Understanding tourists on a bicycle trip "in the wild"

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ABSTRACT
In this paper we describe and discuss a requirements analysis that aimed at informing the design of a pervasive application. We approached the requirements analysis by conducting a survey and a field study to understand tourists on a bicycle trip. Both studies yielded significantly different results. We therefore join arguing that studies of different types should be mixed in order to get a complete understanding of the target situations. We showcase that the field study, although supposedly being less valid than the survey, yielded important results that we would not have found by concluded the survey only. Our field study also highlights that there is a need for guidelines about ethics when evaluating pervasive applications in the field.

Categories and Subject Descriptors
H.5.2 [**User Interfaces**]: Evaluation/methodology

General Terms
Human Factors, Experimentation

Keywords
Requirements Analysis, Pervasive Applications

1. INTRODUCTION
In order to design successful and useful pervasive applications it is important to understand the user's needs beforehand. Currently it seems to be agreed that a single method for understanding users "in the wild" is not enough. They rather have to be triangulated for countering the disadvantages of each method alone [4].

In our previous work we designed a pervasive navigation aid for tourists on a bicycle trip. At first, we aimed at understanding how tourists on bicycle trips can be supported by pervasive applications. We conducted two supplementary studies: a survey where details about a trip were asked and a field study where we observed tourists on their actual bicycle trips. The two studies drew considerable different pictures about the tourists' situation.

In this paper we present the conducted studies and highlight the different results of the survey and the field study. In addition we discuss the topics that would be relevant for any requirements study for pervasive applications, comprising the different results of both studies, and validity and ethical issues with the field study. This discussion aims at contributing to the discussion about methodologies for requirements studies for pervasive applications.

2. RELATED WORK
"If I'd asked what they wanted, they would have said a faster horse" is a famous sentence by Henry Ford. It stressed that designers need to understand the users underlying needs to produce successful designs.

Surveys, such as e.g. questionnaires, interviews, or focus groups, are established means for understanding the user's needs. While there are usable for gather the user's needs they suffer from relying on the subjective views of the informants [7].

According to Kjeldskov et al. [7] the most common practice in mobile HCI is engineering prototypes and evaluating them in the lab. Field evaluations are rare, but can yield useful and context-related insights (e.g. [1]). Nevertheless, engineering prototypes is useful for getting specific feedback, but it's rather ineffective in understanding the general needs, since participants tend to focus on the presented prototype.

In early design stages, where prototypes are not yet existing, methods such as the Wizard-of-Oz Kelley [6] can be used to inform the first iterations of the design. The prototypes logic is then simulated by an experimenter, allowing investigating requirements and potential design issues early in the design process. While the Wizard-of-Oz method does not depend on an existing prototype, it still requires an idea about the system to simulate and thus has the same problem as engineering prototypes.

An approach that does not depend on engineering prototypes first is investigating current strategies and practices. In the case of pedestrian navigation systems, May et al. [8] studied how people describe routes to others in order to understand the structure and properties of good and usable route descriptions. While this approach produces valid and

reliable results, it can mostly be only applied to parts of the design.

Adopting methods from ethnographic research (e.g. [2, 3]) is another option for requirements analysis which has the advantage that it yield natural and rich results. As they are very costly and time consuming, low cost variants of ethnographic research have been employed, such as cultural probes [5] or diary studies [9].

3. UNDERSTANDING TOURISTS ON A BICYCLE TRIP

In order to understand what kind of system would support tourists on a bicycle trip the most, we conducted a requirements analysis "in the wild". The goal was to inform a design of a system that should support tourists on their bicycle trips in unfamiliar environments. The methodology of the conducted studies and the results are discussed in the following.

3.1 Methodologies

We approached the requirements analysis by conducting two different studies. First, we assessed how tourists plan and conduct their bicycle trips by a survey. Second, we conducted a field study where we observed tourists at parts of their bicycle trips. Both studies took place at the North Sea Island Borkum. Due to the size of about $30km^2$ only and the infrastructure of the island, it is very well suited for exploring it by bicycle. The local tourist agency has optimized routes and signs for tourists bicyclists. Typical tourists are families with smaller children as well as people with chronic cardinal or respiratory problems. The large number of bike rental outlets indicates that it's common practice to go on a bicycle trip as a tourist.

Survey
The survey was administered by semi-structured questionnaires. We cooperated with a local bicycle renter at Borkum who handed out these questionnaires to people that rented bicycles. Thus, our sample contained a random set of tourists and other visitors that did trips by bicycle on the island. The questionnaire was split into three sections. The first section asked the informants about their plans regarding the trip. The second section focused on the experiences during the planned trip. The third section gathered relevant participants' details, e.g. how familiar they are with the island at the time they were doing the trip.

Field Study
The field study also took part at Borkum and lasted several days. Tourists making a bicycle tour were observed for a part of their trip. An observer rode around the island on busy cycling paths and followed random cyclists, mostly in the range of audibility. The observer did not attract attention, since around the time the study took place the island was full of cyclists. The tourists were mostly only observed for a part of their route and as long as they stayed in public space. Once they decided to stop e.g. at a cafe, the observer discontinued the observation. The observations were written down from the observer's memory. No personal information was noted.

3.2 Results

The survey and the field study were analysed separately, as they described two different sets of participants. Here, we present a brief summary of the results relevant for this position paper.

Survey
Ten people returned the questionnaire in a way that it could be interpreted. Eight informants reported that they used a navigation aids on their trip. These were mostly paper maps and seldom public overview maps. None of the participants used electronic navigation aids. Another interesting finding was that although eight of ten informants had given a destination for their trip, only five of them actually reached that destination. In general, the destinations described rather large areas, such as a beach that spans across half of the island. Seven informants stated that they had lost orientation at least for a short period of the trip. Nevertheless, they still expressed that the navigation aids were found helpful.

Field Study
Notes were taken about six groups and four single persons during the field study. The use of paper maps was observed twice. We did not observe the use of any other navigation aids. Route choices often seemed intuitive and spontaneous. Sometimes they were heavily discussed within the group. At other times it did not seem to be much of a deal. One family, for example, turned around three times during the observation. They seemed to make those decisions, because they just did not like the environment. Overhearing a few conversations we discovered that often there were no definite destinations for the trips or they were re-planned during the trip.

3.3 Discussions

After having analysed both studies, we compared the results in order to get a more complete picture of what a good support system should offer the tourists. The survey indicated that destinations were often imprecise and not always reached, and despite using map, disorientation events occurred. The field study showed that the nature of navigation was mostly undirected and spontaneous, while mostly no navigation aids were used.

Limited map usage
In the survey, seven of ten informants reported to have used a map, we could only observe two map usages in ten observations. We suggest that this discrepancy might be due to the fact that the observed people had a map with them but used it at times where we did not observe them anymore. We also suggest that there might be differences between the observed people, and those who participated in the survey. As participating in the survey was voluntarily, a different kind of people might have participated, who are also more likely to use maps. The survey also showed that maps are perceived helpful while the informants still saw room for improvement.

Frequent loss of orientation
Seven of ten survey participants and seven of ten observed tourists lost orientation at least once and for a short time.

Thus, both studies consistently indicate that tourists often frequently experience disorientation events.

"Easy-going" navigation

The observation showed that people were uncertain at decision points but nevertheless spontaneously decided how to proceed. This indicates it was not that important for the tourists to take the most efficient route. This might be attributed to the holyday experience in general. One survey participant commented a case where he lost orientation with the words: 'One time, I chose the wrong way, but it did not matter. I am on holiday!'

Spontaneous change of destination

While eight of ten survey participants specified a destination for their trip only five of those actually reached that place during their trip. Additionally, most destinations were not specific places but larger areas. From the observed tourists only few seemed to have a specific destination. Therefore, reaching specific places does not seem to be a high priority for tourists. It also shows that those tourists were willing to alter their plans and accept unexpected changes.

4. DESIGN OF THE TACTICYCLE

We derived four design implications for a system that is aimed at supporting the experience of tourists on a bicycle trip: They high number of reported and observed disorientation events and the limited use of maps suggested that such a trip companion should **provide orientation help**. The spontaneous nature of navigaton indicates that preplanning of trips is not desired by the user. Instead, **planning trips on-the-fly** should be supported. The field study also showed that people are open for spontaneous deviations from their current goals. In order to improve the experience, a travel companion should therefore **highlight interesting spots** nearby. Since destinations were rather denoted by large areas and actually reaching those goals seemed mostly optional, a **drift towards the destination** should be supported rather than providing detailed route instructions.

These implications drove the design of the Tacticycle, an exploration aid for tourists on a bicycle trip. It consists of two parts: a Personal Digital Assistant (PDA) with integrated GPS receiver linked via Bluetooth to a self-developed hardware platform with control over an attached digital compass and two vibrator motors that are fixed to the steering rod handles (see figure 1). To provide orientation help, we convey the direction to the destination via tactile feedback (see figure 2). To support the general drift towards the direction, we present the directions independently of any existing paths. With the PDA application the cycle trip can be planned on the fly, selecting new destinations. If a point-of-interest is in the immediate surroundings, the visual and tactile information presentation changes to attract the user's attention to the POI.

5. OPEN CHALLENGES

There are open challenges that we came across during our requirements study. The survey and the field study yielded significantly different results. In addition, the field study had issues with the validity of the results as well as privacy
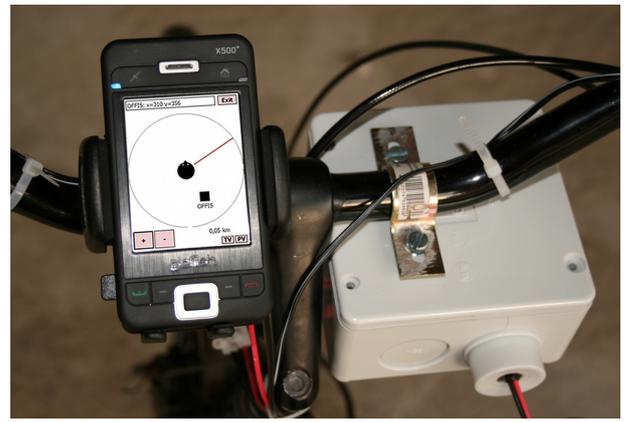
Figure 1: The hardware of the resulting Tacticycle system attached to the steering rod of a bicycle.
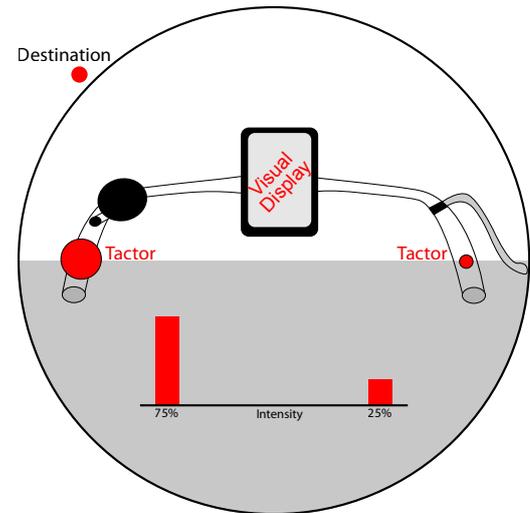
Figure 2: The destination (at $315°$) gets divided into two intensities applied to the actuators.

and ethical concerns. Our reflections on these challenges are discussed in the following.

5.1 Survey vs. Field Study

While the survey results might suggest that tourists mostly have a pre-defined route and destination, the observations made in the field study contradict that conclusion. There are several explanations for these results: 1) The survey participants did not want to admit that they felt lost for some reason, 2) the survey participants did not feel like being badly oriented, or 3) the survey participants represent a different population which actually does not get lost so easily compared to the observed people. The aspects 1) and 2) are always problematic in surveys, as they rely on the participants being honest and capable of self-reflection. Our results indicate that relying on self-reports only can be very misleading. Aspect 3) is a problem of voluntary participation, as people that are more likely to volunteer for participating might also be more likely to plan their trips in more detail.

The fact that the majority of the survey participants re-

ported to be content with their navigation aids despite having lost their orientation supports the second aspect, that people did not feel badly oriented. Only in the combination of field study and survey we learned that people might be willing to accept unexpected deviations from their plans. This supports the conclusions of previous workshops on evaluating pervasive applications [4] that triangulating methods is necessary to compensate for the weakness of each.

5.2 Validity of Observations

The field study lacked a direct communication between the observer and the informants, such as thinking aloud. Instead, any observation is in fact an interpretation of the observing person. The observer acts as a second filter which can distort results further. Thus, the quality of the results strongly depends on the observer's capability of classifying the observed behaviour correctly. Given the fact that the survey and the field study yielded significantly different results (e. g. map usage) there is a good chance that the observations from the field study where partially misinterpreting.

Nevertheless, in retrospect, the field study yielded obvious results, such as the spontaneous und undirected nature of navigation observed in many cases, which would not have been uncovered by the survey alone. Most likely, only few other methods would have yielded the same results. Thus, even if the validity of findings is questionable, such studies can greatly contribute in understanding the design space when building pervasive applications.

5.3 Privacy and Ethical Considerations

If possible, experiments should gain informed consent from the participants of their study. The consent is required if personal information are collected during a study. Failing to due so may be considered unethical and even counter laws. On the other hand, informing participants that they are being observed will most likely alter their behaviour. In the case of our study, the participants might have focused much more on navigation, leading to the impression that there is actually no need for an orientation aid.

To avoid unethical behaviour, two aspects have to be considered. First, informed consent is required when collecting personal information. Personal information can be defined as information, where the person's identity can "reasonably be ascertained" from the information. Examples are names, video and audio material, but also the context of observation. In our study we approached this issue by forgoing any recording tools and only taking written notes from the observer's memory. Second, if people are observed their privacy may be violated. However, in public places, there is no general expectation of privacy. Thus, we restricted our observations to public spaces, namely to the highly frequented roads and bicycle trails. The observed people were aware that their actions could potentially be observed by anybody.

This issue shows that there is a need for clarifying the ethical and privacy aspects of evaluation "in the wild". Future methodology for understanding requirements of pervasive applications should provide guidelines for researchers in order to keep their work ethical.

6. CONCLUSIONS AND FUTURE WORK

In this position paper we presented a requirements study aimed at informing the design of a pervasive system and the challenges we faced. The study comprised a survey and a field study which yielded significantly different results. While especially the validity of the field study is questionable, it still yielded very helpful insights. This finding supports previous conclusions that combining different types of studies is necessary to get a complete picture about a pervasive application. We also highlighted that conducting such field studies raises ethical issues which should be addressed when building a set of methodologies for evaluation pervasive applications. In the end, reaching a "safe spot" with any number of studies might be impossible. Prototyping designs and evaluating them "in the wild" is not an option, but mandatory. We therefore will validate our findings by evaluating the Tacticycle in future user studies.

7. ACKNOWLEDGMENTS

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