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Paper Prototyping as a Rapid Participatory Design Technique

Aznoora Osman
Faculty of Computer Science and Mathematics, Universiti Teknologi MARA Perlis
02600 Arau, Malaysia
Tel: 60-4-988-2811 E-mail: aznoora@gmail.com

Hanif Baharin
Faculty of Computer Science and Mathematics
Universiti Teknologi MARA Perlis, 02600 Arau, Malaysia
E-mail: ahmadhanif@perlis.uitm.edu.my

Mohammad Hafiz Ismail
Faculty of Computer Science and Mathematics
Universiti Teknologi MARA Perlis, 02600 Arau, Malaysia
Tel: 60-4-988-2811 E-mail: mohammadhafiz@perlis.uitm.edu.my

Kamaruzaman Jusoff (Corresponding author)
Faculty of Forestry, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia
Tel: 60-3-8946-7176 E-mail: kamaruz@aeroscan.com.my

Abstract
This paper describes participatory activities with university lecturers to design an online community. The objective of this study is to engage the users of an online community to collaboratively design their online community. We speculated that by involving them in the design team, we can identify their specific requirements, and they will accept and use the system. However, lecturers have heavy workload and tight schedule. For that reason, we thought that paper prototyping is the most suitable tool to be used because it is fast and easy to create. Therefore, paper prototyping technique has been adapted in a two-day participatory design session. We found that paper prototyping is indeed the most suitable technique to elicit requirements from the end users under a time constraint. Moreover, participants came out with unexpected requirements and novel interface.
Keywords: Participatory design, Paper prototyping, Requirements elicitation, User centered design

1. Introduction

University lecturers need to communicate with each other in their very own online community. Online community comprises of many standardized features such as forums, announcement, advertisement column and poll. However, for a group of lecturers, they need specific features that might not be needed by other user groups. Thus, online community for lecturers should be designed to fulfill their requirements. They must participate in the design process because it is possible to get a deep knowledge of their work context and needs (Dix, Finlay, Abowd & Beale, 2004, p.198). This can be achieved through a participatory design session. Nevertheless, the lecturers are busy with their teaching schedule. So, there should be a method to gather them and engage them within a short time frame. That is why we chose paper prototyping technique in the participatory design session because it is cheaper, faster and easier to elicit feedback from the users (Snyder, 2003).

1.1 Participatory design

Participatory design allows end users to become part of a design team as well as to test the usability of a system. Therefore, when they are actively involved in the design process, the system requirements and system design can be

refined iteratively. In this session, the end users will sit together with the developers and designers to discuss their requirements. Dix et al. (2004, p.466) stated that participatory design aims to improve the work environment and task by the introduction of the design. It also enforces collaboration between the end users and the developers. The approach is iterative in which the design is subject to evaluation and revision until an optimal design has been produced. There are many methods to conduct participatory design session such as brainstorming, storyboarding and paper prototyping. Butler & Fitzgerald (1997) discussed that participatory design activities have indeed contributed to the development of systems that adequately captured user requirements and hence satisfied user informational needs. A study conducted by Denef, Ramirez, Dyrks, Schwartz and Al-Akkad (2008) on the other hand shown that participatory design can be used to evaluate multimodal application by inviting participants to join participatory design workshops.

1.2 Paper prototyping

Paper prototyping is a method to brainstorm, design, create, test and communicate user interfaces (Snyder, 2003). It uses only papers, pencils, sticky notes, scissors and highlighters to create a mock-up of the system design. This technique requires less budget and time to develop as compared to computer prototyping. Since it is easy and fast to create, developers are more willing to accept changes to the design because there has been no effort in writing the program code yet. Paper prototyping technique can be employed to design the interface of any software, websites and devices. A study conducted by Bailey et al. (2008) revealed that paper prototyping can be used to develop effective interfaces for Multi Display Environment (MDEs). However, they claimed that designers must employ methods that allow them to rapidly generate and test alternative designs early in the design process. The technique also needs to be adapted to effectively simulate the use of multiple displays and allow testing with groups of users. In another context, paper prototyping has successfully helped in structuring the feature of the interface for children's collaborative handheld application (Black et. al, 2004).

1.3 Usability testing

Usability testing is a process of evaluating the degree to which a product or system meets specific usability criteria. The evaluation should be made by the participants who are representative of the target population (Rubin, 1994). In usability testing, the participants work on typical tasks using the system (or the prototype), and the evaluators use the results to see how the user interface supports the users to do their tasks (Zaphris & Kurniawan, 2007). A study on conducting usability testing of a website using paper prototyping technique has proven that it required low cost and time, generated critical feedback from the users and lead to improved usability (Grady, 2000). Sousa & Furtado (2005) discussed user participation throughout requirements elicitation, requirements validation and prototyping process of an interactive application. The process contributes to user satisfaction and the design of usable prototypes. Participatory design has also been used successfully to design and evaluate mobile phones as described by Massimi (2007). In order to conduct a usability test using paper prototype, the team members need to take a role-play for four different roles. The first role is the user. The person who takes this role must know the needs of the real users. The user will interact with the prototype to accomplish a set of tasks. Another person becomes the "Computer" who will simulate the system behavior. A team member with more experience in usability should become the facilitator to conduct the session. The rest of the team should become note-taking observers (Snyder, 2003).

The objective of this study is to engage users in a participatory design session to design an online community using paper prototyping technique. The study is carried out to elicit requirements from the end users by inviting them to be part of the design team. By involving the end users in the design process, the end-product will be accepted and used.

2. Methodology

Four participatory design sessions were conducted in two days. Eight participants were selected among Computer Science lecturers. They were divided into two groups whereby the researchers acted as the facilitator for each group. In each group, a participant became the user, another participant became the "Computer" and the other two participants became the observers. Table 1 summarizes the participatory design sessions.

2.1 Session 1

Participants were briefed about the overall objectives of the sessions and the goals to be accomplished at the end of the first day. Then they were introduced to the paper prototyping technique. Five aspects were emphasized during the introductory briefing:

The history of paper prototyping – The participants were brief about the history of paper prototyping to show them the importance and the relevance of the prototyping technique in the industry and how it relates to participatory design. The participants were also reminded that they were a part of the design team, and not merely end-users that answer questions and give feedbacks.

The workshop is a hands-on process - The participants were told that they were learning paper prototyping techniques as they develop their first paper prototype, and the researches acts as facilitators to guide them through the process.

There is no right or wrong way to develop a paper prototype and the participants were free to explore their creative side with the guidance from the facilitators.

Roles in the workshop – The two groups worked separately in developing the prototypes, which mean that at the end of the sessions, two different prototypes were made. All the members in each group collaboratively developed the prototypes. But in doing the usability test, each team members was assigned a role, either as Computer, Observer or Facilitator. Two members from a group acted as the users for the other group and vice versa.

Materials used in paper prototyping and paper prototypes sample – The participants were briefed about the stationeries and materials used to develop paper prototypes. This was followed by showing the participants samples of paper prototypes. By examining the samples the participants quickly learned how to manipulate the materials to create interface widgets such as drop-down menu, radio buttons, or how to make windows and internet browsers.

The benefits of paper prototyping techniques - The benefits and the positive aspects of paper prototyping were highlighted throughout the briefing, to convince skeptics and to encourage the participants to give their full commitments.

In the session, participants were reminded that they were part of the design team, and not merely end-users that answer questions and give feedback. The task design is an adaptation of Snyder's. In the first step, the concept of user goals was explained to the participants. They were told that they were the users and that they were developing an online community for Computer Science lecturers. Thus, as the users, they know their specific needs. They were asked to think about the things that they do frequently and the things that were important. Next, they were asked to list a set of questions regarding the functionality, navigation and terminologies to be used in the prototype. In the last step, the participants wrote their tasks in the template provided. They were shown several examples of tasks. The facilitators were involved with the participants in the task design process. All user goals and questions came from the participants and they worked hand-in-hand with the facilitator to translate the user goals and questions into tasks. The facilitators made sure that the instruction for the tasks did not reveal the way to navigate the website. Session 1 took about four hours with half an hour break between introductory briefing and task design.

2.2 Session 2

Once the tasks have been designed and written in the task sheets, the groups started developing the prototype with the assistance of the facilitators. This is the moment where they could explore their creative side to design an online community. Before ending the session, a walkthrough was done. Walkthrough is like a rehearsal of usability test, in which any problems of the prototype can be detected and corrections can be made. During the walkthrough, the facilitators acted as the user in a usability test. As a result, several mistakes were found in the prototype such as incomplete interface and missing links. Corrections were made and the participants practiced and get ready for the usability test on the second day. The session wrapped up in two hours.

2.3 Session 3

This session took three hours to complete. Two members from each group acted as users for the other group in a usability test. The facilitators observed the participants and helped them to identify usability issues encountered during the test. The results of the usability test are discussed in the results and discussion section. After the usability test, the participants rejoined their group and made refinement to their prototypes according to the findings of the usability test.

2.4 Session 4

Once the participants finished refining the prototypes, a second walkthrough was done. The aim was to document the prototype navigation. One of the team members read the instruction from the task sheet and another member used the prototype to complete the task. Using a video camera, the facilitator recorded the walkthrough session, focusing on the prototype interface. The video recording will be an important reference for the researchers in using the prototype for the next iteration of the design process.

3. Results and discussion

The participatory design session and usability test were able to elicit user requirements that are unique for a group of lecturers. It has helped in determining the best navigation technique for the online community as well as proper terminologies to be used. Nevertheless, it was observed that doing participatory design with busy people has its weaknesses as well.

3.1 Requirements elicitation

The most significant outcome was when a participant revealed unexpected requirements, which was equipment booking. The equipment that can be booked are printers, digital cameras and laptops. The idea came from the head of the Computer Science department who has been handling the equipment booking process manually when any lecturers come to her office. The process takes away some of her precious administrative time since she has to record every item that has been booked, taken and returned. The record will keep track of the availability of equipment. So, by having equipment booking facility in the online community, she hopes that it will ease her burden and that she can use her time for more productive tasks.

Furthermore, a participant suggested having a function to update research information. At the moment, research information can be updated in the departmental website. However, it is done solely by the webmaster. So, whenever a

lecturer wants to update or add research information, he or she has to submit it to the webmaster. This is a waste of time for both parties. Therefore, the participant wishes that the online community will provide a channel for every lecturer of the department to update research information instantly. The necessary information includes research title, team leader, team member, grant awarded and its amount, duration of research and research synopsis.

There were few other requirements disclosed by the participants. The first group suggested a function for files uploading and downloading. They believed that it is important to share any type of files among the lecturers. Another function was links to useful websites. They were mainly links to electronic journals, electronic library, electronic newspapers and university websites. Besides that, the second group suggested a function to post advertisement and announcement.

3.2 Novel interface

The participants came out with a novel interface for the equipment booking function. They suggested creating the booking form in a table where information of a particular item can be viewed in a single row. The information includes availability, the person who is currently using it and the date it will become available. Hence, by looking at the table, the user will not only know the availability of the item, but he or she can also book the item directly without navigating to a different booking page.

3.3 Terminologies

The terminologies used should be more descriptive to reflect its function. For example, Resource Sharing did not represent uploading and downloading of files. As a result, it was changed to Files Uploading and Downloading. The term Advertisement was inappropriate because there were two options under it which were Classified and Announcement. The users were confused when given a task to advertise used car. Therefore, the keyword was changed to e-notice board and the two options under it were removed.

3.4 Navigation

The navigational issue also came into concern. The first group did not employ the 'breadcrumb trails' in their interface. It is a navigation technique that helps users to keep track of their current location within a program or website (Dix et al., 2004, p.764). For a website, it allows users to follow back to the starting point or home. It was discovered that users prefer to navigate using breadcrumb trails. Thus, it was added onto every interface.

3.5 Weaknesses of the study

There are few issues that need to be addressed when conducting a participatory design session with busy people. Since the end users were divided into two groups, we assumed that there might be some pressures to compete with each other. We observed that there was a tendency to build a perfect or nicely drawn prototype. This took them a longer time, hence making them feel bored in the end. Towards the end of the session, there was lack of enthusiasm among few participants even though they enjoyed using papers and pencils in the beginning. Therefore, we believe that in order to conduct an effective participatory design session using paper prototyping, the participants must be assured that it is an alternative method to computer prototyping. On top of that, they must also be convinced that paper prototyping is able to refine design ideas as effective as computer prototyping. This will help to minimize or even eliminate skepticism among them.

4. Conclusion

The participatory design using paper prototyping technique has helped in eliciting requirements from the end users of an online community for Computer Science lecturers. It is indeed the most effective technique to reveal user requirements within a short time frame. The users who acted as part of the design team were more willing to make changes to their design because paper prototyping is easy and fast to create. Since it requires no skill in computer programming, it is possible to conduct the same session to develop an online community for lecturers from non-technical departments as well.

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Table 1. Sessions in the Participatory Design

	Session 1	Session 2
First Day	Introduction to paper prototype Introduction to task design Designing tasks	Paper prototype development Walkthrough 1
	Session 3	Session 4
Second Day	Usability test Prototype refinement	Walkthrough 2 (Video documentation)