

Pocket Bee - a multi-modal diary for field research

Jens Gerken, Stefan Dierdorf, Patric Schmid, Alexandra Sautner*, Harald Reiterer
University of Konstanz
Universitätsstraße 10, 78457 Konstanz
firstname.lastname@uni-konstanz.de

*Daimler AG – Customer Research Center
Leibniz Straße 2, 71032 Böblingen
alexandra.sautner@daimler.com

ABSTRACT

In this paper we present Pocket Bee, a multi-modal diary tool that allows researchers to remotely collect rich and in-depth data in the field. Based on the Android smart phone platform, we especially focused on an easy to use user interface. We introduce the notion of *core questions* that serve as cognitive triggers for pre-defined events. Multiple modalities allow participants to compose notes in the most appropriate and convenient way. Instant network synchronization allows researchers to view and analyze the data on-the-fly while also being able to create new tasks or questionnaires during an ongoing study. These can also be linked to certain trigger events, such as time and date. Thereby, Pocket Bee supports diary and Experience Sampling (ESM) studies. The system was developed in a user-centered design process and its potential value is described in a scenario of use illustrating an upcoming study.

Author Keywords

Diary, ESM, longitudinal, tool, multi-modal, evaluation

ACM Classification Keywords

H5.1. [Information interfaces and presentation]
Multimedia Information Systems – *Evaluation/methodology*

INTRODUCTION

Remote research methods such as the diary method or the Experience Sampling Method (ESM) [8] have always intrigued researchers, as they allow data gathering in their “natural, spontaneous context” [2] without being obtrusive and thereby in places where observation would be impossible or inappropriate. They have been applied both outside (e.g. see [3]. for a variety of usage scenarios) and inside HCI (e.g. [6], [11]) in various forms, such as pen & paper or PDAs. Besides, diaries and ESM have shown to minimize retrospective effects (e.g. compared to retrospective interviews) and allow both qualitative and

quantitative data collection. They are especially useful in longitudinal studies as they allow analyzing and modeling changes within and between subjects [3]. Drawbacks however include a high burden on the participant and as a consequence thereof such diaries are often reduced to simple repeated questionnaires. Nevertheless, as our world is becoming more and more ubiquitous and HCI research is thereby more interested in investigating how people deal with such technology in the wild, the need for these methods has increased even more and technology itself has been a helping hand to support both the researcher and the participant. In this paper we present Pocket Bee (see figure 1), a multi-modal diary tool that allows participants to gather data in multiple ways on Android [1] based smart phones while allowing researchers to access this data immediately via a web-based control center and react on it accordingly, e.g. by sending out specific tasks or questionnaires. Pocket Bee integrates an easy to use client user interface that reduces the burden on the participant while maintaining a high flexibility towards the method and the possibility to capture in-depth data. We furthermore discuss several design goals which illustrate the importance of the tool for both the diary method and ESM.

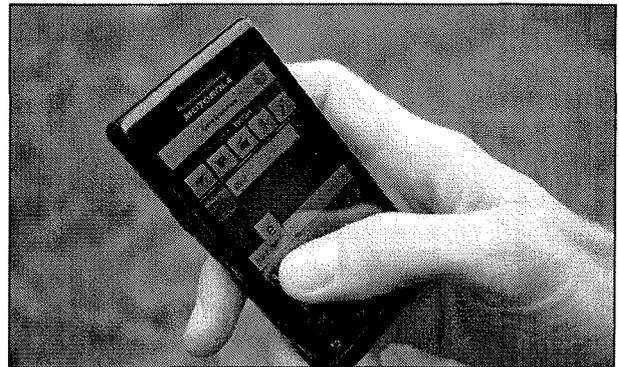


Figure 1: Pocket Bee running on a Motorola Milestone

Early electronic diary or ESM tools focused on simply providing questionnaires on a PDA [2], while current approaches have focused especially on the integration of sensor data to better support ESM (e.g. [7]), multiple modalities to enrich the data-gathering process (e.g. [4], [9]), or the integrated testing of mobile device applications [5]. The existing tools seem to have focused on functionality and extensibility but not so much on the design of the client user interface itself, as it has been

merely discussed in the according papers. However, an electronic device does not magically reduce the participants' burden for collecting data and it might even increase the burden for some users that are not familiar with smart phone technology. In the following sections we will first present our research questions for the user interface design and go on to discuss the user interface concepts by illustrating an upcoming study in the automotive sector.

POCKET BEE – A MULTI-MODAL DIARY

Designing the Pocket Bee diary tool was motivated and guided from two perspectives, one being HCI research in general and the second being the automotive sector, for which we designed and developed the Pocket Bee diary in particular. We collaborated with Daimler AG, a well-known manufacturer for luxury automobiles with a high percentage of discerning customers. In such a case, a deep familiarity with modern technology, such as smart phones can't be assumed as naturally given. Furthermore, comfort is one of the most important aspects when these customers are deciding to purchase a vehicle. This stresses the importance of an easy to use, yet powerful and flexible user interface even more.

Design Goals and Solutions

Khan et al. [10] did an analysis of current experience sampling tools and derived some requirements for future tools, such as multi-modality or instant synchronization. We agree with most of these and they influenced our choice of design goals. As stated before we will, however, focus on the research questions from a user interface design perspective and the methodological benefits that can be achieved thereby.

Reduce the burden on the participant: We think this should be one of the main goals of any diary or ESM tool. In principal this starts with carrying the device along – as a best case scenario that can be achieved by using either the user's own smart phone or replacing it for the time being. Besides, it should provide the most convenient means (as in [9]) for data gathering for any situation as well as being easy to use. This does not only mean that all functionality can be easily accessed but also that the UI is designed in a way that the user is reminded of his tasks without having to look them up.

Link the data-gathering closer to events: In order to reduce retrospective effects of memory, data-gathering should happen closely related to events. In case of ESM this is essential in itself (e.g. as in the [7]), but also for diaries we think that event-based designs as described by [3] should be supported.

Increase the quality and depth of collected data: Early electronic diaries only incorporated simple questionnaires which made it difficult to benefit from the "in-situ" quality of the diary. We think it is essential that a diary allows capturing of rich data which is both appropriate to the situation and the participant (as stated above). This should

include both manually-triggered data gathering as well as automatically triggered or logged data. This also means that both, qualitative and quantitative data-gathering should be integrated.

Increase the bonding between researcher and participant: Motivation is a serious issue in diary studies. We think that having a direct communication channel provides participants with the assurance, that their comments and feedback is being recognized, making it valuable and worth-while to continue contributing. This also means that researchers should be able to examine and analyze diary material before meeting with participants for an interview.

Bridging the gap between ESM and diaries: The tool should be designed in such a way, that it can be adapted to either focus on experience sampling by triggering questions or tasks at certain events as in ESM or on manual user input as in classic diaries. It should be possible to adjust to changes during the study and react upon user data by e.g. adding additional tasks or questionnaires remotely.

Scenario of Use

In the following, we will illustrate how Pocket Bee works and how the user interface is designed to address the research questions. We will present a scenario of use to do so, by outlining an upcoming study in the automotive sector.

Electrically powered cars are not only environmentally conscious but add to the customers' mobility and flexibility. Instead of having to rely on fixed gas stations, every power outlet can become a source for recharging. While little is known about how practical this might be, investigating these kinds of tasks is difficult to say at least. Direct observation is hardly possible, since the car is a very private environment. Using interviews, retrospective effects might cover the little hurdles one has to master during the charging process. We will outline in the following how Pocket Bee can support such a study.

The Pocket Bee client's user interface consists of a home-screen widget (see figure 2a) and the diary application itself (see figure 2b,c). The widget allows the participant to use the phone as such while having constant access to the diary application. It provides the entry points for the user and is a constant reminder of any pending tasks. Essentially, the widget supports both event-based diary designs and time/trigger-based designs (see [3]). The upper part is reserved for what we call *core questions*. As it can be a mental burden for participants to constantly think about whether they should record a diary entry during any given situation, these core questions serve as visual and cognitive triggers to reduce this burden. In our scenario of use, these are a "charging car" event and a "needing to charge" event. Thereby the user can simply wait for these events to happen and is constantly reminded to "get triggered" by them. Such an event-based diary design also allows coupling the diary entries closer to the events that need to be reported as they

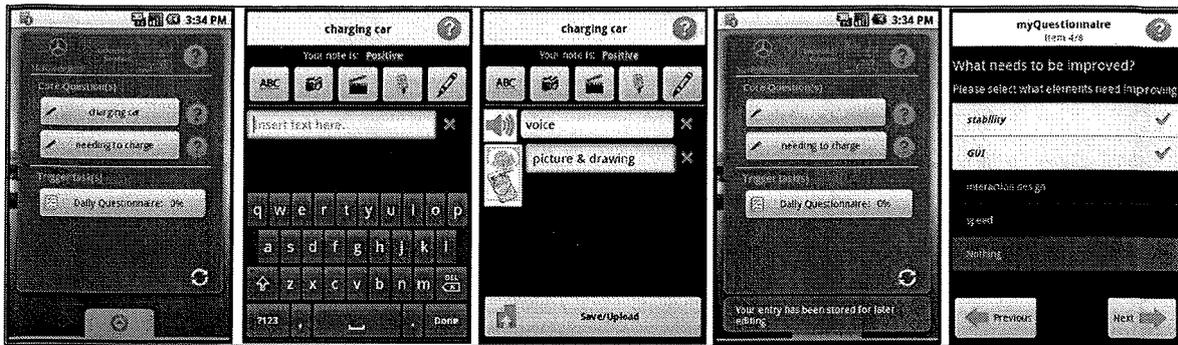


Figure 2: The user interface on the client device (left to right). a) home-screen widget, b) an empty diary entry c) a diary entry composed of several notes d) a temp. saved diary entry e) a questionnaire item

motivate an instant capturing. By tapping on a core question, a diary entry is created which can then be enriched with data (see fig. 2b,c).

Let us assume that our participant Sarah is about to charge her car. The interface allows her to compose a diary entry out of several notes. To begin with, she might want to simply write a text note, that she is about to charge the car at a friend's place. During charging, the display in the car tells her how long it takes to fully charge the car. She takes a picture of the display and adds a textual note. She would like the researchers to know that she would like to enter the distance she wants to drive, so that she knows how long to charge for a specific ride. She then saves the diary entry – it is now immediately sent to the server in the background together with her current geo-location (if she has agreed to this prior to the study). Later on, she gets another idea – the car should send her a text message as soon as the charging is complete. She quickly records an audio note while walking to the car to check the status by herself. By providing these different modalities for data-gathering Pocket Bee reduces the burden on the participants, as they can just select the most convenient one. By allowing the composition of several modalities to one entry, we motivate to provide rich and in-depth data. The GPS location can furthermore help during an additional retrospective interview to remember this particular situation and discuss it further. The researcher on the other hand has immediate access to the diary entry via the control center (see figure 3) or as soon as the device has a network connection (WiFi or GSM/3G). This allows the researcher then to 1) start with the data analysis right away, 2) prepare the data for an interview session, and 3) react on the data. We currently provide a basic list-like view of the entries that can be sorted and filtered by several criteria (e.g. core question, participant, etc.) as well as exporting possibilities to analyze the data with e.g. MS Excel. In order to react on the data the researcher can modify existing or create new core questions as well as create additional tasks and questionnaires individually for each participant. The latter two then reside on the lower part of the client interface (see figure 1a). Tasks are meant to provide specific instructions such as “please take a picture of the power cable”, allowing the researcher to interact more closely with the participant which tightens the bond between the two as the latter receives direct feedback on her actions. This will also help

to increase the motivation for continuous use of the diary. Questionnaires can be designed in an XML template (see figure 4), which provides several different question types for most necessities, such as multiple selection, rating scales, or open ended questions (see figure 5). The latter also allow the participant to record voice instead of typing text. The template allows for branching of questions as well as forced or optional questions.

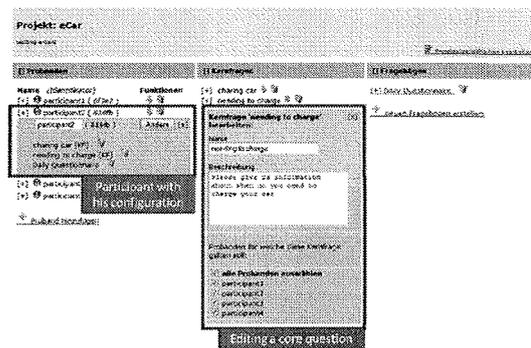


Figure 3: Web-based Control Center

Our participant Sarah comes home again. As on every evening since the study started, the device notifies her with two short beeps that the daily questionnaire is available now, asking her about the mileage she drove today, how she rates the ease of use of the charging device and additional feedback.

Implementation

A short video demonstrating the Pocket Bee tool can be accessed online: <http://www.vimeo.com/13397614>. Pocket Bee is a distributed system including a mobile device (the bee), a server (the hive), and a control center for remote access to the server (for the beekeeper, see fig. 4). Pocket Bee runs on every current Android-based phone (Android 2.01 upwards). Given the steadily rising market share of Android devices¹, this increases the chances of allowing the user to use their own device for the study. The researcher can both setup a study and manage multiple projects within

¹ See: <http://www.gartner.com/it/page.jsp?id=1372013> within the last year from 1.6% to 9.6%

the control center without having to touch the mobile device and during runtime of the study. The client diary application is written in Java/Android. It directly integrates drawing and text notes modalities and furthermore integrates the Android internal camera, video, and voice recording application seamlessly into the user interface. Each diary entry is automatically tagged with the according core question and the GPS location. If no network is available, a queue holds the diary entries until submission to the server is possible. Besides, the client tries to contact the server every x minutes (default: 30). If successful, the client automatically asks for any updates available (e.g. new or modified tasks) and the server responds accordingly. The server hosts a MySQL database and a web server. All communications are handled via PHP scripts. Currently we support time-based triggers for tasks and questionnaires which can be specified in the control center similar to setting up events in a calendar application (e.g. daily questionnaire from 18:00 to 22:00). The infrastructure however is built in a way to be able to react on any sensor data that we may receive. This can be internal data such as GPS data as well as external sensor data, such as CANbus data in case of a car. Thereby, PocketBee allows the researcher nearly endless possibilities to create ESM-like events and triggers for both automatic as well as manual data gathering.

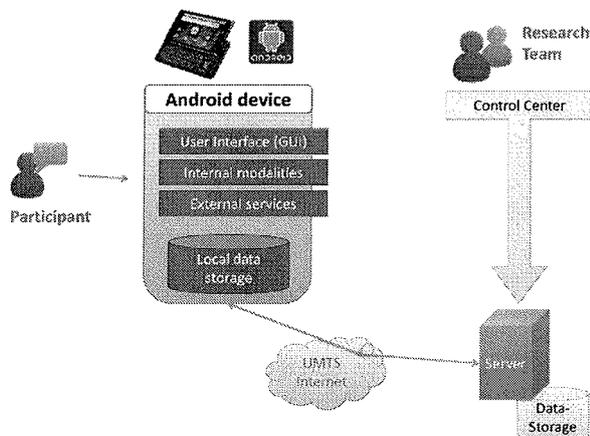


Figure 4: Schematic view of the Pocket Bee system

CONCLUSION & FUTURE WORK

We have presented Pocket Bee, a multi-modal diary tool that allows researchers to conduct remote field studies while maintaining an in-depth quality of data. Complementary to existing diary and ESM tools, our focus was on the design of a usable and flexible interface on the mobile client. The core question and widget approach allows for an event-based diary, which reduces the burden on the participant who then can use these core questions as cognitive event-triggers. Multiple modalities can be easily composed to an in-depth diary entry, allowing the participants to choose the most appropriate or most

convenient modality. The interface is flexible enough to also include “trigger” events that can react upon internal or external sensor data (e.g. time-based triggers) and allow for ESM-like data-gathering. While we have not been able to use Pocket Bee in a study (the presented scenario of use illustrates an upcoming study), the system was developed in a user-centered design process, integrating several informal test studies with both potential participants and researchers. Future work will enhance the concept in several areas. The control center will integrate more complex visual representations of the diary entries in order to allow better on-the-fly evaluation. E-mail notification will allow researchers to act upon certain events (e.g. a specific diary entry or a participant not using the device for a certain time). We also plan to provide an interface which allows easy coupling of tasks or questionnaires with sensor-based events. For the client interface we will explore design solutions that will ease the choice of modality for the participants by providing an instant preview upon the composition of a diary entry.

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