

# Towards a Handbook for User-Centred Mobile Application Design

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**Abstract.** Why do we have difficulties designing mobile apps? Is there a “Mobile RUP”?

## 1 Introduction

The starting point for the discussions in the working group was the observation that it is harder to design mobile applications than “normal” ones. Starting from there, we first tried to identify reasons why this is the case. Our approach to doing so was to first collect and discuss sample scenarios for mobile applications and their characteristics. We then shared our experiences in developing applications for some of these scenarios. We quickly realized that the term “mobile applications” covers an area that is too broad to come up with any common characteristics for all the different application domains and scenarios. Therefore, we decided to concentrate on applications supporting mobile users (in contrast to, e.g. applications where exclusively or primarily the code is mobile or applications with no human user). From there, we tried to identify design dimensions that need to be regarded when designing user-centred mobile applications. The sheer number of dimensions identified is an indication of the complexity of the mobile design process. We discussed the notions and the issues of mobile application development along these identified dimensions. We concluded our discussions with the realization that a handbook for mobile application design that gives hints about how to handle the individual dimensions and also which interrelationships exist between those dimensions would be extremely helpful.

The remainder of this paper is structured as follows: In Section 2, we briefly summarize the scenarios regarded. Section 3 describes our experiences with developing mobile applications. Section 4 gives an overview of important design dimensions, while Section 5 explains about the idea to create a design handbook.

## 2 Scenarios for Mobile Applications

In the working group we started discussing several scenarios to elaborate relevant requirements for a user-centered mobile application design. The results are briefly summarized in the following paragraphs.

In the *Tourist Scenario*, mobile users with their devices need location-related information provided by an institution. There are both non-commercial and commercial variants of this scenario.

The *Mobile Gaming Scenario* is an Adventure Game in the "real world", without intrusive AR equipment. In this scenario mobile users in different roles explore a physical area and solve virtual and real world riddles and tasks, alone but also cooperatively to achieve a common game goal. Besides the game idea and the technical realization, important aspects of these games include learning from social interaction as well as an increase of creativity of mobile users.

The *Travel Scenario* can be considered as a "Bring me home button" on the mobile device. This scenario is task-oriented, has high practical relevance due to a high frequency of usage.

The *Personal Memory Scenario* represents the use of mobile applications for remembering personal experiences, improving access to personal information (date, location, people, ...), and easily sharing and extending personal "memory" by direct interaction with peers.

*Sales Force Support Scenario* (blue collar)

*Health-Care Scenario* collaboration

In the "*In the field*" Scenario (military, police, disaster, ...) use of sensors, monitoring, support, ...

*Dating scenario* represents interacting with peers by tooting (bluetooth contacting), i.e. to organize conference meetings or taxi sharing at airports.

### 3 Experience with developing mobile applications

This section makes the attempt to summarize a rather unstructured, brain-storming like discussion on our experiences with developing mobile applications. Most of the experiences listed were made by a significant number of the working group participants. Thus, we believe, that all the aspects mentioned are relevant not only for the concrete situation in which they occurred, but are of broader interest. Also, we tried to identify those experiences that were strongly related to the fact that we were developing *mobile* applications, i.e. experiences that would not have occurred if the software developed had been for a desktop computer system.

The experiences can be classified in three major groups: scenario-related, prototype-related and general.

#### **Scenario-Related Experiences:**

Scenarios are an excellent tool for communicating ideas and visions. They can be used to motivate the need for funding, to make sure that user requirements and expectations have been properly understood, and also to communicate within a development group. However, even a well worked-out scenario is not a replacement for a requirements analysis and a clear specification.

Scenarios are particularly suitable for new (visionary) application domains. They might be less appropriate when the task is the optimization or mere adaptation to mobility of existing applications. However, even in these cases, a scenario-driven approach might help to exploit the full potential of mobility.

A big advantage of scenarios is that it is easy to center them on the user. Thus, a scenario will help to focus application development on the user needs. This is even more important in mobile applications than in desktop ones. The main reason for this is that often mobile users will not be focused on the mobile application, but will be in a more complex usage situation and prefer to use intuitive, appliance-like applications. For some scenarios, e.g. vehicle ones, determining what degree of intrusiveness is appropriate is a non-trivial task.

Scenario-driven development should be clearly distinguished from technology-driven development. In the first case, a (visionary) usage scenario drives the development, in the latter case, a “neat” technology is the driving force and a showcase scenario is added later on to justify the development. In our experience, scenario-driven development brings up the fancier, farther reaching, and more influencing, but sometimes also easier to implement (“simple things work better”) applications than the technology-driven development. The hard thing is to get both together: to showcase cutting-edge technology using fancy applications.

#### **Prototype-related Experiences:**

On the one hand, prototype development is harder for mobile applications, on the other hand it is even more crucial here than in the traditional case.

One reason why it is harder is the comparatively high cost of development of meaningful prototypes. In particular, the cost and difficulty of content creation (in particular rich AV content) have to be considered. Also, if prototypes are to be used in evaluations, they need to run on appropriate, i.e. often expensive, devices. For instance, users will not be willing to evaluate a mobile game if forced to use heavy laptops. The limited resources of small but handy devices increase the complexity of the prototype development even further.

Prototypes are particularly crucial in mobile application development because often they are the only way to identify non-anticipated “difficulties” arising from new technology and new usage situations. Some difficulties that have been encountered by members of the working group and that are specific to mobile applications are: include the following:

- GPS coordinates are in practice less precise than in theory.
- There can be a mismatch between the DB model and the state of the real world.
- In one case, the designated users refused to take laptops with them to field work for fear of their cars being broken into with such a valuable cargo.

Also, users may use the system different from the expectation the designers had.

### **General Experiences**

There exists a certain conflict between "practical relevance" (& non-commercial funding) and "openness towards innovation". A typical example for this are mobile gaming applications.

Simple things may work better than complicated solutions. While this certainly is true for almost every piece of software, it seems to be particularly true in mobile environments. One reason seems to be the different usage situation: Often, the user will not concentrate on the mobile application, but will be busy doing something else, e.g., driving a car. In such a context, the user is easily overwhelmed by too much or too complex information or interaction. Examples of successful, easy solutions are: “toothing” (dating scenario) and “sound navigation”(volume only, not volume + sound pattern).

## **4 Design Dimensions for Mobile Applications**

When trying to generalize from the characteristics described in the scenarios’ section and our own design experiences, a number of dimensions that need to be taken into account when designing mobile applications can be identified. Not all of these

dimensions will be of importance to any given application; however they can be used as a guideline.

It is important to note, that these dimensions are not necessarily orthogonal. In the contrary, a number of them are highly dependent on one another. This makes it impossible to regard them individually, e.g., in a sequential order. Rather, it is important to be aware of the interdependencies and to ensure common modeling of interleaved aspects. Existing and different mobile applications in different application domains for different user groups show different characteristics. However, to our observation, they share the commonality that they all realize different dimension, though to a different degree.

During the working group meeting, we compiled the following list of dimensions. It is quite possible, that further analysis of the problem will identify further dimensions. We believe, however, that this list is a good starting point for a more systematic approach to mobile application design. The order in which the dimensions are listed is random:

#### **Scenario-related dimensions**

- Story design
  - This aspect covers the question what the central story of the design. Even though certain mobile applications do not necessarily actually instantiate a “story” the central underlying message and the central goal of the application needs to be identified.
- Task design
  - Within the task design the single tasks a user performs to achieve a certain goal need to be identified. These can be navigation, orientation, finding, seeing, investigating, learning, .... in and with the mobile environment.
- Spatial layout
  - movement of the application and the user
  - indoor, outdoor
  - user has been at the same place earlier
  - Design where to put base stations and where to go for (inter)actions.
- Temporal layout
  - When is the application running
  - How long does it take in total, in different steps
  - How many users at the same time (interacting, collaborating, competitive)
  - Synchronous, asynchronous usage, communication
- Spatio-temporal design, user movement
  - The spatio-temporal design aspects of a mobile application concern those design aspects that have to be additionally considered, because the users’ location and topology in 2D (or 3D) space as well as its change over time are influencing the software design process. This concerns the requirements

analysis, the implementation and the evaluation of the software developed. During the requirements analysis it is important to select special spatio-temporal requirements of the mobile application, such as retrieval of the location of the mobile users in time, max. required spatial area, expected movements, expected speed of the mobile users, expected size of areas for ad-hoc networks, other types of spatial or spatio-temporal database queries, topology of the users, neighbourhood relationships, history of software development etc.

- When and where are the user moving over time
- Remember location and time and movement

#### **Interaction-related dimensions**

- Interaction design, interaction patterns
  - Which interactions are expected, needed between the mobile application and the user, can we identify interaction patterns
- Collaboration
  - Are the users achieving a collaborative task? alone, in pairs, in groups, sequential, parallel,
- Modality Design
  - input and output modality – which are the most suitable input and output modalities for the user group and application task
  - degree of intrusiveness– to which degree should or even must the user be left alone or warned/informed about an application or environment change

#### **User-related dimensions**

- User groups
  - Crucial, not only for mobile applications is to clearly identify the targeted user group(s). For whom is this applications, single user, user groups, age, background, physical capabilities, cognitive capabilities, cultural background. Identify different user situations and intention of the user at a particular time
- **usage (user) situation,**
  - **Where is the user?**
  - **What is she/he currently doing?**
  - **Who else is close to the user?**
- Personalization design
  - how user adaptive is the application is the system
- User (profile) design
  - anonymous, identified user, language, preferences
- Role of the participants
  - Are the stationary user, who are the mobile users, is there an audience, are there different roles of users wrt the application

#### **Data/Content-related dimensions**

- Content design
  - For the application it is to be decided what content is needed for the application is, and in which different media types.

- Data design
  - Data model, distribution of data, data movement design (post it notes, hints/ server/mobile device)
- Context design
  - how context adaptive is the application, what is the relevant context, how should it influences the application

#### **Communication-related dimensions**

- Communication
  - Are the users communicating with other users, with a central / distributed server, with a location, leave messages, send messages, find messages; Synchronous, asynchronous; unidirectional , bidirectional, Point-to-point vs. broadcast
  - Connected/disconnected mode design
  -

Orthogonal aspects that apply for mobile application development are

- Scalability, cost of the game, devices needed, security, privacy issues, network traffic, local storage,
- Device “independent” design, heterogeneous devices, changing capabilities of devices
- Technology design and selection
  - which technology is used, software, protocols, devices, hardware, network, ....
- Content implementation design
  - rely in existing content, get it, integrate it, up to date content
- Implementation design, implementation plan
- Prototype planning, Prototype realization
- Field test planning and evaluation planning
- Field test and evaluation

## **5 From Ad-hoc Experiences towards a Design Handbook**

First our goal is to evaluate the example to elaborate relevant aspects of user-centered mobile application and develop a design handbook as a result. The handbook possibly plays a role in proposing new process model concepts (RUP).

The potential uses of a design handbook could be mobile application development in education and as a research methodology (Engineering). Moreover an industrial usage of the handbook is also possible for mobile application development projects.

Since a number of the participants from the working group were highly interested in the development of such a design handbook, the working group agreed to further pursue this goal.

We decided on the following approach: This document will be used to solicit further contributions to such a handbook. At the same time, efforts are undertaken to obtain the possibility to edit a special issue of an appropriate journal on the design process. Contributions to this journal should be made by members of the working group, but also by people from the outside.