

Approach to Human Centered Design Innovation by Utilized Paper Prototyping

Kazuhiko Yamazaki

Faculty of Engineering, Department of Design, Chiba Institute of Technology
2-17-1 Tsudanuma Narashino-shi,
Zip 275-0016, Japan
designkaz@gmail.com

Abstract. The purpose of this study is to discover a design methodology for User Centered Design (UCD) Innovation. This paper focuses on paper prototype method for user evaluation and design. After proposing an approach to utilize paper prototype method, author proposed detail approach based on UCD process. In case study, author utilized this method for design education of design course on university. As a result, author received several innovative ideas from UCD view point.

Keywords: UCD, innovation, prototyping, design.

1 Introduction

Purpose of this study is to propose effective paper prototyping method for User Centered Design (UCD). Recently, UCD is very popular for many companies to develop a product or system from user view point. One of philosophy of UCD is to focus user at each stage of the design process and to repeat prototyping and evaluation to reach user goal.

On this paper, I focus paper prototyping method to utilize on UCD process. Snyder defined "Paper prototyping is a variation of usability testing where representative users perform realistic tasks by interacting with a paper version of the interface that is manipulated by a person "playing computer", who doesn't explain how the interface is intended to work.". And, Snyder described the benefits of paper prototyping as follows;

1. Provides substantive user feedback early in the development process-before you've invested effort in implementation.
2. Promoted rapid iterative development. You can experiment with many ideas rather than betting the farm on just one.
3. Facilitates communication within the development team and between the development team and customers.
4. Does not require any technical skills, so a multidisciplinary team can work together.
5. Encourages creativity in the product development process.

2 Utilize Paper Prototyping Method

2.1 Utilize Paper Prototyping Method for Design and Evaluation

Snyder defined paper prototyping as a variation of usability testing. We know most designer utilize paper to study idea as a draft prototyping method. And we know one of presentation method is to act user and product to describe new product or system.

During concept stage, we utilize sketch very often. Based on my experience, following is the merit of paper prototyping to compare with sketch.

1. Real size prototyping is good tool to consider idea from human body perspective. For example, small sketch affect different feeling from real size prototyping because size is very important for human. In case of software, screen size is very important for user and paper prototyping has to be real size.
2. For future product or systems, we need to consider hardware, software and human ware as an integrated design system. The paper prototyping will be able to cover hardware, software and human ware. For example, the paper prototyping will cover new product with hardware and software.
3. In case of sketch, it is very different image by technical skill to make superior sketch. Non designer will not easy to join the idea creation by sketch. By paper prototyping, most people will be able to join the creation and promote collaboration.
4. To make innovative idea, it is important to create from user experience view point. The paper prototyping helps to feel user experience because of real size and real steps.

By considering merit of paper prototyping, I propose to utilize paper prototyping for creating idea, make presentation and evaluation as integrated tool for UCD. And I try to define paper prototyping as follow;

“Paper prototyping is an integrated tools to design interactive product and system by UCD. Paper prototyping is useful for creating idea, making presentation, design walkthrough and user testing on UCD process. Based on this definition, I categorized paper prototyping for 4 phase as follows and also I summarized this phase on Table-1.

Table 1. Utilize prototyping by each phase

| Phase | Title | Purpose | Team |
|-------|---|------------------------------|--|
| 1 | Creating idea with paper prototyping | Study idea | Designer |
| 2 | Acting out with paper prototyping | Propose idea | Actor as a user Actor as a product |
| 3 | Design walkthrough with paper prototyping | Evaluate idea in design team | Actor as a user Actor as a product Coordinator |
| 4 | Usability testing with paper prototyping | Evaluate idea by user | Actor as a user Actor as a product Coordinator Observer |

1. Phase-1: Creating idea with paper prototyping
2. Phase-2: Acting out with paper prototyping
3. Phase-3: Design walkthrough with paper prototyping
4. Phase-4: Usability testing with paper prototyping

2.2 Creating Idea with Paper Prototyping

During concept design phase, paper prototyping is one of good method to create idea from user view point. We should make paper prototyping as real size based on user scenario and inspiration quickly. It is different from paper model for styling because paper prototyping has to be real size, describe controls and screen and not need fancy model. It is important to check paper prototyping by considering user experiences. (Fig.1 and Fig.2).



Fig. 1. Paper prototyping for hardware



Fig. 2. Paper prototyping for software

2.3 Acting out with Paper Prototyping

During concept design phase, paper prototyping is one of good method to perform acting out for presentation. Based on user scenario, two actors will play skit with the paper prototyping. The paper prototyping has to cover all the material for the scenario such as hardware product and software interface. One actor is a user and another actor is a product with paper prototyping. By this acting out, actor and observer will find out problems or the point for modification. (Fig.3 and Fig.4).



Fig. 3. Acting out for hardware



Fig. 4. Acting out for software

2.4 Design Walkthrough with Paper Prototyping

During concept evaluation phase, paper prototyping is one of good method to evaluate idea in design team. Based on user scenario, two actors and one organizer will collaborate with paper prototyping. One actor is a user, another actor is a product. One

organizer directs skits and observes performance. By this design walkthrough, actors and observer will find out problems and idea from user view point.

2.5 Usability Testing with Paper Prototyping

During concept evaluation phase, paper prototyping is one of good method to evaluate idea by user. In this case, it is important to prepare several pass for user scenario for user testing. Based on user scenario, two actors, one organizer and one observer will collaborate user testing. One actor is a user, another actor is a product. One organizer directs skits and observer check the problem and findings. By this user testing, observer will find out problems and idea from user view point.

3 UCD and Paper Prototyping

3.1 Variety of Prototyping Method

On this section, I confirm variety of prototyping at each UCD process. Arnowitz described major prototyping method for software development as follows:

- Wireframes
- Storyboard
- Paper prototyping
- Digital prototyping
- Blank model prototyping
- Video prototyping
- Wizard of Oz
- Coded prototyping

In this paper, I classified prototyping for low fidelity prototyping and high fidelity prototyping to cover software development, hardware development and service development

Low fidelity prototyping is to show design concept from user view point. By low fidelity prototyping, we can see and touch the user value and user experience in draft. For example, we utilize paper prototyping as a low fidelity prototyping and it is very useful method with cheap cost. Following is the example of method for low fidelity prototyping.

- Wireframes
- Storyboard
- Paper prototyping
- Paper mockup
- Blank model prototyping
- Wizard of Oz

High fidelity prototyping is to show detail design from user view point. By high fidelity prototyping, we can see and touch the final design or detail design. For example, we utilize hardware mockup which has final color and shape, and also software prototyping by flash. High fidelity prototyping is useful method on design step or detail design step on UCD. Following is the example of method for high fidelity prototyping.

- Digital prototyping
- Video prototyping
- Coded prototyping
- Rapid prototyping
- Detailed mockup

3.2 UCD Process and Paper Prototyping

The paper prototyping is useful method to get user feedback with minimum effort. But this method has several demerit and we need to consider these demerit to utilize this method on UCD process. Following is the demerit;

1. User will be influenced by shape and color of the paper prototyping. For example, when the conceptual idea is superior for the user, user will have negative feedback because of the shape and color of the paper prototyping.
2. The paper prototyping will not cover user feedback for image and appearance. For example, rendering sketch or video image will be able to cover user feedback for image and appearance as a low fidelity prototyping.
3. For user testing by the paper prototyping, we need to consider the knowledge of prototyping. When user does not knowledge of prototyping, most users will evaluate by the image of paper prototyping. For example, most users will have negative feedback for paper prototyping. When user has experience for development, user will be able to understand the quality of paper prototyping.

By considering merit and demerit of paper prototyping, I propose to utilize paper prototyping on phase 2 (Understanding user) and 3.(Concept design) on UCD process. In case of utilizing on phase 4(Detail design), we need to consider demerit of the paper prototyping.

I summarized UCD process and paper prototyping on Table-2.

Table 2. UCD Process and paper prototyping

| Phase | Process-1 Define Requirement | Process-2 User Research | Process-3 Concept Design | Process-4 Detail Design | Process-5 Verification | Process-6 Life cycle |
|-------|---|-------------------------------|--------------------------------|---|---------------------------|----------------------------|
| 1 | Creating idea with paper prototyping | Create Idea for research | Create idea | Create idea | | |
| 2 | Acting out with paper prototyping | Present Idea for research | Present idea | Present idea | | |
| 3 | Design walkthrough with paper prototyping | Evaluate Idea internal | Evaluate Idea internal | Evaluate Idea internal | | |
| 4 | Usability testing with paper prototyping | Evaluate idea by user | Evaluate Idea by user | Utilize detailed prototyping instead of Paper prototyping | | |

4 Conclusion

To paper focuses on paper prototype method for user evaluation and design. After proposing an approach to utilize paper prototype method, author proposed detail approach based on UCD process. In case study, I utilize this method for design education of design course on university. As a result, I received several innovative ideas.

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