

# RECON: Capturing Mobile and Ubiquitous Interaction in Real Contexts

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## ABSTRACT

Evaluating the user experience of mobile and ubiquitous applications is a challenging task. They are becoming increasingly complex and tightly interwoven into the fabric of everyday life and thus cannot easily be taken out of context and evaluated in controlled experimental environments. Methods for studying the user experience of such applications in the field tend to be cumbersome and expensive with regard to time and manpower, and they generally do not scale well with number of users and duration of studies. RECON addresses these challenges and provides an addition to the methodological and practical toolbox from which researchers and practitioners can draw when conducting field experiments. It facilitates automated capture of general usage and application specific interaction augmented with information about the context in which it occurs. RECON enables researchers and practitioners to conduct large scale remote studies of mobile and ubiquitous applications in real contexts.

## Categories and Subject Descriptors

H.5.2 [Information Systems]: User Interfaces — Evaluation/methodology, Graphical user interfaces (GUI), Prototyping, Theory and methods

## General Terms

Measurement, Performance, Experimentation, Human Factors.

## Keywords

Ubiquitous, mobile, usability, user experience, interaction, context, capture, tool, field study, in situ.

## 1. INTRODUCTION

As emerging mobile and ubiquitous computing systems get more complex and tightly interwoven into the fabric of everyday life, it gets more difficult to evaluate the user experience of such systems. They cannot easily be taken out of context and evaluated in controlled experimental settings. Intuitively they should be evaluated in their intended contexts of use. However, arguments against field studies are that data collection is difficult, costly and that such experiments lack control of the contextual parameters [4]. They tend to be expensive with regard to time, manpower and logistics, to be obtrusive to the user's experience as they rely on the user to actively report data or observers to be physically present, and to not scale well with the number of users, duration of study, and geographic area in which the study is conducted.

## 1.1 Mobile Devices as Data Collectors

Mobile personal devices are becoming increasingly powerful with regard to processing power, memory, network capabilities, permanent storage and sensing capabilities. By utilizing these features of today's mobile devices it is possible to capture rich data about the usage and context of mobile and ubiquitous applications in the field.

## 1.2 Context

When discussing context capture through mobile devices the following definition of context will be used:

*"Context is the sum of relevant factors that characterize the situation of a user and an application, where relevancy implies that these factors have significant impact on the user's experience when interacting with that application in that situation."*

It builds on the widely quoted definition by Dey [1] but emphasizes the user experience and the situatedness. When talking about capturing context in this paper, it thus refers to capturing information about these factors; while acknowledging that such information will never be complete as both the capturing capabilities of mobile devices and our understanding of what factors influence the user experience are limited. It is up to the individual evaluators to specify which factors are relevant for their specific studies.

## 1.3 State of the Art

Several other tools have emerged in recent years for capturing data about the user experience from mobile personal devices. The following are representative of the state-of-the-art systems and have all been successfully used in field studies: ContextPhone [6], MyExperience [2] and Xensor [3]. All of these, like RECON, feature generic capture of context through a given mobile platform.

Most notably RECON differs by integrating tightly with the specific application to be evaluated at the interaction level (see section 2.1). Also, with a goal of being unobtrusive to the user experience, RECON does not use qualitative user input through questionnaires during the study - although it has been included as an optional feature in the design.

## 2. RECON

The aim of RECON is to capture *reality traces*, i.e. combined datasets of interaction traces augmented with contextual information about the situations in which it occurred. The main goals for RECON can be summarized in the acronym SIERRA: Safe, Invisible, Efficient, Robust, Remotely controllable and Autonomous.

## 2.1 RECON Architecture

Figure 1 shows the four main components of RECON. **RECON Log** is a dynamic-link library (DLL) linked to the application. Interaction is captured through source code instrumentation and a simple log API is used to report events based on a predefined interaction model, which include states, events, user actions and system actions. The **RECON Client** does all the context capture and is responsible for enforcing the logging and upload policies, battery/power management etc. Everything is set up by an XML based configuration scheme and periodically kept up-to-date through the **RECON Server**. It can be changed remotely by the evaluator during an experiment. All data is saved locally in a database until successfully uploaded to the Server. **RECON Commander** is a desktop application where the researcher can setup and manage experiments (e.g. update the configuration file) and retrieve data from the server.

## 2.2 Using RECON

The client has been developed for personal mobile devices running Windows Mobile 5.0 or newer. Smartphones have been used as the main test platform. RECON has been deployed and tested with several application prototypes. Most notably it is an integral part of the field evaluation of  $\mu$ CARS – a mobile and ubiquitous car rental service using distributed speech-recognition combined with stylus input to let users rent cars while on the move [5].

## 3. DISCUSSION

The main benefits of using RECON can be summarized as:

- Enables the study of long term usage and interaction in real contexts.
- It is unobtrusive to the user experience.
- It is cost-efficient with regard to time and manpower.
- It scales well with many users and long duration studies as well as studies that are geographically spread out.
- Possible to automatically anonymize data and conduct studies in domains where normal observation would not be possible.

A number of downsides exist as well when conducting such studies and these must be taken into account when designing experiments, e.g.:

- There is a lack of direct control during the experiments.
- Noise, ambiguity and uncertainties in the data.
- A fully functional application prototype is needed, which must be robust enough for deployment in the field without too much maintenance.

The type of studies enabled by RECON also raises privacy, security and other ethical issues, and thus strategies must be made for ensuring anonymity and security of personal and sensitive data during and after the study.

RECON is specifically targeted for objective and mostly quantitative data, which makes it complementary to the wide range of qualitative methods available (interviews, questionnaires, etc.). Uncertainties in the data set can be grounded using these methods during or after the study.

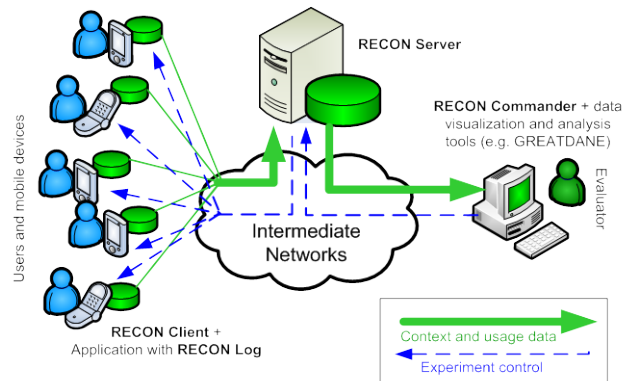


Figure 1: RECON conceptual overview

Although the capture of interaction traces with RECON scales well, it has the potential to produce huge datasets - essentially making the data analysis the bottleneck for the size of studies. It is thus crucial to look into automated analysis methods and tools for data visualization. A RECON compliant software tool dubbed GREATDANE (Generic REALity Trace Data ANalysis Engine) is under development for this purpose.

## 3.1 Conclusion

A new tool, RECON, has been presented for automated capture of interaction and context in the field. It enables researchers and practitioners to conduct remote and large scale field studies to evaluate the usability and user experience of mobile and ubiquitous applications in real contexts. RECON facilitates studies that are complementary to current practice and integrates well with existing qualitative methods.

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