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Challenges in "Mobilizing" Desktop applications: a New Methodology for Requirements Engineering

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Abstract

With the proliferation of mobile devices, the challenge today is to provide users with applications that are of real value. These applications are, in most of the cases, mobilized versions of desktop applications that fit the contextual requirements of mobility constraints. When developed from a desktop application, it is difficult to align the mobile application with user expectations because of the experience the user has from the desktop application. In addition, in current practices, we can notice a lack of relevant guidance that assists the analyst in building such applications. To overcome this shortcoming, we propose a methodology for requirements elicitation when mobilizing desktop applications. This methodology relies on using knowledge the user has from her/his experience on the desktop application on one hand and learning from strengths and limitations of desktop applications on the other hand. It helps the definition of the set of features that the mobile application should provide to meet users' expectations. An application has been mobilized following our methodology to evaluate it.

1. Introduction

Nowadays, mobile devices host a variety of applications from basic access to weather information to somehow complex transactions. One vision of mobile computing and applications is to deliver the power of network computing through devices one can easily carry and efficiently use. During the development of such applications, the challenge for the mobile industry is to provide applications that are of real value to people and businesses.

Most of the mobile applications are developed to mobilize existing desktop applications [1]. As defined in [2], there are mainly two differences between mobile applications and desktop applications: 1) usage patterns and 2) duration of use.

Usage patterns define the way in which people use mobile applications. Usually, a mobile application should have a few and specific features to make the discovery of information quicker, making them more focused than desktop applications. Duration of use refers to session length. The restricted resources as well as the context of use of mobile devices make people have short sessions when using their mobiles comparing to their desktop sessions that may last for hours and even days. Consequently, mobile applications have to provide a useful set of functionalities with an acceptable quality of service while being natural, focused, and intuitive.

Due to the aforementioned differences, the development of mobile applications has to be quite different from the development of desktop applications. Tools and techniques that have long been studied for desktop computing environments do not translate well the needs in the mobile environment [14].

Unfortunately, nowadays, we can observe that rather than mobilizing desktop applications, many industries have implemented miniaturized versions of desktop applications that are pushed into mobile devices. As expected, these applications suffer from poor usability, the root of user dissatisfaction [3].

In this perspective, we propose an approach for requirements elicitation when mobilizing desktop application. It makes use of the desktop application requirements, the knowledge users acquired from their desktop experience, and the usability study on the desktop application to build the features that the mobile application should provide. These features are further adapted to the mobile context to improve their usability.

The paper is structured as follows. Section 2 presents some related work. Section 3 defines the

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importance of usability when mobilizing an existing desktop application. In section 4, a classification of mobile application features with respect to desktop application features is proposed. In Section 5, we present our approach for introducing usability study in mobile features' definition. Finally, Section 6 concludes the paper.

2. Related Work

Too often, when companies decide to make a mobile version of their applications, they take their desktop applications, decide which features can/should work for mobile applications, and then convert those features to fit into mobile devices. While this approach leads to many product failures, to the best of our knowledge, no approach has been defined to guide the software engineer in the requirement elicitation phase of such applications.

Nevertheless, many researchers have demonstrated the importance of the usability study in the development of mobile applications. For instance, the authors in [4] showed, through two real-life case studies, that usability has to be integrated in the development of any mobile applications to end up with a useful product that takes into account real usage contexts. In line with the approach we are proposing, authors in [13] and [14] have made the previous user experience on desktop applications drives the implementation of the mobile versions. More precisely, in [13], the authors described the usability challenges of designing a mobile messaging application with voice capabilities. The key challenge they tacked is how to maintain the experience of the desktop when designing the mobile application. In [14], the authors have proposed a tool to re-author existing web sites. The *Highlight* re-authoring environment allows users to start with existing sites they already used and create mobile versions that are customized to their tasks and mobile devices.

Moreover, many researchers tackled the integration of usability in the design phase. In fact, they propose to evaluate the architecture with respect to the usability. One of the evaluation approaches used is the scenario-based approaches. As shown in Figure 1, quality sensitive scenarios are defined and used for architecture evaluation. However, they are not used in the requirement specification phase. Hence, the requirements are not evaluated against these quality-sensitive scenarios and the product may miss these in the case of mobilizing a desktop application.

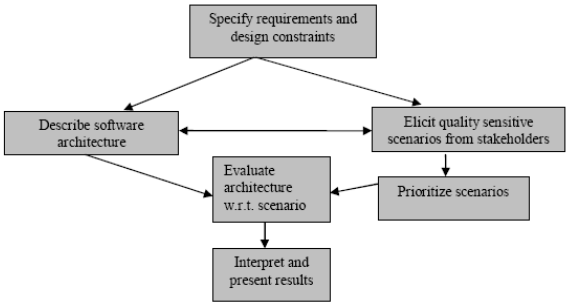

Figure 1: Common activities in scenario-based evaluation methods [5]

3. Usability: a Key factor for Mobile applications' success

Usability is a non-functional quality attribute of a software product. It is characterized by *the degree a product can achieve goals in a particular context efficiently, effectively and satisfactorily* [6-7]. Nowadays, it is well established that usability is an essential factor for determining the success and the user acceptance of any software product.

Usability attributes are the outcome of a usable product or system. These attributes are either objective or subjective. The objective usability attributes are related to the product such as effectiveness, learnability, and reliability. However, the subjective usability attributes are related to the user experience, such as positive attitude, user satisfaction, and product/system attractiveness [7-8]. In order to achieve high usability attributes, researchers have identified some usability properties to consider when designing the software product. They establish how well users can interact with the system and meet their goals [9-10]. They also embody heuristics and design principles that researchers have found to have a direct impact on system usability such as users' feedbacks, error management, consistency, and accessibility.

In current practices, usability properties are introduced as requirements at the design stage. We believe that such approach is not efficient when it comes to mobilize desktop applications. In fact, the user will always recall her/his knowledge from the desktop application and compare it to the current experience she/he is having on the mobile application. Ignoring this fact when collecting the requirements may lead to the omission of features of importance to the user, the implementation of features that are almost unused or inconsistent with the desktop application [11].

Consistency must be considered with great care. Unlike for new applications, the user has a preconceived idea about how to execute a specific scenario (where to click, how many required steps, etc). Changing this usage pattern will implicitly increase the learning curve of the mobile application which may lead to user frustration and, probably, her/his dissatisfaction. The challenge in fact is how to determine the requirements of mobile applications? And how the usability properties, more specifically, the consistency, should be taken into consideration during the requirements phase?

4. Classification of mobile application features

When mobilizing a desktop application, the analyst will start with the desktop application on hand. As previously mentioned, the goal is not to replicate the desktop features. To build a usable mobile application, the analyst has to identify the mobile features of importance to the users and that are aligned with her/his previous experience. To help the requirement elicitation, we propose to classify mobile application features into three main categories, as shown in Figure 2:

1. **Movable Desktop Application Features**: they represent the set of features that can be reproduced in the mobile applications either exactly or with little modifications to fit the mobile platform.
2. **Improved Desktop Application Features**: they represent the set of desktop features that have to be included in the mobile application but with major modifications. The modifications target to improve the usability of the desktop feature when moving to the mobile environment or/and to overcome some limitations observed on the desktop application.
3. **New Mobility Related Features**: these are features that do not exist in the desktop application. Since mobility may add some advantages, software engineer may use these advantages to build some new features that cannot be on the desktop application, to improve the usability of the application.

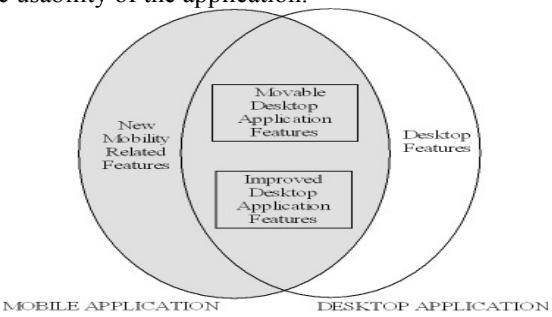

Figure 2: Mobile Application Requirements

5. Approach Description

The set of requirements of the mobile application would be different from the set of requirements of the desktop application. However, there is a clear intersection between the two sets. They should represent the scenarios of importance to users' satisfaction.

We target to use the desktop application during the selection of the set of features to consider in the mobile application, and during the refinement of these features, as shown in Figure 3. The purpose is to maximize the degree of consistency the mobile features have with the desktop application.

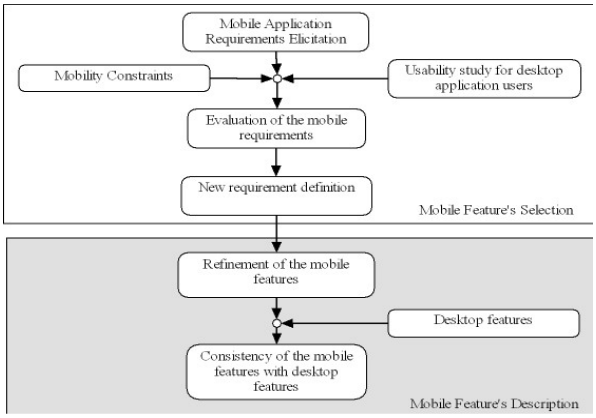

Figure 3: Approach Overview

5.1. Feature Selection

To guide the software engineer in determining the requirements of the mobile application, we describe a novel approach that takes into account the previous user experience of the desktop application. The approach consists of the following steps:

1. Classical requirements elicitation step: based on the requirements of the desktop application, generate the set of features to consider. They fall in one of the two first categories mentioned earlier: either "Movable" or "Improved" desktop features.
2. Usability study on the desktop application: during this study, we target to detect:
   a. The successful scenarios along with the most used features.
   b. How the end-user is using the application (which is usually different from how the designer was expecting it). Having such information helps the analyst to improve the features and more importantly remove any unnecessary steps especially that mobile applications have many restrictions.

c. The unused features (They in fact represent feature that can be dropped on the mobile application), and
d. The limitations of the desktop application to avoid them in the new application.

3. Projection of the result of the usability study on the mobile application requirements collected in phase 1. During this phase, some features may be added/dropped or annotated for modification or/and improvement. As shown in Figure 4, Feature 3 of the desktop application, kept by the analyst in the initial set of mobile application requirements, has been dropped when applying the desktop usability study and the mobility constraints. It reflects the case of rarely used feature that has little impact on the application usability and/or a hard feature to design in the context of mobility.

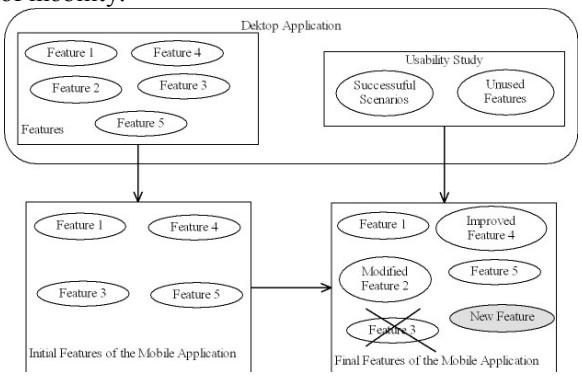

Figure 4 : Mobile Requirements Generation from Desktop Application

4. Complement the obtained set of features with mobility related features: These are features that are not in the desktop application. However, the analyst believes that they may provide a better user experience and hence improve the product usability. For example, features which push information to the mobile device.
At the end of this step, the analyst will conclude with a set of features to implement in her mobile version of the desktop application.

5.2. Features' Description: Consistency with desktop application

Having the set of features, the analyst should decide about their design: how to complete a user task using the mobile application? A key aspect is to leverage users' existing knowledge of the desktop application to the mobile application. During the definition of the mobile feature steps, consistency with the scenarios of usage of the desktop application plays an important role [14] in the final product usability: all the features should be designed in a way to preserve as much as possible the consistency with their counterpart in the desktop application.

6. Approach Application: M-2Me Case Study

To evaluate our mobile requirement definition approach, we developed a mobile application called "*M-2Me*" to provide students/parents with information related to students' grades, attendance, and schedule, in addition to other relevant information such as news, and events. This application is built based on an existing desktop application that exposes similar features to students.

The M-2Me implementation followed the desktop mobilization approach as stated in the above figures (3 and 4). We aim to maintain more or less the same features of the desktop application and expose them to be used via mobile devices. We first extracted and classified the desktop application requirements from the user perspective as shown in "Initial Features" in Table 1. Then, using the desktop usability study, we have derived the final set of features the M-2Me mobile application should implement. We draw the attention to two important facts: 1) three features that have been considered in the first stage, were simply removed. *Mail Service* and *Discussion board* turn to be two features that are almost not used. However, *Post/upload files* is a feature that requires desktop application since different formats/size of files can be uploaded. 2) We defined a new actor to the application: *parent*. Most of students' parents are mobile users; while very few are computer literate. We take advantage of this and define a new feature to process request parent's authorization.

Table 1: M-2Me Features Definition

List of features	Initial Features	Final Features
Students calendar, Grades, and schedules	Movable Feature	Movable Feature
Events and news	Improved Feature	Improved Feature
Authorization		Mobility Related Feature
Discussion board	Improved Feature	Removed
Post/upload files	Movable Feature	Removed
Mail services	Movable Feature	Removed

Subsequently, we refined the M-2Me features to come up at the end with final mobile features that are comparatively consistent with the original desktop application: the steps that a user goes through to complete a task in the mobile device are as close as possible to the steps she/he used to complete for similar desktop task. The figure below shows the

architectural design of the *M-2Me* mobile application we have developed to validate our approach.

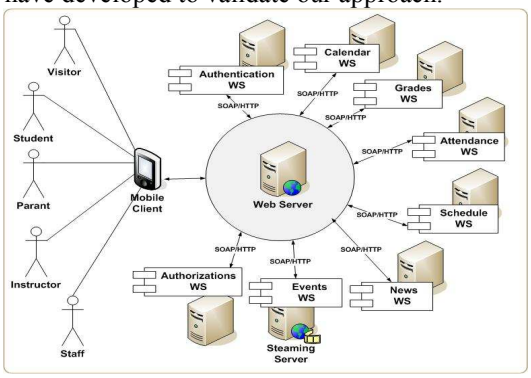

Figure 5: M-2Me Implementation

The M-2Me is developed fully based on Web Services technologies for many reasons that can be summarized as following: (1) increase the flexibility and the reusability of the application features, (2) improve the portability of the desktop application's features since all web services can be used by both desktop and mobile application, and (3) ensure scalability by supporting increased number of features. Snapshots of the application are shown in Figure 6.

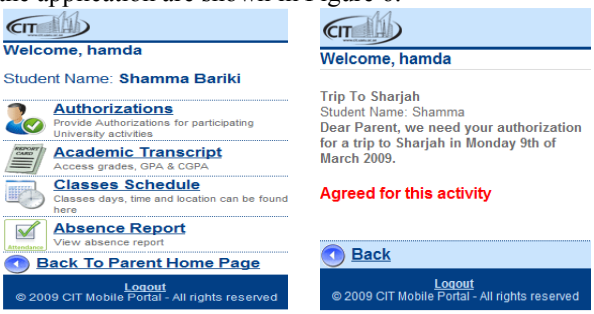

Figure 6: Samples of M-2Me Snapshots

7. Conclusion

In this paper, we presented an approach for requirements elicitation when mobilizing desktop applications. This approach is twofold: 1) features selection phase where the usability study on the desktop application is used toward an efficient selection of mobile features, and 2) feature description phase (or refinement), where desktop application features are considered as reference/benchmark when building their mobile counterparts in order to achieve high level of consistency between them. We have used the mentioned approach in the development of M-2Me application.

We are currently conducting a usability study for the M-2Me application. It targets two groups: users that are familiar with the desktop application and users that are not familiar with the desktop application, in order to evaluate the impact of applying our approach on the usability of the mobile application in general. We are also investigating formal techniques to measure the consistency of features.

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