SNS as a Platform of the Activity Monitoring System for the Elderly

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Abstract. Social networking services (SNS) offer new ways of tackling challenges related to maintaining elders' autonomy in their later life, ageing in place, loneliness and cost pressures of welfare system in ageing communities. In this paper we present a communal activity-monitoring concept that utilizes SNS and sensor technology. We propose that acceptability of the activity-monitoring system can be increased with context aware data delivery and by using social media as a platform for the monitoring system.

Keywords: Elderly, Social media, Monitoring, Context aware.

1 Introduction

Social media continues to expand popularity among all age groups. In the past two years, social media use among Internet users age 65 and older has grown 150% between April 2009 and May 2011 [1]. Besides professional help, the psychological and perceived wellbeing can be achieved through the social support given by friends and other related parties. Social support is found to have an indirect link to the subjective health experience through the psychological effects [2]. Connections and interaction with the community have increasing role of preventing loneliness, which forms an important health and safety risk for the elderly. For those older people living alone, social participation can become more difficult, and they may need encouragement, communication and participation [3]. Although high degree of acceptance of the Ambient Assisted Living (AAL) has been found and it would likely make seniors feel safer and more secure in their homes, the main concern is still how it will impact their daily lives. This question has been largely overlooked. Seniors have identified and valued the positive impact of AAL system on their daily life as providing possibility to age-in-place and remaining safe in their homes. On the other hand seniors were concerned of intrusiveness of the system and how AAL could affect their behavioral freedom within home space [4].

The safety systems should not replace the existing safety nets, but should rather act as complementary solutions. In particular, monitoring through technology should not

increase isolation, but should ideally lead to strengthening of social networks and increase in user independence.

In this paper we will contribute to field of Mobile Monitoring and Social Media Pervasive Technologies by presenting communal caring concept (Comcare) that is built on online communication and simple sensors. The main idea of the Comcare is to form a social aware, bi-directional and equal care-giving community to take care of a certain person. Social awareness is defined as a system that is able to distinguish and understand user's social environment, like social structures, human relationships, community and user's roles in it [5]. The Comcare is designed to keep relatives informed through SNS on everyday routines of their loved ones in a positive way. The source data may come from sensors or community members. However, all the information of the target is presented as status updates.

2   Challenges with Older Population and Technology

There is little knowledge about older adults' experiences and perceptions of social media as well as on seniors' attitudes towards communication overall [5, 6]. The lack of studies reflects clearly a brief history of social media in contemporary society. It has been noted that strong social integration and interactivity often play a beneficial role in maintaining quality of life and contributing to a better mental health of older adults [7, 8]. Elders that have weak social network are more likely suffering cognitive decline, which is a result of isolation or high stress levels caused by the loss of a spouse [9]. On the contrary, socially active seniors are physically and mentally healthier [7]. In this light, the main challenge is how to improve seniors' capability and possibilities to communicate with their friends and relatives, and how to prevent isolation. In recent years there have been many publications dealing with social media and the elderly, see e.g. [10, 11, 12, 13, 14]. It seems that social networking sites can be used to assist users in sustaining and strengthening ties with the circle of important people, but there is a risk that non-technical elders are left out within their own family [7].

2.1   Acceptance and Attitudes

Seniors' attitudes towards communication and assisted living can be shaped by how they perceive technology from the perspective of privacy, security and independence. It is suggested that relevant factors to the use of in-home technologies are perceived usefulness, key social relationships, data granularity, and sensitivity of activities, i.e. where, when and in which situations the user is monitored. Also seniors' perceptions of privacy related to these technologies are highly contextual, individualized, and influenced by psychosocial motivations [15]. Beringer et al. [4] suggest that the future research should be directed and emphasized on probing how users would feel to live with such technologies on a daily basis. The study [16] presents a practice-based approach for technology acceptance evaluation that is in line with above-mentioned suggestions. In this approach, contextual and dynamic user-product relationship is a starting point, as it is seen strongly affecting technology adoption. In this light, acceptance is seen as part of user experience and is built on the willingness of users to bring monitoring technology

into their existing practices in daily lives and on the appropriateness of the technology to user practices and their social and cultural environment.

There is evidence that physical spaces and environments, as well as techno-logy itself, affect to acceptance [17, 18]. For example, the room types have found to be in relation to acceptance of the monitoring technology [17]. Several researchers have presented multiple constructs on environmental classifications covering at least three levels [19, 20, 21, 22]. In the study [18] different levels of these environments are classified, and they were used in the study on acceptance of health care applications. The classification consisted following levels: 1) private/personal level, 2) semi-public/group level, and 3) public/organization and community level. This classifica-tion can be applied with the Comcare like it was presented in research of Lindley et al. [5]. They proposed that interaction with peripheral circle of friends can be less focused and less personal, and therefore lightweight communication could be a proper tool to maintain contact with those that it might otherwise be lost.

Privacy concerns are major barrier to Internet usage, and the elderly are also more concerned about their privacy than younger generations. In the study of Maaß [23], 67% of people in age 18-24 reported concerns about privacy where as the same figure among people age 55 and more was 86%. Privacy and things what are considered to be private ultimately depend on the context. Depending on the situation, the norms as well as behavior and how they are fitted with the prevailing norms change. However, it is always a risk that a particular set of norms spread to another context in which they are interpreted incorrectly [24]. Using surveillance technology at home raises ethical questions regarding the treatment of human dignity and self-determination and good life. Due to these tensions, a need for ethical choices between safety, transpa-rency and security must be considered case by case [25].

Xie et al. [6] conclude that major barriers to older adults' adoption of social media are technological and social or cultural. It is similarly important that they feel to be in control of technology. Related results were also found in a more recent study [15], in which it was discovered that if seniors rely on others to manage the technolo-gical devices in their homes, it may place them at disadvantage and may reduce their ability to stay in control of decision-making. Therefore, the collected data should be transparent and verifiable by the senior, who should be able to easily and flexibly control when and what data is collected, and with whom it is shared.

As a summary, we conclude that the Comcare should combine contextual aware-ness, and personal communication as well as sensory data in a sensitive, ethical and privacy requirements fulfilling fashion. To achieve this general objective, the following design requirements were considered for system development;

- leave time to react before a response is expected
- provide freedom to control communication and technology
- provide multilevel interaction with different circles
- avoid high cognitive load in user interface
- consider seniors' special needs in the user interface

3   A Context Aware Monitoring Solution for the Elderly

The Comcare is built to monitor daily interaction and activity of an elderly person. It combines sensor technology and manual updates from the elderly person's peers to form a lightweight, semi-automated monitoring system. Both sensor and manual updates are relayed by Comcare server to corresponding recipients, according to pre-determined rights and rules in server configuration.

The main difference of the Comcare compared to existing SNS is context sensitive data delivery, which means changing data content and representation in the followers' user interfaces. For example, certain peers can see exactly what is happening in the elderly person's environment, but other peers might only know that an activity took place, oblivious to the finer details. For this purpose, peers with different permissions have dedicated user interfaces, as depicted in Figure 1.

The Comcare has three different modes for monitoring activity of an elderly person; normal, enhanced, and continuous monitoring. Normal monitoring checks and forwards updates and sensor inputs once per day, while enhanced monitoring does the same four times a day (6-hour intervals). Continuous monitoring forwards all events realtime to the followers.

Fig. 1. Screenshots of the user interface; a) Target, b) Relatives and c) Professionals.

3.1   Target and Circles

Target refers to a person, who is the subject of monitoring (i.e. an elderly person). The target has three different circles that together are called a Comcare community. The circles have different access rights for activity updates coming from the target, relatives, professionals and sensors. The target is always aware of the sent messages through the transparent presentation of status updates, shown on the target's client software. In addition, the target is able to switch off the system at any time. Communication with the elderly (target) includes two options; 1) status updates, and 2) private messages.

Relatives circle consists of family and friends. All the updates from the target are presented authentically and appear in their original written form. **A*cquaintances* circle may comprise for example of neighbors or voluntary support staff, as well as other acquaintances, with whom the target has regular contact. *Professional* are persons who are in a professional relation with the target, e.g. home or health care personnel. With these persons, the target is supposed to share activity information for professional

purposes. The status updates are shown to the acquaintances and professional circle as the activity information without the original written text. However, all community members can send private messages to each other and the relatives or the acquaintances can make updates on behalf of the elderly on the basis of personal observations.

4   Implementation

In our initial Comcare concept the plan was to utilize existing online social networking platforms, such as Facebook and Google+, for realizing all the desired functionalities. However, due to several restrictions in the APIs offered by existing solutions, we ended up in implementing our own social networking application. Another reason for this was retaining full control and ownership of the system and the possibly sensitive data that it handles daily. Technically the Comcare system is loosely based on client-server model, but with communication functionality relying on a third party publish/subscribe mechanism instead of direct point-to-point communications. An overview of the technical functionality is depicted in Figure 2.
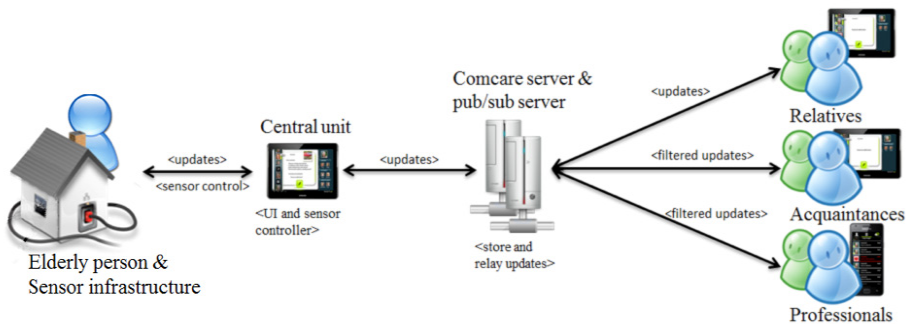
Fig. 2. The Comcare system overview: elderly person controls the sensors via a central unit, which delivers all updates to the Comcare server. Server relays filtered messages to and receives messages from all the three circles.

4.1   Server

The Comcare server was implemented using Java Platform, Standard Edition (Java SE) 6 and MySQL. The Comcare Server is used for configuring the Comcare environment including targets, their circles, and contact data points. The targets belonging to a Comcare environment are defined at server side in separate XML files, which can be manually modified and reprocessed by the server runtime, if requested. Secondly, the server is responsible for logging all messages in the Comcare for analysis purposes. Thus, all messages are relayed also to the server and stored in a local MySQL database, which is mirrored to a backup server once per day to prevent data loss in case of hardware failures. Finally, the server provides the clients their message history and other information about the Comcare environment in runtime.

4.2   Clients

The Comcare client software was developed for tablet PCs and mobile phones using Android OS (version 3.2 or higher), and it primarily serves as the user interface for making and receiving updates. Upon first startup, administrators of the Comcare are required to define the unique user ID of the client, matching one of the user IDs defined in the configuration of the Comcare environment at server side. Using this ID, the client is able to request information from the server and auto-configure itself and the user interface to match the corresponding Comcare environment and the role of the defined user. The client of the elderly person, i.e. of the target, has a secondary role as well: it serves as the connecting computational resource for sensors at the target's home. The sensors are attached directly to the client tablet via USB connection, and the raw sensor data is abstracted to high level, human readable sensor events at client side to be dispatched to the server.

4.3   Sensors

Sensors are realized using a do-it-yourself sensor kit called Phidgets (http://www.phidgets.com/). The sensors connect to the client tablet, and provide automated activity updates by monitoring the elderly person's environment. The sensors to be used are as follows; 1) *the front door*, detect tenant's movement: magnetic switch and motion sensor, 2) *the mailbox*, detect mail pick-up: pressure sensor, 3) *the fridge door*, detect door opening: magnetic switch and 4) *the central unit*, control the other sensors: hub with an on-off switch.

4.4   Communication

The Comcare is designed for large-scale deployments. Its environment is anticipated to be fragmented with problems in connectivity and serendipitous data events from tens of sensors in geographically varying locations. For stability reasons, we chose to utilize a third party lightweight publish/subscribe system, Message Queue Telemetry Transport (MQTT) from IBM (http://mqtt.org/). MQTT is an "Internet of Things" connectivity protocol, designed for such environments as ours and for high volume sensor data with very low overhead. Clients subscribe to events belonging to them, and all sensor messages and updates from clients are relayed directly peer-to-peer using MQTT. Simultaneously, copies of messages are dispatched to the server for logging. Thus, clients never have to directly connect to the server, and the environment can operate in "Comcare namespaces", instead of e.g. handling IP addresses.

5   Discussion

We have presented a new concept for communal activity-monitoring service that utilizes SNS. We believe that social media applications combined with context sensitive data delivery could increase acceptance of monitoring systems and engage young

generations to take care of their older relatives. The Comcare is directed to independently living elders and their close ones, providing a new way to take care of relatives living far away and strengthen ties in the community. The main difference of the Comcare compared to existing SNS services is context sensitive data delivery, members' ability to make updates on behalf of the elderly and transparent monitoring messages shown on the target's Comcare client software. Our starting point is to empower older people to decide who gets their monitoring data and who do not. Thus, the target has to be able to switch off the system at any time and also decide who are included in the Comcare community. We see that security systems should provide equal communication ability between the elderly and relatives. In other words, activity monitoring should combine contextual awareness and personal communication as well as the sensory data in a sensitive, ethical and privacy requirements fulfilling fashion.

While we have chosen to construct a standalone social networking system, we acknowledge the potential of integrating existing online social networking solutions. Even though the limitations of their current APIs prohibit relying solely on them, their features such as getting profile pictures and other details of contacts could be leveraged especially in the setup phase of a Comcare deployment. Further, users in any of the three circles might prefer to receive non-sensitive activity information as private or chat messages in Facebook, instead of using the dedicated Comcare client.

In the next step, we will setup the system and start preparations for a longitudinal field study in authentic settings, where the system will be used for 3 months. Data from the pilot will be collected through observations and extensive follow-up surveys.

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