The Connected Vitality System: Enhancing Social Presence for Older Adults

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Abstract — The social isolation of older adults in Europe is a key and continuously growing issue that demands immediate attention. Older adults might feel isolated and lonely mainly because they lack human contact and social support. This is because their closest relatives, such as their children and grandchildren, live and work at distant places, while contact with friends and care professionals is also rare. In this paper a tele-presence system is presented, which enables social presence and facilitates social interaction contributing to e-Inclusion of older adults. This is supported by the results obtained in this work based on the conducted user studies with older adults and expert evaluations.

Keywords—Social presence; e-Inclusion; human-computer interaction; multimedia systems.

I. INTRODUCTION

The modern way of living often demands that people live and work at places distant from their birthplace. This is an initial factor that contributes to the fact that older adults often become isolated. Moreover, health issues contribute to older adults' isolation, since they are often unable to visit family and friends. Hence, they tend to lose social contacts [1]. Research studies revealed that loneliness and non-integration in social networks affect mood and wellbeing of older adults, underlying a serious proportion of depressed mood [2] [3]. Hence, to be integrated in a social network is a critical factor to support mental health and a high quality of life.

Nowadays, ICTs offer a variety of possibilities to communicate with family and friends (e.g., via Skype), and aid older adults to face the difficulties of modern life and overcome social isolation and loneliness; achieving as a result a higher quality of life [3]. Eurostat's data on Internet usage in the 27 countries of the European Union in 2010 [4], indicates that 37% of older adults between the ages of 55-74 use the Internet at least once a week on average. Although the use of ICTs is increasing, there is still a significant age-based digital divide; i.e., the percentage increases to 73% for individuals between 25-54 years old [5]. Thus, it remains a challenge to motivate and support older adults to use a computer and its applications.

Existing systems allow older adults to communicate with family and friends, and thus contribute in overcoming social isolation. They do lack though in terms of providing the sense of social presence improving thus e-Inclusion. The term ***social presence*** has no unique definition within the literature, but it is rather continuously re-defined [6] [7]. In one of the initial definitions social presence is defined as: "*The degree to which people are perceived as 'real'"* [8]. In this work we consider social presence as "*the perceived user experience of being together when communicating and interacting over distance, enabled through a system's capabilities that allow conveying a variety of non-verbal cues such as facial expressions, postures and gestures, thus offering a realistic animation of human behaviour.*" On the other hand, e-Inclusion "*refers and aims to achieve that "no one is left behind" in enjoying the benefits of ICT. It focuses on participation of all individuals and communities in all aspects of the information society, reducing gaps in ICT usage and promotion, to overcome exclusion, improve economic performance, employment opportunities, quality of life, social participation and cohesion"* [9].

*The **C**onnected**V**itality – the Personal Telepresence **N**etwork (CVN)* project delivers a novel device and a high-quality (i.e., H264, VP8) audio and video communication system. The device is powered by a Mac mini, it has two monitors (lower is touchpad) positioned together at a certain angle, two high definition web cameras for a multidimensional and panoramic view of the other person including body language, a high fidelity microphone for optimal sound experience and two side-attached speakers. This system addresses the aforesaid key issues of (i) social presence and (ii) e-Inclusion by fully noticing the importance of social connections, as attested also in [10], and delivering via the use of ICTs the appropriate social activities that enable the experience of being connected, offer lifelikeness and the feeling of being part of a community. This allows

creating small-scale networks that link groups of older adults, offering communication capabilities and multimedia-enabled social activities of shared interest. Moreover, the CVN system is designed and implemented by taking into account the technological capabilities of the target group, to enable, simplify and motivate older adults to use it. For this purpose specific user interfaces (UIs) have been developed based on the CVN concept of the one-button interface, which refers to providing simple and clearly comprehensible and identifiable "click-to-perform" user actions, offering the optimal information feedback, user control and freedom.

As a starting point in the user-centered development process a literature study on social presence (e.g., [6] [7]) and a user requirements analysis were carried out, aiming at capturing the target group's needs for identifying meaningful social activities. A variety of different methods were applied such as workshops with potential end-users, a survey and interviews with end-users and experts. Details on these research methods can be found in [11] [12] and more complete information on the results is reported in [26]. A variety of requirements were identified, that encouraged the development of three different formats: ***Meet, Club*** and ***Classroom***.

The central requirements with respect to the ***Meet*** format are outlined in the following:

1. One-to-one high quality audio/video calls enabling displaying an almost real-life sized picture of the other party, which makes it possible to experience being present within a remote communication. This is especially important for older adults, who might lose face-to-face contacts and often feel lonely.
2. An opportunity to easily contact family or friends, in order to enable regular contact, even if people are living distant to each other.
3. Opportunities to be in contact with health care experts, seeking advice and medical guidance providing a sense of safety. This seems to be especially important for older adults who face a variety of different age-related disabilities.

The following requirements obtained from the literature and user studies are addressed within the ***Club format***:

1. Communication between groups of people familiar to each other.
2. Possibilities to participate in a club or association, so as to engage in social activities together with others.
3. An opportunity to engage in physical and mental activities.

Within the ***Classroom format*** the main requirements for meaningful social activities that promote the feeling of being useful for the society are detailed as follows:

1. Activities that promote social interaction and enable to exchange and discuss interests (e.g., hobbies).
2. An opportunity to engage in voluntary activities (e.g., teaching other older adults or grandchildren) in order to stimulate the feeling of being useful.

Apart from these individual requirements, the ***key user requirement*** that was considered imperative in all three formats was the ability to enable ***social presence*** and as a result ***e-Inclusion***, which called for the provision of suitable technical capabilities that enable older adults and other users to mimic real-life face-to-face interactions. This called for ***a device and a system that enriches audio and video communication by auditory and visual signals that animate real-life behaviour***; i.e., body language.

The formats are delivered through the implemented system modules and enabled by high-quality H.264 and VP8 implementations [14] [15], so as to enable social presence via audio and video conferencing capabilities provided to older adults. Fig. 1 illustrates the one button user interface that shows the implemented system modules, namely the ***Meet, Club and Classroom***. The design of the one button UI aims at providing large, clearly visible and instantly comprehensible user controls, to enable simplicity in interaction and communication.

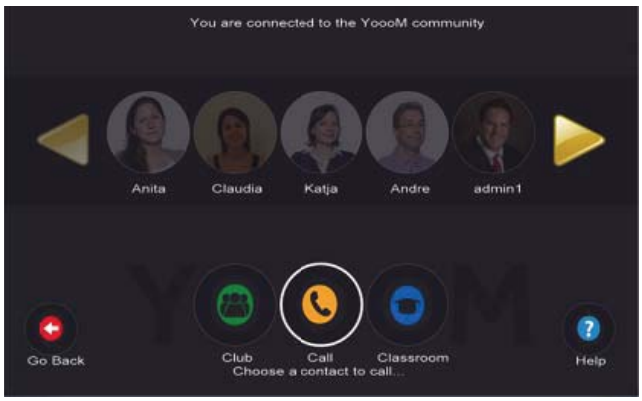

Fig. 1. One Button User Interface: The three communication formats

II. Background Study

A. One-to-One and Multiparty Communication

In this project an important background research was conducted, considering projects and services in the areas of telepresence and audio/video conferencing. The aim was to identify the types of systems currently available at the market and understand the issues and challenges in the area, so as to establish a communication system required to serve the project's objectives. Although proprietary, closed-source systems were examined, these systems were excluded, since the target (even at the proposal stage) was an open source, extensible and modular system.

BigBlueButton [16], [17] is an open, web conferencing system, distributed under the GNU GPL v3. The system offers video conferencing, text-based chat, screen sharing and document sharing (e.g., presentations). It is mainly marketed as an e-learning solution (e.g., conducting online lectures in real-time). It is not a hosted service: users must run their own BigBlueButton (BBB) server and clients use their web browsers (or Flash player enabled software) to

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connect to the BBB service. The system uses Flash media for video conferencing and includes an integrated VoIP solution. BBB is composed of many open-source sub-components such as the "Red5" Flash media server, "MySQL" as a database, "Tomcat" as a Java Application server and many others. There also exists an active developers' community and a hosted demo service of the BBB system is available, which provides an easily accessible overview of the main features [16].

Openmeetings [18] is an open-source, web-based video-conferencing system with similar functionality to BBB; offering audio/video, text chat, screen sharing and collaboration via a whiteboard or shared documents. As with BBB the Openmeetings system uses Flash media as the medium for conferencing. Thus, clients use their own web browser to connect to the Openmeetings service (i.e., either their own service or via the hosted Openmeetings demo service). Other important projects are Opentok [19] and Scenic [20]. There are also projects focusing on providing services for people with special needs, such as older adults. Willow Garage Texai (Mobile Remote Presence for Older Adults) [21] offers a robot allowing the target group to communicate with remote locations. The robot is equipped with a camera and a microphone, placed at the remote location and is operated remotely by the user.

A new project is WebRTC [22], which aims to provide an API to application developers to develop web-based real-time multimedia applications. This project is under development providing currently only the core WebRTC components. Thus, the Web API is still in an early stage of development and cannot be used at the moment for developing pure web-based applications. Therefore, this project was considered for the implementation of the YoooMRTC module, which is an extended version of WebRTC and implements one-to-one communication; i.e., the Meet format. It provides also the UIs (see Fig. 1), used by the elders interacting with the CVN System. WebRTC was selected because it enables scalability, performance and flexibility because of its peer-to-peer communication model; in contrast to the others. However, WebRTC does not support multiparty communication at this stage. Hence, on the basis of the requirement analysis [11] [12] and the background study an open-source and modular multi-party communication system was selected for the development of the Club and Classroom formats.

The following criteria were taken into account when selecting BBB over its counterparts: (i) the key advantage of the BBB system is the modular architecture that allows developers to implement new modules, in order to extend it based on their business requirements, (ii) BBB has a highly active developer community fully committed to the project, which continuously upgrades the system with new features and resolves system issues, (iii) audio and video communication critically improved since high definition audio and video codecs are currently supported (i.e., H.264 since Flash 10.3), providing echo cancellation algorithms, reduction in audio and video delays, etc. (iv) it offers a client-server architecture for exchanging and storing information between clients (session creation, messages, etc.) and (v) it can be integrated with widely accepted Content Management Systems (CMS), such as Moodle.

B. Interactive Multiuser Applications

In addition to the multimedia communication provided by the system, which aims at enabling social inclusion and social presence to avoid isolation of older adults, the system aims at fostering physical and mental social activities that keep older adults active. This was regarded as highly important by healthcare experts. Thus, a study was conducted to overview projects and services dealing with applications for older adults that involve them into various entertaining and interactive physical activities.

On the basis of the design considerations of the CVN device (see Section C), it was considered important that the system's applications should follow the philosophy of today's mobile and tablet applications. Therefore, an essential background study was performed that involved tablet application design methods and considerations of appropriate multiplayer activities; i.e., activities performed in multi-party communication.

Activities such as movement games (e.g., handball, pong, bubble shooter) may contribute to the older adults' health state [25]. Others are considered entertaining and contribute to the mental health of older adults, e.g., taking virtual tours together via shared panoramic imagery or browsing together the Internet (i.e., browser sharing that allows viewing and navigating the same webpage). Thus, a selection of these activities was made and activities were designed in a way that revealed their concept and functionality. Then they were handed over to user-oriented organizations, so as to be evaluated by means of user studies and expert evaluations. On the basis of the results obtained, the respective applications were implemented.

In particular, based on these results, the conclusion was made that a device is required that is able to capture a wide range of movements (push of buttons, movement of head, hands, etc.). It should also provide proper feedback on facial expressions, movements, hand gestures, promoting physical activity and entertainment, while communicating at the same time. Hence, the system needs to allow the user to focus on and be involved in the social activity. As a result, it was intended to implement interactive multiuser applications that consider the need for feedback and movement control, promoting mental and physical health.

Garrido et al. [23] point out that an intelligent application and its UI should provide two methods in order to avoid users getting bored or frustrated with a kinetic application. As shown in Fig. 2, the methods involve: (i) feedback control and (ii) level control. Feedback is an important part in the CVN system to provide an interactive experience. In specific, feedback can be presented in several ways to the user such as visual, audio, action, etc. Changhoon and Park [24] claim that several alternative types of feedback should be offered from the use of multimodal interfaces, so as to suit a higher number of people. The other key element refers to the possibility of dynamically changing the difficulty level, in order to avoid overstraining or under-challenging a user.

Consequently, applications of the CVN system need to detect the difficulty users are facing at any given moment. This is performed through a challenge function, which converts an explicit game state into a value that specifies the game difficulty perceived by the user.

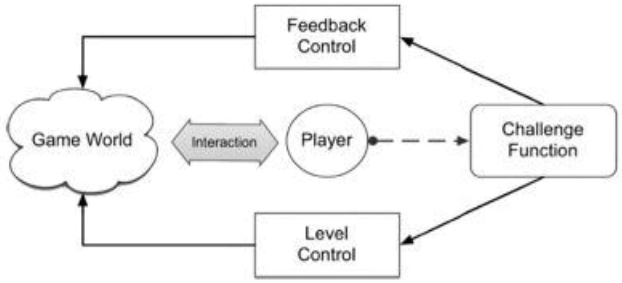

Fig. 2. Kinetic module design principle [24]

The study on interactive multiuser applications and the results from the evaluation of different activities by potential end-users and experts working with older adults, contributed to the decision of implementing the following multi-user applications: (i) Bubble Shooter, (ii) Pong, (iii) Ludo, (iv) Browser Sharing and Excursion (i.e., virtual sightseeing tours). As aforesaid, these applications are selected since they adhere with key requirements identified for keeping older adults mentally and physically healthy and socially active (feeling also useful), by involving them in fun and interactive activities [25], enriched with lifelike communication between groups of users.

C. Device Physical and User Perspective

Based on the aforementioned results of the initial user-oriented research [11] [12], we concluded that a social presence system aiming to provide enriched physical experience and social interaction requires focusing on the following key aspects:

1. Enrich media by auditory and visual cues.
2. Mimic face to face communication.
3. Provide realistic animation of human behaviour.

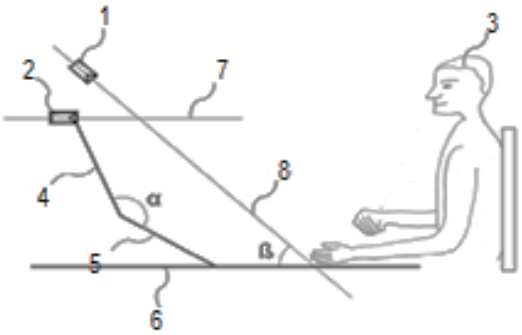

Fig. 3. The design of the device – enabling social presence

In order to deliver a system that supports the aforesaid critical aspects, it was deemed important to manufacture a novel device. Fig. 3 presents the design of the new device, which shows the positioning of two webcams on the top of the device. The primary webcam (2) provides a view of the upper part of the user sitting in front of the device; i.e., the face view (3). The second webcam (1) provides a view of the user's acting perspective (8), which shows user's activity; e.g., writing. Moreover, the two screens of the device (4, 5) are arranged at an angle of $\alpha = 135^{o}$, enabling the feeling of presence displaying the communicating user almost life-sized. Thus, a digitally shared face view and acting area is enabled through the cameras positioning and allows the transportation of a variety of auditory and visual cues (e.g., face expressions, gestures), improving natural communication and mutual understanding, providing a realistic animation of human behaviour; e.g., see Fig. 5.

III. CVN: A Social Presence System

A. System Architecture

The CVN system architecture is defined on the basis of a hybrid communication model, which combines the client-server and the peer-to-peer communication models. This hybrid model is defined as a result of the study and analysis of existing multimedia communication systems (e.g., WebRTC, BBB, OpenMeetings), in an effort to exploit, modify or extend their technical features and resolve any weaknesses in order to support the objectives of the CVN project. The hybrid communication model serves as the basis for the definition and implementation of the system modules. It also allows addressing quality, scalability and performance requirements for the three key categories of communication formats. These categories refer to the one-to-one, one-to-many and many-to-many communication formats, which are delivered by the implemented CVN system modules.

Fig. 4 presents the CVN system architecture that includes the three modules developed by adapting and extending the open WebRTC and BBB projects. As part of the Club module, the Kinetic sub-module implements the interactive multiuser applications enabling the older adults' physical and social activities.

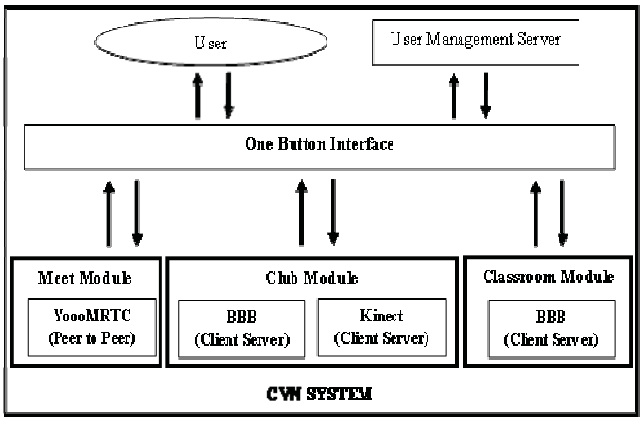

Fig. 4. The CVN System Architecture

The CVN system is implemented as a Windows application using the C and C++ programming languages. This was performed since the technical analysis revealed a straightforward approach in integrating the desktop-based ***Meet*** module (i.e., WebRTC based) with the web-based ***Club***

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and ***Classroom*** modules. The Meet module main user interface allows launching an MSDN WebBrowser control that hosts the Club or the Classroom web-based module within the C++ application. The system's main interface is tightly coupled with the Meet module, while it is loosely coupled with the Club and Classroom modules. For the Club and Classroom modules the integration is declared as loosely coupled, since when the WebBrowser control is invoked the handle is passed to the implementation of the web-based modules. This means that the WebBrowser control hosts the web-based modules but the functionality of multiparty communication and the interactive multiuser applications are executed via the Flash implementation. The following subsection provides details on CVN system modules implementation.

B. System Developments

B1. Meet Module

The one-to-one communication format is implemented by extending the WebRTC technology [9]. The WebRTC-enabled module offers quality, performance and scalability to the CVN system. It conforms to the peer-to-peer communication model, the implementation of the VP8 high-quality video codec and the iSAC and iLBC high-quality audio codecs. The WebRTC libraries that could be embedded into well-known browsers are currently in the development stage. Hence, the ***Meet module*** illustrated in Fig. 5 was implemented as a C++ application.

Fig. 5. The Meet Communication Format

B2. Club Module

The ***Club*** module (i.e., many-to-many communication format) is realised by two sub-activities that enhance the communication and social interaction of older adults with their family and friends. Specifically, the upper screen of the YoooM device hosts the application that facilitates multi-party communication, while on the lower touchscreen the users are provided with interactive multi-user applications (e.g., Browser Sharing, Pong). While interacting with the communication partners on the lower screen, social presence is supported through the upper screen, providing a realistic animation of the users' behaviour. This simulates a real-life situation by enriching ICT-based communication and interaction with auditory and visual cues, mimicking real-life face-to-face communication.

The BBB Flash-based, Red5 media server was modified and extended in order to support many-to-many, high-quality audio/video communication in the Club format. Initial implementation involved enabling H.264 support, since this feature was in beta phase and not enabled by default. The Flash official release that supported H.264 was planned to be released at a later stage. Thus, the needed functionality was implemented, so as to enable the compilation and testing with high-quality audio and video. The next development step involved the implementation of the functionality for streaming and displaying two adjacent streams per participant, which is not provided by BBB, so as to enable the feeling of social presence. Fig. 6 illustrates on the upper screen the extended functionality of the BBB media server, which displays four participants that are communicating with high-quality audio and video, while at the same time they interact by navigating and sightseeing different places using the synchronized view of the same map.

Fig. 6. The Club Communication Format

Initial tests were also performed to determine the optimal number of participants in a communication session, which were limited to four participants for the Club format and five participants for the Classroom format. This decision was a result of the technical tests (e.g. latency, packet loss, audio-video synchronisation) conducted, so as to provide a smooth communication experience that resembles near real-life conditions, taking also into consideration UI design. For the experience it was deemed essential to avoid video streams delays, while at the same time keeping the voice communication quality at an optimal level. Consequently, the bandwidth and quality parameters were fine-tuned via the implementation based on the results of several testing sessions.

Overall, the principal goal was to define the accurate balance between audio and video quality and bandwidth consumption. For instance, providing high quality video streams during the testing revealed the high consumption of bandwidth, which typically caused problems such as audio delays, blocking of the video streams, stalling and synchronization issues. In contrast, setting parameters to low quality provided pixelated video streams but limited greatly bandwidth problems. Thus, the process aimed at testing and defining the optimal settings for the purposes of the CVN system, which resulted to tuning these settings so as to use the maximum bandwidth available for streaming two videos feeds with 87% quality in terms of the H.264 standard, at a frame rate of 15fps.

The next stage involved the implementation of the Club format UI client functionality and the functionality at the BBB server side that allows detecting if the Club format was selected. This enables management of the video windows, when clients log in and out of an activity. Finally, the C++ application was implemented that hosts two WebBrowser controls of the MSDN library. This was critical in order to permit executing the multi-party audio and video call as a Flash-based application on the upper WebBrowser control, while loading and running on the lower WebBrowser control one of the multi-user, Flash-based interactive social applications. As aforementioned, the WebBrowser application allowed integrating the Club and Classroom formats with the Meet format, and allowed to take advantage of the entire UI space of the device.

The interactive multiuser social applications of the Club format were implemented as an individual Kinetic sub-module based on the modular architecture of the CVN system (see Fig. 4). This sub-module is also implemented using Flash-based technologies on the client-side, which communicates and exchanges information with the socket server over the network. At the server, the required management actions are implemented (e.g., user, room management) that facilitate the coordination of multiuser interactive social activities. The developed applications of the Kinetic sub-module are presented as follows.

Ludo, Balloon Shooter and Pong

The Ludo[1], Balloon Shooter and Pong games are developed in the form of Flash-based client applications that need to be loaded via a web browser. Due to Flash security restrictions (i.e., file system access permissions) it was required to store the games executable and all assets on the server, from where they can be accessed and downloaded by the client when the Club module loads. In particular, each game is downloaded and loaded via a URL that includes the location of the Flash-based media application (i.e., compiled SWF file) and specific start-up parameters. These parameters aid server actions such as determining the room the user is joining, the username needed for updating the UI of other users when a new user joins, etc. In the integrated CVN system each game is loaded in the second lower WebBrowser control of the implemented C++ application. Fig. 7 shows the Flash multimedia communication loaded on the upper control and the Balloon Shooter game on the lower control.

Fig. 7. The Club Format – Balloon Shooter Application

Browser Sharing and Excursion

This Flash application is also based on the same client-server architecture as the games. It is executed on the lower WebBrowser control and has practically two modes: (i) it allows navigating and viewing the same synchronized webpages with other users in the session and (ii) it allows navigating and viewing the same synchronized view of a map with other users, simulating a real-life sightseeing in the form of a virtual tour. In specific, a transparent layer is implemented on top of the WebBrowser control, which listens for click events generated by the lower touchscreen (e.g., clicking a hyperlink, clicking the implemented zoom and scroll buttons) and broadcasts through the server the events to all client applications in the current session. This enables users in a specific virtual room to navigate the same webpages or watch the same places on a map. The application includes parameters that aid server actions, such as determining the room the user is joining.

B3. Classroom Module

Finally, the implementation of the ***Classroom*** module (i.e., one-to-many communication) is considering one of the room participants in each session as the "teacher", and thus in a central position, while the rest of the participants and placed in the four corners of the lower touchscreen (Fig. 8). This participant is playing a key role in the session and is positioned enlarged in the centre, so as to be clearly visible by all other participants. Hence, one older adult is considered as the coordinator of the communication session, who teaches other older adults, e.g., how to knit. The central enlarged position of the "teacher" is necessary in order to enable a clear understanding of what the lead participant is showing, so that participants can follow the activity.

Therefore, in terms of the developments it was critical to implement the functionality that allows identifying at the server side that the classroom format is selected and be able to distinguish between the "teacher" and "students" in a session. This allows setting accordingly the video stream resolutions and the position of the UI windows. In addition, during the HCI and UI experts' evaluation of the initial

[1] Ludo has been developed by a sub-contracted team led by V. Páli in Budapest.

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version of the CVN system, it was considered important to provide the capability to resize "student" participants and actively move them directly to the centre position. This allowed observing and having a clear view of a specific participant at any point, which is useful since the "teacher" might want to observe if a "student" is performing the activity correctly. It is also very important for other "students" to be able to look clearly at another participant when speaking or showing something to the rest of the group. Hence, a participant is able to double-click using the touchscreen on another user to resize and position that participant in the centre. This action is only affecting and changing the view of the user that initiated it, and does not affect the views of other users in the session.

Fig. 8. The Classroom Format – CVN Demo at EU Parliament

IV. User-Oriented Evaluation Of The CVN System

During the whole development process, the system was iteratively evaluated together with potential end users and HCI experts, in order to actually meet the target group's needs. The evaluation steps and the most important insights on the results are outlined in the next paragraphs.

The major goal within the first user studies was to gain preliminary insights to what extent the first prototype of the device actually meets the target group's needs. Within workshops participants got the opportunity to try out the Meet format and first ideas on the activities the system provides (e.g., Club games, Reading a book using the Classroom format) were presented. The majority of participants appreciated the different formats and activities, especially the opportunity for the one-to-many communication, enabling, e.g., to participate in courses. With respect to social presence and as a result e-Inclusion, the majority of participants were impressed by the system quality, allowing an almost natural conversation and pointed out that it provides a great sense of realism.

Based on the results, the technical implementation of the activities was performed. In a second step, focusing more on improving the usability of the system, a heuristic evaluation was carried out. Ten experts were invited: four HCI researchers with general knowledge on usability, four experts working in the area of adult education (i.e. teaching them in working with computers) and two experts working in the care area (i.e. having expertise in older adults' physical restrictions that might affect the usage of technologies). This evaluation revealed a variety of different usability problems essentially concerning consistency and feedback issues. Experts mainly advised to highlight clearly important UI areas, provide explicit and clear feedback for all actions, increase the font size of writings so that any information was easily accessible for older adults and actions were clearly identifiable and easy to comprehend and perform. Additionally, the SUS[2] (system usability scale) was used in order to assess effectiveness, efficiency and satisfaction when operating the system. A score of 63 indicated that users accept the system but that there is a tendency that they did not like it, making it necessary to improve usability aspects.

Within the additional development process the identified problems were addressed. Lab tests were carried out, so as to bring in again the user perspective. The major goal was to evaluate the usability and gain insights into end users' experiences and attitudes towards the system, as well as gather information about likes, dislikes and suggestions for improvements. Overall 30 older adults took part in the study. The results indicate that social presence was rated high by almost all participants and interviews at the end of the study showed that most of them especially appreciated communicating via the Meet format, pointing out that it provides a great sense of realism.

With respect to the usability, the SUS score substantially increased from 63 to a score of 78 indicating that participants accept now the system and that there is a tendency that they like the system. Nevertheless, a variety of problems were found and needed to be addressed before the field tests could take place, in order to actually ensure that participants will use the CVN system and that the system will adhere to their expectations and to the need to provide easily usable, comprehensible and interactive social activities. Most of the problems concerned the operation of the Club format. Participants, for example, were not sure how to play the games, how to use browser sharing and what to do if system fails. Therefore, help functions were included, feedback on the system status was further improved and remedial actions were implemented to bring the system to a stable state (e.g., in the rare occasion of system failure).

Within the iterative evaluation process a second heuristic evaluation was conducted. Although a variety of problems were addressed, this expert evaluation revealed further usability problems. Several issues concerned the information architecture, user control and freedom. Experts pointed out that feedback on the system status was lacking or even missing (e.g., when the Internet connection breaks or when a user is not available). Again these issues were addressed and resolved in the development process.

[2] A score from 80-100 indicates that users like the system from 60-79 that they accept the system and a score below 60 indicates that the user does not like the system.

As a preparation for the field tests the CVN system was again evaluated with potential end-users in a laboratory environment. Thereby, a few participants who took part in the initial user study, conducted also in the laboratory environment, were invited again and asked to give feedback with respect to the usability of the CVN system. The results revealed that participants experienced the system as easy to use and appreciated communicating and interacting via the social activities provided by the CVN system. Nevertheless, some final refinements were needed, especially concerning consistency issues. Currently, field studies are conducted in Spain, whereas the field tests in Netherlands and Sweden were executed over a period of six weeks. Overall 13 participants took part in the study, and the needed CVN devices were installed at their homes. For data assessment qualitative (interviews, diary method) and quantitative methods (questionnaires) were applied.

V. Conclusion And Next Steps

Summing up, the CVN system provides an opportunity to interact over distance while supporting at the same time social presence (i.e., the experience of "being together"). In this way it allows addressing e-Inclusion key aspects like the participation of older adults in communities, reducing gaps in ICT usage and promotion, contributing to their wellbeing and quality of life and achieving the "no one is left behind" vision by fully exploiting ICT benefits. Overall, it offers a solution for older adults who face restrictions (e.g., in mobility) and thus, might be in danger of getting isolated. Extensive end-users field tests are performed to identify issues not detected by the heuristic evaluation and the initial user studies. Early results from users' feedback on usability and user experience show that the system provides a valuable approach for older adults to be in contact with family and friends, enabling social presence and e-Inclusion via the offered activities.

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