Developing useful mobile applications in cross media platforms

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Abstract—As the app market expands, new challenges arise for developers. Creating useful applications is important in achieving extensive and cohesive use. This paper presents a mobile application called "The Time Machine", offering location-dependent information about the environment in a town. The app is evaluated through expert evaluation, as well as user evaluation conducted as a field observation with 15 participating users, measuring the level of usability in the application. Results are used to discuss guidelines on how to develop useful mobile applications. Knowledge about user behavior, a clear application purpose, an understandable interface, and cross-platform functionality are all important aspects for developers to consider.

I. INTRODUCTION

In 2006, Nokia, Motorola, Samsung, Siemens and Sony Ericsson covered 75% of the global mobile phone market [1]. However, everything changed when Apple entered the market in 2007, launching their iPhone; a smart phone, combining the PDA with the mobile phone, equipped with wireless network interface and sensors. Along with the iPhone came the AppStore, an application market making it possible to buy and download applications for the iPhone.

With the advent of the first iPhone, an extreme hype was created surrounding the product. It enhanced both expectations and curiosity, and consumers were for the first time introduced on a broad scale to the concept of applications, or apps. In March 2008, Apple released their iPhone software development kit (SDK), making it possible for third-party developers to start programming applications for the iPhone and the iPhone touch, and later also the iPad. Year 2008 also saw Google entering the market, launching their open source Android platform targeted for app development, and T-Mobile announced the world's first Android-powered phone.

In late 2011, 86% of the total human population had access to mobile phones. The number of mobile phones had reached almost 6 billion, and is growing in a pace that is ever increasing. [2]

Today, developers have access to the powerful technology (e.g. mobile OSs, application markets, powerful mobile devices, and a new emerging version of HTML) and a record number of people are involved in the business surrounding mobile applications. The everyday use of mobile devices has become extensive, and in turn led to high demands concerning quality and robustness in the mobile use situation. Another effect of the mobile paradigm is that the interaction between

the user and the technology has become even more important; small, mobile devices have qualitatively different pros and cons compared to stationary computers. Also, mobile trends seem to come and go at a faster pace, while product lifetimes becomes shorter and shorter. [3]

A. Research Problem

The number of smartphones and mobile broadband subscriptions around the world is ever increasing [2]. Users have become dependent on their mobile devices and expect to be able to access their services anytime, anywhere [4] [5]. Extensive use of these new devices, applications (or "apps") and the mobile infrastructure leads to higher demands from the users concerning quality and stability, which in turn gives rise to an increased need for better interaction between user and technology [1]. Statistics show that out of the hundreds of thousand available apps in the respective markets of Apple and Google, 26% of the downloaded apps were only used once [6]. Exceptional apps can have more than 1 million downloads, while others receive none, underlining the different adoption of apps. Mobile application developers express difficulties in being noticed on the vast and increasing market, and also difficulties in keeping up with new technology and standards. [1] As trust and reputation often is spread through word-of-mouth [7] and good recommender systems [8] are scarce, marketing through good products becomes important.

B. Target and Disposition

In this paper, we present a case study of a mobile, location-dependent application, and evaluate the app through both expert and user evaluations. The results are used to identify important aspects to consider in developing useful mobile applications, promoting extensive and cohesive use situations.

After this introduction, section II is dedicated to the description of our methodology and the actual case. In section III we present our results, while section IV contains a discussion and concludes the paper, summarizing our findings and pointing out directions towards future work.

II. METHODOLOGY AND CASE

A. Application

Our idea was to create a prototype application, "The Time Machine", offering citizens and visitors in a town location-dependent information about e.g. houses, parks, streets from

Fig. 1. System design

different ages, both past, current and future. The application communicates with both the town museum's digital archives and an external map service, as seen in figure 1. Application functionality includes geolocation-supported navigation; viewing information and photographs tied to the different locations; sharing information and photographs through social media; and a photo gallery.

Wireframes (see example in figure 2) were produced to display the user interface of the app and create navigations paths. The wireframes were used as a basis for an expert evaluation, where the lead interaction designer behind the official town application framework was interviewed regarding his view on our chosen application design. Expert evaluation results came to inform our final prototype design proposal as changes were made to both user interface and underlying ideas.

The application was deployed as an e-service within a container application [9] available for both iPhone and Android (free of charge for everyone to download), allowing us to use HTML5 and related frameworks for development, thus receiving increased cross-platform support compared to iPhone or Android specific design. Figure 3 shows screenshots of The Time Machine, run in the container application.

B. User Testing

For our user evaluation, we chose a qualitative method. It is highly suitable when trying to gather in-depth data about the behavior and opinions connected to the test situation. [10] To examine the usefulness in an application, identification of errors in the use situation is often a good way to find weak spots in both concept and design. A heuristic study can help researchers to find interface problems and gather opinions from the user, hopefully resulting in better design. We therefore adopted a heuristic approach, as presented by Nielsen [11].

A qualitative approach also advocates a small group of test subjects [10]. Our test subjects were made up of 15 users, totaling 8 males and 7 females, evenly distributed in the ages between 20-55. Before each test, the user filled out a survey covering personal data and mobile habits, and was

then informed about the application concept: *"An application that contains pictures from the past, the present and the future connected to a GPS map"*. The user could then use the app in any way she wanted during 10-15 minutes, the time depended on what tasks she did and where she chose to go. Test subjects were observed during the use situation, and data was captured using a digital video camera and a dictaphone, along with the "think-aloud protocol" [12], i.e. a recognized technique where users are encouraged to talk about their actions (and thoughts) during the whole test situation. Users were interviewed after the test.

C. Analysis

Data was analysed focusing mainly on usability and usefulness aspects (as defined and discussed in e.g. [13]). We were also looking at possible interface problems, and tried to identify which features the test subjects liked and disliked, informing possible re-design. The typical outcome of this kind of experiment is a detailed description of the application implementation, data of the major application process, description of different types of participants and different kinds of participation, a description of how the application has affected participants, observed changes, outcomes and impacts. It will therefore provide data regardless of the app's strengths and weaknesses as experienced by the participants. [10]

III. RESULTS

A. The usability aspect

Several ideas for improvement came up during both the user testing and the interview sessions. Many comments concerned The Time Machine interface. As for modalities, voices were raised for the inclusion of both augmented reality and voice-over commentary.

Functionality was also addressed. Some wanted the possibility to "pause" the app when multi-tasking, but also to receive push notifications when walking past interesting sites. Addition of a compass for navigation was also desirable.

Some users had comments about the visual content, e.g. photo meta data, output modalities (e.g. addition of video material), a time axis on the photo etc. The future photos were much appreciated and there were comments on extending this part even further in upcoming editions of The Time Machine. To be able to comment and interact with the persons responsible for city planning would encourage more people to use the app and trigger them to use it more than once. Some users also suggested the addition of guided history tours, or up to date information about events taking place here and now.

Users also had bad experiences during testing. For example, on some occasions the Internet connection was broken, and this was both distracting and irritating for the users. Some users also had conceptual concern with the application: *"It's called Time Machine. If the idea is that it should provide historical looks, I do not think so when I'm looking at the map?"* (Female test subject #5).

The most common answer to the question of what need or usefulness the app would bring was information, curiosity and history: *"My girlfriend is interested in history, she would love this app."* (Male test subject #3)

Fig. 2. Wireframes

If users find applications too difficult and hard to understand, they won't appreciate them. Most of the users commented that the most important requirement for an app is that it should be simple and easy to understand: *"So you do not need to think... at all"* (Male test subject #7).

Users are more inclined to favor apps that are recognizable. Therefore, developer knowledge about trends and how to transfer them into applications is very important. Although not statically valid (due to the qualitative nature of our test), one finding was that younger test subjects had a faster learnability rate than the older participants of the study. This might indicate that older people does not have the same habits as the younger generation. One explanation can be that the younger has grown up with more technology around them. Many participants stressed that apps give greater freedom and are nice tools for every day life, but also that they can deliver great entertainment at times.

B. The time aspect

Only one test subject (Male test subject #6) used up all the 15 minutes that was the maximum time limit for each individual test. He was also the one walking the longest distance during his test. An average usage of ca 10 minutes was clocked for the rest of the participants. The time spent varied largely due to how and where the applications was used. The application was designed for and used mostly outdoors, but in case of indoor usage, our prediction is that consecutive usage time will decrease, approximately 3 to 5 minutes on each occasion.

C. The information aspect

Regarding the text and the image status of the application, almost all test subjects saw potential in the application and would like to use it outside the test situation. However, many saw the application as a "seasonal app", best used during summer or holidays, when there is much spare time and the weather is fine. The narrow information provided was somewhat problematic in some cases: *"If it doesn't come up with some new material I would use it a few times but, finally I would have gotten all the information, I would not use it again"* (Female test subject #5). Constantly updating The Time Machine might be an important building brick in trying to achieve cohesive use.

D. The design and navigation aspects

Users appreciated the simplicity of the map and found it easy to navigate. There were some interface problems regarding markers that were not clickable and also some confusion about the function of the photo archive included. This was mainly due to a lack of content in the application prototype regarding this particular feature.

Recognition proved to be important. For example, female test subject #5 wanted a Google guy icon instead of the existing you-are-here-representation, others wanted an arrow icon with the motivation that they were more accustomed to such iconography. Older users seem to have more difficulties finding the search function compared to the younger users, but again, the small number of test subjects does not allow us to draw any far reaching conclusions.

A clean interface was found helpful during navigation. Easy access to the search function was also stressed as an important thing for increasing usefulness. The small display of the smartphone used in the test however proved to be challenging when important buttons were placed too close to each other. One test subject was in a wheelchair, and she preferred navigation through clicking rather than swiping.

E. Junk apps

During the interview sessions, test subjects had the opportunity to give their general opinions of what characterizes both good and bad apps. It is clear that users can be quite judging, and that far from all applications turn out to be useful: *"3 of 5 apps that I had been using have been an disappointment, but it might as well be the phone's fault, not the app."* (Female test subject #1).

Male test subject #8 saw himself as more spontaneous in the early days of his smartphone usage and downloaded many apps out of curiosity, just because he found them innovative at the time. Nowadays, more and more apps are bad or even unusable in his opinion. *"Junk apps don't work properly or don't do what they said they would in a good way and in the end the user never uses them again."* Our interviews showed that many of the users had several junk apps installed on their phones.

Some users had downloaded apps that automatically closed down other apps, no longer needed. This pinpoints a problem

Fig. 3. The Time Machine

that users have too many apps that become too cumbersome to control. When answering the survey, many users were surprised to find out how many apps they actually owned. Some even found it to be tiresome to count their applications and wanted to make estimations instead.

To have users download apps, there must be an attraction, a trigger that connects to the lifestyle of the user. Equally important is to deliver the promises that led the user to download the application in the first place, otherwise the user will quickly move on to the next application.

Regarding download patterns, our interviews indicated that the number of spontaneous app downloads seemed quite low. Most test subjects stated that they download apps based on recommendation from friends or websites, and don't use the search functions or top lists guiding customers at the application markets: *"Now I'm almost never at appstore"* (Male test subject #4).

IV. CONCLUSIONS

In this paper we presented a location-dependent mobile app, that was evaluated through expert evaluation, as well as user evaluation conducted as a field observation, measuring the level of usability in the application. Results were used to form guidelines on how to develop useful mobile applications. Three main categories of results could be identified, being in the areas of:

1) *Usability/interface*. To be able to use an application, a simple and easy to understand interface was the most common requirement stated by the test subjects. Moreover, many comments specifically targeting single interface objects or

functions within the specific app were received during the field study. Many requests from users were already included in the wireframes, created before prototype design. This hints that the application has a good chance of being adopted for extensive and cohesive use by users.

2) *Purpose/needs*. Users also favored functionality that was easy to recognize, and that the app had an underlying idea that fit their demands. The informative nature of The Time Machine also raised requests regarding information updates, and a more dynamic approach to information and photo publication, also involving users. The time spent using the app varied a lot, e.g. depending on how much the user stood still or walked during the test.

3) *Knowledge of user habits and preferences*. In general, the main idea behind the app was considered interesting and the simple interface was much appreciated. Key factors to this success were developer knowledge regarding user needs; does it solve a problem and/or meet a demand? Will it provide simplification of tasks, an important service, or act as a time-killer? Or a combination of these? A successful app often combines different needs and answers different questions. The Time Machine provides users with historical as well as to-date information in a way that is perceived as both exciting, fun, and at the same time a great way just to pass the time. To translate and communicate these pretenses to the actual user, the developer must give extra attention to creating an user interface that reflects the anticipated user experience. Also, designers have to acknowledge the often heterogeneous user group. The user study carried out around The Time Machine is a good example on how diverse a target group can be today. Our user test pointed out examples of the target group

customization. Developers need to find problems that needs to be solved, and good basic concept that the applications will be based on. Design should reflect this basic concept or purpose of the application, but also take into consideration the application's target group. If these variables are in harmony, the chance of success is increased and developers may end up with applications that people are talking about and, most of all, are using.

Future work includes redesign of the application according to feedback from the users. A prototype that includes augmented reality has recently been designed, and implementation details can be found in [14].

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