Using Ambient Communication and Social Networking Technologies to Reduce Loneliness of Elders

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Abstract. Online social networks have become part of our everyday lives. However, many elders do not use these networks even though social connections are important for their health and quality of life. To help elders feel more connected to their safety network we have developed an assistive solution based on the elders' requirements that aims at improving their communication and sense of presence. The prototype, consisting of a touch screen device and web services was evaluated in two field trials lasting for 28 weeks in total in Finland and in Austria. In addition to interviews, we used the logged usage data to analyze the user's experience with the system.

Keywords: Online Social Networks, Ambient Communication, Sense of Presence, Ambient Assisted Living.

1 Introduction

Online social networks have become an important part of peoples' everyday lives. Especially, they have gained popularity within the younger and middle aged population that is already used to computers in their lives. However, even though many elders are not used to computers and social networks they would certainly benefit from increased social presence and social connections as elders also often suffer from fears of safety and health [1]. These fears could be reduced by providing a continuous sense of presence [2].

Various reasons keep elders from using social networks. The elders might have misconceptions about nature of online social networks or they might not perceive their usefulness. Fears of privacy may also reduce the interest towards these social networks [3]. However, more than lack of interest might be the lack of suitable solutions for their needs [4]. Elders who have not invested much time in learning the skills to operate such systems or user input methods such as a mouse or a keyboard can find user interfaces and web pages too difficult to use. [5]

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In this paper we present the AMCOSOP (Ambient Communication for Sense of Presence) platform, which was developed to decrease the elders' loneliness and to encourage communication with their safety net consisting of their friends, families and professional caregivers. AMCOSOP demonstrates how recent research on ambient communication and technical advancement can be used for improving the elders' quality of life and health. A user centered design approach was used to attain user friendliness and to analyze the specific needs of the elderly users.

The system itself is a server-client application that provides different end-user technologies and experiences to different user groups: primary-, secondary- and tertiary users. Primary users represent the elders, whereas secondary users are the elders' families and other close ones. Tertiary users represent other stakeholders such as service providers or care givers. Primary users use the system by Home Terminals featuring touch screens and a novel, pleasant and easy to use-UI. Secondary and tertiary users interact with the system through using a web portal, and in addition secondary users may also use a native mobile phone client with location-based automatic context recognition.

A prototype system was developed based on comprehensive requirements analysis, involving elders and their relatives in Finland, Austria and Greece. The prototype system was then evaluated within two field trials in Finland and Austria. Extensive data was collected from these field trials in order to analyze the usage behavior and to derive design implications for similar systems. Section two of this paper gives and overview on related projects and studies; in sections three and four we provide an overview on the implementation of the prototype; and in sections five and six we discuss the usage logs of the prototype devices.

2 Related Work

Different ICT systems that help and improve the life of elders have been a topic of interest in recent years. The research has been further driven by research initiatives like the AAL JP (Ambient Assisted Living Joint Programme), run by the EU. The AMCOSOP project was funded by the AAL JP. Below we will discuss research that is directed to improving the elders' life quality through communication and sense of presence. Another large group of services are those more related to safety and healthcare, although both goals can be fulfilled in a single system as well.

Many systems propose using a TV set as a communication device. The main argument is that TVs are already present in the elders' lives and they are accustomed to using them. Unfortunate drawback is that TVs are not primarily designed for such a function and usability may be limited with the use of remote controls and long viewing distances. The FoSIBLE [6] project within the AAL JP program provides social games, social sharing and clubs for users based on a TV interface Hybrid Broadcast Broadband TV (HBBTV) platform. In addition to remote controls the user interface is enriched by gestures and the ability to use a tablet as an input device or even independently. TV-Kiosk [7] is another TV-based solution implemented with the Virtual Private Ad-Hoc Network (VPAN) instead of the more traditional client-server

architecture. TV-Kiosk allows its users to access information from caregivers or relatives and also some content posted in Facebook using a remote control. Mazadoo [8] circumvents the problem of low social networking activity by using Facebook as the social network. The software is used with remote, but also has a text-to-speech feature to counter the inconvenience of reading long texts from a television display.

Facebook is also used as the social network within ePortrait, an ambient picture frame that aims at improving the social inclusion of elders by showing pictures shared by their relatives in Facebook. This will help the elders to stay up-to-date on events shared by family members in social networks. In addition to ePortrait, eBowl was also designed to complement the ePortrait to allow feedback by putting objects equipped with different RFID tags to this bowl. Any object added to the bowl will trigger a certain action in Facebook [4].

Another direction is to build computer software or a web page which is designed specifically to elder users. The Senior Social Platform [9] is a web application using Googles OpenSocial APIs and RESTful protocol with JSON data format.

Touch interaction is a direct and therefore more intuitive form of interaction compared to traditional point and click systems [10], touch interaction shows high potential for adoption by novice users in general, and specifically by older adults with little to no ICT experience [11] [12] [13].

Mobitable [14] is a touch based gestural interface and device aimed at supporting older adults in social networking. According to Leonardi et al. the touch interface was quickly mastered. However, older users had some exceptions due to unfamiliarity with digital user interfaces. Tapping consistently and quickly proved difficult leading to misinterpretations with the drag operation. Performing actions by moving objects using the drag operation itself was not entirely intuitive for the older users. Finally closing the active area by clicking on the background was surprisingly hard to remember and conceive.

Social Interaction Screen [5] is another AAL project aiming at reducing interaction barriers from elders to participate in social networking services. They created a specific touch tablet for elders and software which may also be used in computers. They use a Social Software Integration Layer to integrate a number of social networks to a single device. Another touch based solution is the Sharetouch [15] device with a large horizontal touch screen. Sharetouch encourages social interaction both locally and via the network as four users may use the device simultaneously. The social network is displayed on the device as fish in pond. Messages may be sent by recording the message and recognizing the sender by the four microphones on the device. In addition to the community pond the Sharetouch system offers a social Waterball game and multimedia sharing functions.

3 AMCOSOP Platform

Major components of the AMCOSOP platform are the Service Platform, the MobSOP mobile client and the Home Terminal. All the user and communication information is

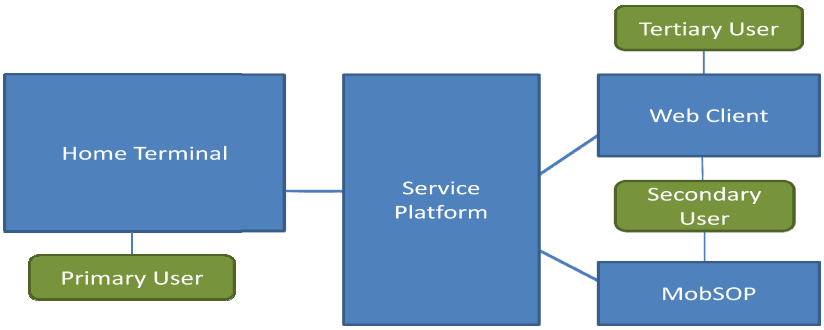

Fig. 1. AMCOSOP top-level architecture

stored on the Service Platform where as the clients; Home Terminal and the MobSOP client, only store relevant information temporally and receive the current configuration state and messaging history during startup. Additionally configuration changes are checked from the server periodically, whereas status changes and messages are sent to the respective clients instantly. The main components of the AMCOSOP system are shown in Figure 1.

The core of the platform's functionality is based on different communication technologies, used for the communication between the AMCOSOP Service Platform and the clients. We use both XMPP (Extensible Messaging and Presence Protocol) and REST (Representational State Transfer)) protocols for communication; additionally JSON (JavaScript Object Notation) is used in encoding the XMPP messages. Communication is secured by using secure SSL connections.

The Service Platform is consists of a database, a messaging server and user interfaces for secondary and tertiary users. The main purpose of the database, using PostgreSQL, is to store the user and service data. In addition, it is used to keep logs about users' activity as well as to store all the possible values of the users' contextual information. User's information stored on the database is managed by a web application. The administrator may use the web application through a simple and user friendly web page to manage user's information and contextual attributes as well as to access statistical information. In addition, the administrator may also manage services that the tertiary user has provided for the AMCOSOP system. The secondary users can access the AMCOSOP by a similar web application as the administrator.

The Secondary user web application is designed for use on both, large display computers and mobile devices. Main functions for secondary users are to interact with the primary users and access their profile and status information. The web application has a simple graphical user interface with a navigation menu on the left side and the content on the right side as shown in Figure 2. On mobile devices the menu is moved to the top and the content is displayed below, as shown in Figure 2 as well. The secondary user web application was implemented with a HTML5-based user interface system, built on a powerful, patterns-based web application engine that enables a clean separation of components enabling fast development.

Communication with other parts of the AMCOSOP platform is implemented by two components: the Instant Messaging Server and an Instant Messaging Client. The Instant Messaging server uses the Openfire Server, a real-time collaboration server which is licensed both with GPL as well as commercially. The Openfire is a powerful instant messaging and chat server that implements the XMPP protocol used in AMCOSOP. The communication between the primary and secondary users is enabled by the Instant Messaging Client.

The Instant Messaging Client connects to the Instant Messaging Server by using the open source XMPP client library Smack, a pure Java library, which can be embedded into the applications to create anything from a full XMPP client to simple XMPP integrations, such as sending notification messages and presence-enabling devices. The messages that this client receives and sends are in JSON format described in more detail in the communications section below.

The User Information Handler is used in order to retrieve and update user's data from the Database. In particular, it is responsible for the communication between AMCOSOP clients (i.e., clients of primary and secondary users) and the Service Platform. It consists of a Web Service implemented with the use of REST technology. The REST service in the AMCOSOP platform uses XML formatted data for exchanging information. The User Information Handler is called by the client applications in the following cases:

- to retrieve user's profile data and user's contact list,
- to retrieve the contextual values from the Database,
- to register a new secondary user in the AMCOSOP system,
- to update user's profile data and user's contacts,
- to retrieve services and messages of services and
- to subscribe a user to an existing service.

The MobSOP mobile client may be used on Symbian^3 smart phones instead of the web application. The application provides mobile phone optimized user interface and automatic context based situation updates based on the phone's location. Unfortunately, the Symbian^3 operating system, which was chosen as a pilot platform in the beginning of the project, is no longer under development. The MobSOP software was implemented using the Qt framework. The user interface is implemented using QML; all views are implemented as separate QML elements. Qt Mobility's Location API is used to get the current phone location. The main view of the MobSOP application is shown in 2.

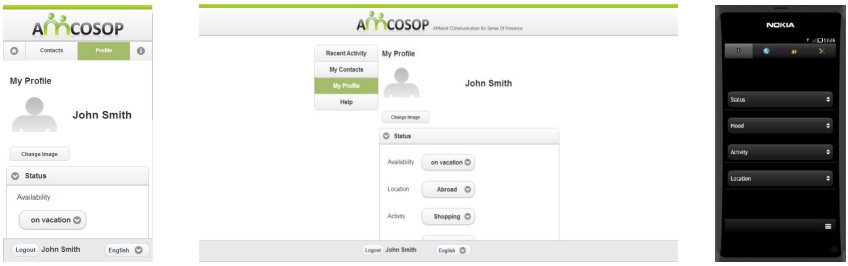

Fig. 2. Mobile UI of the Secondary User Web Application (left), Standard web UI of the Secondary User Web Application (center) and Secondary user MobSOP mobile application (right)

3.1 Communication

The main communication between the AMCOSOP Service Platform and the clients is performed using the XMPP, an open Extensible Markup Language (XML) protocol for real-time messaging, presence and request-response services. Developed originally as Jabber, XMPP is designed as near real-time instant messaging and presence information. It is defined as an open standard, and it uses open systems approach which enables different implementations to interoperate easily. Since these are exactly the characteristics that the AMCOSOP system was aiming for, XMPP was chosen as the main messaging protocol.

In the AMCOSOP system XMPP is used for all status updates and updates in contextual information such as location, mood, activity etc. Also contact invitations and deletions are handled through the XMPP service. The Home Gateway uses Smack Java API version 3.2.2 for XMPP communication, which is an open source client library by Ignite Realtime community. Normally the contact list is also handled through XMPP, but in AMCOSOP the Service Platform has one XMPP user called "admin", and every Home Terminal has this contact in their contact list. The reason for this is that this way the Service Platform can handle the user management in a more diverse way and keep the records in its own database. Therefore, the contact list is not received through XMPP, but from a REST interface.

REST is a style of software architecture for distributed systems such as the World Wide Web. Over the recent years it has become the most popular web API design model. It aims for scalability, generality of well-defined interfaces and independence of components. It is therefore well suited for AMCOSOP, especially for retrieving user, service and other information. In the AMCOSOP system a REST interface is used using the HTTP methods GET, PUT and POST on the AMCOSOP server port 8080. The data from the REST interfaces is in XML format. The REST interface is used for getting possible types of status and contextual information, to retrieve and edit the contact list of the primary user and to retrieve the list of available third party services.

4 Home Terminal

The primary client software for the elderly is the Home Terminal. It is divided to the Gateway component, responsible for communication, and the Home Terminal part, providing the elder friendly easy-to-use touch screen interface. Both of the components are implemented using Java language; however since the Standard Java Development Kit did not have adequate support for designing modern user interfaces at the time we decided to use an external graphics platform. Therefore the Home Terminal implementation uses JavaFX 2.0 software platform for the UI. Although the second version of JavaFX was still in beta during initial design and in the beginning of the implementation, it was selected for the implementation of the UI. The alternatives were also considered as well, mainly Processing and Piccolo2d, both compatible with Java language. Since then JavaFX has now been bundled with standard Java releases beginning from Java SE 7 update 6.

The Home Terminal UI and the Gateway components can be run separately on different computers using RMI to interact. However, in our pilot installation both parts were run on the same machine, and the ability to separate the parts was made for future flexibility. In addition, a single Gateway could in future serve multiple UI parts instead of all the UI's running their own communication with the server. We also made a version that removed the RMI communication and run both parts in the same virtual machine. This was used during the second part of the user evaluation in order to improve the user experience as there were occasionally some communication problems occurring with the RMI implementation.

The Home Terminal is a straightforward model-view-controller (MVC) application. Most of the implementation of the Home Terminal is for the graphical user interface. The graphical user interface is one of the most important parts of the Home Terminal implementation. Since the targeted users are elder people who have limited or no experience using computers, the UI had to be simple and intuitive. Additionally, designing the UI concept we also paid attention to usability and accessibility aspect, such as the contrast of the UI elements. The screen is divided between the bottom bar and the main view above. From the bottom bar the user can select one of five views. The main view displaying contacts, the management view, which is used to control the contacts and to change their position on the screen, the view for the primary users own profile, the view for accessing the different user controlled settings for the terminal and finally a services view where user can subscribe to third party services and view announcements and descriptions of these services. Additional layers of the UI are reduced to a minimum. Only in the main view a pop-up will be shown in the center of the screen when the user opens up a contact for communication or checking contacts current status. More details of the UI design are available in [16]. An example view of the main user interface of the Home Terminal is shown in Figure 3.

The Gateway part of the Home Terminal, was implemented with a simple messaging architecture. To avoid lockdown, all communication between the Home Terminal and the Service Platform was run on different threads each having its own message queue. Our initial plan to build the Gateway on OSGi framework had to be abandoned because of unsolvable compatibility problems between OSGi and RMI.

Fig. 3. Home Terminal main user interface

4.1 Home Terminal Hardware

Since the Home Terminal was designed to be an ambient display suited in living spaces, instead of constraining it to a desktop like a traditional PC, we wanted a slim aesthetically pleasing touch device resembling of photo frames. However, since such devices were not available and using resources for designing and building a limited number of such devices was not feasible we resorted to using standard PC-computer. Fortunately, the All-in-one PCs manufactured by ASUS with pleasing looks and equipped with touch screens were adequately suitable for deployment for example on bookshelves, dressers or cabinets.

For the pilot we selected the white ET1611 model with 15.6” single touch wide screen display. The device is powered by 1.8 GHz Intel Atom D425 processor and 2GB RAM, which are well enough for running the AMCOSOP Home Terminal application. If needed, the use of Java language gives the benefit of easily porting the system for other devices and operating system providing Java runtime environment.

5 User Evaluation

The AMCOSOP system was evaluated within two consecutive user trials in two countries, Finland and Austria. Between these evaluation phase’s the system was updated implementing the tertiary services, not part of the first trial phase, and also integrating improvements based on user feedback after the first trial phase. In total, the trials lasted for 28 weeks and involved 23 primary users. Quantitative and qualitative data was collected in the form of system logs and periodic questionnaires. System logs recorded both, the internal behavior of the Home Terminals and all the interactions that users performed with their terminals.

6 Results

In the following we will analyze the usage data that was extracted from the log files. Most of the users rarely turned the system off, which was encouraged to achieve the ambient communication and ease of use (the display, however could be turned off separately from the device). Almost all users preferred to use only the large text size within the evaluation. The preferred settings for the contrast showed a higher variation between the different users. Background images, an important feature that came up within the initial requirements analysis, were changed occasionally during the first trial phase, but kept mainly unchanged during the second phase.

The users communicated with two main methods status updates and messages. The status was divided into four separate fields: status, mood, location and activity. The messages were person to person communication between primary and secondary users. The secondary users could write their own messages while the primary users had a collection of predefined messages, mostly for requesting for the secondary user to contact the primary user in different ways. In the second phase of the trials the selection of predefined messages was extended as well as giving the primary users an option to use a keyboard for writing free-text messages.

The Figures 4 to 9 below show usage averages for all the users during phase 1 in Finland and phase 2 in Finland and Austria. Status changes depict a change on any of the four status fields. Messages depict any message, predefined or free text, exchanged between the primary user and a secondary user. Blue diamond lines show the messages coming to the Home Terminal from secondary users, whereas the red square lines show messages sent by the primary user with the Home Terminal. The y-axis shows the number of messages or status updates in a week whereas the x-axis shows a week number from the beginning of the evaluation phase.

During the first evaluation phase (shown in Figures 4. and 5.) the usage of the system was relatively constant after the first weeks when the system was introduced to the users. Status updates were used more often than the messages, especially by the elders. This is in line with the original concept of ambient communication, where actual conversations were to be performed with more traditional methods, like visiting and phone calls.

The second evaluation phase in Finland (shown in Figures 6. and 7.) showed a similar amount of activity as the first phase. However, there seems to be an increase in the activity of the secondary users, especially by updating statuses more often. One explanation might be the added e-mail notifications for received messages to secondary users. Even though some primary users were very insistent on having a keyboard (in the beginning not provided because of usability problems) to write free-text messages the average number of sent messages actually declined in the second evaluation phase. Furthermore, in addition to the average, neither any single user was using the message functionality substantially more than others. There is also a large reduction in the communication activity around the 4th week of the test which can be explained by Christmas time. Interestingly the effect is clearer in Finland than in Austria, shown in Figures 8., and 9.

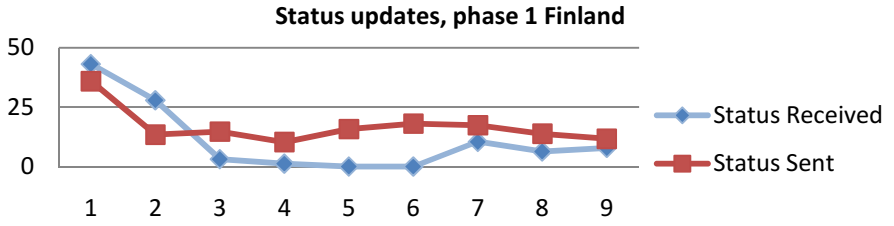

Fig. 4. Status update averages in Finland during first trial phase

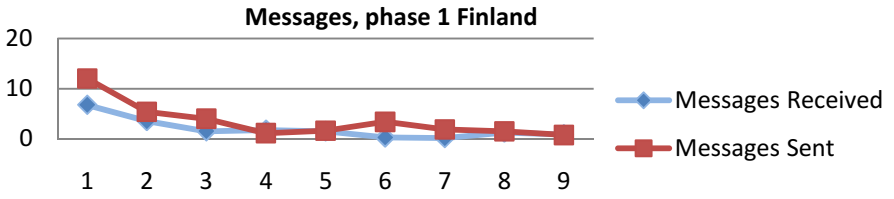

Fig. 5. Message averages in Finland during first trial phase

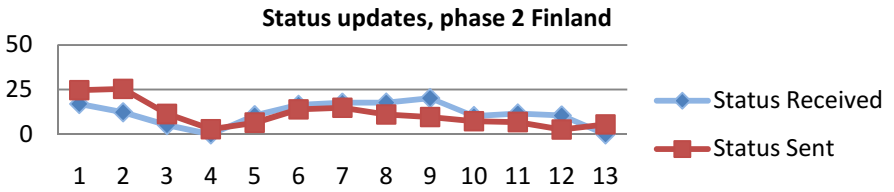

Fig. 6. Status update averages in Finland during second trial phase

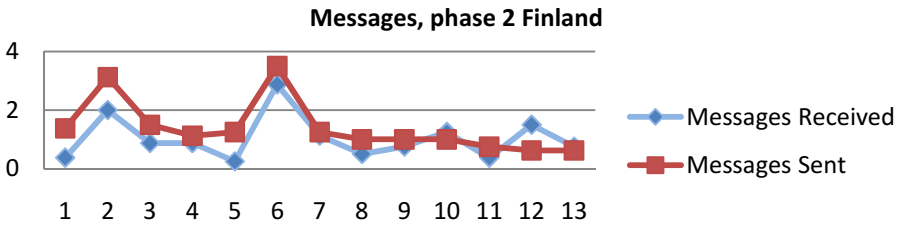

Fig. 7. Message averages in Finland during second trial phase

In Austria the total activity was similar to Finland, however, there was a clear difference in the popularity of messages and status updates. The status updates were used less by both primary and secondary users, but especially by secondary users, whereas messages were used more than in Finland by both user groups.

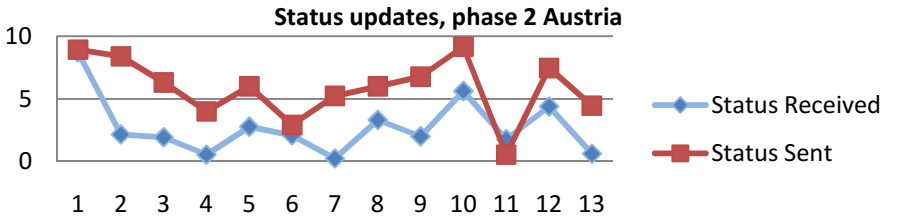

Fig. 8. Status update averages in Austria during second trial phase

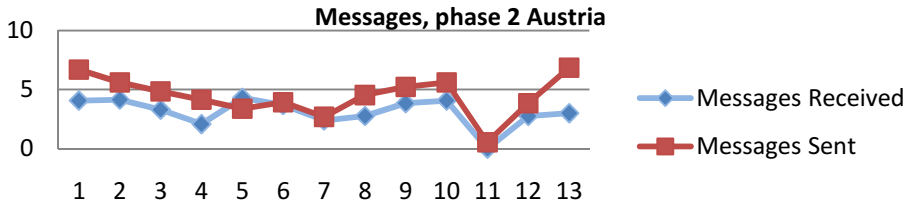

Fig. 9. Message averages in Austria during second trial phase

Conclusion and Future Work

We developed a social networking system based on ambient communication for elders and their safety networks. The elders received a special user-friendly touch screen based Home Terminal device whereas relatives, friends and formal caregivers and local communities can use the provided web based services. A native mobile application was also developed for Symbian^3 devices. The AMCOSOP system is a client-server architecture based on XMPP and REST technologies for communication.

The prototype devices were developed evaluated in user trials in Austria and Finland. The trials were conducted in two phases with a short development period in between. On total the trials lasted for 28 weeks and involved 23 primary users. The usage logs containing records of system activity were analyzed.

In addition to user logs presented in this paper qualitative data was also gathered by questionnaires and interviews. Further review and publication of this data will be an important goal in the future.

The developed prototype system and the results of the user evaluation have shown how modern technology and ambient communication can be used to create solutions that support elders' communication with their safety net. Commercial systems and service providers are needed to bring such technologies to a wider audience, thus making ambient communication and online social networks part of elders' lives.

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