



Challenges in Mobile Application Development

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Mobile systems and mobile applications have gained a lot of attention both in research and industry over the last years. The market share of mobile devices is constantly growing. More and more, users expect their mobile devices to provide functionality similar to the one they know from their desktop computers, but also to provide additional, mobile device specific functionality, like location based services.

However, software development for mobile devices is still cumbersome and a methodology geared towards supporting the development of such mobile applications is still lacking. While there is broad agreement that developing for mobile devices is more difficult than traditional software engineering, we lack a precise understanding that goes beyond anecdotic evidence of why this is the case and how the situation can be ameliorated. We do not precisely know where and how the development of mobile application differs from “normal” software development and where new methodologies are needed.

Aspects that need to be addressed in this context are, among others, the questions of software architectures for mobile applications, approaches to the software design for mobile applications and how the consequences of being mobile, e.g., changing location, changing

context, changing connectivity, heterogeneous software and platforms influence the software development process and what design approaches do reflect the specialties of mobile applications and systems appropriately.

While this special issue cannot provide a definite or complete answer to these questions, it does provide answers to some important aspects. In the following, we will first try to get a more thorough understanding of some of the main differences between mobile and classical application development and will then discuss how the papers contained in this special issue address these differences.

Design Dimensions

In 2007, a GI Dagstuhl Research Seminar on “Software Development Methodologies for Mobile Applications” took place. During that seminar, which was attended by most of the authors of this issue, the challenges with respect to mobile application development were grouped into three main dimensions:

Architecture. Mobile devices are challenging environments for software development: They have limited capabilities and programming interfaces and they are highly heterogeneous. Together, these factors often result in the need for

customization of mobile applications for individual device types – a time consuming and costly endeavor. On the other hand, many mobile applications require similar building blocks, e.g., the possibility to determine a user’s location and use it to influence the application’s behavior, or the integration of different context sources. Application environments geared towards traditional software engineering support these specific needs only poorly, if at all.

Data and Context Management.

Data and context management really are two dimensions, however, often they are so tightly intertwined that we decided to treat them together. The main question that needs to be answered with respect to data management in mobile applications is what data to store on the mobile device, how to get it there and how to keep it synchronized with data on a central server. The underlying assumption here is that mobile users will not constantly be connected to a central server but will need access to data nevertheless. Data will thus need to be transferred to the mobile device and to be managed locally before being reintegrated with the original data source. Often, these decisions are dependent on the context of the user, e.g., the task he is solving, but also his location, and maybe even fac-



tors like the time of day etc. Context plays an important role for mobile applications beyond the data management, however. Often, the user context will directly influence the application and its behavior. It is therefore important, that context is correctly modeled, stored, and efficiently handled.

User Interface. If an application needs to run on a smartphone and must be usable by someone whose main task at the moment is not to deal with the application but rather to drive a car or to find her way, the user interface quite obviously needs to be completely different from that of a desktop application: It needs to adapt to a small screen, to input and output capabilities that are on the one hand limited compared to traditional computers, but that on the other hand comprise modalities not available in a classical setting. The developer needs to make sure that the interaction is adapted to the current situation of the user, e.g., switch between visual and acoustic output, postpone output until a user is not distracted or a distraction is not critical, etc. All of these issues represent aspects that interface designers have no experience with from normal software development. In particular, while we possess knowledge about ergonomically good interfaces for desktop computers, there is little data yet on what is a good interface for a given mobile application. User tests thus play a far more important role here than they do for desktop applications.

Overview of the Special Issue

This special issue contains altogether four papers.

The first paper authored by *Daniel Wichmann*, *Martin Pielot*, and *Susanne Boll* all from the University of Oldenburg and the OFFIS research center, deals with the *architectures* dimension: It argues that dedicated development frameworks that optimally support the needs of mobile application developers are

needed and presents the COMPANION development framework that has been created in the authors' group. This framework provides a collection of reusable modules for often needed functionality like location sensing as well as a library of commonly needed supportive tasks like logging. Developers can use these building blocks to create their own mobile applications.

The second and third paper both deal with the *data and context* dimension. In their overview paper, *Hagen Höpfner*, *Essam Mansour*, and *Daniela Nicklas* describe and classify the different possibilities for data management for mobile applications. After briefly describing how data can be stored on a mobile device, they introduce three classes of data management approaches, namely caching, hoarding, and replication, and explain how they differ with respect to aspects such as: Which resources are required on the mobile device to support this solution? Can data on the mobile device be changed? Who decides which data to put onto the mobile device? etc. The paper thus provides an excellent basis for decision making by an application developer, but also points out which aspects require further research.

The authors of the third paper, *Daniela Nicklas*, *Matthias Grossmann*, and *Matthias Wieland*, all have gained extensive expertise on context-aware applications within the NEXUS DFG Collaborative Research Center. In their article, they use one of the NEXUS applications as a running example to introduce their approach to context modeling. At the heart of this approach lies a layered context modeling architecture that allows to decompose the complex context modeling and management into well defined sub-tasks and eases sharing of context across different applications.

Finally, *Thomas Grill*, *Bettina Biel*, and *Volker Gruhn* address the *user interface* dimension. They propose a pattern based approach to-

wards mobile interaction design. They identify and explain the different phases involved in interface design. This abstract description is followed by a detailed case study involving exhibition visitors using their mobile phones to interact with a projection of the earth.

In this special issue of *it*, we have put together a number of articles that will hopefully help the developers of mobile applications to make the right decisions and that will also help people new to the field to understand the challenges of mobile application development. Ideally, it will inspire them to develop their solutions to these challenges.

Of course, a single special issue cannot provide a complete and balanced solution to such a complex problem area — in fact, it cannot even provide a complete description of the problem. There is, however, an ongoing effort that aims at providing such a more complete look: The participants of the GI Dagstuhl Research Seminar “Software Development Methodologies for Mobile Applications” are about to finish compiling an overview book. This book will provide an in depth discussion of the state of the art on software development for mobile applications and will comprehensively cover all the dimensions that could only be touched upon in this special issue.

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2008 | XVI, 419 S. | Flexcover

€ 34,80 | ISBN 978-3-486-58650-3

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