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Towards a Lightweight Approach for On-site Interaction Evaluation of Safety-critical Mobile Systems

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Abstract

The infrastructure organization of large-scale events involves high safety requirements for the visitors and is a central issue for the officials in charge. To assist in dealing with this, we developed the RESCUER app, which runs on smartphones and allows the crowd to report about an emergency, thereby improving the process for rescuing humans in an emergency. For the evaluation of the app, we faced the problem that people participating in a large event, such as a soccer match, are not willing to spend time on completing a long survey or interview. Hence, the goal of this contribution was to select and perform an on-site mobile evaluation approach that fits this context and allows us to evaluate the user interaction. The evaluation took place during the FIFA World Cup 2014 and tested the usability of the app with 112 users in Brazil and in Germany. As a result of the evaluation, we found severe usability issues and concrete insights into how to solve them. For our evaluation approach, it means that on-site mobile evaluation is an appropriate method for improving the usability and interaction of safety-critical software systems.

Keywords: Mobile app; Emergency management; Evaluation; Usability

1. Introduction

The measurement of usability and user experience as part of user studies is made possible by the use of quantitative and qualitative methods[1]. These methods can be applied as part of controlled environments as well as in

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real contexts. However, there are important questions regarding the adequacy of these methods. Lang (2013), for example, claims that the usage of user studies in the field of mobile software systems within real context of use is overrated and it is not necessary[2]. This statement is based on statistical insights such as that 73% of smartphones users also use their devices in bed respectively on the couch[3]. This implies that user tests in controlled environments are more adequate because there would be reproducible influence factors. Contradicting Lang (2013), IGD (2015) revealed that 69% use their smartphones during work, 51% on weekends, and 42% while commuting between home and work[3]. This means that a preference for controlled environments for evaluation purposes implies that many usage contexts would not be taken into account.

Considering the main objectives of a user test is essential, i.e., understanding a user's behavior in a real context, such as while interacting with objects of daily use. This includes considering the fulfilment of user requirements in specific usage scenarios and analyzing the extent to which the system meets the mental model of use[1].

These objectives can only be achieved by field studies. In contradiction to Lang (2013), we consider it highly relevant to evaluate mobile software systems in real settings as part of field studies[2]. Known approaches for field studies of mobile software systems are for instance: Guerrilla and Lightweight Testing[4], In-The-Wild Testing[5], or Fly on the Wall-Study[6]. These types of studies show that evaluations in the field – i.e., where the users apply the mobile software system – reveal deep insights into the usage of the mobile software system. The performance of user tests in real context may be quick and flexible. Furthermore, they are adequate for samples of any size and enable the combination of quantitative and qualitative measurement approaches in order to examine the interaction between mobile devices and the real world[7]. These factors were essential arguments for our decision to perform field studies in order to collect experiences.

The field study presented in this paper was performed within the scope of the project RESCUER (Reliable and Smart Crowdsourcing Solution for Emergency and Crisis Management), which aims at developing a complete platform to support command centers in quickly handling emergencies and managing crises based on reliable and intelligent analysis of crowdsourcing information during large-scale events[8]. The RESCUER app is one of the components of the RESCUER platform, which also includes the Data Analysis Solution, the Emergency Response Toolkit, and the Ad-hoc Communication Solution. The RESCUER app supports the notification and characterization of an emergency situation by involving the crowd at the place of an incident. Our goal was to explore the participation of the crowd just after an incident has occurred, while they are still close to the site of the incident, in terms of informing the command center about the incident and describing its main characteristics. Consequently, we needed to answer the following question:

> How to evaluate the usability and interaction of a mobile application for emergency situations in the site of a large-scale event?

Especially right before a large event, such as a soccer match, visitors are not willing to spend time on completing a long survey or interview. Therefore, when planning the performance of a user field study, it is necessary to keep it as short as possible, while still covering all essential aspects. This paper describes the RESCUER mobile crowdsourcing app, our on-site evaluation approach, its results and discussion. Finally, we present first insights and lessons learned based on our study, which was performed at venues of the FIFA World Cup 2014.

2. The RESCUER Mobile Crowdsourcing App

The RESCUER app uses crowdsourcing information, meaning that eyewitnesses and first responders to an emergency provide data to the emergency services via their smartphones. This includes data from physical sensors embedded in the mobile device as well as information purposefully given by the user through a specifically designed app (see Figure 1, right). These data should be transferred via mobile Internet networks. They include information about the incident (e.g., categories such as "fire" or "explosion"), pictures or videos of the emergency site, the GPS location, and more detailed information about the emergency depending on the emergency type, e.g., whether people are injured or the extent of a fire. By filtering, combining, and analyzing different pieces of crowdsourcing information, the emergency centers and services should be able to react to an emergency more quickly and efficiently. To help achieve this goal, the RESCUER app should have a high degree of usability and support the user even in stressful situations with a user-friendly design.