Prototyping with Experience Workshop

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Abstract. In order to investigate deformable user interfaces (DUIs) on mobile devices, an experience workshop was developed to encounter the new interaction style. The design of the workshop strives to bridge form factors and use cases with genuine interaction, which was made possible through prototyping. Prior to the workshop, an explorative experiment was designed to study the role of form in DUI design. Based on the result, several shapes were 3D-printed for further investigation in the workshop. During the workshop, experts in design and engineering experienced a whole design process in which various prototypes were built and the interaction was practiced. The participants were encouraged to practice the imagined scenario with prototypes in real life setting. The result of the workshop became valuable input for building a working prototype.

Keywords: organic user interface, deformable user interface, prototyping, participatory workshop.

1 Introduction

In order to investigate organic user interfaces[1], or more specifically, deformable user interfaces on mobile devices, an experience workshop was designed to encounter the new interaction style. The main idea is to understand how people manipulate a mobile device when its deformation is utilized as an interaction style. Therefore, the workshop involves the identification of three main factors in the new interaction paradigm; the form, the use case and the interaction.

This one-day workshop was designed so that participants could explore the form factors of deformable materials and imagine the use cases. To make real interaction happen, prototyping is utilized as a tangible approach. With the real-life setting, genuine experience was encountered in the workshop. The outcome of the workshop was taken into the next development of a working prototype.

2 Preliminary Preparation

2.1 The Experiment on Form Factors

An experiment was conducted in order to study the form factors of a flexible mobile device. Traditional design methods focus on human's cognitive skills despite the fact

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that other senses are as important as visual skills [2]. Unlike the method in which users invented gestures to associate with given commands[3]–[5], a more explorative manner was adopted in this experiment.

The purpose was to find insights from people's instinct and tactile sense on flexible materials by observing participants' action and response. Shape preference and possible gestures on flexible materials were examined, which became the design hint for the next prototype. In this experiment, four different models were presented to the participants. They were asked to play with and manipulate the models with the presence of stimulus, a video clip.

Four models were built and function as a medium in the experiment (Fig. 1.). In order to achieve flexibility, felt and sponge were chosen as raw material. Starting from the left to the right in the figure, the first model is in cylindrical shape with the intention to manifest one-dimensional characteristics. The second model is in oval shape with plan flat body. The third is basically a rectangular pillow in which sponge is stuffed in the middle. These two models mainly manifest two-dimensional characteristics. The last one is a ball presenting three-dimensional characteristics. Although, in practical, all the models are three-dimensional objects, the intention was to embed different spatial properties into the models so that the interaction in different dimensions can be studied.

Fig. 1. Four felt prototypes

A video clip was composed for providing content for users to imagine possible interaction while the models are in their hands. That way contextual interaction can be generated accordingly.

There are three parts designed in this video, each with different purposes. The first part consists of geometric objects, which provide a neutral content without specific meaning. This way, users' reaction on stimuli could be observed. The second part is street view enhanced with informative signs. Solid connection between participants' personal experience and this experiment was provided. The last part is simply bubbling water. Similar to the first scene, the setting provides neutral content without specific meaning, while the linearity and predictability were removed.

The procedure can be divided into four steps:

1. Explanation of the experiment

The purpose and the procedure of the experiment were explained to the participants so that they understood the scope and tasks.

2. Participants look at the models and describe their perception without touching

Before touching the models, participants were asked to inspect visually all the four models on the table and describe possible deformation on the models.

3. Participants touch and describe their perception without looking at the models

Participants closed their eyes and played with the models in hand. They were asked to describe their perception.

4. Participants watch, imagine, act and react with the presence of the video

The video was played on a large display in front of the participants. They were asked to watch the video and imagine that there was real interaction created between the content and the model in hand. Their task was to use imagination to interact with the content via the model in hand as a medium. Meanwhile, users were asked to think out loud, which means they verbally describe their thinking and action.

The reason why steps two and three were designed in this manner is to examine how people perceive and understand an artifact's ability through different senses. In Norbert Streitz's study, he explained macro affordance as physical shape and form factor of an object, while micro affordance is addressed as tactile characteristic of the object's surface[6]. In step two, users were able to see the whole model and described their visual perception of it. In this way the perceived macro affordance was revealed. After, they could touch and play with the model but with eyes closed. Users in this stage understood the models by hands exploring every part of the models. The purpose here was to examine the instinct through tactile sense. With a physical object in hands, they were also asked to try to deform the models. At this moment, micro affordance was perceived and action was manifested accordingly.

The findings from the experiment provided insights from three layers: form, gesture, and application of deformable user interface. On the layer of forms, different properties of macro and micro affordance could be revealed. On the layer of gestures, the characteristics that could bridge fundamental functions were identified. As for the layer of applications, physical actions were linked to practical intentions. For example, the application could be starting a car, opening a lock, and similar interactions, whose operation model is based on its mechanical implications. The interactions match those found in prior work[7], but also provide new ones, such as pointing along with twisting.

A set of device shapes was refined for development. After several iteration, a selection of acceptable device shapes were built, and a few chosen for the workshop. The selected shapes were 3D-printed in order to give a proper feel and weight, but to also withstand the rigours of workshop.

2.2 The Material and Locale for the Workshop

One of the tasks designed in the workshop was to build quick mock-ups. Various flexible raw materials were provided, such as rubber, foam cushion, foam board, etc. In the field, a field kit, which included notebook, pen, and camera phone, were given to the teams. Instruction of the tasks in the field was attached to the notebook, and the teams were particularly asked to use camera phones to document their exercise in the field. After the workshop, the kits were collected back for data analysis.

In order to come up with a suitable locale, the metropolis was scouted for different surroundings. We decided to have the workshop along a bustling street with cafes, small specialty shops and groceries, but also with a few larger stores focusing on e.g. second hand shops and antiquities. The core of the workshop was held at a restaurant, which acted as a central location. These were seen as important factors for the exploration and for being able to play in real and authentic user settings. The variety of the shops was seen as support for keeping up the interest, and allowing different situations to be readily available. One could as easily get a feeling from a bridal shop, as from a bookstore. Such approach has been developed during several years[2].

3 Workshop

3.1 The Method and the Context of the Workshop

Three tasks targeting different aspects were designed: prototyping, generating scenarios, and playing in the field. To bridge form factors with applications, the content of each part was constructed first. The form factor of flexibility was explored by quick mock-up building, while application was imagined by understanding the context and discussion in the groups. Practical application cases were then presented as scenarios. Finally, the scenarios were practiced with the prototype in the field, from which, form factors and applications could be bridged by interaction. (See Fig. 2.)

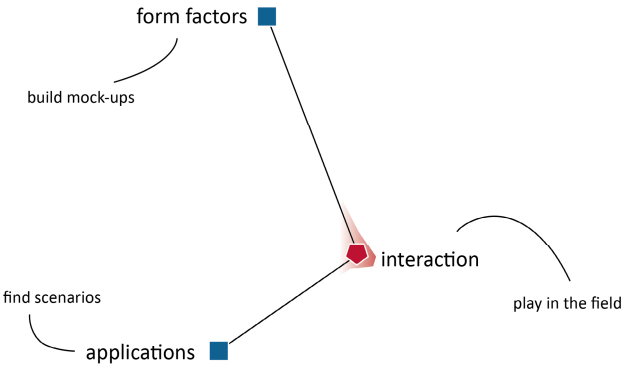

Fig. 2. The form factors and applications are bridged by interaction

The context was derived from the intention of answering the question: how do DUIs enable users to engage with the immediate environment? It is quite common that people immerse themselves in their phones even when walking on the street. A flexible phone might provide interfaces that could avoid the phenomenon of detaching from the immediate environment. The tasks assigned to the participants in the field exploration session especially addressed this issue.

The derived context was then brought into the design of the tasks. In the brainstorming session, groups were told to investigate the detaching issue and imagine solutions based on DUIs. The tasks assigned in the field exploration session were related to the context as well. Since the immediate environment is perceived through our five senses, the groups were asked to imagine and practice how the DUI could mediate the perception of five senses via the prototypes.

3.2 The Procedure and Tasks

The detailed agenda is depicted in Table 1. The workshop started with introduction and ice breaking sessions. Basic information about the workshop and its purpose were presented in the introduction session. The participants did not know each other beforehand. Therefore, the ice breaking session provided an opportunity for each other to get acquainted. Tasks such as naming the team and designing the logo were assigned to inspire the team spirits.

Four teams were formed. Within each team, half of them have technical background and the other have a design-oriented background. The groups were intentionally mixed, so that there would be a clash in the common topics and perceptions. This was deliberate, as our aim was that the other half would understand the technical difficulties, and would perhaps provide technical solutions or see problems, and the other half would see the opportunities and out of the norm solutions. Following the introduction and ice breaking were the sessions illustrated in below.

Table 1. The agenda of the workshop

Session	Duration
Introduction	20 mins
Ice breaking	10 mins
Warming up	25 mins
Brain storming + mock-up building	60 mins
Lunch	40 mins
Mid presentation	30 mins
Field exploration	60 mins
Prototype adjustment + summing up	15 mins
Final presentation	45 mins
Ending	15 mins

Warming Up

The subjects, flexibility and mobile devices, were presented to the teams in this session. Teams were given a short period of time to answer the following questions.

- What are the benefits and limitations of flexible phone?
- What else in your daily life do you want it to be flexible?
- What does your phone mean to you?
- Other than its ordinary functions, i.e. making a call, checking e-mail, navigation, etc., how do you utilize your phone's physicality?

Brainstorming and Mock-Up Building

The context was brought in at this session. The issue of immersing and staring at the phone was brought into discussion. Several questions were designed for this part.

- What are the reasons causing the detaching from the immediate environment?
- How can a flexible phone help with the situation?
- What are the scenarios where flexible interaction can help engaging with the environment?

The participants were asked to reflect on the questions individually before starting group brainstorming. That way, the perspectives could be diversified.

The teams were also asked to build quick mock-ups with the provided raw materials.

Field Exploration

A 3D printed prototype along with a field kit was given to each team. Each kit had one notebook with instruction of the tasks and one camera phone which can be used for documenting the scenarios. Along with the prototype built by them, each team had at least two prototypes. They were asked to practice the following tasks with the prototypes.

- Practice the scenarios presented in previous session in the field. Capture color, sound, texture, smell, and taste of corners in the city.
- Use one prototype to leave your trace (sound, smell, etc.) at some spot, send it to another member who is holding another prototype. Practice sending and receiving.
- Discover your friends' trace.

Prototype Adjustment and Summary

After returning from the field, teams were asked to modify the prototypes and summarize their findings. It was not to compare the two prototypes each team has but to improve the prototypes individually.

4 Interpreting/Adapting the Results of the Workshop

4.1 The Outcome of the Workshop

Away from labs, acting in the field was apparently an involving and encouraging manner for participants to encounter the experience of the interaction scenarios, especially with prototypes in hand. The teams practiced out the scenario in the real-life situation where interpersonal interaction was made possible. It can be seen that the prototypes became tangible medium and involving the surrounding people (See Fig. 3.). The format of the final presentation varied. Some teams performed the scenarios, while others show the video taken in the field.

Fig. 3. Participants acting in the field

In the end of the workshop, six mock-ups were built. Each was associated with scenarios. As for the data collected, there were text and figures drawn on paper, notebooks, post-its and posters. There were also pictures and videos taken by teams via camera phones. The presentation of the teams was video recorded as well. With the help of mock-ups, acting appeared to be an inspiring and involving method in presenting interaction scenarios.

4.2 Findings Considering Flexibility

Shape changing appeared to be one of the major concerns from the participants. The teams explored multiple ways of changing the mock-ups' shape and size to trigger a certain types of event. The gestures were no longer confined in pressing a button but deforming the entire device as action trigger. Furthermore, the possibility of switching operation modes by changing the shape was examined. Different shapes convey different information in terms of affordance. Therefore, different operation modes can be associated with different shapes.

In the tasks of capturing the five senses, the teams performed physical touch on all of the intangible substances. Namely, in the case of capturing the color of a vase, the prototype was bent to align with the curved surface of the vase. In the case of capturing the sound of a surface, the mock-up was placed on it and rubbed against the surface. While the substances to be captured were intangible, the way to capture with the tangible mediator was through physical touch.

Another interesting finding is collective flexibility. In this case, the concept of flexibility was expended from one single physical device to a flexible platform where multiple devices communicate with each other. Flexibility on each device on this platform could form a piece of information. The synergy generated through the platform could result in a greater effect.

4.3 Findings Considering Applications

Environmental awareness is expected so that the devices understand the locale. The point was not only to know the location, but also to be able to provide relevant information associated with the specific locale.

Moreover, a mobile device was also expected to be aware of both the context and the content in the situation. Understanding the intention of the user, a mobile device could provide intimate services. One practical example was to obtain traffic information by the mobile device. The device was expected to know whom the user is, where the user wants to go, and reply with the timetable and number of the bus.

Another interesting finding is the idea of communication between devices. When devices can communicate with each other, the information is able to be shared. That way, social interaction is possible to be extended. Associated with the concept of collective flexibility, communication between devices enables shared information to be delivered in the form of flexibility. Each device manifests different level of flexibility according to the shared information.

Continuing with the social aspect, teams also looked for possibilities in directly involving people to tackle the issue of detaching. A flexible device could be able to foster a situation where all the people can surround and share face to face. Engaging with the environment is not only about the physical objects in the space but also the people in the situation.

4.4 Leading toward the Next Working Prototype

The result from the workshop has provided abundant insights in designing a working prototype. The design of the prototype does not intend to include as much functionality and features as possible; rather, it is to select relevant features so that flexible interaction can be examined on certain applications.

The working prototype consists of a flexible mobile device and an information system that is in charge of processing digital data. A wireless communication channel is built in between so that commends and information can be exchanged between the device and the information system. It is also possible to allow more than one mobile device communicating with each other on this platform. The results from the workshop gave hints on applications that could be implemented on the platform.

5 Conclusion

The design of the workshop enables the encountering of genuine experience of the new interaction style. As a physical representation of hypotheses, prototypes serve also a medium for making real action happen.

Through the workshop, participants developed concepts based on their own experience and discussion within the teams. Starting with understanding the questions, developing concept, building mock-ups and practicing the scenarios, the teams were able to contribute magnificent findings and precious insights on this issue. The findings regarding application provide a basis for associating flexibility with practical application cases. Meanwhile, the findings regarding flexibility give hints on designing flexible interaction.

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