Issues of Spontaneous Collaboration and Mobility

Mattias Esbjörnsson & Mattias Östergren
Mobility, The Interactive Institute
P.O. Box 24082
SE – 104 50 Stockholm, Sweden
http://www.tii.se/mobility/
{mattias.esbjornsson, mattias.ostergren}@interactiveinstitute.se

ABSTRACT
Spontaneous collaboration occurs abundantly among people on the roads. We account for the outcome of three research projects and the experience of designing the applications: Placememo, Hocman and SoundPryer. They all support various types of spontaneous mobile collaborative road use activities. We emphasize the impact of setting when developing applications intended for this scope. The main issues considered concern: simultaneous activities, mobility, information composition and sharing.

Keywords
Mobile CSCW, ad hoc networking, opportunistic meetings, ubiquitous computing, prototypes

INTRODUCTION
Spontaneous interaction is defined as the actions taking place where human and/or computational participants coincide temporarily at a location and interoperate to satisfy immediate needs[i]. We believe that spontaneous interaction occur when at least two humans meet to negotiate, to coordinate or to collaborate in order to achieve a common goal. This happens at many occasions in our society. Our research focusing on the social aspects and their impact they have on the design of tools to support such events. In particular our interest is mobile technology and the spontaneous interaction that occurs among people on the roads.

In this setting a variety of mobile activities take place, work as well as recreational ones. In our research projects we explore it to understand and learn about issues on mobile spontaneous coordination and collaboration.

Our opinion is that research has to emphasize the setting when designing applications for spontaneous collaboration. We will demonstrate this reasoning by summarizing our experiences from on-going work with a collection of prototypes: Placememo [4, 3], Hocman [7, 5] and SoundPryer [1]. These prototypes span the realms of work, leisure and entertainment.

Moreover, we will also give an account for our experience of design these tools. We believe there are four issues that must be considered when designing tools for spontaneous interaction in traffic. The first concerns the fact that users are involved in several *simultaneous activities*. The second issue deals with users moving about under conditions of extreme *mobility*. Third, great care must be taken when deciding on the *information composition*. Finally, the timing of *sharing* information is vital to arrive at an appropriate system.

A COLLECTION OF PROTOTYPES
Our research focuses on investigating and supporting various types of mobile collaboration between more or less acquainted people. The common denominator is the concept of truly mobile activities in the road setting. The collaborative activities are loosely related to either places or persons. In the following we will describe three ongoing projects. The Placememo and Hocman prototypes began with empirical fieldwork, while SoundPryer started with an informed idea of an eligible application.

Placememo
Here we investigated the practices of road inspectors. This is a truly mobile work, which includes the identification, reporting and repair of defects on the road infrastructure. The inspectors cooperate with others in order to solve their tasks and they hold valuable knowledge about the roads. The primary aim of the fieldwork was to gain knowledge of the working situation and competence of the road inspectors as well as evaluate current technical support. Second, we wanted to identify services and applications that could be used to develop the work at the maintenance contractor.

We found a primary hampering factor in the practice of road inspection. The inspectors need to stop the vehicle in order to report a defect. Second, they have no means to access, or share, reported defects. Third, since there is no access to reports made, there are no mechanisms that remind inspectors to actually take care of a defect.

A system that makes road inspection easy to perform while being mobile will increase the number of reports, and thus strengthen the articulation of the inspection activities. With a tool to report the defects on the move, to delegate reports to others, and to handle individual reminders, it is clear that the organization would gain better knowledge of the defects and would plan the work more effectively.

From these design requirements, we constructed the PlaceMemo-prototype. It lets the user create memos in the form of voice recordings associated with a geographical position while driving. Moreover, it lets user share

collected memos with others while being on the road. When a defect is identified and the memo-capturing process is activated, the position is collected from a GPS-receiver and later a voice-message is recorded and associated with the position. The memo is stored at the device for further reference. When moving close to the spot where the memo is recorded, the system automatically plays the associated recording. It is also possible to activate a recording without going to its corresponding position. A user may browse his or her list of memos at any time. We designed the process of delegating memos to be detached from the moment they are captured. The distribution is implemented by using a mobile phone as a modem to hook up to a remote mail server. The memos are distributed as attachments to SMTP mail messages. Memos are imported by downloading a set of messages from the users account. The prototype parses the messages and includes the memos in the local collection.

The prototype is built on the Pocket PC platform in order to become a truly mobile device, which not necessarily needs to be mounted in the vehicle. We are in the late stages of completing the prototype for final testing and evaluation.

Hocman

The project started with a field study on motorcyclists. They were selected because they are explicitly using the road on the premise of a social activity [8]. Much could be learned from their practices and use of information technology, which perhaps hints future road use. The bikers are a special form of road users whereas they often travel as a group of vehicles. They also travel to meet other bikers at specific events. To study their interaction practices and the tools they use to coordinate their activities is of interest from a CSCW perspective. The secondary challenge concerns the transformation of these empirical findings into design implications, and finally an implementation of a prototype.

The fieldwork reveals the importance of the *visual interaction* i.e. to be seen and to observe likeminded. They coordinate themselves by co-movement, for instance, by going together on highway, or place-centered movement, circulating around a specific site, to enable visual interaction. In the group of bikers we have studied, coordination is mainly achieved by exchanging postings on a public web message-board.

A problem with visual interaction is it cohesiveness to a particular time and place context. Accordingly, identities built upon visual interactions are inconsistent, which dilutes the handling of contingent meetings in retrospect. Moreover there is a need for more information exchange provided during visual interaction, between booth acquainted and unacquainted bikers during opportunistic meetings.

Hocman is an application for a handheld computer with WLAN cards (Fig. 1). The Hocman prototype supports running in two complementary modes. The first is *browse mode*, which is a basic HTML browser. Using browse mode a user may browse other user's Hocman directory of pages within wireless reach. The other is *cruise mode*. It works as an automatic browser in the background of the user's attention. Upon detecting that a new peer entered the ad hoc network it downloads the index page of the main directory on the newly discovered peer. The cruise mode also logs the time of the event. Hocman is designed as a HTTP peer-to-peer application for handheld computers that enables sharing of HTML documents, audio clips and images over wireless ad hoc networks. We chose the PocketPC operating system as our computing platform. The communication is implemented over WLAN network interface cards operating in ad hoc mode.

Fig. 1 The Hocman prototype.

We are currently working on evaluating a prototype system. For a more thorough discussion on the matter, see our contribution to the workshop on *Mobile Ad Hoc Collaboration* [6].

SoundPryer

With a CSCW perspective the activity of sharing music is an interesting leisure activity [2]. It is pursued in a variety of forms, from the simple ways, such as physically handing over a record to a friend, to making digitally encoded music files available to unacquainted users through large-scale Internet peer-to-peer systems. However, we are interested in the sharing experience that takes place when jointly listening to music. Is it possible to transpose this kind of sharing to the situation of brief meetings that occur among unacquainted people on the roads? Would a tool like that make road use more enjoyable?

SoundPryer (Fig. 2) is an application designed for sharing music experiences between people in vehicles in the immediate surrounding. This is accomplished by streaming MP3 files between nodes in an ad hoc network. Since the application is based on handheld computers, the usage of the tool is accommodated in a wide variety of settings. An effect of traffic being a highly mobile situation, the distribution carrier network must be able to handle swift changes in connectivity. We arrived at a peer-to-peer application model where networking is implemented over WLANs in ad hoc mode. The SoundPryer concept is heavily dependant on the number of co-located peers. When co-located the remote-listening function is dependant on the number of music providers. All users are required to assemble a play-list, prior to activating the remote listening

mechanism. There must be a balance in listening to, and playing for others. A peer can only select to listen to a peer that listens to a local file. When sharing, it is important to know from whom you are receiving. This is achieved by displaying three properties of a user: a nickname, a stylized shape of a vehicle and the color of it. A system for sharing must support related activities, such as finding music encountered at a retailer. We suggest a "favorites" database where the user may log, the time, the user information, title, artist and album of a shared track. Finally, it is important not to infringe on ongoing cognitive intense tasks such as driving. The GUI is designed to allow effortless finger-based interaction.

Fig. 2 The SoundPryer prototype.

We are currently working on a series of prototypes to collect requirements, as well as evaluating the concept of sharing music in traffic.

ISSUES IN MOBILE AD HOC COLLABORATION

In each of the projects presented above, a number of problems are recurring due to the setting. The main issues found either in the empirical studies, or in the implementation of the prototype, are:

- Simultaneous activities
- Mobility
- Information composition
- Sharing

Simultaneous activities

The road setting raises the complexity of the users generally being occupied with several simultaneous activities, such as driving the vehicle and planning where to go, etc. This restricts the intrusiveness of the human computer interaction-design. In principal, our intention is to develop applications that do not disturb the main activities. Furthermore, our goal is never to replace the situation at hand. Our main premise is to benefit from moments when the cognitive load is low enough to allow interaction with mobile IT. Applications must adjust accordingly.

In the case of the Placememo-prototype we have chosen to limit the human-computer-interaction when driving the vehicle. The road inspector only needs to press a button when marking the spot of a defect. Later he may record a voice annotation and associate it with the position. The detachment of capturing a position and annotating makes actual reporting task load light when other tasks are running high.

The main use of the Hocman-prototype when motorcycling is having it in cruise mode. Being tucked away, for instance in the pocket, it works completely in the background of user attention. Information from other Hocmans will automatically be downloaded when being in the vicinity of others. There is single reason for this mode. When motorcycling it is impossible to perform other activities than driving. The users gain from the information collected in this mode, when in retrospect pondering on prior contingent meetings, such as *who* did that then and there.

In the mobile music-sharing tool, SoundPryer, the users may listen to music while driving. The major difference from an ordinary car stereo or portable MP3 player is the possibility to eavesdrop the music played in other vehicles. The application contains an automated mode to let the user eavesdrop without continuous supervising the prying selection.

Mobility

On the road, users are in motion. They move in high speed with respect to places and other people. Semi-stationary situations, such as a user being still, for instance when stopping a car at an intersection, are exceptional and rare cases. When developing systems we take account for the conditions of extreme mobility. Therefore our systems are made to handle velocity relative to geographical positions and/or velocity relative to other people on the road.

In Placememo places are important. This concept is utterly dependant on accurate handling of velocity relative to position. It is essential to have a captured reminder replayed in time for the user to react on it. The prototype uses a combination of current position, speed and length of the recording to time the playback.

In Hocman and SoundPryer, the aspect of relative velocity to people is managed by dividing it into to two separate issues. The first is the relative distance to other users. The other is the time a user stays within a certain distance. The first works as a filter. By using the range of the wireless transmitter, users deemed interesting are singled out. The other aspect governs the rate at which we can expect other users to become available or disappear. It is critical that Hocman and SoundPryer are able to promptly discover and act on such events. They both use a custom protocol for rapid mutual discovery.

Information composition

Traditional communication in traffic is limited to the use of flashers, honking the horn or gestures. The mobility also creates a sensation of being cut off from social activities. In our empirical fieldwork we recurrently find a need to collaborate on matters that requires exchange of richer information. However, care must be taken to find the appropriate composition of information to collaborate on. We believe that the user should have the largest freedom possible when deciding on what to communicate, both

regarding content and format. By providing such channels, we aim to break the isolation in road use.

With the Placememo-prototype each inspector has the possibility to provide the system with voice-messages associated with geographical positions. The use of audio enables him to record the annotations in free form.

In Hocman, the users share HTML documents. HTML is a very flexible format that may contain various media formats other than tagged text, such as embedded audio clips, and images. By letting the user be in control of the authoring he or she is control of both content and format, which allows the system to mediate a personal expression accurately.

In SoundPryer, the freedom is reduced to the selection of music he or she wants to play for others. However, this is enough to mediate a hint of personal identity in the form of a statement about music taste.

Sharing

When designing applications supporting collaboration in traffic, the timing of information sharing is important. The mobility issues give two variants. If meaningful collaboration is achieved only when co-located, the information exchange must be synchronous. We have found that ad hoc networking is highly appropriate carrier to achieve this. However, in difference to MANETs as defined by the IETF working group, data need not be routed in order for it to be delivered at destinations out of immediate wireless reach. Moreover, due to the transient nature of ad hoc networks, any scheme using fixed infrastructure is inherently unreliable. By using a peer-to-peer architecture robust networked applications may be achieved. However, in contrast to peer-to-peer system for wired networks, there is no need for a virtual peer-to-peer network. If co-location is not an issue, the timing of information sharing is not as important. However, collaboration independent of location may gain from being asynchronous, depending on the amount of simultaneous activities.

Placememo uses an asynchronous collaboration scheme. Data transfers are implemented with attaching memos to SMTP mail messages. Messages are uploaded to servers over PPP links using mobile telephones as modems.

Hocman and SoundPryer are concepts based on co-location and thus use ad hoc networking and peer-to-peer architectures to achieve collaboration. In Hocman data is shared using the HTTP protocol. In SoundPryer uses a custom streaming protocol based on UDP.

CONCLUSION

In this paper we have summarized our ongoing research-projects in the field of spontaneous collaboration that take place among people on the roads. The three projects Placememo, Hocman, and SoundPryer, elaborate on various types of support in order to achieve mobile collaboration. Moreover we have discussed the four most prominent issues that the impact of setting has on developing applications with this aim. They concern: *simultaneous activities*, *mobility*, *information composition* and *sharing*. By accounting for these issues we endeavor to contribute to a framework applicable to others developing support for collaboration during mobility.

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[i] http://www.dcs.gla.ac.uk/~pd/Workshops/spontaneity02.html