Evaluating Indexicality: The Importance of Understanding Place

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ABSTRACT

The research presented in this workshop paper proposes the importance of understanding users' perception of a "place" when designing and evaluating the usability of mobile indexical information systems. It is our contention that by acquiring a detailed understanding of social and physical aspects of a built environment through empirical field studies, we can explore people's ability to make sense of their surroundings in the design of interfaces for context-aware mobile information systems. In addition, we argue that the understanding of a place developed through such field studies can also play an important role in informing the planning and conducting of subsequent evaluations. Supporting this, we present a field study conducted at Federation Square in Melbourne, Australia, and the design of an indexical context-aware mobile prototype. We then discuss some challenges and benefits associated with using the experience from conducting the field study to inform not only the design of the prototype but also the planning of our forthcoming usability evaluation.

1. INTRODUCTION

Many mobile information systems involve the user being situated in the context of public built environments. Yet only a few studies have investigated the challenges imposed and opportunities offered by adapting these mobile information systems to the context of buildings and other architectural structures in urban spaces. In order to exploit the user's ability to make sense of architectural features in the physical surroundings in interaction design for context-aware mobile information systems, we need to achieve a better understanding of the role of the user's physical environment in defining their context and the contribution of existing information embedded in that environment to people's experience of it and to their situated interactions (Agre 2001, Bradley and Dunlop 2002, McCullough 2001). Also, we need to learn how to make a clear connection between the user's physical surroundings and the information presented on their mobile devices (Dix et al. 2000, Persson et al. 2002).

1.1. Indexical Interfaces for Mobile Devices

An interesting approach to making a clearer relation between mobile device interfaces and the user's context is to apply the idea of *indexicality*. Indexicality is a concept drawn from semiotics, which is currently being applied to the design of mobile device interfaces to streamline the information and functionality delivered to the user (Kjeldskov 2002, Paay and Kjeldskov 2004). In relation to interface design, indexicality is defined as a property of a representation that has a context-specific meaning and thus only makes sense in a particular context. The idea of applying indexicality to mobile human-computer interaction is that if information in the interface can be *indexed* to the user's situation, then information already provided by the context becomes implicit and does not need to be displayed. Hence, the user's environment becomes part of the interface. On the basis of this, the limited screen real estate of mobile devices can be optimized to contain only the most vital content.

In order to include meaningful and useful indexes to the built environment in context-aware mobile devices, the key properties of the target built environment needs to be understood and modeled. Subsequently, examples of indexical interface design need to be carefully evaluated. So far, our research has resulted in the development of systematic methods for (1) gathering, analyzing and understanding the properties of built environments that provide insight into the user's physical and social contexts (Paay 2003) and (2) creating analytical abstractions of this data, in the form of descriptive frameworks, which can be used for informing mobile device interaction design. On the basis of this, a prototype design has been developed and is currently being implemented (Paay and Kjeldskov 2004). We are now faced with the challenge of how to evaluate context-aware indexical mobile device interfaces in order to provide designers with appropriate feedback on the validity of their understanding of the built environment being designed for and the usability of their specific interface design. This is the topic we would like to discuss at the workshop.

In the following sections, we briefly describe the field study conducted and outline some of the outcomes including the design of our prototype system. After this, we reflect on the lessons learned from our initial field studies and discuss how these can inform the planning and conducting of our forthcoming usability evaluation.

2. FIELD STUDY: EXPLORING PHYSICAL CONTEXT

In order to investigate the role of the user's physical environment and the contribution of existing information embedded in that environment to people's experience of it, we conducted a field study of the recent architecturally designed Federation Square, Melbourne, Australia. Federation Square is a multi-modal public space with a mixture of distinct architectural features and embedded digital elements that provides a variety of activities to visitors. The aim of the field study was to identify important properties of the built environment as an inhabited public space and to create an analytical abstraction, which could inform the design of a mobile information system supporting visitors to this place.

The field of architectural design has a history of incorporating user needs into design methods for the built environment. Urban Planner, Kevin Lynch (1960) and Architect, Christopher Alexander (Alexander et al. 1977) have both modelled built environments, specifically cities, with regard to the people that inhabit those places, hence implicitly including the users in their analysis of physical space. Their methods have not only proven their value within architecture, but have also been applied previously to human-computer interaction design (see e.g. Dieberger and Frank, 1998, Borchers 2001).

Combined with qualitative research methods, the work of Lynch (1960) and Alexander et al. (1977) inspired the development of a method for analyzing and modelling the architectural and social elements of a physical place for the purpose of informing human-computer interaction design for mobile or pervasive information systems. In the method devised, observational expert audits were made of Federation Square, recording through photographs and field notes the elements of the physical environment for concept formation and open coding analysis. Encoding schemas based on classifications from both Lynch (1960) and Alexander et al. (1977) were used to combine elements of the images with observational field notes and classify them. Open coding was then used to identify critical terms, key events and themes and to derive categories that synthesized the outcomes of this empirical study.

2.1. Outcomes from the Field Study

The key outcomes from the analysis phase were (1) a map identifying four key districts and four key landmarks, and (2) an abstracted visualisation of an emergent "vocabulary" of the human experience of the informational and architectural properties of the space called MIRANDA (Multilayer Information Related to Architecture aNalysis Data Abstraction). This is illustrated in figure 1.

MIRANDA clarified and identified the essence of the characteristics of the space, providing a representation of human experience of that space. Surveying the resulting diagrams (as illustrated in figure 1), it is possible to draw summary conclusions about the space, which would not be evident from viewing the original data, or from merely visiting the space. For example, at a glance it is possible to ascertain that Federation Square has a dominant characteristic of "Activity around the Edges" indicated by the dominant line linking the two words.

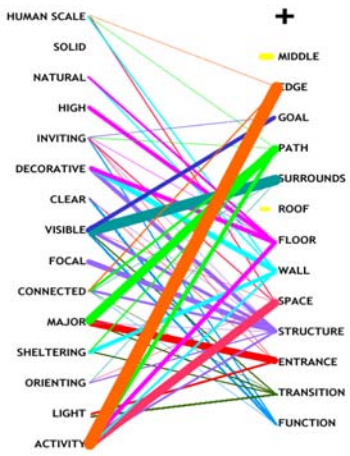

Figure 1. Abstraction of the human experience of Federation Square based on MIRANDA.

3. AN INDEXICAL MOBILE PROTOYPE SYSTEM

Exploring the use of MIRANDA in the design of physically indexed interfaces for mobile devices and making way for an empirical user-based evaluation of indexicality as a design concept for context-aware mobile information systems, we have designed a mobile information system for use at Federation Square. The design is currently being implemented as a functional prototype using Bluetooth for positioning and GPRS for wireless access to the Internet. The prototype system incorporates three overall design ideas exploiting unique characteristics of the physical space analyzed and indexing to some of the identified features of the built environment:

- The mobile guide responds to the user's location in terms of one of the defined districts rather than Cartesian coordinates;
- Each district is represented in the mobile guide by an interactive photorealistic depiction of the physical surroundings augmented with textual or symbolic information needed to better understand the place;
- Locations and instructions for navigation are expressed through rich descriptions derived from the distinctive characteristics of the place rather than through Euclidian coordinates.

Four districts define the user's location. This acknowledges people's ability to make sense of the physical environment in which they are situated, and that location is not defined by coordinates but by the human experience of the physical layout of the space. The location districts and the corresponding screens are illustrated in figure 2.

The information pushed to the mobile device is tailored to information needs within a specific district. When a user moves into a new district, their context changes, and so does the information that appears on the screen of their mobile device. As the user enters a district, an interactive photorealistic depiction augmented with textual and symbolic information pertinent to that district is pushed to their device. To allow the user to align the information on their display to their physical surroundings, the initial screen displays the corresponding landmark for that district. From this starting point, the user can alter the current perspective and select linked information.

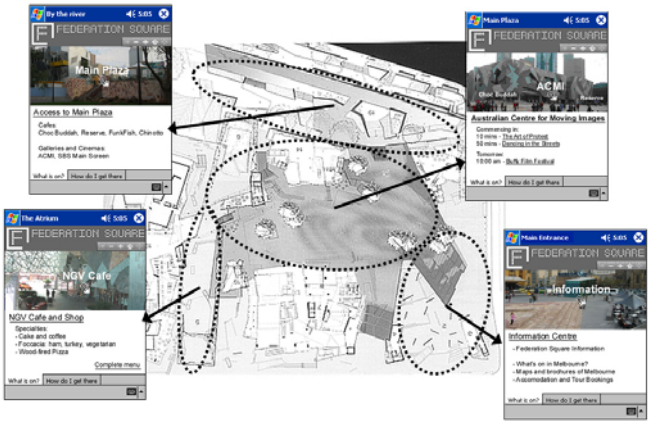

Figure 2. Four location districts and corresponding screens.

Based on the knowledge from MIRANDA we are able to use terms in the rich descriptions that relate to human experience of the space. This is an alternative to absolute location descriptions typically used in mobile guides, and holds more meaning to the users of the system, because it makes use of their understanding of the built environment in which they are situated, thus indexing the information in the interface to the user's physical environment.

4. EVALUATING INDEXICALITY

The discussion of whether to conduct usability evaluations of mobile devices in laboratory or field settings is ongoing (see e.g. Kjeldskov and Stage 2003). For the prototype system described above, however, we believe that a field evaluation at Federation Square will be needed to investigate the usability of aspects of the interface design that rely fundamentally on indexing to the user's built environment. Even though several studies have documented the possibility and value of simulating use contexts in laboratory settings, we believe that this will not be possible to do satisfactorily with the built environment of Federation Square.

Conducting usability evaluations of mobile devices in the field is, however, not trivial. Mobile use contexts are often highly dynamic and involve several physically distributed actors. Also, field evaluations complicate data collection and limit means of control. In relation to the evaluation of indexical interfaces for context-aware mobile systems targeted at public spaces, these challenges are taken to an extreme. Public spaces are typically very crowded and lively and the subsequent analysis requires that the collected data provides views of (at least) 1) the interface display and user's interaction with it, 2) the user's perception of his physical settings, and 3) how the user is situated in, and interacts with, objects and people in the physical space surrounding that person.

Planning and conducting an evaluation that meets these challenges can be very complicated, time consuming and difficult to get right. However, having conducted considerable field studies in the use domain prior to the evaluations has provided us with valuable insights.

4.1. Lessons Learned From the Field Study

Apart from informing the design of our prototype, the time spent in the field during the collection of empirical data for the MIRANDA framework also resulted in significant experience with conducting field studies generally and at Federation Square specifically. It has also provided us with detailed knowledge of the elements of the built environment itself and with anecdotal evidence of people's interactions in it. In turn, this has provided us with important input for planning and conducting the forthcoming usability evaluation of our prototype system.

One of the key lessons learned from the empirical field study leading to the prototype development was the need for flexibility and adaptability in relation to original study plans. Even the best-laid plans can go awry and be difficult to execute when encountering unexpected conditions, such as bad weather, huge crowds attending special events, or large temporary structures. Since participants are not easy to reschedule, the field study typically has to go ahead despite changed conditions, often requiring the investigators to improvise and make impromptu decisions.

A second lesson was to fully understand the limitations of our data recording equipment in different conditions, and to have strategies ready for collecting the best possible data under difficult conditions. During the analysis phase we found that high quality sound was vital but that wind, traffic and crowds all interfere significantly with this. To get a good sound recording, the camera needs to be directly in front of the speaker, which is difficult when participants are on the move and when you don't want to lead them in a specific direction. Also, people tend to talk less in crowded spaces, and thinking aloud in public spaces seems to make participants feel socially uncomfortable. In our present study, we also found it impossible for the interviewer to take field notes on paper while on the move.

4.2. Some Implications for Usability Evaluation

To date there has been no empirical evaluations of indexical mobile information systems. Our prototype therefore provides a unique opportunity to test the applicability of this concept in interface design. Unlike many other mobile information systems, the proposed design explicitly uses insight into user perceptions of the built environment to tailor the information presented on the screen to the users physical context. In our evaluation we thus have to investigate (1) the validity of the underlying analysis of the outcome from the field study, (2) the success of transferring knowledge about the place encapsulated in MIRANDA into a system design, and (3) if the indexes between the interface and the user's surroundings are accurate, meaningful and effective.

The following guidelines for our evaluation have emerged from our understanding of the place investigated and the challenges experienced when conducting fieldwork there.

Planning and flexibility. Careful planning is needed to find ways to efficiently use the time spent in the field to collect relevant data. The time available for a single visit is determined by tape time, battery time, and human enthusiasm (which observably waned after 2 hours in the field). In data collection this was best achieved by using any stationary time for reflective contextual interviews. An overall plan, or checklist, that covers all aspects that need to be tested during the visit allows participants to use their individual paths through the space and ways of doing tasks, but the evaluator can adeptly guide them to complete all tasks within the planned time limit, and thus minimise activities that do not contribute to the data.

Participant briefing. A familiarity session with participants before going into the field is needed so that they fully understand their part in the evaluation. More importantly, they need to practice "think aloud" protocol while being video taped with others watching them, (which is not natural to most people), *before* they go into the field. Although Federation Square is a place where tourists are often videoing and photographing each other, participants still found it difficult to think aloud.

Recording equipment. Movement around the square is useful because it tends to trigger conversations, but recording speech while on the move is difficult. Multiple camera angles are needed including a camera directly in front of the participants to facilitate lip reading during transcription. An improved technique for recording conversations, such as radio microphones should be used, and there should be periods of time where the participants are drawn to a quiet location and asked to reflect on what happened in the previous evaluation task. Rehearsal of the use of all the simultaneous recording equipment under difficult circumstances (such as e.g. while holding an umbrella) would also be a useful exercise.

We believe that a situated familiarity with a specific context, gained through fieldwork during analysis and design phases of mobile system development, better supports the evaluation of indexicality in interface design for mobile systems.

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