MyPlace LOCATOR: FLEXIBLE SHARING OF LOCATION INFORMATION
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MyPlace Locator: flexible sharing of location information

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Abstract. Pervasive computing research makes it feasible to model people’s location. However, there are challenges in effective sharing of location information, with support for user control, enabling people to choose the location information available, at the same time, providing information that is useful. We describe our exploration of these issues, in our MyPlace Locator, an interface to people’s location within a closed community. First, we surveyed how people use MyPlace Locator. Then we created an interface for controlling personalised displays of location information and we studied its use. We conclude that the preferences people chose for releasing their own location information were generally consistent with support for the uses valued by the participants in our use study: to facilitate meeting people and contacting them, for awareness of others and to check the accuracy of their own information.

Keywords: location modelling, pervasive computing, user control, scrutability

1 Introduction

The vision of pervasive computing is based upon the availability of information as it is needed, in the form that meets the needs and preferences of the individual. To date, one of the dominant themes of pervasive computing research has concerned modelling of location, largely dealing with the technical issues of collecting sensor and other information that can contribute to modelling a person’s location [1].

Some research has been cognisant of the need to consider people’s concerns about privacy [2]. So, for example, the BlueStar system [3] addresses privacy issues by keeping the high-resolution location information under the user’s local control. There has also been some exploration of people’s attitudes to the management of their location information [4]. However, there has been no work that systematically explores user control of sharing their own location information with others and the ways that people have used it. It is timely to explore these challenges.

Our MyPlace Locator service has been in use for two months. Its location modelling is based on Bluetooth proximity sensors and system activity sensors. It has been restricted to a small community of users. As a prelude to broader

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use, we wanted to improve user control. We wanted inform this step in two major ways. First, we wanted to understand just how that location information is used so that this would inform the design of displays of information. This is important for the design of personalised control mechanisms: we want to ensure that we are aware of the uses that people make of the location information when it is presented uniformly for all users.

In addition, we wanted to seek the views of our existing users about the ways that they would like to be able to restrict their location information. We wanted to explore the design of an interface for people to specify their preferences for personalised control of the display of their location. In light of previous work that highlights the challenges of such interface design, for example [5], we wanted to study how people cope with an interface for specifying this personalisation.

The next section summarises related work. In the Section 3, we introduce the MyPlace Locator system. Section 4 describes our study of the ways that people used the information available in MyPlace Locator and Section 5 describes the study of people’s personalisation preferences for that location information. Section 6 has our conclusions.

2 Related Work

Location modelling has been a major focus of work in pervasive and context-aware computing, for example [1,6–8]. Much of that work has acknowledged the importance of privacy and user control. A number of systems have noted that privacy was one of their architectural goals [9,10]. Indeed, at one extreme, Hazas and Ward [10] proposed only holding the location information on the user’s own device. There is also a developing set of privacy principles for managing personal data in ubiquitous computing contexts [11]. These highlight the importance of the good interfaces that are essential if these principles are to be put into effect: it will be challenging to create such interfaces based on previous relevant experience, for example, in relation to P3P [5] and Lederer et al [12].

There has been some work about the ways that people make use of location information about other people. For example, ActiveMap [13] and the location display based upon the Olivetti Active Badge [6] show where people are: however, there were no reports of the ways that people use this information. One illuminating study was conducted by Iachello et al. [14] over two weeks. Their eleven participants, in family groupings, made use of a location-aware mobile messaging service. Participants valued control of the release of their location information, including being able to give inaccurate information. This gives some insight into the ways that people want to control release of their location information but not on how people make use of such information about others.

There is some indication of the use of location information for the “ActiveMap” [13] project which displayed pictures of users’ faces on a building map. Location was determined by infrared badges and the map was available from both an information kiosk in a busy hallway, and as a desktop application, with
the former getting far more use, by those within the department and outsiders. Some users raised privacy concerns, and the authors noted the potential benefits of being able to obscure one’s location, for example leaving one’s badge at their desk.

The issue of controlling location disclosure was explored by Lederer et al. [15] in an internet-based questionnaire completed by 130 people. They were asked to choose levels of released information in two hypothetical situations, working lunch and social evening, and for four classes of recipient, a spouse elsewhere, employer elsewhere, a nearby stranger and a nearby merchant. They found the recipient was more important than the situation. Notably this information did not come from actual use of an actual system that provided location information.

Patil and Lai [16] report a study of people’s predicted privacy preferences for “mySpace”, which allowed people to ask about others’ location. Thirty six participants were asked how they would configure “mySpace”, in terms of sharing of location, availability, calendar information and instant messaging (IM). This study indicates a preference for defining privacy preferences in terms of groups, such as “family” or work “team”. Significantly, this work, like Lederer et al. [15] discussed above, involves hypothetical preferences as the participants had not actually used the system.

In summary, location is an important aspect of ubiquitous computing and the importance of privacy and control of release of location information is widely recognised. There have also some been studies of potential interfaces for managing release of privacy information and of people’s predictions of how they might feel about release of their location data in systems that they have never used. However, there has not been a study of how people want to use location information about others. Nor has there been a study of the privacy preferences selected by people who have actually used a system that provides location information. Clearly, these interact: people need to be able to control the release of their location information and, at the same time, we need to understand how this interacts with the quality of location information that is needed if it is to be useful. It is this pair of inter-related issues that we explore in the remainder of this paper.

3 System Overview

The main interface to MyPlace Locator is a web page that allow users of the system to view their own and other people’s location. This section describes the ways that MyPlace Locator models user’s location and the way that it is displayed at the main MyPlace Locator web page.

MyPlace Locator uses two forms of evidence about people’s location: Bluetooth Phones and Computer Activity Sensors. We chose these because both are readily available without any special hardware. This means it is straightforward for people to join the system by registering their Bluetooth-enabled phone, or installing a small sensor program on their computer. We have sensors in 16 locations within our building. Each of these constantly scans for any Bluetooth
devices within the coverage area of a few nearby rooms. Computer system activity sensors bleep out how long it has been since the user last used the mouse or keyboard. Both evidence sources have their limitations: a Bluetooth device may be left on a user’s desk, or turned off when they have gone to another location or objects may be accidentally left on the keyboard to give false data.

MyPlace Locator has been designed to be extensible in its source of evidence about location. It is simple to add arbitrary new location evidence sources as they become available.

The reasoning about location is based on accretion/resolution [17] and this allows a system to accrete arbitrary information about users and then to apply one of a selection of resolvers to interpret it. MyPlace Locator determines a user’s current location through either sensing a Bluetooth device or by monitoring activity on a computer. If both are available and conflicting, the resolver deals with this to determine a location value. In the current implementation, we use a simple Point resolver [17].

MyPlace Locator provides details of the location of all the people who have registered to this service. It has been running for two months and the current interface is shown in Figure 1. This displays the four wings of a building, with a list of the registered users either in the building or elsewhere. The enlarged display of a single wing at the left shows that the display includes a list of the people whose last location was determined to be on that wing. This is the anonymised list associating people’s names with a coloured dot. That dot appears also on the map at the last location for that person. The size of the dot indicates the freshness of the data: so if there is recent evidence that the person was at this location, the dot is larger.

The blurred location data at the right of the figure has four pieces of information for each person: their name, their most recent location, the freshness of the information and a link to an explanation.

The link labelled explain takes the user to a page with the full details of the last ten pieces of location evidence. So, for example, for an activity sensor, it would show the person, the location suggested by the evidence, how long ago the evidence was collected, the event type that created the evidence and the details of the computer that collected the evidence. If a person saw that their location was incorrect, they could use this information to check why it occurred.

4 Study of use of location models

MyPlace Locator has been running within a closed group of 20 tracked users for the past two months. In this time it has been accessed 2747 times. People have used the system from both within the office building, and from home. Given this user base, we had the opportunity to learn about the ways that people use location information displayed in the MyPlace Locator interface.

We began to explore this issue by sending email to existing users, asking them how much they use MyPlace Locator, what they use it for and for comments on any problems or shortcomings. Seven registered users responded. We analysed
Fig. 1. An example of a map that plots the location data collected by the MyPlace Locator on a floor plan of our building. The radius of the circles are proportional to currency of the data, with smaller circles indicating older data.

The second group of questions relation to the reasons for use. Details are shown in the table caption. There is a broad spread of answers, with different people making use of the location information for different reasons. Only work related meetings are strongly more highly rated, with 8 participants ranking it 4 or 5. What emerges most strongly is the diversity. Importantly for defining privacy preferences, we can see that these goals of meeting or contacting people indicate that the recent location information is most important. They also indicate that the information needs to be fine grained enough for these purposes, as we will discuss in the next section.

The “Group” section also show diversity of uses across participants. Notably, the use of the location information to see who is around for work-related group activities has only three participants giving ratings of 4 or 5. The social and general awareness uses all rate more highly for more participants.

The results use of one’s “Own” location information indicate that just four participants often used the display to check the correctness. Among the authors of the paper, two rated this 5 and two rated it 2. This was a less common use than
Table 1. Column 1 shows the participant identifier. Column 2 is actual number of times accessed. Remaining columns are on scale (1 for low .. 5 for high). Column 3 is estimated use. Next five columns are amount of use about an individual: to meet or contact them, either socially or for work or just for awareness of their current activity. Next four columns are for exploring group location: to see who is around for social aspects; for work; just to be aware of who is at work and to be aware of where everyone is. Next two columns are uses related to user’s own location: to check correctness and to check where they have been. Final column is perceived reliability of location.

Most of the others but for the four people who did use it often, their rating was 5 suggesting this was an important use for these people. The review of previous location was not heavily used by any participant.

The final column of Table 1 shows answers for How reliable do you consider the information you have seen. There are no ratings of 5 (meaning perfect) and ratings are split between the middle score (3) and 4. This is consistent with the level of reliability of the two evidence sources.

Overall, this study of the ways that people have used the information about the location of others indicates diversity of uses across the participants. It also defines some minimum requirements on the quality of information needed. For example, if one decides to contact a person now, one needs to know their recent location. The granularity of the spatial location required is more complex. For example, if one is at work and the person is not, finer grained information is needed.
5 Study of personalisation for location information

We now consider the issue of personalisation of the release of location information. Our goal is to enable people to choose what location information is revealed to other users of the system. To explore this, we first asked three existing users of our system to consider a prototype interface for expressing preferences for location information release. This, combined with previous literature, such as [12–14, 16] informed our design of a prototype interface.

This is shown in Figure 2. As the instructions at the top of the screen indicate, preferences are defined in three stages. the user chooses the default level of information to be provided to registered users done by clicking a button in the leftmost column. In the figure, the third option “sit” has been selected. In Step 2, the user can specify people who should be provided with a different level of information, by listing their logins under “Special users”. In the figure, this has been blurred to obscure the names of the actual people selected. Finally, users can add other people, beyond the registered users.

Each row has a short description of that option. There are also some illustrative examples and, in the rightmost column, the current value for this user is
Fig. 2. Interface for selecting the resolver to be applied to each person, shown, as suggested in [16]. Not shown in the figure, there is also a column at the right with a list of all the registered users.

The choices lower on the screen are more restrictive. In particular, the last three may make it impossible to achieve some of the uses made by the participants in the use-study.

Twenty-four users used this interface to show their preferred presentation of location information. We observed them using the interface, to gain usability information and to gain feedback on any other aspect that they identified. Table 2 summarises the results. The ten users in the top section are the registered and currently active users of MyPlace Locator: those below the line are users who have just been introduced to it. The first column shows the user identifier, which is the same as in the use study. The second columns shows the number of times the participant changed their preferences. These changes were made as participants reconsidered their choice of default or recalled additional users to specify separately. The next column shows whether the participant had a registered Bluetooth device and the fourth column shows the number of system where a sensor has been installed for the participant. The next column shows the default choice.

We discuss the results from the experienced users first. All these people registered with the system when there was no choice about the information disclosed. They generally have more sensors. All but one had a Bluetooth phone which, and all but one had system sensors both at home and at work. Five chose ‘all’ as the default and two each chose ‘recent’ and ‘area’. Notably, P2 and P9 chose a
more restricted default and then listed most of the currently registered users for all information. They explained that they were happy to release their location to the current users who they knew; however, they were concerned about new people joining the system.

The new users had a somewhat more diverse set of choices. Four chose ‘all” and four more chose “recent”, with two choosing to restrict location to the building and two restricting it to the area in the building. One chose the restrictive “work” and one chose to reveal no information, because they saw no benefit: both these options could prevent the uses that were valued by the users in our first study.

6 Conclusions

We have described our MyPlace Locator system which has been used for two months by twelve registered users who work together. We have reported a study of the ways that they have used the location information available at this interface. The uses are quite diverse: to facilitate meeting individuals, both for social and work-related reasons; to work out how best to contact individuals, for example, choosing between email and the telephone, both for social and work-related reasons; for awareness of where individuals are; to see who in the group is around, both for social and work-related reasons; to be aware of who is at work and where else people are; to check the correctness of one’s own location information. We also observed that different participants in the study valued different aspects, although the use of location information to facilitate work-related meetings was the most highly rated use.

We want to create future interfaces that can support these uses which were so valued by our participants. At the same time, we want to enable people to personalise the location information released about them. To assess how compatible these goals are, we conducted a study of the personalisation preferences for both our existing users and potential new users. Only one of the potential new users opted for releasing no location information and only one selected to merely be shown as at work when at work and unknown otherwise. All other location information preferences were compatible with the highly rated uses.

There are limitations in our study. It concerned one workplace and the use-study involved one cohesive work group. In addition, all the participants in the studies are computer scientists. This means the results may not generalise to other groups.

However, the results give important new contributions in reporting how people make use of location modelling in a workplace and in the study of the choices people made for privacy preferences, both in the case of users of the existing system and others, who have not had experience in using MyPlace Locator. A notable aspect of the study is the diversity in participant responses: different people made different uses of the location modelling information and different people elected for different approaches to specifying their preferences for release of their own location information to others. A case for personalisation!
References

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