Using Virtual Reality to Provide Nutritional Support to HIV+ Women

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Abstract

South Africa has one of the highest rates of HIV infection in the world. Health sector resources are limited and novel approaches to providing timely, accurate information are vital. Nutritional support and care has been recognized as an important aspect of HIV care. We developed a prototype virtual environment (VE) to provide nutritional information, and tested it at a government clinic in Cape Town, South Africa. 9 HIV+ women explored the VE and were interviewed after their experience. Despite the sample's low computer literacy, the system was found to be usable and enjoyable. The information provided by the system was rated highly for quality by the test group, although the amount was found to be lacking. In general, it seems that the system will be a useful adjunct to peer support groups as a way to disseminate relevant medical knowledge.

1. Introduction

South Africa currently has the largest living population of HIV positive individuals in the world [1]. This, combined with the limited resources of a developing world economy, presents significant challenges for the South African health sector. In particular, the shortage of qualified medical personnel to deliver care and accurate information is of concern. In 1993, the World Health Organization [2] reported that South Africa had 1640 persons per physician (contrast that figure with 370 for Germany, 630 for the USA, 719 for Albania and 1001 for Mexico). Therefore, the development of methods to extend the reach of health care professionals is a major research interest.

Due to a number of socio-economical factors, computer literacy in many South African communities is low. We are interested in investigating whether virtual reality (VR) is an effective information dissemination technology for individuals with minimal (if any) prior computing experience.

This paper reports on a prototype system designed to provide primarily nutritional and some social support to HIV positive patients (specifically pregnant women). The prototype system was deployed on a desktop PC, and input to the system was through minimal keyboard and mouse usage.

We report on an initial trial of the system, which took place at a government clinic in Cape Town, South Africa. The purpose of this system is to provide a widely accessible source of accurate information, while reducing the need for fixed facilities and highly trained medical staff.

1.1. Previous work

The use of virtual environment (VE) systems in health care has had some success in the past. For example, *Breast Cancer Lighthouse* [3], designed to provide support for cancer patients, makes use of a spatial experience as a metaphor to structure its content. Similarly, Hamza *et al* [4] used a virtual woodland campfire storytelling space to structure social support information, which consisted of personal narratives based on experiences of receiving an HIV positive diagnosis. Unlike pure information or multimedia systems, such as CHESS [5], these systems attempt to deliver information while making the interface as transparent as possible. This is of course highly desirable for populations with low literacy and computer literacy rates. Our prototype follows this pattern of using a VE to deliver health care information and social support.

1.2. Focus on nutritional support and care for HIV+ pregnant women

An HIV diagnosis often implies changes in most aspects of a patient's life. For our prototype, we decided to provide a basic structure which could be expanded to include information on many aspects of everyday life, but focused on nutritional information for the present. This information can have a significant impact on HIV prognosis (see for example [6, 7, 8]); also, dietary habits can be relatively easily influenced by the presentation of new information, and thus present a good opportunity for the system to make an impact.

For this trial, we focused on pregnant women for a number of reasons. Firstly, HIV status, due to social stigma, is usually kept secret; therefore finding volunteers can be difficult. Many HIV positive pregnant women, however, attend support groups, and are thus an accessible population of HIV positive participants. Secondly, young pregnant women are highly over-represented in HIV positive populations (in South Africa, about 30% of all pregnant women are HIV positive [1]), making the development of support tools for this group an important goal.

2. Description of the Virtual Environment

The VE's design was based on a South African council house, placing emphasis on creating an environment that

users could recognize find familiar. Table Mountain is a familiar site in most Cape Town suburbs; we therefore used panoramic photographs incorporating the mountain to texture the VE skybox (Figure 1).

Figure 1: The skybox outside the house shows Table Mountain, providing a familiar context for the VE.

The house contains four rooms, in which information is presented in its context in the home. In the proposed completed system, each room will contain information and interactions relevant to the activities that occur in it. For the prototype, two of these rooms contain virtual actors and points of possible interaction: the lounge and the kitchen. The actors communicate with speech (recorded from voice actors to represent a cross-section of local accents) and body gestures. Three of the voice actors were photographed to provide textures for the virtual actors. Background sounds were used outside the house (quiet neighborhood sounds such as chirping crickets and traffic hum), and in the kitchen (water running from the tap when applicable).

2.1. Introduction and Lounge Interactions

Figure 2: Andile welcomes the user to his home. This is the first actor the user sees.

The user starts her VR experience outside the house and is greeted by an actor named "Andile" (Figure 2). When the user has crossed a trigger positioned near the front door of the house, Andile walks inside and encourages the user to follow him.

When the user enters the house she meets two other actors. Andile joins the others in the lounge who are all meeting in a casual support group (Figure 3). The user can listen to their discussions about their HIV experiences.

This scene serves as an introduction to the house and to the characters, and by the sharing of personal HIV stories, provides some social support [4]. After the introduction in the lounge, the user is encouraged to move into the kitchen to learn about nutrition.

Figure 3: Each of the three actors in the lounge tells something about their HIV history. This serves both as an introduction and provides social support.

2.2. Kitchen Interactions

An actor in the kitchen ('Sandi') introduces herself and explains the room's different points of interaction. Two areas are presented: the first presents the concept of food groups, and the second, presents concepts of cleanliness and hygiene in the home. The user is then free to interact in one of the two areas and may move freely between the two at any time.

2.2.1. Food Groups interaction At this site Sandi introduces the concept of food groups, each arranged in a labelled wooden bowl. The groups presented are "Fats & Oils", "Sugars", "Herbs", "Milk", "Energy", "Vitamins", "Proteins", "Fruits" and "Vegetables". Sandi then encourages the user to select one of the food groups to learn more about it (Figure 4). The user can select a food group by means of a cross-hair cursor.

2.2.2. Cleanliness and hygiene interaction At this site, Sandi explains the importance of keeping items in the house clean and sterile to minimize the risk of opportunistic infections. Three concepts are presented: "Clean Food", "Clean Stomach" and "Clean Water" (Figure 5). By selecting an icon, more information on that concept is provided.

Information presented in the kitchen was compiled primarily from *Positive Health*, a booklet written by Neil M. Orr [9]. Documents from the South African Health Department [10] and United Nations Food and Agriculture Organization (FAO) [11] were also used.

3. Method

We set out to explore the impact of our prototype and its possible benefits as well as identify areas for future development. The system was therefore deployed for an initial pre-trial at a local government clinic. This research is part of a larger study on the long term impact of the system.

Figure 4: Sandi introduces food groups. Each of the nine different food groups is in a bowl. Selecting a bowl provides more information about the group.

Figure 5: Concept of cleanliness and food safety. From left to right "Clean water", "Clean Food" and "Clean Stomach" presented at the sink in the kitchen.

3.1. Initial Trial

The trial was conducted at a Midwife Obstetric Unit (MOU) at a public hospital in Cape Town, South Africa. Permission was obtained from the hospital's Matron-in-Charge and the University of Cape Town ethics committee.

The hospital's head dietician approved the information content. Due to the stigmatization around HIV status, a great deal of care was taken in the recruitment of volunteers and confidentiality was of utmost importance.

3.1.1. Equipment & Venue The VE was displayed on a typical desktop PC. Subjects wore headphones and input was by means of mouse and keyboard. We anticipated that the participants' prior experience with computers would be limited (if any at all) and thus decided to use only one key for virtual walking. The mouse was used for directional control and to look around. The frame rates varied with scene complexity, ranging from 12 to 40 frames per second. A dedicated room, usually used by counsellors, was made available for the study. Additionally, a trained HIV counsellor was on-site and available to the participants for the entire duration of the study. During the participant's experience of the VE, a researcher was available to deal with any participant queries.

3.1.2. Participants 9 participants were recruited from a support group for HIV+ pregnant women, who attended the MOU weekly. The study was conducted over two weeks on four different afternoons. Generally, two participants were seen per afternoon at scheduled times.

3.1.3. Procedure Participants were first taken through a training VE, in which they became familiar with the controls. Prior computer experience of all participants was minimal, with most subjects never having used a computer before. The training VE thus served to make them more familiar with computers in general (i.e. the names of the peripherals), and make them comfortable with the controls and skills required to navigate in the VE. This training environment contained same basic house model used in the main VE and participants were given five tasks, similar to those given in the main VE. These tasks involved navigating through the house and selecting (using the mouse) specific items displayed in each of the four rooms.

When participants were finished training, they were asked whether they felt comfortable with the controls and were ready to experience the main VE. One participant chose to re-explore the training environment while all other subjects were comfortable enough to move onto the main VE. The training VE took 5 minutes on average and the mean time spent in the main VE was 28 minutes. All participants viewed all of the available information in the VE.

3.1.4. Interviews Directly after experiencing the VE, semi-structured interviews were conducted. These were voice-recorded and later transcribed. The interviews ranged from 12 to 15 minutes.

4. Results & Discussions

Our evaluation of the prototype system is based on the data acquired through the semi-structured interviews. From a qualitative content analysis of the interview transcripts, three main themes arose: quality of the content information,

ease of use of the system, and accessibility of the information through the VE interface.

4.1. Quality of information

Almost all of the participants (one exception) said they felt excited about the amount and quality of information presented by the system. All agreed that the information was useful to them – a majority said they learnt something new. One participant in particular said that the system highlighted for her how much she still needed to learn. All participants agreed that the information in the system would be of great help, and should be presented soon after an HIV+ diagnosis. There was some disagreement as to what the time frame should be. Two (of nine subjects) would have wanted to see the system immediately after diagnosis; while the other seven women stated they would prefer to have reached some degree of acceptance of their status before the system should be introduced.

4.2. Ease of use of the system

Half of the participants had used a computer before this study. Of those five, only two had used the internet, and only one had used it to search for information on HIV. However, all participants reported that the system was easy to use, although most expressed some anxiety at using or possibly damaging the equipment during the early phases of their experience. The ease of use is corroborated by the overall impressions given of the system. All participants found the system useful, and about half stated that they found it exciting. About the same number mentioned that they enjoyed the freedom afforded by walking around the VE and being able to choose the information they wanted.

4.3. Accessibility of information

The ease of use of the system suggested that the information was highly accessible to our target population. We asked participants if they would return on their own to use the system if it were deployed in clinics. Without exception, all participants responded that they would return to use the system if it were available. Interestingly, when asked if the system could replace the function of a peer-support group, most participants expressed that the system would make a good adjunct to a peer-support group, for providing more specific information. When asked if this type of information was difficult for them to find, most agreed that it was easy to get though their counselors. This suggests that in areas where counseling support is limited, the system may be particularly useful. In general, we found that while the interface presents no problem, the volume of information should be vastly increased – in the average 28 minute session, each participant selected and listened to all of the available information, and more than half specifically mentioned that they would like to see the amount and variety of information in the system increased.

5. Conclusions

We are greatly encouraged by the results of this initial trial. We feel that while the prototype requires expansion in terms of the amount the information presented, VR is an extremely useful and promising medium for our target population. Off-the-shelf hardware, which is affordable to both government agencies and NGOs, was used. Therefore the deployment of such a VE system in a number of clinics or mobile clinics is economically viable. Also, our interviews indicate that patients want and are able to make use of the system. So it is unlikely that the systems once deployed will lie idle. Also, due to the simplicity of the system, peers could train each other in its use, even in communities with low literacy and computer literacy rates. Although computing experience was minimal, all participants mentioned that they found the system easy to use and enjoyed their VR experience. Additionally, training time was minimal (5 minutes). This provides some evidence that VR can, and would be used in communities with low levels of computer literacy.

Indeed, the information presented by our system could conceivably be adapted to the needs of a narrow community of users by periodically interviewing them about their needs, and adding content as required. Our general conclusion is that, used together with peer support groups, our system could provide a very useful stopgap measure in the face of limited counselling resources.

The outstanding feature of this system is its potential to empower communities to deal with the HIV epidemic. The current shortage of medical staff and knowledge pose a problem since many people have little means for coping with the disease. However, by making high-quality information easily and widely available, the emphasis can shift from looking to a scarce group of outsiders to provide solutions, towards looking to one's peers to cope with the problems of living with HIV. Patients can not only exchange information, but, by teaching each other how to use the system, increase the flow of information from the medical community to the patient community.

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