

USER REQUIREMENTS IN MOBILE SYSTEMS

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Abstract

It has long been realized that knowing precisely what to build is the hardest single part of building a system, and the saying holds true in mobile systems. This paper identifies challenges that mobile systems pose in requirements engineering and examined seven studies selected from recent literature in both research and academic worlds. These leads to one conclusion: the current status of practice in mobile systems is more prone to “giving users what we have, not asking users what they want.” To solve these issues, methods aimed at effective and efficient requirements gathering and analysis in mobile systems are proposed.

Introduction

Though wireless voice communication has been around for a while, truly mobile systems and applications have just started. The versatile applications span from PDAs to wearable computers to electronic gadgets attached to GPS receivers. Despite of all the hypes and promises, the current mobile systems and applications are disappointing. This paper aims at tracing these issues back to their origin: the requirements phase. In particular, the research questions are:

- What are the challenges that mobile systems pose in requirements gathering and analysis?
- What is the current status of practice of requirements engineering for development of mobile systems?
- What methods would be effective in conducting requirements engineering in mobile systems?

Given this is a new field, there are very few work that have been done so far. The limited researches that have been conducted are rarely from requirements perspective, but are mainly usability studies after systems have already been developed.

Challenges of Mobile Systems in Requirements Engineering

Compared with fixed-location applications, mobile systems have the following characteristics: [Rodden, 1999] [Pascoe et al, 1999]

- Dynamic environment: The interaction between system and user is highly fluid.
- Contextual: Applications are highly related to the context of where they are in.
- Limited Attention: Users can only pay limited attention to applications
- Spurts of activity: Activities in time-dependant observations happen in spurts.

Based on these characteristics, the challenges that mobile systems pose in requirements engineering are:

1. Users don't know what they want. This known-fact in requirement engineering get worse in mobile systems as users can only have remote imagination of mobile systems that they have never used before.
2. No fixed forms of interaction. In order to get requirements, it is necessary to identify typical use cases. In mobile computing and communication system, this is hard to accomplish because of the dynamic and contextual nature of mobile systems. Diversified users, tasks, contexts and the interaction between these factors are hard to describe and thus makes requirements gathering difficult.

3. Context dependent. Because applications are highly integrated into their context of activities, traditional requirements gathering methods that separate users from their real working environment don't work.
4. Project schedule and confidential concerns make large requirements gathering activities impractical. Mobile and wireless systems market are highly competitive. Actual projects are always under extremely tight schedule and highly confidential to retain the first mover advantage. Thus only limited requirement elicitation and analysis can be carried out.

Selected Studies of Requirements Engineering in Mobile Systems

Table 1. Selected Studies in Mobile Systems

No.	Researchers	Purpose	Subjects	Methods	Sample Findings
1.	Pascoe et al.	To get usability of mobile devices in field work environment	Fieldworkers—e.g. ecologists and archeologists	* Iterative process using prototyping applications on Palm Pilots	* Needs for in-directive operation, e.g. eye-free / single-hand operations • Needs for context-awareness applications, e.g. use a GPS receiver attached to Palm and automatically fill in location info
2.	Brown et. al.	To learn information capture practice at work for design of information capture devices	11 professionals who worked at Hewlett Packard	* Diary method using digital cameras for one week to record incidents of information capturing • Semi-structured interviews	* Taxonomy of information capture activities • Detailed descriptions of subjects' capture practice.
3.	Koskinen	Short Message Service—Its current use, impact on social norms, values etc.	Young adults between 20-25 years	* Ethnographic research, iterative process • Individual/ group interview • Participatory/non-participatory observation	(Expected results will be used for user interface & application design for Nokia)
4.	Väänänen-Vainio-Mattila & Ruusk	Gather Users' needs and design ideas for Nokia 9000 Communicator	6 mobile professionals	* Observation for a few hours of each subject. • Contextual inquiry and affinity diagram to identify emerging themes of users' activities.	* Users needed to organize info according to their own logic—provide means for personalization • Frequent contact info needed to be treated differently than other contacts.
5.	Palen et al.	Behavior and practice of new mobile phone users	19 new mobile phone users	* Three interviews for each user during the first 6 weeks after service acquisition • Voice-mail “diaries”	* Mobile devices were integrated into daily life and social life.
6.	Hjelmeroos et al. (Usability study)	Nokia 9000 Communicator browser usability -- internal/external consistent	Group 1: novices/friendly users Group 2: error hunters + developers of third-party software	* Interview (video taped) • Questionnaire	* “Hot list” as default home page worked fine • Functional layers were confusing • “Back” & “Previous” button were confusing
7.	Nielsen J. (Usability study)	Effectiveness of WAP (Wireless Application Protocol)	20 experienced mobile phone users in UK	* Self-recorded diary • Usability test • Interview	* 70% said that they would not be using WAP in a year • Time-consuming and expensive. E.g. check local weather took about 2 minutes

Of these seven studies, the first five were conducted on the purpose of getting requirements. Study 6 and 7 are both usability studies that were conducted after products were developed.

Suggestions in Conducting Requirements Engineering in Development of Mobile Systems

The two major phases in requirements engineering are requirements elicitation and analysis. In requirements elicitation phase, the methods frequently used are interviews, self-reported diaries, and participatory observation. These methods are mainly based on heuristics and result in qualitative results or ad hoc comments from users. In the requirements analysis phase the methods used are context inquiry and prototyping. These methods also lack of formality. The iterative process between requirements elicitation and analysis depends heavily on effective use of qualitative results to refine prototype. The current practice of this phase is done in an ad hoc way either. To improve the situation, the following approaches are proposed:

- Context based requirement gathering. Mobile applications are highly dependent on their contexts. Analysts of mobile systems need to catch dynamics of systems in “Life World”. This approach is similar to what has been used in social science where the world in which people live is incorporated into researches. To get requirements in mobile environment, it is necessary to go into users’ real life to capture their needs of system. For example Väänänen-Vainio-Mattila and Ruuska [1998] used contextual inquiry method to get users requirements for Nokia 9000 communicator. This method can be used in the early phases to get input and create basis for design ideas.
- Prototyping for educating users and developers alike. The importance of prototyping in getting requirements cannot be overstressed. Prototyping is especially useful when the requirements are not clearly understood. [Gomaa, 1990]. Mobile systems present a whole new world of future communication and computing patterns, and users’ needs are vague at the current stage. Using prototyping can make users and developers clear of what users want and what are feasible to achieve.
- Formative evaluation. One important usage of prototyping is to get further requirements from users. These requirements are usually in the form of qualitative information, such as interviews, diaries etc. How to make effective use of such information to improve prototype is a crucial issue. A method called formative evaluation [Galal, 2000], which aims at shaping the system through iterative prototyping and evaluation process, was proposed. Other methods based on mathematics can also be applied in the analysis of qualitative information.
- Scenario analysis. Scenario analysis is the process of understanding, analyzing, and describing system behavior in terms of particular ways the system are expected to be used. [Hsia, 94]. This method is particularly suitable for mobile system development because of users and engineers can break down highly diversified tasks into scenarios in which users can better describe their needs. The end product of scenario analysis is a document that consists of sets of correct, complete, consistent, and validated scenarios. These scenarios can be used as guideline for system design and testing as well.
- Establish user profile. Due to the confidential and competitive nature of mobile industry, it is impossible to conduct fully scaled studies given limited resource constraints. Establishing user profile helps analysts quickly identify needs for new products. Previous research results can be used to establish these profiles, such as young adults, or new mobile phone users practice. These profiles are also helpful when no overt users for products under development are available.

Future Researches

Given time and resources limits, the current research focused mainly on literature published in conference proceedings in recent three years. Future research needs to expand the breadth of the coverage. The mobile devices markets in US and Japan are of particular interest and should be included in the research, given resources availability.

Besides extending the breadth, the depth of research is another avenue to pursue. For example, case studies of prevalent mobile devices from Scandinavian countries such as Nokia 9000 communicator and its relative unpopularity in US would be another topic to explore.

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References

References are available upon request with the first author.