaces. Planning of such an interaction aims at effective operation and control of an application or a device, and it requires knowledge on information technology, design, and other sciences. Usability of an interface describes the ease of use of the application or the device controlled by this interface; well-designed interface facilitates the use of the application. Therefore, computer science students should be aware how important the usability of interfaces is, and learn how to prepare good interfaces, especially when they are to be used by general public.

This paper describes the process of training of computer science students how to prepare interfaces of high usability. This is a two-stage process. First, students prepare paper mockup interfaces, and test them [1]. This can be done relatively fast. Two scenarios are given to students as case studies, and students are also requested to invent their own scenarios and test them. Afterwards, interactive working prototypes are created on the basis of the paper mockups [2], [3].

The task students are required to do is to prepare an interface for ticket vending machines. Students are informed that the main goal is to develop the skill of designing and improving interfaces. Tests of the usability of the designed interfaces show problems that may arise in practical use of the interface. Finally, digital graphical user interfaces are built on the basis of the paper prototypes.

A. Paper Prototyping

Paper prototypes are fast and easy way of designing and testing user interfaces. The prototypes combine hand-drawn buttons and elements cut-out of a sheet of white or colored paper, see Figure 1. In the testing phase, realistic tasks are performed with the paper version of the interface, manipulated by a person (the
designer in our case) “playing computer”. The tester uses his or her finger as a mouse, and the designer updates the “screen” with sticky notes etc., to reflect the choices that have been made.

![Figure 1. Designing of the paper mockup interface; a lesson for Polish students](image)

**B. Graphical User Interface Based on the Paper Prototype**

When the paper prototype of the interface is ready, tested, and possibly corrected, then the software version of the interface can be built. There exist tools for building graphical user interfaces based on paper mockups and other input [3], [4]. In the simplest version, only the graphical version without interaction is build, but many tools allow adding interactive features to the graphical user interface.

**II. PREPARING PAPER PROTOTYPES OF INTERFACES FOR TICKET VENDING MACHINES**

The computer science students of the Polish-Japanese Institute of Information Technology in Warsaw, Poland, learn how to prepare a user interface during the second year of their studies. They are instructed to design a front panel of a ticket vending machine for a fictional city. Paper, scissors, glue and other similar supplies are provided for preparing paper mockups during these lessons. Students work in groups of 3-4 persons.

This task significantly differs from other tasks the students are usually given in laboratories, because they have to use paper instead of programming techniques. They are often surprised, but then they quickly get involved into designing, and prepare sophisticated interfaces for the vending machines, discussing very lively how to find the best solution for the task. Students enjoy freedom of solutions chosen, without being restricted to the use of any particular programming tool and its limitations.

The front panel for the ticket vending machine must have the screen (or touch screen), slots for inserting coins, banknotes, credit cards, and travel cards, slots for the change and for issuing tickets. The vending machine should allow the following functionalities:

- Buying tickets (prices shown in dollars here):
  - Single ride ticket: regular fare 1.50 dollars, reduced fare 75 cents,
  - 20-minute unlimited travel ticket: regular fare 1 dollar, reduced fare 50 cents,
  - 60-minute unlimited travel ticket: regular fare 2 dollars, reduced fare 1 dollar,
  - One-day unlimited travel ticket: regular fare 4 dollars, reduced fare 2 dollars,
• Seven-day unlimited travel ticket: regular fare 8 dollars, reduced fare 4 dollars,

☐ Add money to the city travel card:
  • 30-day unlimited city travel card: regular fare 60 dollars, reduced fare 30 dollars,
  • 90-day unlimited city travel card: regular fare 120 dollars, reduced fare 60 dollars,

☐ Pay with:
  • Cash,
  • Credit card,

☐ PIN code authorization,

☐ Print the receipt,

☐ View the bus/tram timetable (the only implemented functionality here is the line number selection):
  • Three bus lines (no. 3, 10, 20) and four tram lines (no. 4, 6, 8, 12),

☐ Change the working language; English, Polish, German, and Russian should be available:
  • The selection screen should be implemented, but all other screens are prepared in one language only, English or Polish,

☐ Access help (implemented as a single screen “This is help”, without details).

Since the students prepare just the paper mockup of the interface, the “screens”, “tickets”, “receipts”, and “buttons” can be only roughly sketched. However, we observed that many students enjoy preparing realistic-looking elements. Students place the parts of the front panel of the machine in any layout they deem appropriate, and even without being explicitly instructed they take various potential user needs (also of handicapped persons) into account, including such elements as loudspeakers and push-buttons for blind.

We are glad to report that students have so much fun when doing this project that we have to stop their work because of time constraints. This task also promotes team work, and helps developing social skills, which computer science students may lack.

III. TESTING OF THE PAPER PROTOTYPES

When the papers prototypes of the interface for the ticket vending machines are ready, the prototypes are tested immediately according to two scenarios. A tester is not familiar with the interface, as one student from each team of 3-4 people is selected to test the interface prepared by another team. The tester uses his or her finger to press “buttons”, see Figure 2, and the authors of the tested interface “play computer”. Testing scenarios include buying various tickets, payment in cash or credit card, and checking timetables, in various orders of the required operations, to check if the interface is well designed for possible user needs.
One of the testing scenarios is listed below:

1. Buy one 20-minute ticket, reduced fare,
2. Check the timetable for tram no. 4,
3. Buy 4 single ride tickets, regular fare,
4. Pay in cash,
5. Get receipt and tickets.

During tests the designers can see when the user hesitates what to do, what should be added or improved in the interface, and can assess the usability, in terms of the time the user completes the task. Testing reveals all design errors, especially missed options (missing “back”/”home” button is a common error). Also, comments on the interface are very useful, and they can be taken into account. Therefore, the errors in the design of the interface can be corrected on the fly.

Other scenarios of usage are also tested, and students are requested to propose and test their own scenarios.

IV. PREPARING DIGITAL VERSION OF THE PROTOTYPES

Although paper mockups seem to be sufficient to teach students preparing interfaces, digital versions of the paper mockups can also be created. There exist various tools to create digital graphical interfaces, including online tools, e.g. Balsamiq Mockups1, gliffy2, UXPin3, and desktop applications, like Indigo Studio4 or Prototyper5 (available for downloading from the Internet). In our case, Balsamiq Mockups software is used for this purpose. The simplest version allows creating an interface without interaction, but producing the interactive prototype of the interface is also possible.

We would like to underline here that the most important skill the students learn is to design an interface of high usability, and preparing the digital version of the prototype is an additional skill only. However, since the classes are addressed to computer science students, preparing a digital working prototype of the interface completes their knowledge on this subject.
V. FURTHER WORKS

Human-computer interaction is of high interest to the faculty members of our Institute, and works on interfaces are continued; also, conferences on user interaction are organized. Works include investigations of the role of color in interfaces [5], preparing hardware and software tools to prepare digital interfaces on the basis of mockups [3], and preparing mobile versions of the interfaces; this work is in progress now. Various tools and devices are used in these works. For example, one of the tools prepared in our Institute uses a webcam to acquire input data for the software designed to create digital graphical interfaces on the basis of mockups [3], see Figure 3. The webcam is placed under a glass tabletop, to acquire markers printed at the bottom side of the elements of the interface. The resulting digital interface is shown in Figure 4. The acquired data are written in XML format, in order to upload these data to Balsamiq Mockups, and then the obtained interface can be used in further works. This project can be used in teaching our students, as it puts emphasis on team work, which is especially valuable and important skill in the case of computer science students.

1 http://www.balsamiq.com/
2 http://www.gliffy.com/
3 http://uxpin.com/
4 http://www.infragistics.com/products/indigo-studio
5 http://www.justinmind.com/
6 http://midi.pjwstk.edu.pl/
VI. SUMMARY AND CONCLUSIONS

Paper prototyping is not a new way of designing user interfaces, but paper mockups are fast to make, and allow focusing on the crux of the matter, since programming details can be skipped in the initial stage. Also, hardware elements of the interface can be easily planned this way. Additional value of this method, very precious in the case of teaching, is the involvement of students into this task, and their joy in designing interfaces of high usability. Also, teamwork motivates students to fruitful discussions, sometimes very heated ones. Therefore, on the basis of our experience, we recommend using paper prototyping as a basic tool to teach prototyping, and later completing this process with the preparation of the working digital version of the user interface.

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REFERENCES


