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Proxy Lady

Mobile Support for Opportunistic Communication

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Abstract

Proxy Lady is a mobile system for informal, opportunistic face-to-face communication, running on a PDA equipped with a radio transceiver. "Opportunistic communication" is anticipated by one party but it only occurs when the parties happen to meet each other. Proxy Lady supports such communication by providing notifications about possible "candidates for interaction" in the environment. The user specifies "candidates for interaction" by associating "people" with an "information item" (currently an email or a task). When "candidates for interaction" enter the proximity of the user, Proxy Lady notifies and makes the "information item" accessible. According to our fieldwork, evaluation sessions, and a literature survey, "opportunistic communication" is an important type of communication that has not been supported previously. This paper describes the interface and use of Proxy Lady and the results from an evaluation study.

Keywords

Mobile computing, hand-held devices, CSCW.

1. Introduction

The importance of informal face-to-face communication "to get the work done" in organizations has been reported frequently in the literature (Whittaker et al. 1994, Kraut et al. 1990). Our focus is on information technology (IT) support for informal face-to-face (as opposed to remote) communication that is work-related (as opposed to, e.g., purely social). We focus on the face-to-face setting because:

- Most empirical studies that have documented the benefits of informal communication have studied the face-to-face setting (e.g., Whittaker et al. 1994, Kraut et al. 1990).
- Design oriented research on the topic has to a very large extent been concerned with the remote setting (e.g., Bly et al. 1993, Isaacs et al. 1996).

The particular type of informal communication on which we focus is what Kraut et al. (1990) call "opportunistic." Opportunistic interaction is anticipated by one party, but it only occurs when the parties happen to meet each other (Kraut et al. 1990). The main reasons why we focus on "opportunistic" interaction are:

- Our fieldwork (Bergqvist et al. 1999) documented the importance of such interaction.
- It is poorly supported by current systems.

The objective of our research is to explore new and innovative ways of supporting opportunistic, informal face-to-face communication with IT.

In this paper, we describe the design of a system called "Proxy Lady" that supports this particular type of interaction. Proxy Lady assumes that "information items" like emails and tasks can serve as the basis for informal interaction. For example, one reason why Bob may want to approach Joe (when they happen to meet each other) is that he wants to discuss an email he received from him previously. Proxy Lady lets the user associate information items (currently emails and tasks) with other people, called "candidates for interaction." When a "candidate for interaction" is in the proximity, Proxy Lady notifies and provides the user with the information item (the email or the task). If suitable an informal communication session

may follow. According to three formative evaluation sessions (Patton 1990, pp. 155) and a larger evaluation in a real use setting, the use of proximity between people seems to be a novel and promising strategy to facilitate informal interaction in organizations.

The rest of the paper is structured as follows: Section 2 describes the objective and focus of the research. Section 3 introduces the Proxy Lady system, its user interface, use and architecture. Section 4 reports the results from the three formative evaluation sessions we have conducted. Section 5 relates Proxy Lady to previous research on the topic, while sections 6 and 7 discusses and concludes the paper.

2. Objective and Focus

Informal communication is synchronous face-to-face interaction that is brief, unplanned, and frequent (Whittaker et al. 1994). It can be strongly related to work, but it can also be purely social (Gaver et al. 1992). Our focus is on the first category. In a recent field study we found two main characteristics of such "work-related" informal communication (see Bergqvist et al. 1999 for detailed information about the fieldwork):

- The interaction tends to have a "closed agenda:" only a few topics are addressed. Informal communication in general has an "unarranged agenda" (Kraut et al. 1990)
- Only people concerned with the topic tend to participate. Informal communication in general can have "random participants" (Kraut et al. 1990).

We also observed that these informal sessions are frequent, and that they often involve a small group of people (often two or three, not more than five).

Informal communication is serendipitous (Kraut et al. 1990). A common example in the literature is two people meeting each other in the hallway; they start to chat and exchange valuable information (e.g., Gaver et al. 1992). The session is not convened, nevertheless it is important.

Whittaker et al. (1994) identify two categories of systems that support informal communication: First, permanent open links between distributed common places, e.g., "VideoWindow" (Fish et al. 1990), and second, desktop video systems, e.g., "CAVECAT" (Mantei et al. 1991). These systems all try to enable

remote people to communicate informally without having to meet each other face-to-face. So far, however, it has been difficult to establish the same quality of informal communication in the remote setting (Isaacs et al. 1996). One reason may be that the remote setting removes the distance between people; everybody is equally close (or far) from each other (Obata et al. 1998).

Some recent projects such as Thinking Tag (Borovoy et al. 1996) and Hummingbird (Holmquist et al. 1999), have explored the face-to-face setting of informal communication. These projects focus on spontaneous, unanticipated interaction, which is related to but yet different from the type of interaction on which we focus, called "opportunistic." The main difference is that "opportunistic interaction" is anticipated by one party, however it only occurs when the parties happen to meet each other (Kraut et al. 1990).

Our approach to support informal communication is based on the idea of notifying of candidates for interaction in the proximity. In many modern offices people are in the proximity of many others during the working day. We want them to become aware of proximate colleagues with whom they may want to interact. The strategy we use to filter "candidates for interaction" is to let people select with whom they want to discuss a particular information item (an email or a task item). When the user is close (within the "area of proximity") to a "candidate for interaction" the system notifies, and (if suitable) an informal communication session may occur.

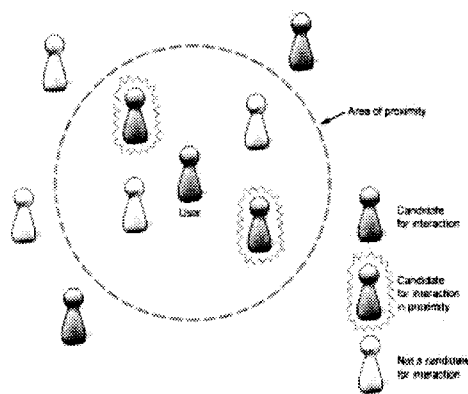


Figure 1. Using proximity to detect "candidates for interaction."

In order to detect "candidates for interaction" the mobile platform needs to be "location aware" (see figure 1). However, it does not need to know where it is (absolute position), only its relative location to other devices (relative position).

"Location awareness" may be viewed as a simple instance of "context awareness." A context aware system collects data about its environment and adapts its behaviour accordingly (Shilit et al. 1995). While location aware systems only collect data about the absolute or relative location, context aware systems may collect data about the history of user operations, the weather, the location, etc.

To sum up, our focus is on opportunistic informal communication in face-to-face settings. Our objective is to enhance and facilitate such interaction by means of IT. Our strategy is to match "candidates for interaction" with the proximity between people. Next we describe Proxy Lady, which is the IT platform we have designed to provide such support.

3. Proxy Lady

Proxy Lady is a mobile system for informal, opportunistic face-to-face interaction, running on a PDA equipped with a radio transceiver. In this section, we describe the use, interface and architecture of Proxy Lady.

3.1. Use scenario

The following scenario demonstrates the type of informal communication that we seek to facilitate with Proxy Lady.

"Bob arrives at his office one morning. He turns on the PC and checks new emails. One email is from Joe. It concerns a project they may launch jointly later this year. They have discussed the issue previously. However, they did not go into details and no decisions were made. Now Joe wonders what to do. "Did you talk to the client? Does Jane know about this? Does the project actually match the new company strategy? Will we have the resources needed?" Etc.

The message raises several open and important issues, but it is not urgent. Since Bob and Joe meet rather frequently, Bob makes the decision to address the project the next time they meet. In order not to forget, he wants the Proxy Lady client to help him. He selects the message, which is immediately transferred to his Proxy Lady client. Bob's PDA beeps; it is time

for the weekly group meeting. He leaves the office and heads towards the meeting room.

On the way back from the meeting Bob receives a notification from the Proxy Lady client (running on his PDA). Proxy Lady tells him Joe is in the proximity. Bob looks around and notices that Joe is entering the office corridor (approximately 20 meters away). Since he has no appointment and Joe does not look very busy, Bob thinks this may be a good opportunity to talk about the project. Therefore, he approaches Joe saying: "Hi there! I received your email about the project. Do you have a minute?" "Sure," Joe replies, "let's sit down in the coffee room and sorts things out." The interaction lasts for five minutes."

The three main situations of the scenario are:

- (A in figure 2) Bob wants to discuss the project with Joe when they meet. He marks the email, which is transferred to his Proxy Lady.
- (B) Proxy Lady notifies Bob that Joe is around. Since Bob finds it suitable to talk about the project, and Joe does not look very busy, Bob makes the decision to approach Joe.
- (C) Joe accepts the invitation and an informal communication session follows (during which Bob may consult the email).

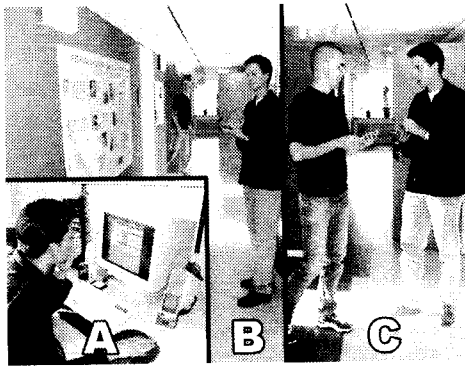


Figure 2. Three basic situations of the use scenario.

In figure 2, we illustrate the three main situations of the scenario.

We will now describe how the Proxy Lady system is operated from a user's perspective.

3.2. Interface and Use

There are two main interface components of Proxy Lady: the desktop and the PDA. Let us now describe these in some more detail.

The desktop: If the user of Proxy Lady for some reason wants to discuss an email with a person, then she needs to associate it with that person. To associate an email with a person, the user makes a copy of the message to a dedicated folder (called "Proxy Lady") on an IMAP server. To make the copy, the user selects the message, presses the right mouse button, and pastes it in the "Proxy Lady" folder (see figure 3).

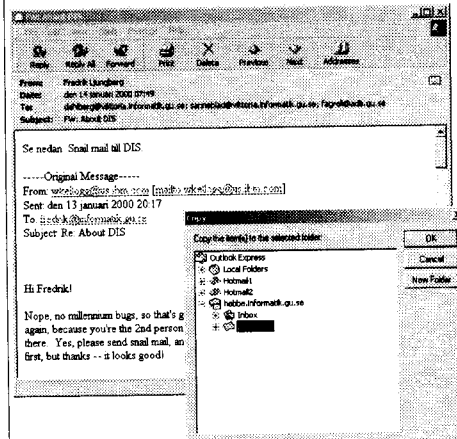


Figure 3. Associating emails with Proxy Lady.

Proxy Desktop manages the flow of information between the email client and the PDA. At regular intervals the Proxy Desktop scans the "Proxy Lady" folder on the server. It converts emails to information items and transfers them to the PDA. The Proxy Desktop lists items that are not yet synchronized. Figure 4 shows an example of the Proxy Desktop.

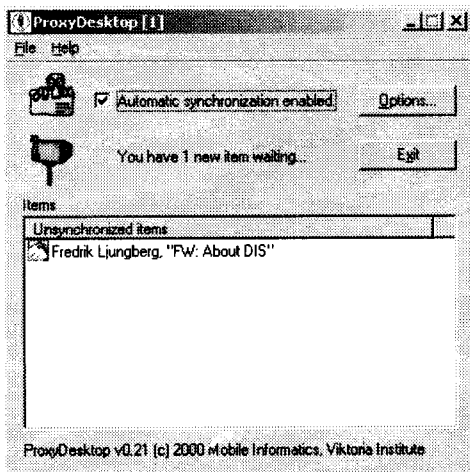


Figure 4. The Proxy Desktop component.

When the option “Automatic synchronization enabled” is chosen, the Proxy Desktop transfers the new email items to the client the next time the PDA is connected to the PC. Four new messages, like in the example above, will only take a few seconds to transfer to the PDA. Now, the email items that the user wants to discuss with other people will be used by the Proxy Client.

The PDA: The main window of the mobile client (Figure 5 a) lists “candidates for interaction,” i.e., the names of people with whom the user has associated emails. The “candidates for interaction” are either within the proximity (“Contacts in proximity...”) or away (“Contacts away...”).

The number previous to each name tells the user how many items she has associated with the person in question. The user taps the name (5b) to view the subjects of the items. By tapping a subject in the list, the properties of the matching information item are displayed on the screen (5 c).

When a “candidate for interaction” enters the proximity of the user she becomes notified by a “proximity alert.”

The “proximity alert” makes three things happens (5 d):

- A sound. The sound can be changed and turned on/off.
- A flashing light that can be turned on/off.
- The name of the person is displayed in a dialog box.

The user can create email and task items on the PDA. The reason why Proxy Desktop only supports email items is that tasks and other information used by common groupware applications often have proprietary standards demanding dedicated solutions.

*XML
↓
classmate*

The user starts and stops the client by selecting “Visible” or “Invisible” in the dropdown menu at the right-hand top corner (Fig. 5 a).

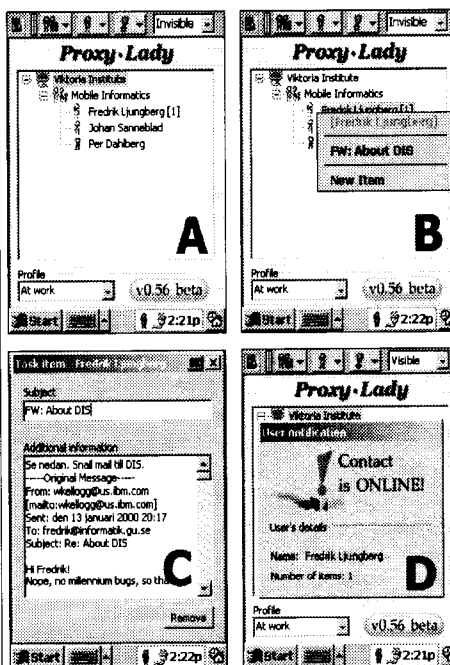


Figure 5. The Proxy Client user interface.

3.3. Implementation

Proxy Lady was implemented on the Windows CE (version 2.11) platform using Visual C++ and Microsoft Foundation Classes (MFC). Using Visual C++ and MFC we were able to develop a solid and reusable software platform with code that could run on both a PDA and a desktop computer (Proxy Desktop shares more than 50% of its code with the Proxy Client). We developed the software using a layered architecture that separates user, business, and data objects.

Software platform: In figure 6 we illustrate the main components of Proxy Lady.

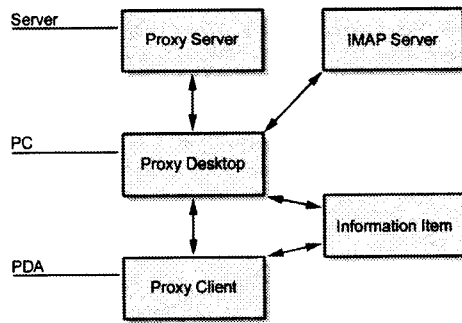


Figure 6. The components of Proxy Lady.

Proxy Server manages a list of users of the system. The list comprises ID, name, and email addresses. The ID is a unique number that the system assigns to the users (when registered). It is used by the Proxy Client in the process of identifying "candidates for interaction." Updates to the list are transferred to the Proxy Client as soon as the PDA is connected to the PC.

Proxy Desktop exchanges information with the Proxy Server and imports email items from a central IMAP server. Because we developed our own IMAP client using MFC we can easily port all functionality to Windows CE when permanent network connections become available.

Proxy Client contains interface components for displaying, modifying and notifying "candidates for interaction." It uses a shared file folder to synchronize with the desktop (using Microsoft's proprietary ActiveSync software).

Information Items are used for storage and information transfer between Proxy Desktop and Proxy Client, and contains the association a user creates between a person and an information entity. An information item is an abstract entity that we so far have realized through two specializations: emails and tasks. Adding new specializations in the future will be easy due to the object-oriented approach we have chosen.

Hardware: Proxy Lady has three types of hardware components: PDAs (Cassiopeia E-105) equipped with radio transceivers (see figure 7), PCs, and a server. The radio transceivers manage the scanning of the area of proximity. The scanning range is today set to 20 meters (in an open environment).

In the current version of Proxy Lady the hardware for short-range communication is customized. This is likely to change in future versions of the system due

to the development of standard radio components like Bluetooth.

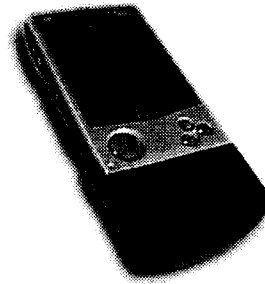


Figure 7. The Proxy Client hardware.

4. Evaluation

In order to assess Proxy Lady, we conducted workshops and user studies:

- A design workshop during the design phase of the system, which aimed at helping us refine the design before the user trial.
- Observations of the system in use
- Closing workshops with the users and selected colleagues (who had experienced the system in use in the organization, but had not used the system themselves)

We used video to capture the workshops and took notes during the observations. We transcribed all the data we had collected. The data was analysed using a grounded theory approach (Glaser and Strauss 1967). We went through the data repetitively and marked important events. Gradually we identified the categories that appeared most relevant. The results of the investigations concern the concept of Proxy Lady and ideas for improvements. The categories are presented in section 4.3 and 4.4. When possible, we have tried to articulate the differences between the different groups. However, in many cases the type of feedback we received was homogenous between the groups.

The research approach adopted by the research we present in this paper has been called "The New Informatics" (Dahlbom 1996) or when applied in the mobile domain, "Mobile Informatics" (Dahlbom and Ljungberg 1999). The overall idea of this genre of Informatics research is to contribute to "innovation"

within the field of IT use. This means that we aim at novel but yet realistic suggestions of how IT could be used within the domain of interest.

The practical orientation of this type of research has been questioned. Is not this what practitioners are supposed to do? Are not researchers supposed to observe and come up with theories? Our claim is not that all informatics research should be practical and design oriented. What we do argue, however, is that our field should open up for more innovation-oriented research. Otherwise, we do run the risk of becoming too much detached from "where the action is."

4.1. The Design Workshops

The workshop sessions involved three different groups:

- Group A: A team of three systems administrators (at our department at the university)
- Group B: A team of three groupware consultants.
- Group C: Two salesmen and three department managers at an IT consulting agency.

The objective of the workshops was to assess the potential use of the system in different mobile use settings.

The three user groups shared many features with the intended users of the system. For example, they meet many people, that are mobile during the working day, and they are involved in much communication. We assume these to be typical conditions under which future users of the system will work. For this reason, however, the results of the evaluation may not be generally applicable, simply because we do not know how Proxy Lady would work in other settings like schools, factories or rock concerts. Since our aim is to support professionals involved in much communication, the selection of workshop participants seemed appropriate.

The workshops were based on the pluralistic walkthrough approach (Bias 1994). Pluralistic walkthrough is related to cognitive walkthrough and "jogthrough" (Nielsen and Mack 1994). It advocates an open discussion between designers, usability experts and users, investigating the usability of the steps associated with a specific task scenario. The user session of the systems administrators explored "helping users," the groupware consultants "cooperating

while working in a project," and the IT consulting agency "organizational communication." During the workshops the participants were able to comment on anything they came up with, even if it did not relate to the specific task scenario. We used a digital video camera to capture all workshop-sessions. The videos were also transcribed.

4.2. Evaluation in Use

The user studies that followed the initial workshops investigated the use of Proxy Lady in a real use setting. At the site where we made the study, we equipped five employees with Proxy Lady clients. The research site is an IT consulting agency (not related to our research department), with about 40 employees (at this particular site). During the trial period, only four were actually able to use the clients, since one person experienced technological problems. The radio transceiver simply stopped working and we did not manage to repair it.

The professional roles of the people who tried out the system includes: a project leader, a systems developer, a manager and a business developer. When we provided the users the Proxy Lady clients, we gave them a brief introduction to the system. We conducted observations during approximately 20 hours during a three-week period. We took notes continuously, all of which we later transcribed.

4.3. Closing workshops

The people who the user study concerned, we also involved in a final workshop session (Group D). The final workshop involved the four people who had used the system, and two who had not. To distinguish between these two groups of people, we use the following categories:

- Group D Users: People who had used the system.
- Group D Non Users: People who had observed the system in use.

We involved non users in the workshop to investigate the views of people who on one hand had experienced the system in use – their colleagues had used it, which they knew, but on the other had not actually used it themselves. The final workshop was also videotaped and transcribed.

4.4. Results concerning the concept of Proxy Lady

Below we summarize the main issues regarding the concept of Proxy Lady. The categories were formed based on the results from the empirical work.

- The task domain was recognized and considered important

Everybody recognized the kind of tasks that Proxy Lady seeks to support. Furthermore, there was a general agreement that these tasks are important. Clearly, this observation is very important, because it indicates that the research addresses situations that people understand and where they think they may need help. Even though this was hinted in the empirical research based on which the concept of Proxy Lady was coined (Bergqvist et al. 1999), this confirmation was really important.

Comments from the users in Group A-C, who had not experienced the actual system in use, were similar to each other. One of the salesmen in Group C said: "It is difficult to remember what to say when you meet people." Another salesman said: "E-mail is very good. It often happens that you mark an email to follow it up later, but forget about it when you meet people."

One participant from Group D Users said: "...It is a good step to take, it is so darn logical and we know that we will take it." As always, this observation may be limited to the domains we investigated. Nevertheless, the result is positive.

- Positive attitude

A similar observation is the positive attitude of people towards the system. As a matter of fact, everyone involved in the user studies was positive towards the system and thought it may help them doing their work more effectively.

People who did not have the opportunity to use the system (Group A-C, and Group D Non Users) all wanted to try it out. One of the groupware consultants in Group B said: "I think it would be interesting. I don't know in what form though. But I would like a tool like this." A salesman in Group C said: "The number of tasks each person has to manage currently surpasses ones ability."

One of the Group D Users commented on integrating a system supporting opportunistic interaction into

everyday work: "...this has shown that it is possible; we have come that far now. Sure, it will work".

- Physical constraints

Obviously, Proxy Lady would mean "yet another device" for people who do not use the Cassiopeia PDA (which was the only platform on which the system was available at the time of the studies). For obvious reasons, the participants did not want to use two or more devices (this was the case for both people who had used the system and those who had not).

Participants in Group B and Group C who had not tried out the system and were using other types of PDAs said they probably would need to migrate to the Cassiopeia when adopting Proxy Lady. One of the groupware consultants in Group B said: "It would have to be embedded in a bracelet or something. A ring perhaps?" The System Administrators in Group A were reluctant both to the thought of switching PDAs for the Cassiopeia, or using two devices.

When discussing the use of a "Proxy Lady-equipped" Cassiopeia PDA, one of the Group D Users said that "the size was less important than the fact that the radio transceiver made it impossible to recharge or synchronize the PDA with the PC." Further, the quality and reliability of the transceivers were not sufficient for a production environment. The participant in Group D Users that was given the malfunctioning transceiver commented that we were doing the evaluation with premature technology.

- Privacy issues

People who had not used the system (participants in Group A-C, and the people in Group D Non Users) expressed concerns for potential misuse of the system, e.g., that people could monitor each other. However, they all seemed satisfied with the "invisible mode." An interesting twist on the privacy issue is that Proxy Lady can be used to prevent interaction. One of the System Administrators said: "Oh great, then I can be notified of annoying users, and just run the other way or close my door."

During our observations we found no situation where the privacy of the user was threatened. However, the period of use was probably too short to reveal such situations. During the workshop, none of the people in Group D Users expressed any concerns regarding

potential misuse of the system.

- Disruptions

The people in Group A-C who had not seen the system in use expressed some concerns regarding the possibility of disruptions. One salesman in Group C said: "There is a risk that the day is becoming fragmented. It is difficult to anticipate how one would act." A manager in the same group said: "The question is how event driven you want to be. Some feel that we already are too event driven." One consultant in Group B said: "You don't want to be too controlled, then you run the risk of missing the informal part of communication."

One workshop participant in Group D Non Users remarked that Proxy Lady might be yet another device interrupting his work. However, his colleagues who actually had used the system did not agree, arguing: "It's not as disruptive as a mobile phone. It is a bit 'softer'." By softer they meant that it is easier to ignore Proxy Lady when it notifies the user, compared to a mobile phone. Further, one of the users claimed that disruption can actually be a positive property, depending on your role in the organization, "It is another device that calls for your attention, in the same way as mobile phones does; when it rings you have to deal with it. But in my professional role this is not a bad thing. On the contrary, it is often such events that lead to positive results..." the business developer in group D commented.

4.5. Results concerned with how to improve the system

Below we summarize the main issues regarding how to improve the system as such.

- New information items

During the workshops with Group A-C, web pages, documents and files were suggested as new types of information items to support (in the list of information items). These types of items were actually suggested by all workshop groups. One of the consultants in Group B also suggested that: "Information Items should also be linked to their current ERP system."

The users in Group D who had seen the system in use, however, seemed to be satisfied with the "task" information item type (during the concluding workshop

no participant had any suggestions of new items).

- Notification of artefacts

Several participants of group A-C expressed that it might be useful to associate information items not only with people, but also with things like computers. For example, one of the Systems Administrators in Group A claimed he wanted to be reminded (notified) about making software upgrades when walking by a workstation.

- Range of proximity

The users in Group A-C who had not seen the system in use requested different ranges of proximity. One group wanted a range of 10 meters, another a range of 50 meters. It may also be useful to specify the range of proximity for different people. For example, one groupware consultant claimed: "If a person who you usually don't meet is in the same building, you would like the Proxy Lady to notify. But if it is your colleague next door, you don't want to know." All users in Group D, however, claimed that the range was sufficient.

- Hardware hassles

Unfortunately, the current implementation suffers from some technological problems:

- The transceiver is a bit too large
- The PDA cannot be recharged without removing the transceiver
- The transceiver consumes much power
- The transceiver is fragile

These problems caused some hardware hassles during the trial period. However, the objective of this project was not hardware design, but to explore and try out the concept behind Proxy Lady, i.e., IT support for opportunistic communication. Therefore, the hardware shortcomings were perhaps not so serious for our purpose here.

- Users and non users

People who had not used the system had more innovative and radical comments for redesign,

compared to people who had actually used the system. For example, the former wanted features to adjust the range of the system, while the actual users were satisfied with the fixed range. Many of the people who had not used the system also suggested new types of information items, while the users thought it was enough with the available information items.

One reason for this might be that it is difficult to picture what functions are useful in a real use situation. Another reason could be that when a person becomes used to a system, she might be used to its limitations and learn how to overcome the shortcomings. The task information type, for instance, is flexible, in the sense that it can store all types of text. This makes it possible to paste addresses to web pages, together with some of the texts of the web pages. The problem with the fixed range, on the other hand, might not have been a problem in a real use setting.

However, it is difficult to make a proper analysis on what the reasons might be for the differences between the users and the non users. Other possible reasons might be that the users were so focused on the hardware hassles that they did not manage to come up with suggestions for future functionality or simply that the users were not in a creative mode during the time of the workshop.

5. Related Work

In this section we compare and contrast Proxy Lady with similar research in two main areas: memory aid systems and interaction support systems.

5.1. Memory aid systems

Memory aid systems like Forget-me-not try to "help with everyday memory problems" (Lamming and Flynn 1994), e.g., recalling a name or finding a document. Forget-me-not seeks to help people retrieve information they once knew, e.g., when something happened, by using context as retrieval key (e.g., Lamming and Flynn 1994). The system creates "biographies" for the users by capturing who they meet (relative location), where they go (absolute location), and other "contextual data." The idea is that we organize our memory about the past in episodes, and that the location, who was there, etc., are "strong cues for recall." Forget-me-not provides people with such cues as a means to help them to remember (e.g., where a document is). Even though there may be similarities

between Forget-me-not and Proxy Lady on a systems level, the types of activities the systems seek to support are very different (memory aid vs. support for informal communication). Forget-me-not runs on PARCTABS, which is a mobile, ubiquitous computing platform (Want et al. 1995). PARCTABS could have served as the technological infrastructure of Proxy Lady.

The Wearable Remembrance Agent is a wearable, ubiquitous memory aid system that shares features with Forget-Me-Not (Rhodes 1997). However, the Wearable Remembrance Agent uses a head-up display for systems output (not a screen), it relies on other contextual clues, and it is more proactive. Compared to Proxy Lady, the Wearable Remembrance Agent has another objective: it is a memory aid system, not a tool for informal communication.

5.2. Interaction support systems

We have identified two types of interaction support systems that are related to, but yet different from Proxy Lady. These are systems supporting intended and spontaneous interaction between people in face-to-face settings.

Active Badge is a mobile system that helps people to find colleagues and transfer telephone calls (Want and Hopper 1992). Badge systems (also implemented at Xerox, MIT, etc.) support "intended" interaction, i.e., situations where someone explicitly tries to find a colleague (Isaacs et al 1996). Proxy Lady, on the other hand, was designed to support "opportunistic" communication, i.e., communication that is anticipated by (at least) one participant, but occurring only when the parties happen to meet (Isaacs et al. 1996).

In contrast to intended interaction is spontaneous interaction that is unanticipated. Examples of systems supporting spontaneous interaction are Hummingbird and Thinking Tag.

Hummingbird is a mobile device that aims to support awareness between group members who are in the physical vicinity of each other (Holmquist et al. 1999). A Hummingbird scans its surrounding (approximately 100 meters range) for other Hummingbirds. It tells its user ("it hums" and displays the name on a screen) when another device has been detected. The Hummingbird system and Proxy Lady may also look similar on a systems level. However, the systems are different: Hummingbird seeks to maintain general awareness in (mobile) groups to support spontaneous interaction, while we want to increase the frequency and quality of

opportunistic, informal communication.

A system related to Hummingbird is the Thinking Tag, which is a wearable, context sensitive nametag (Borovoy et al. 1996, Borovoy et al. 1998). It displays the name of the person wearing it (just like an ordinary nametag), but also the extent to which she has picked the same answers to five multiple-choice questions as the people she meets. The five questions are represented by five diodes on the Tag. A green diode means that two people have answered the same to a question, a red that they have not. The Thinking Tag seeks to augment the social processes of people mingling at conferences (and similar events) by augmenting spontaneous, unanticipated interaction. Accordingly, it is less work-related than Proxy Lady.

6. Discussion

Privacy issues and the problem of disruption have been discussed frequently in the literature on systems supporting informal communication. Obviously, they also need to be considered carefully in the case of Proxy Lady. Let us start the discussion by exploring these issues in some more detail.

6.1. Privacy and disruption

Systems that support informal communication may be perceived as disruptive and a threat against privacy. For example, consider the following quote from Hudson and Smith (1996, p. 248):

“...the more information about oneself that leaves your work area, the more potential for awareness of you exists for your colleagues. Unfortunately, this also represents the greatest potential for intrusion of your privacy. Similarly, the more information that is received about the activities of colleagues, the more potential awareness we have of them. However, at the same time, the more information we receive, the greater the chance that the information will become a disturbance to our normal work.”

The problems of privacy and ethics of “invasive technologies” such as Proxy Lady and Media Space systems have been discussed frequently in the literature (e.g., Anderson 1991, Bellotti and Sellen 1993). Clearly, these problems are important and they need to be taken seriously.

Because Proxy Lady is based on relative location, the potential misuse of the system seems less than systems based on absolute location, e.g., Active Badges. In fact,

one user claimed he could use Proxy Lady to increase privacy by letting the system warn of annoying people coming nearby.

Technically, users of Proxy Lady could simply activate the “invisible mode” to disappear when suitable. However, this would not always be enough. For example, what if using the “invisible option” is against the ways in which the system could be used intelligibly in the organization? In such a situation, users who turn off the system would be expected to come up with “a good reason why.” Otherwise, turning off the system would mean breaking an unwritten law requiring an explanation.

Since intelligible use patterns partly derive from the social context of the organization, sometimes called “the corporate culture,” issues like privacy and ethics cannot be handled technologically exclusively. In other words, a feature like the “invisible mode” of the Proxy Lady system can hardly solve the problem, even though it can be helpful. So, when introducing an “invasive technology” like Proxy Lady, what social rules would be defined, how could “good rules” be assured?

The social rules that define intelligible and not intelligible use of technology derive from complex organizational processes, which have been researched frequently within our field. One further case for this strand of research could be the adoption and use of the Proxy Lady system. The initial evaluation studies we report in this paper clearly need to be completed with additional empirical data. However, that is not the main topic of the research reported in this paper, i.e., the rationale and design of a novel mobile system based on relative location between mobile personnel.

The problem of disruption has also been reported from studies of informal communication systems. Attempts to make systems less disruptive include trying to simulate how people approach each other in the real world (Tang et al. 1994). One strategy to cope with disruptions is (once again) the “invisible mode,” which makes it easy to disappear when experiencing too many annoying interruptions. However, as noted above this strategy is primitive. Other possible solutions are filtering (who to notify) and the use of ambient media (Ishii and Ullmer 1997).

As the discussion above implies, the success or failure of a system like Proxy Lady to a considerable extent relies on the social use context of the user organization. Questions you then may ask are:

- What is a typical example of a social context within which Proxy Lady would be a success?
- What is a typical example of a social context within which Proxy Lady would be a failure?
- What is a typical example of a social context within which Proxy Lady would be misused?

These questions are serious, and you could of course have hypotheses regarding the possible answers. For example, inasmuch as using Proxy Lady as a control tool is regarded as "misuse" of the system, we could suspect this could happen in an organization characterized by, for example, a management culture that says anonymous control of workers is legitimate. The other way around, we could assume that a company with a flat organization, where management supports spontaneous cooperation and the workforce is empowered, could be an example of a user organization with the "right preconditions." However, to us it seems risky to speculate too much about this without empirical data. That is, future empirical investigations of Proxy Lady in use will have to be conducted to find out.

6.2. The problem of proximity

Proxy Lady uses the relative proximity between users to notify "candidates for interaction." Using the terminology of Harrison and Dourish (1996), the system is based on "space," not "place." "Space" is the three-dimensional world of objects and events, while "place" is "the understood reality" (Harrison and Dourish 1996, p 69):

"It is a sense of place, not space, which makes it appropriate to dance at a Grateful Dead concert, but not at a Cambridge college high table; to be naked in the bedroom, but not in the street... [..]. Place, not space, frames appropriate behaviour."

Accordingly, the notion of proximity on which Proxy Lady is based could be problematic (see also Redström et al. 1999). For example, a user could be notified that a "candidate for interaction" is in the proximity when she in fact is in an office on the next floor. In this case, being 3 meters away is not being in the proximity simply because those three meters are vertical.

According to the workshop sessions, different use situations require different radius of the area of proximity. This implies that the radius should be easy to adjust. One option to explore further is default radius modes. For example, the "large office landscape" mode could have a radius of 50 meters,

"small office" 20 meters, and so on. Another option to explore is the possibility to adjust the area of proximity for different users or type of users. For example, you may always want to be notified when Jimmy Connors is less than 500 meters away, or when someone in the board is nearby.

One way to turn space more into place would be to "annotate" (or "tag") space and use positioning techniques. This would make it possible to know if someone is in Nick's office, the kitchen or the meeting room. However, representations are always simplifications. For example, they cannot tell you whether or not it is appropriate to interact, which may be very important (Kristoffersen and Ljungberg 1999).

Even though Proxy Lady makes simplifications about the world it may still be a useful interaction tool. For example, communication systems like ICQ, which makes many simple (and arguably naive) assumptions about human conduct, is still very useful. The important point may be that users can learn and understand the simplifications. This is an important issue for a long-term evaluation study.

7. Conclusion

We have introduced the Proxy Lady system supporting opportunistic, informal communication in face-to-face settings. By using relative proximity between people and "candidates for interaction," obtained through explicit user actions, the Proxy Lady system supports informal sessions in the workplace. In doing so, the system aims to support a valuable asset of work: opportunistic communication.

The main contribution of Proxy Lady is its support for opportunistic communication in face-to-face settings. It is an interactive system that addresses previously unexplored use situations. Previous systems supporting the face-to-face setting either focus on spontaneous (e.g., Borovoy et al. 1996) or intended interaction (e.g., Want and Hopper 1992). The objective of augmenting informal communication as opposed to "help with everyday memory problems" makes Proxy Lady different from memory aid systems like Forget-me-not (Lamming and Flynn 1994). Reviewing the literature we may also claim that using relative proximity to support interaction between people is a novel approach.

The informal workshop sessions we conducted

reported promising results. Even though there are issues to consider in re-design, Proxy Lady seems to be a useful, lightweight interaction tool that people are willing to use in their work.

There are several upcoming standard components for short-range communication, e.g., Bluetooth. The Proxy Lady project could be viewed as an attempt to start exploring one type of applications that such components will realize.

Future work involves a long-term evaluation study of Proxy Lady in use. Previous to that, we need to redesign the transceiver platform to be more robust and easy to

operate. We also need to update the software design according to the evaluation results, as well as redesign the software for the latest version of Windows CE (called Pocket PC).

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References

- Anderson, B. (1991) "The Ethics of research into invasive technologies," EuroPARC Technical Report (EPC-1991-107), Cambridge, England
- Bellotti, V. and A. Sellen (1993) "Design for privacy in ubiquitous computing environments," in Proceedings of The Third European Conference on Computer-Supported Cooperative Work, Kluwer Academic Publishers.
- Bergqvist, J., P. Dahlberg, S. Kristoffersen, and F. Ljungberg (1999) "Moving out of the meeting room: Exploring support for mobile meetings," in Proceedings of The Sixth European Conference of Computer Supported Cooperative Work, p. 81-98.
- Bias, R. (1994) "The pluralistic walkthrough: Coordinated empathies," in Usability inspection methods, J. Nielsen and R. Mack, Editors. 1994, John Wiley & Sons.
- Borvoy, R., F. Martin, M. Resnick, and B. Silverman (1998) "GroupWear: Name tags that tell about relationships," in Proceedings of ACM 1998 Conference on Human Factors in Computing Systems, ACM Press, p. 329-330.
- Borvoy, R., M. McDonald, F. Martin, and M. Resnick (1996) "Things that blink: Computationally augmented name tags," IBM Systems Journal, Vol. 35, No. 3 & 4, p. 488-495.
- Bly, S., S. Harrison, and S. Irwin (1993) "Media Spaces: Bringing people together in a video, audio and computing environment," Communications of the ACM, Vol. 36, No. 1, p. 28-47.
- Dahlbom, B. (1996) "The New Informatics," Scandinavian Journal of Information Systems, Vol. 8, No. 2, p. 29-48.
- Dahlbom, B. and F. Ljungberg (1999) "Mobile Informatics," Scandinavian Journal of Information Systems, vol. 10, p. 227-234
- Fish, R.S., R.E. Kraut, and B.L. Chalfonte (1990) "The VideoWindow system in informal communications," in Proceedings of ACM 1990 Conference on Computer-Supported Cooperative Work, ACM Press, p. 1-11.
- Gaver, W., T. Moran, A. MacLean, L. Löfstrand, P. Dourish, K. Carter, and W. Buxton (1992) "Realizing a Video Environment: EuroPARC's RAVE System," in Proceedings of ACM 1992 Conference on Human Factors in Computing Systems, ACM Press, p. 27-35.

- Glaser, B. and A. Strauss (1967) "The discovery of grounded theory. Strategies for qualitative research," Chicago: Aldine.
- Harrison, S. and P. Dourish (1996) "Re-Place-in space: The roles of place and space in collaborative systems," in Proceedings of ACM 1996 Conference on Computer Supported Cooperative Work, ACM Press, p. 67-76.
- Holmquist, L.-E., J. Falk, and J. Wigström (1999) "Supporting group collaboration with interpersonal awareness devices," Personal Technologies, Vol. 3, p. 13-21.
- Hudson, S. and I. Smith (1996) "Techniques for addressing fundamental privacy and disruption tradeoffs in awareness support systems," in Proceedings of ACM 1996 Conference on Computer Supported Cooperative Work, ACM Press, p. 248-257.
- Isaacs, E., J. Tang, and T. Morris (1996) "Piazza: A desktop environment supporting impromptu and planned interactions," in Proceedings of ACM 1996 Conference on Computer Supported Cooperative Work, ACM Press, p. 315-324.
- Ishii, H. and B. Ullmer (1997) "Tangible bits: towards seamless interfaces between people, bits and atoms," in Proceedings of ACM 1997 SIGCHI Conference on Human Factors in Computing Systems, ACM Press, p. 234-241.
- Kraut, R., R. Fish, R. Root, and B. Chalfonte (1990) "Informal communication in organizations: Form, function and technology," in Readings in Groupware and Computer-Supported Cooperative Work: Assisting human to human collaboration, R. Baecker, Editor. Morgan Kaufmann Publishers Inc: San Francisco, CA. p. 287-314.
- Kristoffersen, S. and F. Ljungberg (1999) "An empirical study of how people establish interaction: Implications for CSCW session management models," in Proceedings of ACM 1999 Conference on Human Factors in Computing Systems, ACM Press, p. 1-8.
- Lamming, M. and M. Flynn (1994) "Forget-me-not: Intimate Computing in Support of Human Memory," in Proceedings of International Symposium on Next Generation Human Interface.
- Mantei, M.M., R.M. Baecker, A.J. Sellen, W.A.S. Buxton, T. Milligan, and B. Wellman (1991) "Experiences in the Use of a Media Space," in Proceedings of ACM 1991 Conference on Human Factors in Computing Systems, ACM Press, p. 203-208.
- Nielsen, J. and R. Mack (1994) "Usability inspection methods," John Wiley & Sons, 1994.
- Obata, A. and K. Sasaki (1998) "OfficeWalker: A virtual visiting system based on proxemics," in Proceedings of ACM 1998 Conference on Computer Supported Cooperative Work, ACM Press, p. 1-10.
- Patton, M.Q. (1990) "Qualitative Evaluation and Research Methods," New York: Sage.
- Redström, J., P. Dahlberg, P. Ljungstrand, and L.E. Holmquist (1999) "Designing for local interaction," in Proceedings of Managing Interactions in Smart Environments (MANSE) 1999, Springer Verlag, p. 227-238.
- Rhodes, B. (1997) "The wearable remembrance agent: A system for augmented memory," Personal Technologies, Vol. 1, p. 218-224.
- Shilit, B.N. (1995) "A Context-Aware System Architecture for Mobile Distributed Computing," Ph.D. thesis, Dept of Computer Science, Columbia University. 1995.
- Tang, J., E. Isaacs, and M. Rua (1994) "Supporting distributed groups with a Montage of Lightweight Interactions," in Proceedings of ACM 1994 Conference on Computer Supported Cooperative Work, ACM Press, p. 23-34.

Want, R. and A. Hopper (1992) "The active badge locator system," *ACM Transaction on Office Information Systems*, Vol. 10, No. 1, p. 91-102.

Want, R., B.N. Schilit, N.I. Adams, R. Gold, K. Petersen, D. Goldberg, J.R. Ellis, and M. Weiser (1995) "The PARCTAB Ubiquitous Computing Experiment," 1995, Xerox Palo Alto Research Center: Palo Alto, US.

Whittaker, S., D. Frohlich, and O. Daly-Jones (1994) "Informal workplace communication: What is it like and how might we support it?," in *Proceedings of ACM 1994 Conference on Human Factors in Computing Systems*, ACM Press, p. 131-137.