Developing an Effective Social Presence System for Older Adults: The Connected Vitality Network

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Abstract. *Communication over distance via the use of communication technologies aims to offer and enable contact for older adults, who are typically restricted in terms of mobility and tend to suffer from loneliness due to the lack of social inclusion. Technologies enable communication over distance but suffer greatly in terms of providing the feeling of being connected, lacking also social presence during a remote contact. The Connected Vitality Network puts older adults at the centre of attention to study their needs for designing suitable human computer interaction methods and implement a social (tele)-presence system, which enables closeness and promotes social inclusion. Key research studies, workshop results, design principles and implementation details are presented in this paper.*

Keywords. Social presence, human computer interaction, social inclusion, social interaction, communication systems.

1. Introduction

Nowadays, widely established technologies offer the capability to communicate over distance. These technologies are essential, since among other reasons, the fact that nowadays people tend to migrate even more and work at cities that are far away from their birthplace, in the case of older adults, it is one of the primary factors that increase social isolation and contribute to loss of confidence, decreases the feeling of usefulness towards the society but also increases loneliness.

In addition, health issues commonly related to immobility contribute to older adults' isolation. This is because they are not able to visit family and friends, thus losing social contacts [3]. Social inclusion is a critical aspect that affects older adults' wellbeing, where studies revealed that loneliness and social networks affect the mood and wellbeing of older adults, contributing largely to depressed mood [5, 10].

The use of ICTs aids older adults mainly in communicating and enables a better quality of life, since it allows overcoming social isolation and the feeling of loneliness [10]. A study reveals that 73% of individuals between the ages of 25 and 54 are using the Internet on a regular basis [9]. Moreover, Eurostat's data on Internet usage in 2010, for the 27 countries of the EU [4], indicates that 37% of older adults between the ages of 55-74 use the Internet at least once a week on average. While Internet and in general technologies usage is increasing, the fact remains that motivating older adults to use a computer and its applications is a key challenge [9].

An important problem is that technologies that aid and support communication, suffer from the absence of the feeling of real-life contact and thus do not enable social inclusion. Providing the feeling of ***social presence*** through available ICTs is vital, since due to the isolation that older adults experience, the need for human contact is such that the seniors enjoy even the simplest everyday social contact with other persons [11]. The term social presence has no unique definition within the literature [7]. In one of the initial definitions it is described as: *The degree to which people are perceived as "real"* [6]. Thereby, the amount of

information that is transported (e.g., behavioural cues) contributes to the level of social presence a person experiences [2]. Based on this definition we perceive and argue that communication systems must enable contact with other people, imitating face-to-face communication as close as possible, providing a realistic animation of human behaviour and body language.

This paper presents the evaluation results of the work conducted in the framework of the EU project ***C**onnected **V**itality **N**etwork* (CVN)[1] that takes into consideration the need for social presence but also the importance of social connections and social activities [13]. Foremost, the study of older adults was conducted via interviews and workshops but also with experts' surveys, so as to identify the key requirements and social activities for a system that enables social presence. Then, the design and production of a suitable device was performed that offers a real-life communication experience. Finally, the social activities and their supporting simple UIs were implemented offering a high-quality audio and video communication system. This system aims at creating a small scale network that links groups of older adults and facilitates social presence. The rest of the paper presents the research objectives (Section 2), the components developed in the framework of CVN (Sections 3 and 4), the system evaluation results (Section 5) and finally the conclusions (Section 6).

2. Research Questions on Social Presence

The study and examination of the key needs for developing an effective social presence system for older adults was conducted using a variety of research methods (experts' surveys, workshops and interviews with older adults). Details on the applied research practices can be found in [8], while this paper focuses on the two qualitative research methods (i.e. workshops and interviews) applied to answer two key research questions:

- **RQ1:** What are meaningful social activities in older adults' life?
- **RQ2:** Which social activities are important for older adults?

For executing the workshops, 27 older adults of the ages of 60-82 have participated while 7 older adults (80-95 years old) were interviewed. This allowed identifying the social activities regarded as meaningful that motivate and interest older adults. The workshops and interviews results showcased (in terms of RQ1) that meaningful social activities for older adults are the following (with order of precedence):

- Spending quality time and communicating remotely with family and friends so as to maintain regular social contact.
- Participants pointed out that it makes them feel useful, when they actually do something for other people; e.g. providing help.

The above points are also further supported by relevant literature [11], where even the simplest everyday social contact with family and friends but also voluntary work is highly beneficial.

The answer to RQ2 revealed the desire of older adults and the recommendation of health experts described respectively as follows:

- Participate in group social activities, where the main focus is on sharing interests together with others.
- Need to engage adults in social activities that promote physical activity and contribute to a healthier life.

The qualitative research methods applied and the results of the two key research questions led to the definition of three communication formats, which are the ***Meet, Club and Classroom***. These formats aim to satisfy the requirements of older adults by providing the capability to imitate as close as possible real-life human communication, while promoting entertaining and safe physical social activities that promote also the feeling of being useful to the society.

The ***Meet*** format offers audio-video call between two older adults at a time for discussing different topics and shared interests in a way that reduces social isolation and preserves the feeling of being together as in real life. Supplementing the above, the ***Club*** format addresses the need for group participation in social activities that promote older adults mental and physical wellbeing. Finally, the ***Classroom*** format adheres and satisfies the need of engaging in social activities that stimulate the feeling of being useful for other people; e.g. teaching others.

The above complementing requirements captured and implemented in the three formats, satisfy the key aspect of the CVN system. This key aspect is to enable social presence through the technical capabilities of the manufactured device and the implemented system, which support older adults (and family) by enriching

[1] EU AAL project ***C**onnected **V**itality **N**etwork* (CVN) - http://www.connectedvitality.eu/

audio and video communication via auditory and visual signals that allow mimicking body language and as a result human behaviour.

3. The YoooM Device

The developments of the CVN system needed to fully adhere to the aforesaid critical requirements identified by the user-oriented research [8]. For this purpose, it was considered essential to create a novel device, as presented in Fig. 1, which offers a digitally shared acting area via the device's web camera views. This digital view of the user's face and acting perspective allows improving natural communication via auditory and visual cues that provide a more realistic animation of human behaviour.

The primary webcam (8) provides a view of the upper part of the user sitting in front of the device; i.e. the face view (22). The second webcam (9) provides a view of the user's activity area (24). Moreover, the two screens of the device (14, 15) are combined under an angle of α = 135º, enabling the feeling of social presence by viewing the other user in a more natural way and with an almost life-sized view.

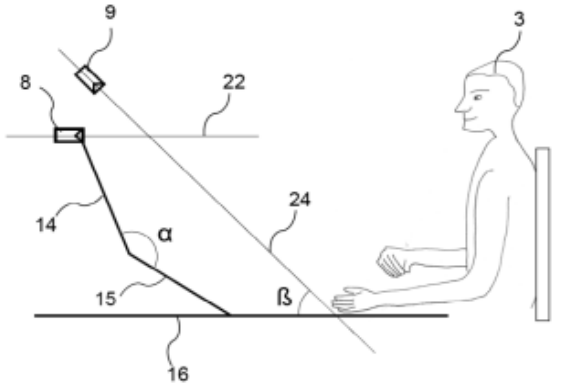

Figure 1. The YoooM device design: Enabling social presence

In addition to the two camera arrangement and the two high-resolution screens, a touch panel is mounted on the lower device screen. This allows digitally sharing the view of the user's activity perspective over the network. Moreover, a high-fidelity microphone and a set of speakers are mounted to the unit for enabling sound quality. In overall, the YoooM device comprises a novel combination beyond the state of the art, which aims to support enhanced social presence and for which a patent is acquired by PresenceDisplays.

4. The YoooM System

The YoooM system (i.e. CVN) is developed in the form of three different software modules that implement the three communication formats.

The *Meet module* is developed in the form of a native C++ application, namely YoooMRTC, which is the main application of the system. YoooMRTC is a modified version of the open-source WebRTC project [15]. It implements the one-to-one call, on the basis of the peer-to-peer model, conforming also to the implementation of the VP8 high-quality video codec [12] and the iSAC and iLBC high-quality audio codecs.

Fig.2 presents the architecture of the YoooMRTC module. As shown, clients exchange signalling messages with the server, which refer to data of the user and other users connected to the YoooM community. The communication with the server is performed only for identifying other peers and their network location, so as to establish a communication channel when a user wants to start an audio and video call. On the other hand, the actual audio and video data are exchanged directly between the peers.

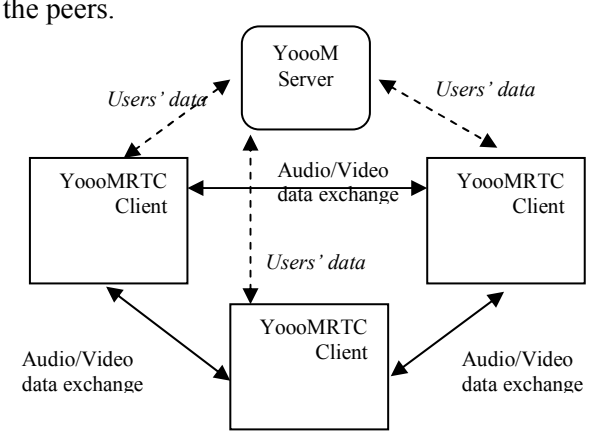

Figure 2. YoooMRTC Module Architecture

The YoooMRTC module implements the main user interfaces (UIs) for invoking the Club and Classroom modules but also for calling another peer.

Fig. 3 illustrates the main interaction point with the Meet module, which refers to the UI for navigating the user's agenda and selecting a person to initiate a one-to-one call. For privacy and security reasons the user's contacts are pre-registered in the YoooM community. Moreover, each YoooM device is associated with a user and registered to the YoooMServer so as to permit secure connections only from registered peers.

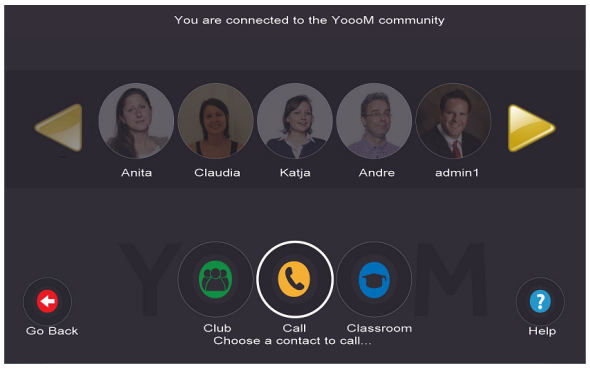

Figure 3. YoooMRTC Module Main UI

Fig. 4 showcases the communication between two older adults using the YoooMRTC module. The feedback and comments received by elders during the user testing sessions revealed that user experience and social presence is increased. This is because the communication offers the feeling that the two parties have physical contact.

Figure 4. The Meet Format: One to One Communication

The *Club module* is developed in the form of two complementary Flash-based client applications, one in the upper screen and one in the lower screen (see Fig. 5). The many-to-many communication sub-module (upper screen) is developed by extending the BigBlueButton (BBB) web-based, videoconferencing and online learning system [1]. In particular, both the client side as well as the server side were modified and extended, so as to support, via the BBB Flash-based, Red5 media server, an H.264 [12] enabled audio/video communication between multiple participants.

The physical and social activities of the second sub-module are also developed in the form of Flash-based client applications (lower screen). These activities are namely the games Balloon Shooter, Ludo and Pong, while social activities include News (i.e. synchronised browsing of the same webpage) and Excursion (i.e. synchronised navigation of the same map). This sub-module is also built on the basis of a client server model, where multi-party activities are coordinated via a TCP server.

In order to aid integration with the YoooMRTC module, two applications were developed that refer to the YoooMBrowser and BrowserSharing. The first implements two MSDN web browser controls that allow loading the Flash-based multi-party communication on the upper screen, while loading on the lower screen one of the Flash-based games.

Fig. 5 shows the audio and video communication between two participants (maximum of four participants), while playing together the Balloon Shooter game that provides minimal physical activity that can be beneficial to the health of older adults.

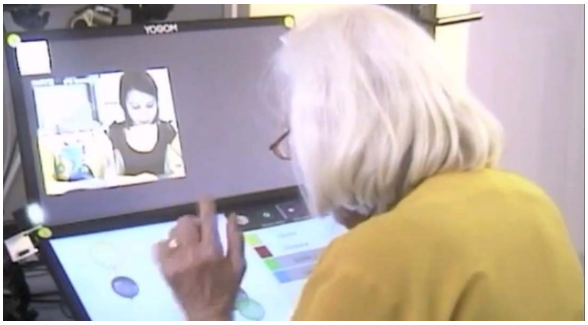

Figure 5. The Club Format: Communication and Gaming

In the case of the social activities (i.e. News, Excursion), the YoooMBrowser starts merely a single web browser control that loads the multi-party communication on the upper screen. Due to performance and synchronisation requirements of the social activities it was decided to develop the BrowserSharing application. This application implements a separate web browser control and a transparent layer for capturing the clicks on the touchpanel and transmitting them via the browser to the other clients connected in the session. This is performed for synchronising the webpage or map through which users are navigating together. As shown in Fig. 6 the social activities application is executed at the lower screen of the device.

The implementation of the *Classroom module* (i.e. one-to-many communication) is also a modification of both the BBB client and server functionality. In this case the YoooMBrowser application is invoked from the YoooMRTC

main application, which starts only a single web browser control that loads the Flash-based implementation. One of the users is displayed in the centre of both screens as the "teacher", with the rest of the users positioned as "students" in the four corners of the lower touch screen; see Fig. 7.

Figure 6. The Club Format – Communication and Sightseeing

Figure 7. The Classroom Communication format – Demo at EU parliament

The central participant plays a key role in the session, positioned enlarged in the centre, so as to be clearly visible by all other participants. This reflects the requirement of the user oriented study, where older adults pointed out that they like to contribute to the society by, e.g. teaching other people. Thus, this enlarged position enables coordinating the communication session while teaching other users (e.g. how to draw). It also allows other users to experience and understand what the lead participant is showing, so that they can clearly follow the activity.

It was critical to implement the functionality that allowed the server to distinct between the "teacher" and the "students" in a session, so as to position them accordingly. Also, during the evaluation of the initial version of the system by HCI and other experts, it was considered important to provide the capability to resize "student" participants and move them directly to the centre position. This allows the "teacher" (or even other users) a clear view of a specific participant at any point, which is useful for observing whether a user is performing the activity correctly. Besides, it is also essential for other "students" to be able to clearly observe a user when showing something to the rest of the group. Thus, a user is able to double-click on the video of another user in order to resize and position that participant in the centre.

The implementation of the modules adheres to the identified requirements of the user-oriented study, so as to enable meaningful social activities augmented by high-quality communication. This enables social presence and social inclusion of older adults by enhancing communication via auditory and visual clues that enable imitation of real-life human behaviour.

5. Evaluation of the YoooM System

Initial end-user workshops were performed that aimed at receiving feedback based on the opinions and comments of older adults.

The participants of the workshops stated that the use of the YoooM device and the *Meet format* provided a surprising feeling, since users were actually impressed and enjoyed the real-life feeling experienced when interacting with the YoooM device and communicating with another user. A user stated that it was realistic enough and gave the feeling of being able to shake hands. In overall, the users appreciated the fact that they could clearly see and observe facial expressions and body language, which evidently made the communication more realistic.

Additionally the feedback received revealed that the *Meet format* was moderately important for contacting caregivers in the case of emergency or for addressing safety issues. Users pointed out that even remote support could be given from a doctor or physician, stating though that in many occasions it's important to have physical and personal contact (especially if one

actually needs support regarding the activities of daily living).

Regarding the *Club Format* participants pointed out that they appreciated the idea of being active together with others (e.g. family, friends). For example, they enjoyed socialising while playing the Pong game and denoted also that the sense of being present and the experience of being close with loved one was very important.

In terms of the *Classroom format* users pointed out that they valued the idea of being active, teaching or learning from others. For instance, teaching how to paint to their grandchildren was regarded as a meaningful social activity. Another critical point made by participants was that they felt useful when teaching others and that they were also motivated to learn new things.

An important general comment was that the three formats are useful for interacting with others. However, physical meetings and contact was still important for the older adults.

An evaluation was also performed by means of a heuristic evaluation, for evaluating the system on usability issues and improving it prior to the final end-user field tests. In particular, ten experts were invited as follows: (i) four HCI researchers with knowledge on usability aspects, (ii) four HCI experts in the area of adult education; teaching older adults in working with computers and (iii) two experts in the care area, having expertise in older adults' physical restrictions that might affect the usage of technologies. The experts performed five predefined tasks and needed to write down violations of heuristics when performing the tasks. The tasks concerned the operation of the Meet format, the Classroom format and the Club format.

A researcher summarized the identified problems and experts were asked to rank the problems with respect to severity (4 = catastrophe, 3 = major, 2 = minor, 1 = cosmetic). Thirty eight usability issues were identified, whereas six problems were classified as catastrophe, which means that these problems are critical to fix. These problems concerned consistency and feedback issues.

The SUS (System Usability Scale) was also used, which is based on the ISO 9241-11 and covers three dimensions:

- System Effectiveness defined as the ability to complete tasks and the quality of output when executing a task.
- System Efficiency level or resource that is needed to perform a task.
- System Satisfaction defined as the user's subjective assessment when working with a system.

Experts were asked to rate their agreement or disagreement to predefined statements. The overall average SUS-score was at 63. According to Tullis and colleagues, [14] an average SUS score under about 60 indicates that the system has several usability problems that should be improved, while an average SUS score over about 80 could be considered as pretty good where the users would like the system. Thus a score at 63 is marginal and indicates that users are likely to accept the system, while there are certain usability problems though that should be addressed, so as to increase system usability and acceptance.

6. Conclusions

The issues identified from the feedback received by workshop participants and by HCI and other experts were considered and addressed. The YoooM system was then subjected to laboratory tests that verified that these issues were resolved. A SUS-score of 63 indicated that users are likely to accept the system, while certain usability problems exist and should be addressed.

All of the experts in the heuristic evaluation mentioned that the YoooM system could be a good opportunity for older people to stay in contact with their family and friends. The things that the experts like most were the two big screens, the videos of the other person and the intuitive and easy navigation. One participant even noted that the communication with the YoooM feels like a face-to-face contact, as you can see the other person's body. Things that the experts did not like were the missing feedback, the Browser-Sharing and some inconsistencies. An expert suggested providing an exercise-function in the Teach-format in order for the users to have the possibility to keep fit. In summary it can be stated, that the YoooM can have a promising future for older people.

Currently several YoooM devices (with the YoooM system installed) are setup at older adults' homes in three countries, forming three YoooM communities: in Sweden, Spain and Netherlands. These communities are conducting extensive end-user field tests with the support of the technical team of the CVN consortium. The

initial usability and functionality results based on the positive feedback received by the end-users are promising.

As future work, the results of the field tests in the three aforementioned communities will be gathered and analysed in order to further improve the usability, effectiveness, efficiency and user satisfaction of the YoooM system.

7. Acknowledgements

This work is supported by the European Commission as part of the Connected Vitality Network (CVN) project funded by Ambient Assisted Living (AAL) initiative. Special thanks go to end user organizations, which supported us in conducting user studies.

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