Annual Review of Cybertherapy and Telemedicine

Volume 3 Year 2005 ISSN: 1554-8716

Interactive Media in Training and Therapeutic Intervention

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Critical Reviews

Motivational Training Tool to Promote Healthy Life Styles

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Abstract: *The aim of the project is to apply augmented-reality technology to teach motor skills to patients suffering from stroke. To achieve this goal the project adopts an innovative approach based on the use of so-called "motor imagery." Recent studies in neuroscience have provided converging evidence that "imagining" a motor action involves the same brain areas involved in performing the action. This supports the idea – already exploited by sports trainers – that training with motor imagery (mental practice) could be effective in learning new motor skills or in promoting motor recovery after damage to the central nervous system. Previous clinical studies have shown that the rehabilitation of post-stroke hemiplegic patients can be made more effective by combining physical practice with mental practice. However, for many patients who suffer from damage to the central nervous system, mental simulation of movements can be difficult, even when the relevant neural circuitry has not been injured. Starting from these premises, we have designed and developed an augmented-reality workbench (called "VR Mirror") to help post-stroke hemiplegic patients evoking motor images. First, the movement is acquired by the system from the healthy arm. Second, the movement is being mirrored and displayed so that the patient can observe and see as if the impaired arm is performing the movement. Third, the patient is instructed to rehearse in his/her imagination the movement he/she has just observed. Last, the patient has to perform the movement with the affected arm. In this article, we describe preliminary results of a pilot clinical study, which has evaluated the feasibility of using technology-supported mental simulation as an adjunct in the rehabilitation of the upper limb following stroke. DESIGN: Single-case study. SETTING: Physical Rehabilitation Unit of Padua Teaching Hospital, Padua, Italy. SUBJECTS: A 46-year-old man with stable motor deficit of the upper right limb following stroke. INTERVENTION: The patient underwent a single-case design, with four weeks intervention. The intervention consisted of 3 practice sessions per week at the hospital using the VR-Mirror, in addition to usual therapy (Bobath method). This intervention was followed by 1-month home-rehabilitation program using a portable device. MAIN OUTCOME MEASURES: The patient was evaluated for level of impairment and disability. Pre-treatment and post treatment measures included: the upper-extremity scale of the Fugl-Meyer Assessment of Sensorimotor Impairment and the Action Research Arm Test. RESULTS: The patient showed improvement in upper limb score as measured by the two scales. CONCLUSIONS: The improvement observed in the patient is encouraging and warrants further study.*

INTRODUCTION

One of the main challenges that developed societies face is the prevention of non-communicable diseases such as diabetes or obesity. These diseases are responsible for 60% of the registered global deaths and for 45% of the global burden of disease. A few, largely preventable, risk factors account for most of the world's disease burden. These are high cholesterol, high blood pressure, obesity, smoking and alcohol. Chronic diseases are the major cause of death and disability worldwide, and increasingly affect people from countries all over the world.[6]

Guidelines on diet, physical activity and health serve two important purposes: to guide policy makers and to educate consumers, about healthful lifestyles. In order to promote prevention and create motivation and adherence to the prevention programmes it is highly recommended to stress the importance of lifestyle-health relationship. And it is also essential to analyse in depth how to formulate these programmes and what the process and information they should convey. The strategies drafted by the international institutions competent in this matter stress the importance to increase the overall awareness and understanding of the influences of diet and physical activity on health and of the positive impact of preventive interventions.

The work presented in this paper contributes partially to solve this situation by using one of the most effective strategies: the prevention, through the procedure of education. In this sense, providing users with personalised information is key to be able to adhere them to the prevention strategy. More than that, the new healthcare delivery process models tend to be citizen/patient centred, that are respectful of the individual preferences, needs and values and place information and training at the heart of the healthcare delivery strategies.[2]

An interactive and visual tool based on virtual 3D technologies for the Internet,[5] using X3D, a powerful and extensible open file format standard for 3D visual effects, has been developed and integrated in an e-learning system that offers personalised information about healthy lifestyles.

MATERIALS AND METHODS

The tool implemented intends to give answers to the situation referred above by offering the users personalised information for their own self-care and moreover, motivating them to make use of this information and take control over their decisions regarding their lifestyle. Personalised information makes users more independent, makes them conscious of the possible results due to their behaviour and facilitates them to take care of their own health. In this sense, the development of a virtual reality tool helps to motivate the user and also improves the e-learning process.[1]

The main contribution of the implemented system is the delivery of personalised information in an adapted environment. This goal has been achieved by the integration of several technologies such as XML, native databases, X3D, VRML or JSP (Java Server Technology). These technologies have been chosen taking into account the interactive, portable, visual and integrative identified requirements for the tool. Furthermore, these technologies allow the possibility of introducing some kind of intelligence to the tool behind the interface in order to obtain a system that could respond to the individual user needs and preferences.

The complete process has been divided into four different stages. Therefore, in each step, a group of technologies has been selected to achieve the required functionalities for the whole system. These stages are: Profiling, Storage, Personalisation & Management. The next paragraphs describe these four stages:

The Profiling stage helps to acquire individual user information, to structure it and hence, to define what the user needs are. The system is designed to be accessed through the Internet. The registration and the questionnaires about nutritional, statistical, physical activity and motivational data have been developed with JSP. The goal of these questions is to define a user profile and to discover his motivation status according to the “States of Change” methodology.[3] The methodology sets the characteristics to be classified in each state of change and the motivational techniques to be used for citizens.

The Storage stage responds to the need of storing the user profiles and the information to be shown in the system. Each profile is stored as an XML file in the native database. The scenarios have been developed in X3D. This allows describing a virtual world in XML by means of predefined tags representing objects. The scenarios are virtual worlds that simulate the “real world” and daily activities. However, as the X3D plug-in was not compliant with the X3D standard at the development time, the display of the sessions is performed by using VRML (an X3D antecedent). Translations between the two languages are made by applying a style sheet to the X3D files in their XML format.

The Management stage is necessary in order to maintain the static information used by the system.

Finally, **the Personalisation** stage carries out the process of adapting the system to the users.

At the time the user profile is created or modified (either by the user or by the intelligence added to the system), the scenarios are personalised to meet the user preferences and are completed with the information that suits the user needs most and they are stored in the system. These tasks involve reading and writing XML files by means of a XML parser. It is used a SAX (Simple API for XML) parser because of its speed and straightforward features. Once the personalised worlds have been created, they are stored.

RESULTS

The tool implemented has been developed to present the following features:

- To offer personalised information in form and content
- To be visual and interactive
- To be integrated in an e-learning system

In this sense, a training activity in the system consists of an Internet multimedia session that shows personalised information by means of an attractive visual interface. The session starts by choosing the users a login and a password for identification and introducing their data. The user profiles are created the first time the user accesses the system by filling in a structured questionnaire about nutritional, statistical, motivational and physical exercise. Each group of questions has a specific objective: the statistical questions try to classify the users per age, gender, health status, ICT knowledge or profession. Nutritional questions try to enquire if the users are vegetarian or if it is common that they often eat out in order to prepare a customised diet. Motivational questions are related to the importance the users give to their self-care through the lifestyle adopted up to the moment or the intentions to incorporate healthier attitudes in the future (i.e., intention to lose weight, to practise any sport, etc).

In subsequent accesses the users must enter the login and password to be recognised by the system as registered users and this way, skipping the questionnaires and be led directly to the welcome page where they can choose either starting their training session or modifying their data.

The personalisation of the scenarios involves presenting different information (links, articles, recipes, sport videos, etc.) to each user profile. In order to perform the personalisation, the system accesses the database and extracts the model files stored in. The user session “world” is then created from this pattern and is filled in according to the user needs. Adapting the information includes not only the content but also the form (i.e. tone in which it is presented, ways in which the information is shown to the user). This depends strongly on the user motivation state[4] to follow advice and to adopt changes to a healthier lifestyle which was identified in the profiling stage. In this sense, only the relevant information in the appropriate mode (direct, indirect, soft, etc.) is delivered to the user through a scenario personalised accordingly (avatar, colours, links, etc.).

The database has been hierarchically structured in three collections (similar to directories): profiles, patterns and information. The most important is the first of them and it is due to be dynamically changed every time a new user accesses the system by storing the user profile and creating a user collection under it. In the user collection, called as the user login, the personalised scenarios are stored. In this way, if the user has not introduced any change in their data from the previous session, the system accesses the adapted scenarios and displays them to the user, thus, saving time and resources. The other collections, patterns and information, contain static data such as scenarios models or information to be shown to the user. The pattern collection stores the scenarios models files. Each of these files contains the common information, which is shared between all the users in a specific scenario, such as images or help links. The second collection (information) stores data related to health care in different modes, depending on the needs the user has. The corresponding information will be selected during the personalisation stage depending on the user needs and motivation.

The files stored in these collections can be modified by the administrator in order to improve the system quality, by adding new information or modifying the existing one; adding new features to the scenarios or readapting the ones stored in previous sessions. It is important to notice that changes to the data and scenarios will not affect the users due to the models usage to generate the personalised worlds. In this way, the next session the users establish with the system, the scenarios ("worlds") shown to them will include the changes performed and the new added or modified information if it is relevant to them.

The tool is completely developed and personalization features are included, a process we started working together with healthcare professionals. Different users´ profiles have been identified.

The tool has been tested with a number of users to check whether the tool and the information provided suited the users' needs. A survey was handed out for completion after the first training session in order to measure their satisfaction with the system. The survey is structured in different parts which are related to the adaptability of the contents, the appropriateness of the relation between the scenarios and the information showed in each of them, the choice of Virtual Reality as the interface and the usability of the global tool. Statistical data were also collected, such as the age, the job or the computer knowledge level.

The results of the survey indicate that Virtual Reality is an unknown technology yet although it presents high potential for the implementation of e-learning systems. Elderly people value it quite negatively opposed to the students and technical professionals. A similar answer is also given to the usability of the global tool due to the strong dependence this aspect has with the ability of handling Virtual Reality. However, the users state that the relation between the scenarios developed and the information provided in each of them was tailored to their needs and the contents were marked as a good educational tool to adopt a healthy lifestyle.

CONCLUSIONS

An interactive and visual tool has been developed and integrated in an e-learning system that offers personalised information about healthy lifestyles. We consider that this is a very interesting research line due to the increase of e-learning systems and the importance of having access to quality information related to health. Joining both in the same system provides citizens with a way to obtain information to possible them to be responsible for their own health. People should have better access to trusted sources for the information they need, tailored to their individual requirements. In this way, the implemented tool goes further by adding a motivational feature with the aim of making users feel taking control of their own self-care.

To conclude, the tool developed provides certified information and achieves personalisation by considering different dimensions of people's lifestyle and filtering the information according to:

- Who the user is: a Healthcare professional, a Citizen, etc.
- What the user needs: different information or services the user may need
- Where the user is: considering different scenarios, including "on the move"
- How the user needs the service: considering different type of devices

However, the tool has strong requirements to perform in an acceptable way. In this sense, it may be a solution to try to adopt more dynamic software in order to be able to include it in other devices such as mobile phones or PDAs that facilitate the information access in active lifestyles.

ACKNOWLEDGMENTS

We appreciate the information provided by Dr. Claudia Duarte and Joy Ngo de la Cruz from GRNC (Group de Reçerca de Nutrició Comunitaria) for their time and advice to make our system more complete and qualified.

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