Designing a 3D Virtual World for Providing Social Support for the Elderly

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Abstract. Due to their built-in properties, virtual platforms offer a unique template for designing systems that can provide social support for the elderly. In this paper we report on some aspects of the design process. From a user-centered perspective we examine the status of technology for the elderly and their needs, and from those we derive the requirements and functionality of our system to serve them.

Introduction

Due to their built-in properties, virtual platforms offer a unique template for designing systems that provide social support for the elderly. In particular, 3D virtual worlds integrate many of the properties found in other successful social systems. For example users can chat with each other publicly or privately using text, voice, and gestures. However, the aspect of shared space is what separates 3D virtual worlds from other systems. Essentially not since the telephone has there been a new technology that puts humans in the same time and place (Coleman, 2008), and includes an interface that allows participants to interact with each other, communicate in real-time, and navigate virtual space together.

And unlike other systems, 3D virtual worlds are distinctive as characterized by their persistence. Therefore similar to the real world, they do not cease to exist when a participant leaves and events continue to unfold in absentia (Harrison et al., 2010). And thus, it is by virtue of properties such as these and the philosophy of space that 3D virtual worlds are readily deployable. Infrastructural components

such as physics, simulations, and space, combine to offer opportunities for innovative real-world applications of virtual technology.

Technology for the Elderly: State of the Art and Issues

Current technological advancements promise very exciting opportunities for providing social support and a higher quality of life for the elderly. To this end, several types of systems exist that seek to address different areas in the lives of the elderly. Health systems (including tele-health systems) are those that seek to address illness or general health issues and include passive monitoring systems (e.g. fall sensors, remote exchange of data such as blood pressure between patients and healthcare professionals etc.) (see: Center for Aging and Technology, 2010). Ambient technologies include smart home tools that involve more complex environments which predict normal and abnormal behaviors prior to alerting care-givers of potentially dangerous behaviors (see: Zhou et al., 2011).

Monitoring tools specifically focus on behavior and consist of sensors and warning systems that alert caregivers whenever the care receiver enters or leaves a designated location such as a bedroom (see: Cesta, 2011). The least common are social systems that enable elders to maintain connections with family and friends, and offer them leisure activities. However, there are newer hybrid systems that are moving towards combining the aforementioned functions into a single unit. An example of this is the SmartSenior project, an integrated platform that contains health provisioning, vital data monitoring, entertainment, and personalized information services.

A number of studies highlight results that disagree with some of the assumptions made about social relationships during design. For example, in a study by Mueller et al., (2010), a large-screen display was deployed as part of a design project in a retirement home for the elderly. Although it was expected that this would help foster social interaction among the residents, the results were otherwise. Different preferences in socializing with other residents influenced the acceptance of activities offered during the study. Another study by Neufeldt (2009) sought to investigate the social impact that cooperative gameplay with the Nintendo Wii could have on the elderly. Also set in a retirement home, the results were again largely unpredictable. Unlike similar studies with the elderly which had been mostly successful, many of the problems faced centered on usability issues relating to input devices.

Overall, there are many successful systems for the elderly. However these are mostly health systems, ambient technologies, or monitoring tools. This means that the limited focus on the social lives of the elderly has consequently led to a limited supply of systems specifically designed to address this area. In retrospect, not only is there a need for more focus on the social lives of the elderly, but we

need solutions that integrate the features of isolated systems and appeal to the needs of the elderly.

The Elderly as Social Being

The social needs of the elderly are a highly misunderstood component of their social network. As a result, the design of technologies for the elderly is often based on theories and assumptions about their social lives (for example, that they are in constant need of assistance or being monitored). Yet, according to Lindley et al., (2008), the deployment of these technologies reveals insights into aspects of their social lives that sometimes contradict these theories and assumptions. The problem does not stop there. Notions of the elderly dictate the popular technological solutions. Consequently, technologies for the elderly address some areas of their lives (sometimes inadequate) while other areas are completely left out.

Some areas of elderly life (e.g. health and healthcare, socioeconomic status etc.) receive much more attention than others. Thus, the least covered area of their lives has to do with social issues. And even when this area receives some attention, the studies tend to recourse back to grand matters. A running theme among studies pertaining to the elderly is the bleakness of their lives. In essence, fewer studies address the brighter side of elderly life. An important point we want to highlight therefore is that, as with all other age groups, the elderly are social beings with reflecting needs.

To summarize, we give consideration to the specific needs of the elderly. Studies such as Lennartsson and Silverstein (2001), Lemmon and Pieper (1980), and Menec (2003), suggest that interaction and communication are the most important social needs of the elderly. Interaction can be seen as happening privately (e.g. visiting or seeing family), or publicly (e.g. visiting friends or taking active part in social groups). Communication focuses on staying in touch and involves activities such as talking with family and friends. Taking quality of life into account, studies such as Gabriel and Bowling (2004), and Borglin et al., (2005), have argued that good social relationships and access to significant relations are principal contributing factors to a higher quality of life. We therefore determine that communication and interaction form the basis to a higher quality of life.

System Design

The advances made with virtual technology now provide a powerful infrastructure that could be utilized for solving problems in the real world. So indeed, as Ciolfi (2004) states, we now have the potential to influence many

aspects of our lives by modifying the spaces we inhabit, creating new places or new forms of presence, and making physical presence itself an interactive interface. Damer and Bruckman (1996), also agree that virtual worlds present a new innovative frontier because users are able to navigate through digital spaces, communicate with other users, build structures, teach, learn, and engage in a variety of other collaborative activities.

This presents a number of opportunities for the elderly in an integrated fashion. As such, 3D virtual worlds provide the platform and tools for designing an environment that supports the social needs of the elderly, specifically communication and interaction. Nevertheless, the question remains as to how we can use virtual technology to solve real-world problems. In particular, how can we use 3D virtual worlds to support the social needs of the elderly? To answer the question, we need to take into consideration the specific functionalities of our system that are able to provide support for communication and interaction. Therefore in this section we look at some of the functionalities that our system will provide, with particular focus on the interface.

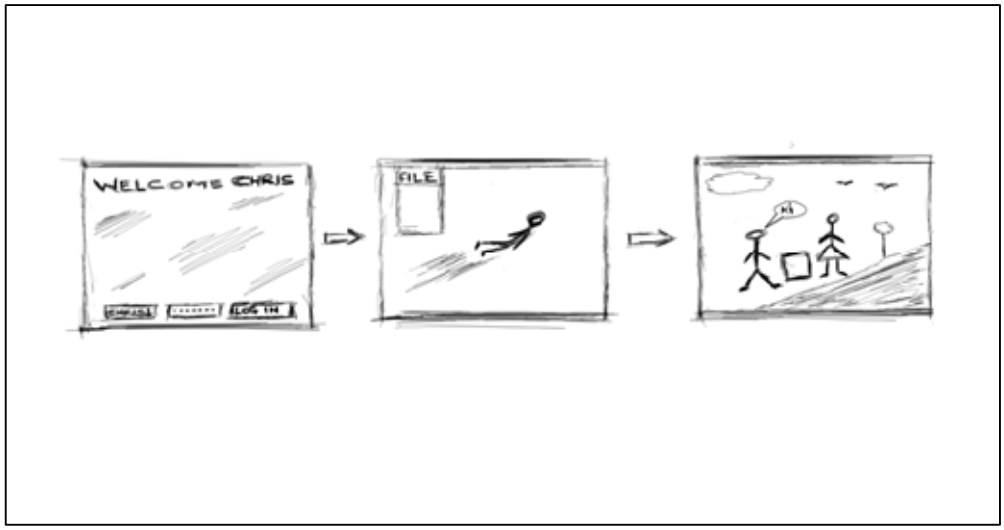

Figure 1 A Sketch of the interface showing the login screen, navigation, communication, and interaction

The graphical layer with which a user could interact with our system will be a 3D web browser with the avatar as the center of the virtual world it leads to. As depicted in the sketch in Figure 1 above, this layer will take care of entering the system (log in), navigation, communication, and interaction. For our model, startup or entering the system represents the initialization of the system and the activation of functions that the user can perform. In other words, once the user has logged into the system, he or she has a range of options to use the functionalities of our system. We now look at a couple of these.

Avatar Control: The avatar represents self (see: Ciolfi, 2004), autonomy, and navigation. The physics function (controlled by the physics engine) in our system plays an important role in defining the user's believability and image of self. Physics defines the line between what the user wants to do as the controller of an avatar, and what the avatar must do as a physical object in a simulated world. The balance helps define the user experience.

Input Control: The user has the option of using command buttons and menu items on the screen in order to navigate virtual space. In addition to this, our system will offer a handful of gestures and the option for text and voice command input (natural language). We also envisage gaze as a function of input.

Movement and Navigation: The primary mode of movement within virtual space is walking. However, for quicker navigation from one location to the other, users are able to run, fly, and even teleport.

Body Language: When the walk function is used, there are a number of other associated functions that our system will use to aid interaction and communication. For instance:

a. During chat, an avatar can move up to another and face it, expressing attentiveness or interest.
b. An avatar may not face the other during chat showing inattentiveness or aloofness. An alternative may be to turn completely in the opposite direction of the other avatar.
c. Avatars chatting may face the same direction and share the same scene, expressing for example, companionship.

Cinematography: In as much as the center of a virtual world is the avatar, user experience does not only rely on the avatar. The environment is as important and the cameras and captured scenery bring this to life. Camera angles in our system will therefore represent important functions which enable various views such as looking up or looking down during interaction or communicating with another avatar.

Functional: The system will connect two or more users together in the same space allowing them to see each other, communicate, and interact, regardless of the time and place of the individual participants.

Data: The system will be cross platform and portable, requiring no installation.

Environmental: The system will be physically distributed over a local area and also a wide area. There should be a capability to share files and other electronic media including streaming hosted content and accessing internet-based content. The system will comply with available communication protocols and be compatible with network technologies.

User: The target user-group is the elderly with varying physical and cognitive abilities, who need to be able to stay in touch with their family and friends over long distances, or even interact with family members or friends within the same location.

Usability: The system will not need any technical configurations such as installations before use. It will support a number of input devices which do not rely on physical ability.

Interactive Scenario

Chris is an active 74 year old who lives alone. He is a bit frail, but nevertheless he has been a lifelong social worker and continues to volunteer for his local charity a few weekdays within the month. This keeps him busy. But today is Saturday and he'll spend the rest of the weekend at home. He is very excited about this. He heads to his media room and logs on to the computer. An application fills his large screen display mounted on the wall. He picks up a remote control and begins to scroll through some names. He presses a button and selects "Max". A voice sounds through the speakers. It's Max, Chris' friend, saying hello. Chris chooses to activate voice chat too.

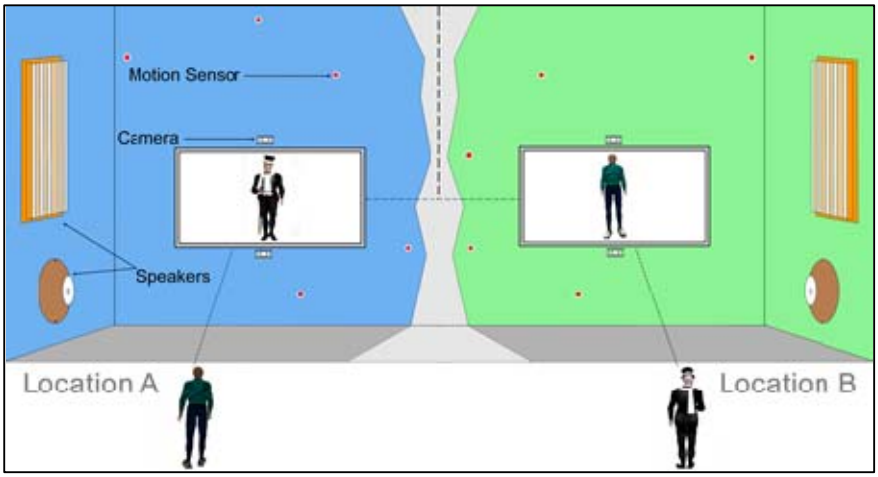

Figure 2 An abstraction of Max and Chris using our system based on a 3D virtual world

The display now shows the avatars of the both of them. Max asks for John, Chris' grandson who's away at University. Chris glances over to the right of his screen and informs Max that John is actually online too. He proceeds to tell Max that John sent some photos of his new haircut the previous week. He points the remote, chooses the 'photos folder' from his application inventory, and drags a file unto Max's avatar. Max says thanks via the speakers. Max adds that John grew a lot taller since the last time they saw each other. There is a popup message on Chris' screen. "Can I join you Grandpa?" the message reads from John. Chris excuses himself for a few seconds to press the response button on the remote.

There are now three avatars on Chris' screen. John uses motion gestures to wave to both Max and Chris. Max waves back but apologizes that he has to leave. Chris and John say goodbye to him. In a few moments Max disappears off-screen. John wants his grandpa to see his certificate from a recent organ course. A dialog box appears on Chris' screen. He pushes a button on the remote control and a file opens on screen. Chris mentions to John that he'll have to sit to read. He puts the remote down and heads off to the sofa. John then tells his grandpa that he has to leave and will return a bit later. He disappears off-screen. Chris issues a voice command that shuts the application down. He is content to have been able to mingle with Max and John even though they are quite a while away.

Architecture

Based on client-server architecture, our 3D virtual platform will be hosted on the Open Simulator server and accessible via a 3D viewer client which is cross platform and requires no installation. The Open Simulator server is a component of a dedicated server environment which will provide an option for users to be able to manage various account related details such as a user profile, online. Without much technical knowledge, the elderly will be able to use a web browser to setup an account by simply selecting an avatar and setting a name for it. Additionally an email and database server will also be hosted as components of the dedicated server, both handling communications and data persistence respectively.

In designing our system we make a few assumptions that should be noted. Multiple end-users are able to use our system from different locations. This assumes at least two users with some distance between them. Also, we assume real-time coordination, but not necessarily the same time zone. We envision at least two scenarios of use. One is between the elderly and their family in the same location, but in different rooms. We do this to capture situations in modern

households where the aged are normally living in a separate room or section, and do not necessarily move about the rest of the house. The other scenario is between the elderly and family or friends over long distances.

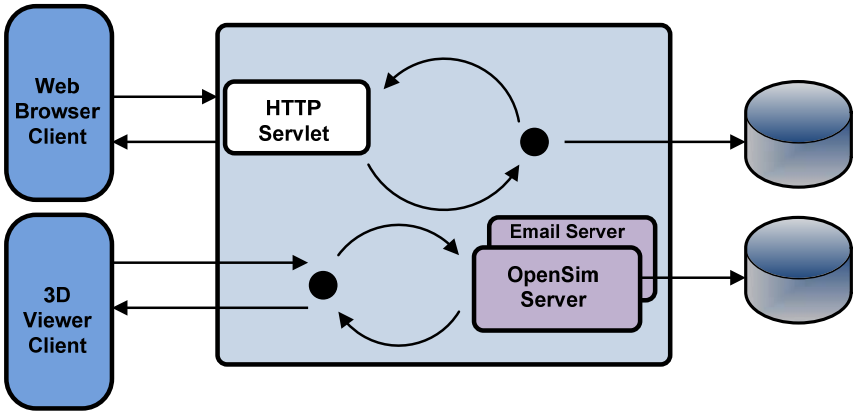

Figure 3 Top-level view of the architecture of our system which is based on a 3D virtual platform

We have also designed our system to be highly accessible. To do so, we employ the use of an eye-tracker device that can be used to navigate virtual space. Further, we replace the traditional mouse with an ergonomically designed remote control taking the different abilities of the elderly into account, and therefore usability. A microphone is the final input device in our system setup. It will be used for voice chats, issuing voice commands to the system, as well as for interacting with the application itself. Our output devices consist of a large screen display, speakers, and headsets.

Conclusion and Outlook

Advances in virtual technology have provided a powerful infrastructure that can be utilized for solving real world problems. In our study, we take advantage of the opportunity by designing a system based on 3D virtual technology to be used by the elderly to support their social needs. In parallel to our work, we examine how 3D virtual worlds can provide support for the social network of the elderly.

With foresight, it is our intent to understand how virtual technology can help improve the quality of life of the elderly. That said, it is therefore not our intention to merge realities, but rather to bridge them in order to provide opportunities for the elderly. In the end, we hope to have given considerable thought to both physical and virtual reality, and go a step further to use our desire for a continuum as the basis for understanding how both can function together.

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