Prototyping and end user involvement in early stages of mobile applications development

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Abstract: The development of mobile applications includes some different requirements compared to the development of PC software since the mobile applications are used in a different context. The user is generally being mobile or doing some special tasks while using the application. Therefore it is important to involve the user during the development of the applications in order to understand the way that the user is acting and to develop a product that better fits to his wants and needs. The tool that we propose in this case is prototyping. For this purpose we first did a literature review in order to gain an overview on the previous work and summarize it. Based on our literature review we built four hypotheses and then conducted an online survey in order to prove our hypotheses. Our survey showed that the use of prototypes is a good tool to involve the end users in the development of mobile applications and that in this way the developed applications better fulfil the user needs and requirements.

1 Introduction

The development of mobile applications is a kind of software development, however it includes special requirements, since mobile applications are used in a new context that is while being mobile and not as a PC software anymore [LH98]. As software development projects, the development of mobile applications include different steps starting from the problem definition until the bug fixing and maintenance. The problem definition is considered as one of the most important steps [La00] [La01] [OWS03], where the interaction with the end user to understand his wants and needs and the communication between the team members to define the future work steps and plan the project are essential.

A bad defined problem is often the reason for failure or difficulties in the software projects [La00] [La01] [OWS03]. And the later the problem is discovered the more it costs [La00]. Especially in the development of mobile applications it should be understood very well how the end user exactly acts while using the application and the context of the use of the application, in order to be able to develop an application that would fulfil his needs and will be widely accepted by the users [LH98] [IKR00]. A
mobile application can be used for example in meetings to take fast notes, or while traveling to gain information about the actual place and so on. During the problem definition phase of the mobile applications development, different methods are used in order to define the problem and the issue that the application should solve or fulfil. The most used methods are interviews, brainstorming and focus groups. These methods are good tools to support the communication and exchange of ideas in discussions, however they have limitations in two directions: first it happens many times that the information is misinterpreted or misunderstood and second the documentation of the results is difficult. These techniques suffer also on lack of structure and organization [WO05] [GL93]. Frequently, users do not know what they really need, they cannot articulate the needs, and they are unaware of the technical possibilities and the costs of their requests [Ku02].

Different studies [La00] [La01] [OWS03] have proved how important problem definition and acting with customers at early stage of software development is, this issue can also be transmitted in the development of mobile applications. Considerable research [GL93] [La01] [OWS03] has been conducted in this direction trying to define methods and ways in involving the user in the problem definition stage of software development. A special importance of understanding user needs is required while designing mobile solutions. Previous studies on mobility show that designing mobile cooperative systems requires a new way of understanding work practices [IKR00].

An important method is also prototyping, which is considered to concretize the ideas and further support them [IKR97] and support creativity. On the other side there is also some criticism regarding prototyping since it may limit creativity of the user and the user concentrate too much on the user interface and not on the functionality of the solution [SML09]. There has been much research regarding prototyping in design and also idea generation. There has been also much research underlining the importance of customer involvement and participation in early stages of software development. Considering both these aspects we propose a combination between them to support the end user involvement in early stages of mobile application development by use of prototyping. In order to verify our hypotheses we conducted an online survey.

2 Design of the work

The work was designed in two parts. In the first part we conducted a literature review and built four hypotheses, while in the second part we made a survey in order to support our hypotheses. By conducting the literature review we followed a systematic approach, based on the approach defined by [WW02].

We separated 15 papers at the beginning that could be relevant at first sight by reading the title and the abstract of them. By reading these papers we could earn a first insight of the existing literature in this context and of the relevant outlets for our work, and also define relevant keywords for the further search. An important finding at this step of the literature search was that there are no concrete publications that analyse the use of
prototyping and its influence during the problem definition step of mobile applications development; therefore we split the topic in four subtopics to be searched:

1) Sketching as visualization tool in design; 2) User involvement in problem definition (participatory design); 3) Particularities of designing mobile applications; 4) Relationship between requirements elicitation and prototyping

Further we defined the following relevant outlets to be searched since the 15 papers that we identified at the beginning, were from these outlets. The relevant outlets at this step were:

Computer Human Interaction; Designing Interactive Systems; Requirements Engineering; Creativity & Cognition; Hawaii International Conference on System Sciences

In each of these outlets we searched with the keywords: innovation, prototype, problem definition, mobile service, user involvement in different permutations, by reaching a total number of 25 combinations. Than we did backward search so that at the end some more papers of and some more outlets were added to our literature list by reaching a total of 39 papers from in total 13 different outlets. The results of the literature review were structured by each of the four subtopics and are explained in the section below.

Based on the results of the literature review for each of the topics we built in total four hypotheses, one for each topic that we analysed. To support the hypotheses we made an online survey. In the following sections of this paper we summarize the results of our literature review, then we present the four hypotheses and describe the conducted survey and its results and we conclude by discussing the implications of our findings.

3 Results of literature review

We reviewed in total 39 papers from 13 different outlets. For each of the four subtopics that were mentioned in the section above we made a detailed literature review and summarized the results of the works that were published until today.

3.1 Topic 1: Sketching as visualization tool in design

Sketching is widely used in design activities and it is closely related with concept and idea generation [Ya09]. Sketching is often used from the designers as a way of illustrating their ideas and thinking by translating the verbal requirements and specifications about a product in visual ones [UWC90], so that the success of design is often related with the quality of the drawing and sketching during the design activity. By sketching the designers visualize not only one concept, but they also can interpret its meaning and identify further patterns by being able to develop further ideas through that [Lu02] [Lu05]. Sketches are a king of external presentation and serve as a cognitive tool to augment memory and information processing [Tv02].
[ST97] proposes that drawing is not simply a representation of design thought, but a critical tool for thinking about a design. They conclude that designers are able to understand the various aspects of a design only through sketching them. In this way the sketching process is a tool that helps in developing innovative solutions and is strongly related to creativity.

While Cross [Cr99] highlights the importance of sketching as a communication tool and as a way of representing the internal thinking. In this way this kind of visualization can be used as a presentation medium to visualize and share the ideas and discuss with the different stakeholders about them.

Purcell/Gero [PG98] suggests that the reinterpretation, or even iteration, of a sketch is evidence of the occurrence of new conceptual design knowledge. Indeed Goldschmidt [Go94] describes the way in which sketches are used both to represent ideas and to spur the generation of ideas.

In summary sketching serves many purposes within the design process. They serve not only as an idea repository, but they also support the creativity by supporting the further development of the ideas. Apart from this, sketches serve as a visualization tool for the internal ideas and verbal requirements and as a communication vehicle between designers and other stakeholders.

### 3.2 Topic 2: User involvement in problem definition (participatory design)

A basic question in the development process of a software product is how to find out what users really need [GL93]. However, the elicitation of this kind of information from users is usually a challenging issue [PLW90]. Frequently, users have difficulties in articulating their needs. For this reason the involvement of end-users during the problem definition phase is a very important topic. Lin/Shao [LS00] argues that user participation in the development of a system improves the quality in several ways and brings many benefits.

The Scandinavian participatory design (PD) model tries to analyse the benefits of involving the user in the product development and to facilitate the communication between the user and the designer team. Participatory design can be defined as an approach in which the customers are already involved in the early stages of system development [BB95].

The active involvement of the customers is necessary to discover sticky information about the system being developed [BMT05]. Warr/O’Neill [WO05] argues that the active user involvement in the software development process leads to more useful and usable software products and the importance of user participation in the development of the product increases as the uncertainty about the product increases [EQM95].

The user participation in the development of a software product brings many advantages. Though it is difficult to find the right way to involve the user in the development and to
profit from the users’ knowledge because part of the users’ knowledge has become tacit through automation [Ku02]. In well-learned tasks, much of the relevant knowledge is no longer consciously available for the person and nonverbal skills and everyday self-evidences are difficult to articulate [Ku02].

In summary user participation in the early stages of software projects brings many advantages and helps in developing better products, however, it is often a difficult issue to find the right way to communicate with the user in order to be able to profit from its knowledge or to let him validate the product.

3.3 Topic 3: Particularities of designing mobile applications

Mobility is a concern area that is becoming more and more important in the last years [IKR00]. Many devices and services are now designed to support the mobility of people. However, it is important to understand that this new field of software development brings new requirements and a new way of understanding the work [LH98]. In order to understand the issues that should be considered while conceiving and designing mobile software products, one has to understand the activities that people carry out and how they act in this situations by cooperating with the user while developing this products [LH98] [IKR00]. However it is difficult for a user to articulate feedback about future products if he cannot test it and imagines a concrete use case of the product [BM01]. Therefore new ways of involving the end user in the development of mobile software products should be developed [LH98] [IKR00].

In summary it is crucial especially while developing mobile software products to involve the end user in the development process in order to create good and usable end products. This is because mobility products bring new issues that can be analysed only “in action”. However, it is a difficult issue to find the right way how to do it, since the user has difficulties in giving feedback about future products that still do not exist.

3.4 Topic 4: Relationship between requirements elicitation and prototyping

Prototyping is an approach that helps to define a better feeling and imagination regarding the product [HH97]. They communicate the product features to clients, users and designers. Designers can try out their ideas and observe the outcomes [WO05]. Prototypes help in trying out ideas and getting feedback about them [DHK09]. Prototyping is already a widely used approach in the requirements elicitation phase of software projects that brings many advantages in the praxis. Many authors already tried to establish a link between prototyping and requirements elicitation process in the software development process [RKA03] [AT00]. In their work [RKA03] demonstrates the existence of a relationship between prototyping and requirements engineering and that both can take advantages from each other [RKA03].

However prototyping can be applied even earlier in the software development process, already in the problem definition stage. This could bring benefits in even better
understand the customer needs and being able in better defining the requirements to fulfil the customers’ needs about the software product.

4 Hypotheses

For each of the topics analysed above we could deduct a conclusion. To prove each of these conclusions we build a hypothesis, which was then tested in the survey.

Sketching serves many purposes within the design process. Sketches serve not only as an idea repository, but they also support the creativity by supporting the further development of the ideas. Apart from this, sketches serve as a visualization tool for the internal ideas and verbal requirements and as a communication vehicle between designers and other stakeholders. Based on this conclusion we build **Hypothesis 1**: As sketching in design, the use of prototyping in software projects serves as a tool to visualize, communicate, further develop and document the ideas.

The user participation in the early stages of software projects brings many advantages and helps in developing better products; however, it is often a difficult issue to find the right way to communicate with the user in order to be able to profit from their knowledge or to let them validate the product. From this conclusion we can define the **Hypothesis 2**: The user participation in early stages of software projects helps in developing better products.

Especially while developing mobile software products the involvement of the end user in the development is crucial in developing good and usable end products. However it is a difficult issue to find the right way how to do it, since the user has difficulties in giving feedback about future products that still doesn’t exist. From this conclusion for topic three we deduct the **Hypothesis 3**: The development of mobile software products needs the involvement of the end users.

Prototyping is a widely used approach in the requirements elicitation stage of software development. However it can be applied even earlier in the software development process, already in the problem definition stage. This could bring benefits in better understanding the customer needs and being able in better defining the requirements to fulfill the customers’ needs about the software product. At this point we can define **Hypothesis 4**: Prototyping can be used in early stages of mobile software development as a communication tool with the end user.

5 Questionnaire

To support our hypotheses and did an online survey in order to take a further opinion of people who have experience in the IT field and in the development of mobile applications. For this we built a questionnaire that was made of five sections, one section for each of the hypotheses and the last section to ask demographic data. In the questionnaire we used a Likert rating scala ranging from 1 (strongly disagree) to 5
To get sure that the questionnaire is understandable we made a pre-test with six people.

The online survey was conducted in March 2013. The questionnaire was made by using an online survey tool and it was shared via different channels to more than 300 people that have some IT background. It was opened for a period of two weeks and a total of 54 participants answered it; that makes a responding rate of approximately 18%. Out of the 54 respondents 67% (n=36) were men and 89% (n=48) were between 20 and 30 years old. 61% (n=33) of the participants, that makes the major part, have a bachelor degree. For each of the hypotheses there were 4 to 7 questions. In order to get the general opinion regarding to one hypothesis we made calculate the average of all the answers that regard to one hypothesis and one level of the Likert scala. For example, there were four questions with regard to hypothesis 2, and for each of the question we calculated the average of the number of participants who responded “Strongly agree”. For example, if for question 1, 35% responded with “strongly agree”, for question 2, 50% and for question 3 and 4 respectively 44% and 39 %, than the average is (35+50+44+39)/4=42%. We made this calculation for each hypothesis and the results of the survey show that for each of the hypothesis more than 75 % of all participants responded with either strongly agree or one level below in the Likert scala. This shows that most of the participants agree with our hypothesis.

6 Conclusion

In this paper we analysed the advantages of including end users to the development of mobile applications through the use of prototypes. To reach to first results we did at the beginning a literature review. Since there is not many literature that analyses directly this topic we split the literature review in four topics that are: Sketching as visualization tool in design; User involvement in problem definition (participatory design); Particularities of designing mobile applications and Relationship between requirements elicitation and prototyping and then tried to combines the results through building hypotheses. We created four hypotheses and conducted an online survey in order to verify them. As a result of this we can say that the use of prototypes serves as a tool to visualize, document and further develop ideas. Furthermore, prototypes encourage the communication about the software being developed not only between the developers but also with the end users. Our survey shows that involving the users in the software development is considered to bear many advantages and helps in developing software that better fulfils the users’ requirements and their needs. However, the participants agreed that it is difficult to find the right way to involve the users in the software development process. The further results of our survey confirms that the development of mobile applications involve other usability issues as the development of PC software so that it is important to involve the end users in the development stage of mobile applications in order to understand the way he acts and interacts while using the mobile applications, also to analyse his behaviour in action. The participants of our survey also agreed that prototyping can be used as a tool to involve the end users in the development of mobile applications. The involvement of the end users in the development of mobile
applications helps in developing more usable and acceptable mobile applications that better fulfil the user requirements.

In our study we showed that prototyping could be used as a tool in the developing process of mobile applications, so we proved on a theoretical basis that the use of prototyping brings benefits. However the majority of the responders of our questionnaire were students. In future studies a questionnaire for people with more experience in the development of the mobile applications can be carried out. Another point that can be done is to set the focus on the questionnaire and try to prove the hypotheses that we built as a result of the outcomes of our literature review, by building a scientifically valid questionnaire and then validating the data statistically.

As a result of our study we could confirm our perception that prototyping not only a tool for communicating and demonstrating early versions of an application to a customer. Prototyping is a tool to interpret an application’s meaning, identify further patterns and further evolving an idea. Prototypes are a tool that helps software developers to structure their thoughts and makes them explicit.

References


