User Experience of Social Ad Hoc Networking: Findings from a Large-Scale Field Trial of TWIN

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ABSTRACT

Modern mobile phones have the capability to detect proximity of other users and offer means to communicate and share data ad hoc with the people in the proximity. TWIN is an ad hoc social networking system which offers applications for social presence, mobile multimedia sharing and ad hoc community-based communication. In this paper we present the results of a large-scale user study of TWIN. In this field study, 250 study participants used TWIN for nine weeks. Our aim was to investigate the user experience of social proximity-based ad hoc communication. We found that the users felt TWIN to be more fun and entertaining than a useful tool for achieving pre-defined goals. Furthermore, users appreciated the possibility to find and chat with both familiar and unfamiliar persons nearby. Privacy concerns did not rise as a significant issue in user experience. We argue that a system like TWIN has the potential of becoming a new social enabler in people's everyday lives.

Categories and Subject Descriptors

H.4.3. [Information Systems]: Communication applications. H.5.1. [Information Systems]: Information Interfaces and Presentation; Multimedia Information systems.

General Terms

Design, Human Factors.

Keywords

Ad hoc social networking, proximity-based communication, mobile service, field study, user experience.

1. INTRODUCTION

Both mobile industry [23] and academia [6] have been studying the potential of mobile phones to detect social proximity and to find effortless ways of communicating and sharing data with people nearby. A new field of research using mobile devices as sensors for social interaction is being established around the topic of sensor-based mobile communication and ad hoc networking (for example, [8], [4], [11]).

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Social networking services are blooming in the internet. Facebook is a fast growing service in the internet [10]. Social networking services have the potential to utilise the capabilities of sensor-based mobile devices. The advances in sensor technologies may make the social proximity applications more interesting for consumers. To evaluate this approach, we created a social networking system called TWIN, which utilises the local connectivity between devices people carry with them.

TWIN is a system for social peer-to-peer applications, combining the social networking presence with geographical locations of users. TWIN automatically creates a peer community from people who are locally present. TWIN is used for sharing experiences, messages, flyers, photos, videos, songs, stories etc. – and for tracking old and meeting new friends. Concrete TWIN applications include social communities with user profiles, file sharing, public and private chat, a message board and community visualization through a "radar view".

TWIN devices are mobile smart platforms, i.e. advanced mobile phones. TWIN implementation on Nokia N900 smart phone operates on ad hoc WLAN. TWIN creates a local community through peer-to-peer networking when other users and devices are within range. No infrastructure WLAN or cellular data transmission is required during use. TWIN was developed in a cooperation project by Tampere University of Technology (TUT), Department of Computer Systems and Nokia Research Center.

Even though some related systems have been implemented, systematic analyses of user experience of proximity-based communication are scarce in previous work. We conducted a large-scale user trial (called *pilot* in this paper) to study the user experience of TWIN's local social networking applications. Altogether 250 participants were recruited for the nine weeks long pilot period in spring 2010. The pilot concentrated on studying the different usage practices and user experiences of TWIN. In addition, we continuously collected users' feedback on the development ideas of the system. Our main aim was to understand how users experience the proximity-based communication as part of their social networking. Another area of research interest was privacy. The pilot also evaluated the implementation technologies, but the focus in this paper is on user experience results.

2. RELATED WORK

In this section we present related work from two perspectives: Related systems which have been implemented by others, and user studies of related systems which have been reported in literature.

2.1 Related Systems

Peer-to-peer (P2P) technologies emerged in late 1990s to facilitate large-scale file sharing. BitTorrent, which was introduced in 2001, provided reliable, low-cost and large-scale distribution of content [5], [28]. Mobile ad hoc P2P systems have been proposed to take advantage of physical peer proximity, e.g. Proem [19]. Peers in Proem are organized in decentralized ad hoc communities that share data. Peers are in physical proximity, that is, within reach of communication technology such as ad hoc WLAN and Bluetooth technologies in mobile devices.

Lien et al. [20] have introduced a mobile ad hoc network (MANET, see also [21]) type of system called P2Pnet. P2Pnet targets at supporting communication and information demand for mobile users in catastrophic situations, such as rescue teams, army groups in battle fields, but also support mobile learning groups.

Karki et al. [17] present a social networking application in an ad hoc peer-to-peer environment that manages social networks based on user profiles. The authors present a middleware that is built on top of PeerHood middleware that offers proactive network management for mobile devices and applications/services on them. PeerHood provides device and service discovery that supports multiple network technologies, including WLAN, Bluetooth and GPRS.

For optimizing the communication network performance, Musolesi and Mascolo [22] propose a mobility model founded on social network theory. The model allows collections of hosts to be grouped together in a way that is based on social relationships among the individuals.

Esbjörnsson et al. [9] propose Hocman, which is a mobile HTTP-based peer-to-peer application for social interaction among motorcyclists. From technology viewpoint, it uses the sharing of HTML documents with peers in the immediate proximity.

MyNet is a P2P personal and social networking platform of middleware and user interaction tools. MyNet is used for connecting to devices and communicating with users in immediate neighborhood [16][3]. The motivation is to enable non-expert users to easily organize their resources and share them in their immediate social neighborhood. Rather than person-to-person communications, MyNET platform considers a variety of personal resources, such cameras, laptops, servers, and music players. Security has been one of the main requirements.

Pietiläinen et al [26] have implemented MobiClique which is mobile social networking middleware enabling ad-hoc networking via Bluetooth. Two short-term user trials confirm the technical feasibility of the system but present no user experience results.

2.2 Related User Studies

There have been several user studies concerning location sharing and mobile social proximity applications. The focus of the studies has usually been usability, privacy or the frequency of application usage. The broader perspective of user experience – including the pleasurable aspects of use (see, e.g. [13]) – seems to have been neglected in the field of social proximity applications. Furthermore, the user studies have been rather small-scale user tests.

Hocman [9] (presented in Section 2.1) has been evaluated in a small field trial with six participants. Hocman helps the interaction between motorcyclists using a specific sound icon. The application gives a loud sound signal when another motorist is approaching, thus giving a biker more time to react in the situation. The trial confirmed that Hocman enhances the enjoyment of driving.

Plummer et al. have presented CampusWiki [27] which integrates location-based information into Wiki structure and, for example, allows the estimation of users' locations. CampusWiki service is not just for mobile use since it can be used also with a PC. Potential users were interviewed during the design process and they perceived several benefits but also concerns related to application. The often mentioned benefits included locating other people on the campus, being informed about campus events and getting help for decision making situations. Interviewees were mostly concerned about their privacy, the credibility of information and misuse. Based on the results the subjects were willing to use the service.

According to Paulos and Goodman [24], there are tools which connect us to our friends, but the connection between strangers is missing. They were eager to find out what kind of tools could help meeting and getting to know better persons we regularly observe but don't interact with. Based on the results of the user studies, the authors developed a system called Jabberwocky which helps users notice people who are usually in the same places.

MyNet (see Section 2.1) has also been piloted in a usability evaluation of 50 users [2]. They state the key thing to the success of social networking is ease of use, so that non-expert users could also use the social networks and share content. One of their primary objectives was to test the usability of the system with non-expert users with various ages. They found out MyNet addressed many usability issues related to P2P social networking. 83% of the users were willing to use MyNet in future.

Persson et al. [25] have proposed DigiDress which they described as *social proximity application* (SPA). The aim was to complement existing social practices, not to replace them. The aim of DigiDress is to be an open expression tool suitable for wide use in different contexts rather than for a specific situation or user group. Users of DigiDress were able to create own profile pages for emphasizing their identity expression, leave comments on other users' pages, search users nearby and send and receive private messages. A salient feature is a phone-to-phone distribution which enables users to distribute the application to non-users via Bluetooth or infrared. A large field test was conducted with 618 Nokia employees who used the application for an average of 25 days in the office context. Participants used the application via Series 60 platform mobile devices which all were equipped with Bluetooth. Based on the results, 20% of the participants quitted the use after one day. This was supposedly because of low amount of other users nearby. "Lookaround" feature which scans the environment for other users was found to be the core of all user activities. 79.7% of the sample used the feature at least once.

Eagle and Pentland [7] conducted a 50 mobile user's survey according to which 90% of the respondents would use regularly a service which would help introduction to nearby strangers. They developed a mobile match-making system called Serendipity. The system contains a central server which calculates the similarities between users and alerts a user if someone interesting comes into the proximity. Serendipity has been tested in conference and campus environments. The reactions of users were overwhelmingly positive. As a conclusion, Serendipity could be used in the future in conferences, at workplaces and for dating.

Humphreys [14] has conducted a year-long qualitative field study of Dodgeball which he describes as a *mobile social network system* (MSNS). Dodgeball allows users to broadcast their location and send messages to other users using text messages. There is also alert feature which helps users to notice friends when they are nearby. During the field study user observations and in-depth interviews were used as study methods. Humphreys compared Dodgeball networks to online social networks, which are usually larger and not so local. According to the participants, Dodgeball involves more "real world interactions" and facilitates more face-to-face interactions than social network sites.

Several studies like [18], [12] have investigated people's willingness to use location-aware services. Results have shown that most participants are willing to share their location information, mostly with their friends but in some situations also with strangers.

There are also some other social proximity applications, devices, frameworks and design outlines like the ones presented in [29], [15] and [1]. However, there seem to no user studies related to these suggestions.

TWIN provides a variety of functionality for the users to detect and interact with their peers in proximity. The main motivation for this research was to run a large-scale user study over a relatively long period of time (nine weeks). Such study would reveal the users' experiences with the system in users' real lives.

3. TWIN SYSTEM DESCRIPTION

In this section, we present TWIN in more detail; its user interface and applications, peer-to-peer (P2P) networking, and the technical implementation.

3.1 TWIN User Interface and Applications

TWIN implements an easy-to-use touch-screen user interface (currently on Nokia N900 device) which can be used with finger or the stylus (see Figure 1).

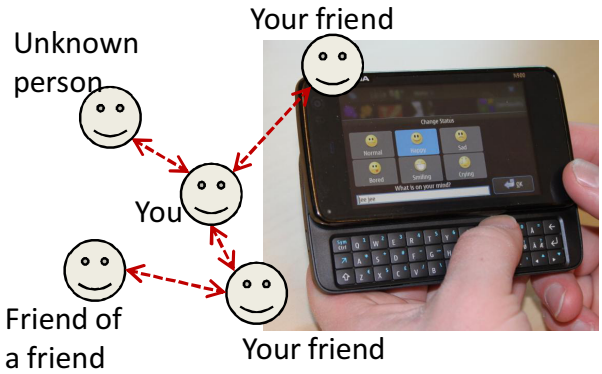

Figure 1. TWIN P2P networking and usage snapshot.

The studied version of TWIN provides the following applications:

Communities: Finding old and new friends, exchanging user profiles, and creating interest communities.

Content sharing: File sharing (browse, search, download), file transfer between users.

Messaging: Private and community-wide (public) chat

Message board: Sharing and announcing items, news, social events, invitations, etc.

TWIN has automatic interactive functions. TWIN can stay idle, and automatically receive message board items, chat messages, and user and community profiles when other users are within the communication range. TWIN alerts the user visually or with vibration if something interesting happens, like someone wanting to have a chat, your friend is nearby, or a favourite topic is seen on the message board. In interactive use, the user can search others and media contents from the ad hoc network and have chats with the community privately.

Figure 2 presents the main user interface screen of TWIN with the selection buttons for the applications: Community, Chat, File sharing and Message board.

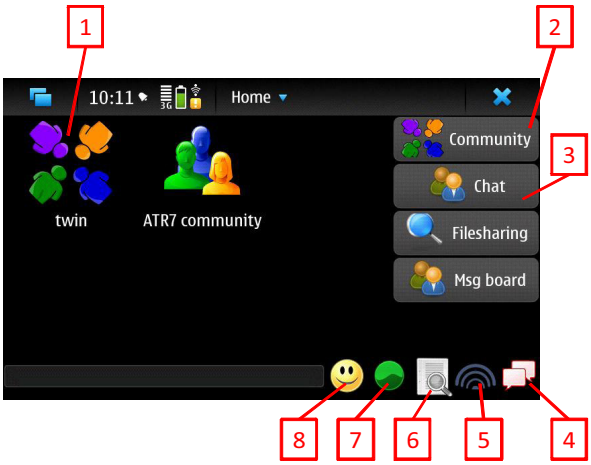

Figure 2. TWIN main user interface and the applications.

Table 1 describes the main functions of TWIN system implementation.

Table 1. Main functions of the TWIN UI, shown in Figure 2.

1	The main view which shows all the communities which the user has joined. Selecting a single community turns all the user actions community-wide, and selecting a single user in a community makes them personal.
2	Create your own community and join communities.
3	Chat with others, search, share and exchange files, check the message boards of others.
4	Incoming messages indicator.
5	Switch to Radar view (Figure 3). This view shows other users as icons on the arcs that indicate how many radio hops away the users are.
6	Event log view. This view shows latest events (like messages or files received).
7	TWIN connectivity indicator. Green icon means the device is connected to TWIN network. If the icon is red, there is no connection available (for example if WLAN is being reserved for internet connection).
8	Change the state of your own avatar (icon that represents you to others), e.g. your current mood (emoticon), or what you are doing.

Figure 3. The Radar view of TWIN showing other users nearby, and the estimated distance in "arcs", indicating the number of WLAN hops.

3.2 P2P Networking

TWIN operates on ad hoc WLAN, and it is independent of any online server and infrastructure connections during use. The design philosophy of TWIN is completely peer-to-peer (P2P), i.e., all peers are equal from the system perspective. Centralised trust is not the principle but instead the design is based on peer trust in which privileges must come from the social (human) level. Also, TWIN peers are all physically local nodes (users) operating in the same IP subnetwork.

TWIN provides multi-hop data transfer between devices. The networking performance differs between single and multiple hops, and also the application features available are different. When communicating over multiple hops, TWIN supports community management, searching and browsing of content and users, as well as chat, but high-capacity file transfer and media streaming are limited to single-hop connections only.

TWIN peers are organized into communities. Communities are identified by text strings. P2P design principle demands that any peer may belong to any public community that it knows about. All users belong to a default community named "twin" which makes finding new friends easier. Peers see each other only when they are in physical proximity which is assumed to induce common (social) interest.

3.3 TWIN Technical Implementation

TWIN runs on Linux platforms, and it is written entirely in Python. TWIN uses a plug-in pattern to allow dynamic extensions. The application consists of utility modules and plug-ins. A plug-in can provide an interface for other plug-ins, and display graphical elements embedded in the application GUI.

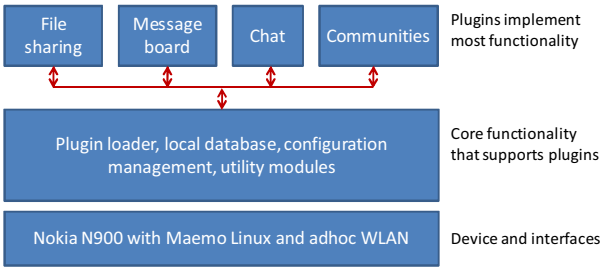

Figure 4. TWIN component diagram

TWIN component diagram is shown in Figure 4. The community plug-in implements peer discovery and provides interface to manage user profiles and community information. A file sharing plug-in implements a method to publish files and events to other peers, to search content and to download files. The message board plug-in implements publication of short messages, notes, invitations, etc. to local communities. The messaging plug-in implements a local chat protocol that supports both private and community chat.

4. THE PILOT AND THE USER EXPERIENCE STUDY

To gain information on the user experience of TWIN concept, a nine week long field trial (which we call *pilot*) and the associated user experience study were conducted in April-May 2010. The following subsections describe the pilot, the participants (users) and the process by which the user experience was studied.

4.1 The Pilot and the Users

To recruit users, the pilot was advertised around the TUT campus. Within approximately a week we got 1051 applications from people who wanted to participate. A total 250 students and employees of TUT were selected for the nine week long pilot. In the registration phase we collected background information from all the applicants. Among other things, the background information included the applicant's typical locations at the campus area, reasons for applying for the pilot and a list of friends also applying for the pilot. Especially applicants with many friends registered for the pilot were favored in the selection. Eventually, the user sample included 240 students, of whom 52 also work at TUT, and 10 were solely employees of TUT. 83% of the participants were male, and 17% female. The mean age of users was 23.9 years, with the age range of 19 to 43 years.

For the pilot, each participant was given a N900 device with the TWIN applications installed. TWIN was improved during the pilot, and several new versions were released. Participants received updates via an update tool which automatically gets new versions and installed them as participant logged on WLAN with her/his device. Information on updates was announced on TWIN electronic forum. Active communication was encouraged both among pilot participants and between the participants and pilot organizers to gather feedback.

One week after the N900 devices were delivered to the participants, a startup meeting was arranged to make sure that participants know how to use TWIN and what is possible to do with it. The participants were also encouraged to use TWIN actively throughout the pilot period, discuss their experiences on TWIN discussion forum and send feedback to TWIN developers. To encourage the participants to be active, ten N900 devices were announced to be distributed amongst the most active or creative participants at the end of the pilot. More than 50 % of the participants attended the meeting and of these people, almost 90% of them found the meeting useful.

In the beginning of the seventh week of the pilot, another meeting was arranged. In this meeting the changes that had been made during the pilot were introduced to the participants, the statistics on TWIN usage collected by that time were shown, and users were given the floor as they had several questions to ask and experiences to share with the developers and other participants.

Six participants quitted the pilots. They were replaced with other applicants. Thus the amount of participants was 250 throughout the pilot.

4.2 User Experience Research Methods

The goals of studying user experience was to find out how the participants use and feel about TWIN, how various TWIN applications are used and what are the new ways of using TWIN. We also wanted to collect users' feedback on their concerns and ideas related to TWIN. To make the most of the pilot of 250 participants, we chose a multiple methods approach for data collection in order to obtain rich empirical data, both quantitative and qualitative.

In addition to using TWIN, all pilot participants committed to the user experience study. The users signed a written agreement where they agreed to answer questionnaires and interview during the pilot. Almost all users (86-100%) answered the questionnaires.

Three questionnaires were conducted during the pilot. The approximate timing of the questionnaires was announced in advance. When a new questionnaire was published the participants were informed via email. All the questionnaires were web questionnaires and they were open from 7 to 11 days.

- The startup questionnaire dealt with user background, use of social media, and expectations of the pilot. All 250 participants filled this out before receiving the N900 with TWIN on it.
- After two weeks, the participants answered the first questionnaire which dealt with the first impressions and experiences of TWIN. Especially the use of different applications, suitability for communication with friends and unfamiliar persons, effect on daily communication and the use of other social media, and pros and cons of TWIN were studied. 214 participants answered this questionnaire.
- The final questionnaire was carried out in the end, after two months of TWIN use. The main topics included the use of TWIN, communication, privacy and trust, overall satisfaction, experiences on N900 and further development of TWIN. We also asked participants' thoughts about the pilot. 242 participants filled out this questionnaire.

In addition, total 31 participants were selected for structured interviews in the final stage of the pilot. 10 most active and 10 averagely active users, as well as 11 active forum writers were interviewed. The interview questions dealt with same topics than the questionnaires. Where the questionnaires mainly consisted of multiple choice questions and scaled statements (scale 1-10, 10 being the highest score), and thus provided quantitative information, the interview included open questions that gave light on the reasons behind quantitative questionnaire results.

Besides the questionnaires and interviews, data was collected from TWIN forum, TWIN feedback feature and user logs. The *forum* offered participants a place for informal discussion with other participants and TWIN developers. Participants were encouraged to bring up any TWIN related matter they wanted to. A total of 1046 messages from 75 users were sent to the forum. Especially further development ideas were reported on the forum. *Feedback* feature, which was integrated into TWIN for the pilot period, allowed participants to report problems to TWIN developers. User *logs* provided information on how much TWIN and its various features were used, as the TWIN setup that was installed on the pilot devices was configured to submit detailed anonymous usage statistics to the researchers.

The data analysis was done using both qualitative and quantitative approaches. The qualitative data was analysed by thematic coding of users' answers in questionnaires and statements in the interviews. The quantitative analysis was based on the basic statistics of users' replies to the scaled questions (e.g. scaling from 1=fully disagree to 10=fully agree). From these results, mean scores and standard deviations were calculated.

5. RESULTS

This section describes the main results of the user experience study, based on the user data gathering described in section 4.2.

5.1 The Nature of TWIN Use

This subsection introduces the frequency of TWIN usage during the two-month pilot, the effect of TWIN pilot to participants' communication on other media, the purposes TWIN was used for, and the experienced pros and cons of TWIN.

5.1.1 The Usage During the Pilot

TWIN was met with curiosity and motivation by the participants. On the very first days of the pilot, usage hit its highest level, as Figure 5 shows. Term "active users" (in Figure 5) means the users who have used some application of TWIN, like private or community chat, sharing or downloading a file or posting to the message board. "All users" counts in all the users, paying no attention whether the participant has really used TWIN or just kept the application running in the background.

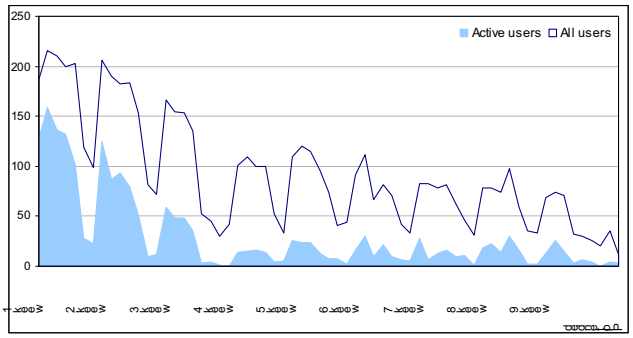

Figure 5. The usage of TWIN during the pilot.

As can be seen from Figure 5, the use of TWIN reduced since the beginning of the pilot. It is normal that the early excitement of using new technology fades with time. Another reason for the reduced usage seemed to be the technical problems that users experienced, in specific related to battery life and initial problems with message delivery. However, the usage continued on a more moderate level throughout the pilot.

"The use [was] not so intuitive in the beginning of the pilot. Uncertainty of getting a message across in the beginning [was also one of the worst things in TWIN]." (male, 37)

The usage dropped during the weekends since the use was heavily concentrated in the campus area where the participants reside mostly on weekdays. This explains the several repetitive falls in Figure 5. Still, some participants reported there was some use around the biggest student houses also in weekends.

Typical usage situations occurred in different areas of the university campus. Chatting and information sharing with other students during a lecture, in corridors or cafes were frequent. There was also minor usage outside of campus. Some used TWIN to chat with neighbors in student houses and some reported usage of TWIN on busses in order to find if other users were nearby.

5.1.2 Effects on Other Means of Communication

We found out that TWIN had only minor effects on participants' other means of communication. The use of SMS (15.0% of the participants) and IRC (9.2%), face-to-face discussion (8.8%) and phone calls (7.5%) were slightly reduced. It seems that these means of communication are used partially for same purposes as TWIN. There were also changes in another direction. 6.3% of the participants told that the use of IRC (chat) has increased slightly and 4.2% mentioned that face-to-face discussion has increased slightly as well. This may be a consequence of the fact TWIN has given a common subject for discussion.

Based on the results TWIN seems to have no major effect on the use of other social media, at least in trial usage. This might be due to the fact TWIN is sufficiently different system than the other social media services, and thus it does not actually replace any other service but rather completes them.

5.1.3 Rather Fun than Useful

During the pilot the participants experienced the use of TWIN mostly fun and delightful rather than useful (Figure 6). These numbers are quite low, especially the scored for usefulness. Technical problems affected the results, even though part of the problems were fixed during the pilot (e.g. message delivery).

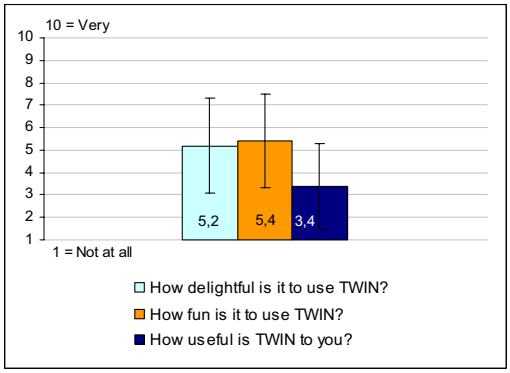

Figure 6. Delightfulness, fun and usefulness (final questionnaire, N = 242).

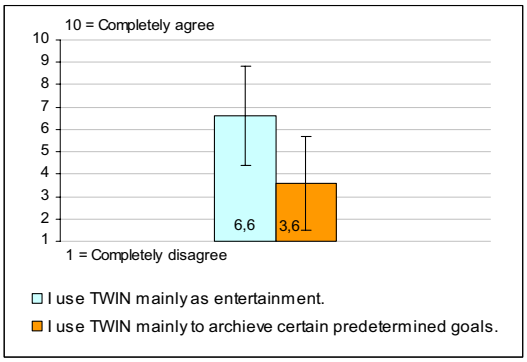

Figure 7. Purposes of use (final questionnaire, N = 242).

As Figure 7 shows, the participants thought they mainly used TWIN for entertainment, not to achieve certain predetermined goals. Also in the final interviews we asked the benefits of TWIN and 19.4% of the interviewees often mentioned entertainment and the use for passing the time as advantages.

"I have thought that the use of TWIN is mostly for entertainment." (male, 23)

5.1.4 The Pros and Cons of TWIN

After two weeks of use, we asked about the pros and cons of TWIN that the participants had experienced. Our aim was to identify these things early, so that the developers could fix the most concerning problems in the early phases of the pilot.

The most common single pro of TWIN was the possibility to communicate with friends nearby (21% of the participants). 19% of the participants told that the content sharing is important, in spite of initial technical problems related to it. 14% of the participants mentioned they simply liked the idea behind TWIN.

Usage of location information seemed to be another interesting topic according to the participants. Based on the results, we identified four different themes related to location information and the use of it. These topics were: 1) You can easily see all the users who are nearby (15% of the participants), 2) possibility to contact people nearby (12%), 3) the radar view is useful (12%) and 4) it is an easy way to find if a friend is nearby (12%).

When asked about the cons of TWIN, 28% of the participants told the message sending and receiving are not reliable. Furthermore, 21% of the participants mentioned that TWIN doesn't inform clearly when a message is received.

"I think that there is something missing about the notifications in TWIN. If somebody writes something on the forum or sends me a message, we have to open the window to see it. […] That's not really handy. Maybe a light signal or even a sound could make it better." (female, 22).

It seems that participants did not notice all the messages their devices received (for example, when the device was in the pocket). To fix this, the developers added a specific vibration feature later which helped user to notice incoming messages. The messaging was also made more stable, although the multi-hop technique still did not work with 100% reliability.

In the final questionnaire, we asked three best things about TWIN, as we wanted to know what were the most valuable things to the participants in the whole pilot. The top things mentioned were file sharing (mentioned by 30% of the participants), radar view (20%), the possibility to communicate with persons nearby (17%) and the possibility to contact unfamiliar persons and meet new people (16%).

5.2 Experiences of Proximity-Based Ad Hoc Communication

Since TWIN offers means to contact and communicate with people nearby, we were interested in finding out what kind of experiences and feelings the participants had about proximity-based communication. The key findings described in the following subsections, were: 1) The participants were interested in using proximity-based communication and they found several advantages in it, 2) the participants were eager to be informed about their surroundings, 3) a wide range is significant in proximity-based communication and 4) there are some challenges in reliability of the current technology.

5.2.1 What are the Advantages to the Users?

In spite of some technical problems during the pilot (described above), the participants seemed to be interested in proximity-based technology and the possibilities brought by it. The

participants mentioned several advantages relating to the communication limited only to the persons nearby. The possibility to chat easier with unfamiliar persons was one issue mentioned.

"You know the people are nearby and you can meet someone face-to-face. It is very cool!" (male, 22)

TWIN offers a method to approach unfamiliar persons. TWIN enables identifying people in vicinity and then, instead of going straight to talk face-to-face, the user can view other person's profile and find if there are similarities between them which can help starting the discussion. According to the participants this kind of introduction of people is interesting, and could help especially shy persons.

"The threshold to talk with a stranger is much lower [with TWIN]." (male, 20)

Meeting new people with TWIN the help of is described in more detail in section 5.3.

The group discussion with other users was also one thing which caused interest. TWIN allows a user to chat with not just one but several persons nearby. This kind of discussion can be useful in some situations. Group discussion is also polite, and for example the participants reported they have used TWIN in lectures to discuss about the topic of the lecture. This could not have been possible in other ways without disturbing others.

The participants mentioned that TWIN gives a possibility to notice a person in certain situations where it would be otherwise difficult to observe them.

"There [in a concert] can be any amount of familiar people, but you don't just know it yourself. With the help of TWIN you can notice them." (male, 21)

Based on the results we also found an interesting aspect in communicating with a friend. TWIN allows finding if a friend is nearby, so the user does not have to ask them that. The discussion gets more straightforward when "Hi, what are you doing, do I disturb?" part drops out.

5.2.2 Interest in Surroundings

According to the participants, one of the most interesting things of TWIN was the radar view. In the final questionnaire we asked the participants to describe the three best things about TWIN and after file sharing, the radar was the second highest on the list (20% mentioned). Following the other peoples' movements on the radar map and observation of the surroundings seems to be satisfying and even addictive.

"The radar option was really fun." (male, 28)

There were also mentions that the radar view is useful when one has to locate a friend in the situation with a lot of people.

5.2.3 Limited Communication Range

The wide range of the ad hoc WLAN plays on an important role in successful communication. 55% of the interviewees mentioned the range had somehow restricted their use. This might be due to several problems with the multi-hop technique which occurred especially in the beginning of the pilot. The problems were fixed, but for some time the participants were not able to chat or send files to other users further than a single hop.

"In practice, TWIN has not been able to communicate further than a single hop. It's range restricts the use." (male, 28)

"Then when it [the range] gets too small, you bump into the people [you see in TWIN]. It is little crazy. The other user is next to you, but you chat with him. It's quite nerdy communication." (male, 21)

The participants felt that the range was restrictive and there was no possibility to universal (long-distance) communication. The basic aim of TWIN is to provide proximity-based communication, but this was not obvious to all users. Furthermore, some participants suspected that TWIN would need a lot of users before it can function well.

5.2.4 Issues with Reliability

There were some problems related the technology, as mentioned above. Unreliability was the most significant reason which caused dissatisfaction among the participants. Unreliability seems to result from the two factors, First, the message sending in a multi-hop network is never 100% sure, because the network is so dynamic with the moving users (peers). Second, there were technical problems with the multi-hop in the beginning of the pilot, e.g. a conversation may be disconnected suddenly and file sharing did not always work with peers further than a single hop.

"The network is so dynamic that is quite impossible to have a long conversation with a peer that is not connected directly to you, or to download a file that you have found in a community." (male, 23)

Getting the message sending and receiving to reliable level were the major technical challenges in TWIN. It was fixed after the first two weeks of the trial.

5.3 Meeting New People

According to the results, the most important reason for the participants to use social media is keeping in touch with friends (76%). Participants also use social media for following other people's lives, sharing content, discussing their interests, belonging to a community and meeting new people. 33% of the users mentioned meeting new people as a reason for using social media.

5.3.1 Hey, I Got a New Friend!

The participants reported that they are willing to use TWIN to find common interests among the other users. They seemed to think that it is easier to meet a new person if you know he or she has some common interests with you.

"It would help to find the persons which have common interests, if these would be listed in their profile." (male, 25)

In spite of technical problems and relatively low amounts of use (see Figure 5), even 22% of the participants got at least one new friend with the help of TWIN (see Figure 8).

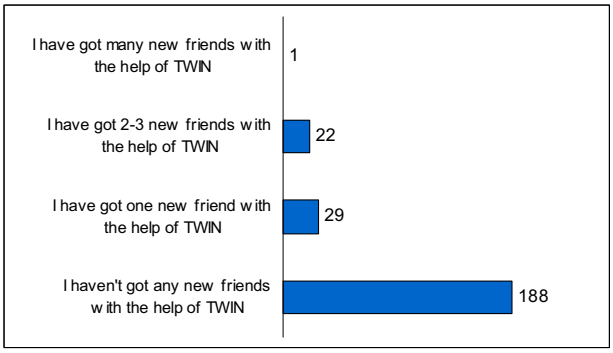

Figure 8. Amounts of users who got new friends with the help of TWIN during the pilot.

The nature of the pilot may have partly affected this; some participants mentioned that TWIN pilot has given a subject for discussion to them.

"I have met few neighbors of my residential area [with the help of TWIN]." (female, 19)

It seems that TWIN has potential to become a way of communication with strangers and meeting new people.

5.3.2 Better Support to Meeting New People

The participants were asked how they would like to develop TWIN further. Many of their ideas related to meeting new people. For example, games and dating applications were mentioned.

"Dating option should absolutely be included (as well as better profiles)." (male, 26)

"Using TWIN as a dating service or for searching similar company. Proximity-based games." (male, 25)

The participants expressed that they would be interested in meeting new people with the help of proximity-based social application. However, more support, like multiplayer games and more customized profiles are required from the service.

5.4 Privacy

Social media is usually based on the content produced by the users of the service. When the users are sharing content about themselves, it is important to be aware of users' experiences about privacy.

5.4.1 How do Users Protect their Privacy?

We found that the participants were not very concerned of their privacy with TWIN-like systems. In the final questionnaire, users gave an average value of 2,9 to the question "Are you currently concerned about your privacy in TWIN" (with the scale 1 to 10 where 1 means "not concerned at all" and 10 is "very concerned"). It is interesting to note that even 26% chose the lowest grade 1 which we consider fairly high amount. None of the participants chose the grade of 10 and only 5% picked 8 or 9.

In the final interviews we asked how the interviewees had protected their privacy in TWIN. Almost all users answered that they had taken privacy into account in their profile information. Not adding their phone number or address to the profile seems to be a custom to many. This is probably not specific to TWIN but people are accustomed to do so also in other services.

"I haven't added my real name or anything else, this relates to the fact I don't add anything for example to Facebook either."(male, 26)

Some participants seemed to think that the protection of privacy was not necessary since TWIN is a closed community and participants are not whoever random people, so the pilot setup seems to have had an influence on the experience of privacy.

"I'm not so skeptical about things like this, I do have my real name there, the users are still quite limited." (male, 23)

"...I suppose there is no danger in place like this, since this is a closed group." (male, 21)

Another interesting factor in privacy is proximity. Some participants seemed to think TWIN is not an open network because it is a proximity-based service and distant persons are not able to reach the network. This may have had an influence on participants' way of protecting their privacy.

"...you have to be close to see [other users in TWIN], so it is not so public information [what you add in TWIN]." (male, 24)

5.4.2 Ideas for Better Privacy

Despite the fact the participants did not feel concerned about their privacy they had ideas how to increase the privacy in TWIN. First of all, the participants wanted to be able to restrict the profile information that other users see. For example, some participants said they would like to share their phone number with their friends only, not all users in TWIN network. Participants would also like to be able to use specific "friend lists" and "ignore lists" for grouping other users more easily.

"There has been plenty of discussion about the friend list in the TWIN forum. I think it would be good. You could look easier which friends are nearby." (male, 20)

Also invitation-only or password-protected communities should exist, according to some of the participants.

"It could be possible to create a private community to which anybody could not join but only by an invitation. There could also be secret groups (similarly like in IRC) which would be visible only for the members." (male, 24)

5.5 Experiences about the Pilot

In addition to gathering data about the user experience of TWIN, we also asked some questions about the pilot. As the pilot was a large one and unique for proximity-based systems, we wanted to learn about users' perceptions of their participation in the trial.

According to the most participants, getting experiences of the N900 device was the most satisfying issue (41% of the participants). Similarly, experiences of a new social application and a new way of communication caused satisfaction (18%).

"I was able to familiarize myself with N900 phone and test new a social media service." (female, 29).

The participants also seemed to be happy with practical arrangements of the pilot. TWIN forum and the possibility to get support in many ways were also mentioned as satisfying things.

The most significant reason for dissatisfaction was technical problems (21% of the participants). Many participants (15%) mentioned also their dissatisfaction for the bad duration of N900's battery. The low amount of active TWIN users (after the beginning) caused dissatisfaction, especially since TWIN is social media application and it needs users to create the content.

"Since the beginning the number of users decreased fairly quickly." (male, 19)

Participation in the development process of TWIN was significant to the participants. Development based on users' feedback caused satisfaction. It was clearly important to them to be able to affect development.

"I was able to find out how the software testing and developing works in practice, and participation was really interesting experience." (female, 19)

"It was nice to notice that software was developed all the time and on the basis of users' feedback. I had a feeling that participating in the project paid off!" (female, 20)

When asked about participants' satisfaction with participating the pilot, they gave the grade of 7.7 (1 = very unsatisfied and 10 = very satisfied), so in spite of technical problems which caused dissatisfaction, overall the participants seem to be pleased with participating in the pilot.

6. DISCUSSION AND CONCLUSIONS

In this paper, we have introduced a social ad hoc proximity-based system called TWIN. TWIN provides means for finding people nearby, vieweing them in the "radar" view, communicating with the other users using chat and sharing media files. A specific feature of TWIN is the multi-hop WLAN connectivity which allows finding other users within a wider range than in typical proximity-based applications. We conducted a large-scale field study (called pilot) of nine weeks with 250 TWIN users with the aim to understand the user experience issues arising while using TWIN.

During the field study, the frequency of using TWIN dropped after 2-3 weeks and remained moderate for the rest of the pilot. On one hand, such drop of usage after the initial excitement is a normal effect in field trials. In case of TWIN, there was a further challenge of some technical problems such as reliability of message delivery. Also, some users seemed to feel that the community, even with 250 users – was not large enough to provide opportunities to frequent ad hoc communication. We thus believe that the system needs to be spread broadly in the specific community to become frequently used. This is a typical "critical mass" challenge of social media services.

TWIN seemed to have no major effect on the use of other social media, at least in trial usage. This might be due to the fact TWIN is sufficiently different system than the other social media services, and thus it does not actually replace any other service but rather completes them.

Users reported that they felt that TWIN is mostly for fun and entertainment and not so much for reaching some practical goals. As previous user experience researchers have pointed out, such "be-goals" [13], which do not have any explicit instrumental value are central in positive users experience with products and services. Social relatedness is an essential non-instrumental goal which is an essential element in social media.

The user study results show that meeting both known and new people is an important motivation for ad hoc proximity-based networking. For the previously known people the usage situations include classroon interaction and finding friends in crowded situations. We also found it very interesting that 22% of the pilot users reported getting at least one new friend with the help of TWIN. The number is high especially in the cultural context of the study, since getting new friends is not routine in Finland.

Privacy did not arise as a major concern in the user study. However, users were aware of privacy and they moderated putting personal information in their profile. The participants also suggested that there could be different levels of privacy to reflect the relationship to differet community members. The pilot setup probably had at least a slight influence on the experience of privacy protection. Participants felt TWIN network was like a closed community, because the participants were not whoever random people but students and workers from TTY. This might affect on the user experience and the results of our study could be different in other circumstances.

With regards to the user trial itself, the users were satisfied in the participating in the study. They felt especially satisfied that their feedback and suggestions were taken into accound. They could participate in the development of this new service which was satisfying in itself. The feedback in the form of modifications, needed features, and new applications will be used in the continuing development of TWIN. Even though this kind of user contribution may be especially evident in our demographic sample (youngish and mostly male students of technology), it could be an additional motivation also in other user groups. This is an important opportunity in fast-paced, iterative service development.

There are related systems (as introduced in section 2, [9] and [24]) which have have been targeted to specific users or specific context of use. Compared to those systems, TWIN aims to be more like a universal communication method for everyone and everywhere. TWIN pilot itself was a large-scale study in comparison to most of the related work. The DigiDress [25] study had more participants, but the field trial was in the office context and participants were all employees of a specific organization. However, some similarities can be found in the results of the earlier studies and our pilot. In DigiDress [25], most of the users were eager to use the Lookaround feature for scanning the environment. The users of TWIN were also very interested in the Radar view for the same purposes. Studies of location-aware services (such as [18] and [12]) have revealed that users are willing to share their location, at least with their friends. The results of our study confirm these findings. The majority of TWIN users were not concerned about their privacy at all and they did not report any concerns about location information sharing.

In conclusion, we believe that this kind of ad hoc networking system can become an enabler of social interactions in people's everyday lives. Ad hoc networking does not substitute the existing social media services, but rather complements them with the focus on people in the proximity. This can create opportunities to combine electronic communication between people with physical (face-to-face) communication in a fluent and delighting way. One direction of future development would be to make the proximity-based system to run on the background and to provide customisable alerts to the user when something changes in the current social environment.

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