

Continuous Presence in Collaborative Virtual Environments: Towards the Evaluation of a Hybrid Avatar-Agent Model for User Representation

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Abstract

This paper is concerned with the evaluation of user embodiments in educational collaborative virtual environments by exploring an important aspect of interaction in virtual environments, namely the degree of 'presence' experienced by participants. Firstly, the influence of different avatar styles is examined using a specially designed prototype virtual art gallery. The choice of experimental procedure, together with analysis and interpretation of the results are presented and discussed. A second possible factor influencing presence, namely the continuous representation of users is examined within the same prototype environment, but this time using a hybrid avatar-agent model featuring an animated conversational agent to control the avatar during absence of its underlying user. A forthcoming set of experiments to evaluate the effect of such an agent on users' experience of presence are described, and the consequences of increasing presence in a collaborative virtual environment, particularly in respect of possible benefits within a virtual learning environment, are discussed.

Keywords

Collaborative virtual learning environments, avatar styles, hybrid avatar-agent model, continuous presence

Introduction and Rationale

The user-computer interface has undergone many changes, from the textual interfaces of the 70's to graphical interfaces in the 80's, from incorporation of multimedia elements in the 90's to current work in portraying sophisticated virtual environments. At the same time, systems have evolved from being single-user oriented to sophisticated collaborative multi-user systems. As a result, traditional HCI (Human Computer Interaction) guidelines are limited in their applicability for the design of such systems and are consequently unlikely to address the full range of aspects now inherent in these virtual environments.

Further, there are currently no evaluation methods specific to collaborative virtual environments (CVEs), and differences between virtual environments and conventional interfaces are not fully understood (Kaur *et al* 1998). Consequently, defining an evaluation methodology is complex but it can at least be argued that the specific diet of evaluation techniques needed depends on the characteristics of the system to be evaluated as well as on the purpose of the evaluation itself (Tromp and Benford 1996). Whilst the experimental design and the evaluation of the experiment

described in this paper are founded on general HCI usability principles, it is argued that the approach adopted nevertheless forms a unique approach to CVE usability evaluation.

The factor that allegedly distinguishes CVE technology is the sense of immediacy and control created by presence: the feeling of 'being there' (Psotka 1995). It is this factor, therefore, which will be addressed via the evaluation approach just discussed. The term *presence* as used in this context is understood as the possible result of the process of cognitive immersion, and is not to be confused with *virtual presence*, which is simply the deployment of avatars within CVEs. *Presence* may be felt in varying degrees (including no feeling of presence) and may or may not be caused by the use of avatars.

An avatar is '*the representation of a user's identity within a multi-user computer environment; a proxy for the purposes of simplifying and facilitating the process of inter-human communication in a virtual world*' (Gerhard and Moore 1998). The use of avatars potentially entails several useful properties within a virtual environment, in particular identity, presence, subordination, authority, and social facilitation. Avatars may provide a way for other users to better understand the actual or assumed persona of the underlying user. They may help establish a feeling of presence within a multi-user virtual environment. They may imply subordination, being under the direct control of the user, without significant control over their own actions and internal state. Avatars may also facilitate social encounters in the virtual world and may imply to others that they are acting with the authority of the underlying user.

Based on a review of existing CVE applications and literature, a theoretical framework for understanding the relevance of user embodiments within a CVE for education was expounded by Gerhard et al (2001). They argue that presence is an important and desirable characteristic for virtual environments, particularly virtual learning environments, and propose that the nature of the avatars involved could be a contributory factor in the degree of presence engendered. In order to explore this hypothesis the series of experiments described below was conducted using a variety of avatar styles.

Presence Measures

The usability of an interface is defined as a measure of the ease with which a system can be learned or used, its effectiveness and efficiency, and the attitude of its users towards it (Preece et al 1994). The main difficulty with CVE usability evaluation is the fact that CVEs are founded on very recent technology and only prototypes of truly collaborative, 3-dimensional virtual learning environments currently exist.

Based on the degree of involvement that has already been observed within full-immersion Virtual Reality systems, Bricken and Byrne (1993) propose that an obvious benefit of presence in educational CVEs will be that it leads to a greater degree of engagement and excitement on the part of the learners. Considering presence as a result of cognitive and social immersion to be the *prima facie* 'key added value', researchers have, however, only just begun to analyse the nature of presence, what cognitive variables are connected to presence, how presence is generated in multi-user VEs, and what its benefits for education and training might be. Further, as presence characterises the response of participants to the system, it is seen as an obvious choice for the key variable in the usability evaluation process of CVEs. Indeed, presence has been used before as the basis for predicting performance in, and potential benefits of, new learning systems in Sheridan (1992), and Held and Durlach (1992).

Measuring presence is not a trivial task, however. Asking questions that measure only the subject's perception of the technology that contributes to immersion can easily be confused with actually measuring a subject's feeling of 'being there', or their behavioural responses to events in

the VE. The vast majority of evaluation studies measure presence through questionnaires in an attempt to elicit subjective feelings of presence (Slater and Usoh 1994).

There have been some suggestions for more objective measurement of presence. For example, Sheridan (1992) was concerned with whether subjects duck, blink or carry out other involuntary movements in response to a sudden event. However, there are problems in attempting to infer the effects of the deployment of avatars in web-based, multi-user virtual environments through such a simplistic mechanism. For example, an involuntary response might also be caused by a sudden loud noise without implying or correlating with a feeling of presence by the user at that time.

The most suitable approach to the measurement of presence is heavily debated among researchers (Slater 1999; Witmer and Singer 1999). Within the current experiment the approach to measuring presence largely followed the methodology of Witmer and Singer (1998) who argue that *involvement* and *immersion* are both necessary for experiencing presence. Whereas *involvement* is defined as a psychological state experienced as a consequence of focusing one's attention on a coherent set of stimuli, *immersion* is a psychological state characterised by perceiving oneself to be in an environment of continuous stimuli and experiences.

However, as these presence measures apply only to single-user virtual environments, extended presence measures, namely *awareness* and *communication*, are needed to cover issues specific to multi-user collaborative virtual environments. All four measures (involvement, immersion, awareness and communication) were therefore used in the current research. Furthermore, it has been argued that measuring presence makes sense only when speaking about the degree of presence in one virtual environment setting relative to another (Slater *et al* 1996), since presence cannot be measured in absolute quantities. The current research acknowledges this and therefore populates the same world model with different types of user embodiments, thus enabling comparative measurement of presence and hence a meaningful evaluation.

Experimental Study

The experimental study aimed to find out whether the appearance of avatars influences the level of presence. To assess this, three types of user representation were constructed: basic shapes, animated cartoon-style avatars, and animated humanoid avatars. The basic shape avatars (Figure 1) were created in VRML, the animated cartoon-style avatars (Figure 2) were created by Avatara (www.avatara.com), and the animated humanoid avatars (Figure 3) were created by Cybertown (www.cybertown.com)

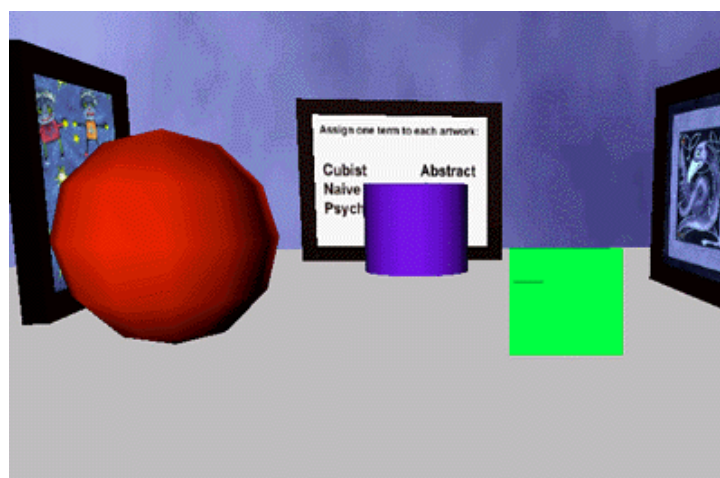


Figure 1: Avatar style – Shape



Figure 2: Avatar style – Cartoon



Figure 3: Avatar style – Humanoid

The implementation of the experiment was fully Web-based. Pre- and post-questionnaires relating to the experience within the virtual art gallery were implemented as CGI/Perl online forms to be submitted by subjects electronically. The virtual gallery model was implemented in VRML and comprised only basic shapes for defining the geometry of the room and the picture frames. The *blaxxun Virtual World Platform* community server (see www.blaxxun.com) was used to make the virtual gallery accessible on a Web server and enable avatar and chat interaction. The *Blaxxun Contact* VRML browser was used on the client side. Terminals to access the system were provided at locations within Leeds Metropolitan University and Axis premises.

Image	Style	Title	Artist Name
	Naive	Silver Haired Children	Mandy Wrightson
	Celtic	Lyre Bird	Christina Scurr
	Surreal	Fantastic Mr Fox	Tomas Lewis
	Psychedelic	Blue Moon Over Marrakesh	Johnny McGuinness

Figure 4: Example Exhibited Artworks from the Axis Database

A collaborative task was given to subjects, designed to stimulate interaction and communication. The task involved identifying the art style of a number of contemporary artworks. To simplify the task and to aid subjects without expert knowledge in the visual arts, participants were provided with a list of six different styles to select from - Cubist, Abstract, Naïve, Celtic, Psychedelic, Surreal. Their task was unanimously and collaboratively, as a group, to assign the most appropriate style to each of four artworks with which they were presented (see Figure 4 for a typical example). Since the group had to agree on one joint decision, the task was collaborative in nature.

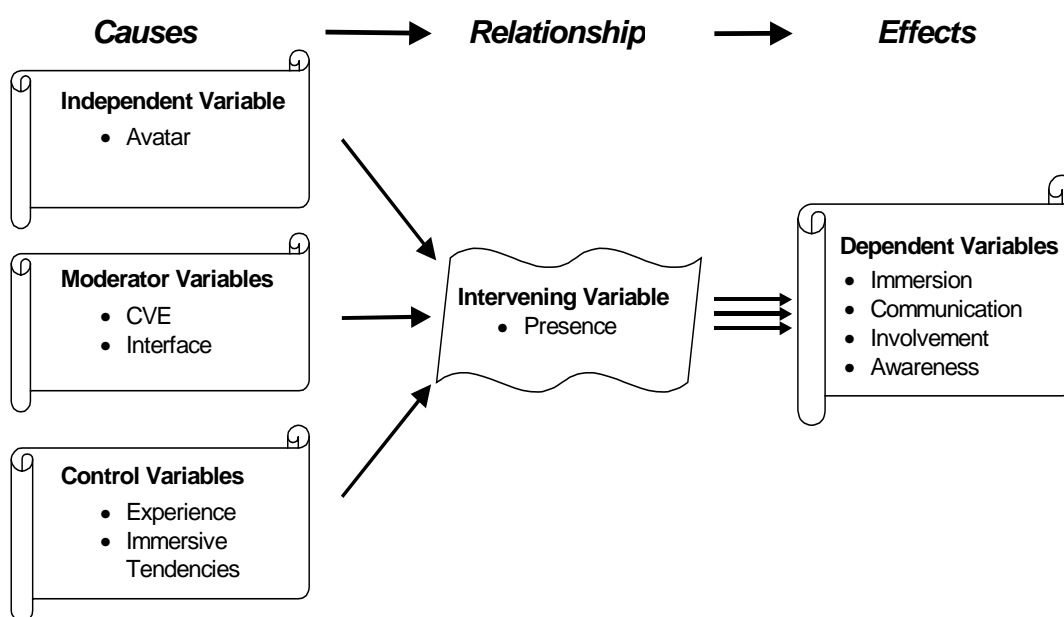


Figure 5: Combined Variables

Twenty seven subjects took part; their scores of the pre-experiment questionnaires, measuring subjects' experience (EXP) and individual immersive tendencies (IMT) (see figure 6), being used to divide them into three matched groups of three subjects each that were then randomly assigned the three avatar styles. To reduce the effects of *maturation* (rehearsal effect), a between-group design was utilised; the experimental design being shown in Figure 5.

Pre-Experiment Questionnaire		Sub-scale
1.	How experienced with using computers do you rate yourself?	EXP
2.	How experienced with Internet chat systems do you rate yourself?	EXP
3.	How experienced with the use of 3D multi-user virtual worlds do you rate yourself?	EXP
4.	How experienced with contemporary visual art do you rate yourself?	EXP
5.	Do you become so involved in a book, television program or movie that people have problems getting your attention?	IMT
6.	Do you become so involved in a book, television program or movie that you are not aware of things happening around you?	IMT
7.	Do you find yourself closely identifying with the characters in the story line of a book, television program or movie?	IMT
8.	How good are you at blocking out external distractions when you concentrate on a task?	IMT
9.	When watching sports, do you ever become so involved in the game that you react as if you were one of the players?	IMT
10.	Do you ever become so involved in doing something that you lose all track of time?	IMT
11.	Do you ever become so involved in a daydream that you are not aware of things happening around you?	IMT
12.	Have you ever got excited/scared by something happening in a movie?	IMT
13.	Are you easily distracted when involved in an activity?	IMT
14.	When reading a good book or watching a good movie, do you feel the emotions of the story such as sadness, fear, or joy?	IMT

Figure 6: Pre-Questionnaire

The post-questionnaire employed attitude statements with Likert-scales as well as open-ended questions to reveal attitudes, beliefs and experiences of subjects (Silverman 1993). These questions aimed to measure the degree to which aspects of the virtual environment engendered a sense of presence.

The questionnaire collected data regarding the dependent variables of immersion (IMM), communication (COM), involvement (INV) and awareness (AWA), and also covered the moderator variables relating to the nature of the environment itself (CVE) together with its user interface (INF) (see figure 7).

Post-Experiment Questionnaire		Sub-scale
0.	Beside you, how many persons were in the virtual gallery?	Qualitative
1.	How stimulating was the design of the virtual world?	CVE
2.	How natural was the mechanism, which controlled the actions of your avatar?	INF
3.	How responsive were the avatars of other participants to verbal communication that you initiated?	COM
4.	How responsive were the avatars of other participants to non-verbal communication that you initiated?	COM
5.	How natural did your communication with other participants seem?	COM
6.	How compelling was your sense of being present in a virtual world?	IMM
7.	How compelling was your sense of other participants being present?	IMM
8.	How credible were the avatars of other participants with respect to representing human beings?	AVA
9.	How aware were you of the existence of your own avatar?	AWN
10.	How easy was it to distinguish between the avatars of different participants?	AVA
11.	How easy was it to control your avatar?	INF
12.	How well could you concentrate on communication and the assigned task rather than on the mechanisms used to perform these?	INF
13.	Were you involved in communication and the experimental task to the extent that you lost track of time?	IVM
14.	To what extent did events occurring outside the virtual gallery distract from your experience in the virtual environment?	IVM (rev)
15.	I was immediately aware of the existence of other participants.	AWN
16.	I was an active participant in the meeting.	IVM
17.	I was aware of the actions of other participants.	AWN
18.	I enjoyed the virtual gallery experience.	IVM
19.	My senses were completely engaged during the experience.	IMM
20.	Was it difficult to find a unanimous decision within the group? Did you experience any other difficulties during the experiment? (Please explain.)	Qualitative
21.	Did you notice others using means of non-verbal communication, such as gestures? Do you consider them useful in this setting? (Please explain.)	Qualitative
22.	Do you think the deployment and appearance of avatars was significant for the virtual gallery experience? (Please explain your answer.)	Qualitative
23.	Do you have any other comments on this experiment?	Qualitative

Figure 7: Post-Questionnaire

Experimental Results and Analysis

Figures 8 and 9 summarise the data from the experimental study. Results showed that the effects of avatars on presence differed significantly overall ($F_{2,24}=26.155$, $p<0.0005$) between the three groups. Further analysis indicated that the degree of presence was significantly higher when deploying cartoon-style avatars as opposed to basic shape avatars ($p < 0.0005$). Similarly, the degree of presence was found to be significantly higher when deploying humanoid avatars as opposed to basic shape avatars ($p < 0.0005$). In contrast, the degree of presence was not significantly different between the use of humanoid avatars as opposed to cartoon-style avatars.

These findings were supported by the data collected from subjects by the questionnaire, particularly the open questions. Subjects with cartoon-style and humanoid avatars displayed a more positive general attitude towards the experiment and answered in much more detail than those with basic avatars. Furthermore, when directly questioned about avatars their answers were more positive and described the avatars as *amusing*, *realistic*, *funny*, *adding to the experience*, *interesting*, or *excellent*. On the other hand, basic avatars were in some cases not recognised as virtual bodies at all and in other cases were referred to as *very poor*, *could be better*, *extremely simple*, or *could be improved*.

Overall, the results of this study show that different avatar styles do influence presence to different degrees, in particular that animated cartoon-style or humanoid avatars promote more presence than basic shape avatars. Further, the former gave rise to sufficiently high scores on the presence scale to strongly suggest that the deployment of such animated avatars does indeed engender a feeling of presence. Additional evidence for this was provided by qualitative data obtained during the experiment and suggested a consequential benefit to the perceived experience within the virtual environment. Thus the experiment succeeded in finding empirical evidence for the benefits of some styles of avatars through measuring the cognitive variable of presence. This evaluation technique will therefore be used again in evaluating the concept of a hybrid avatar/agent model for user representation in educational CVEs, which is the focus of forthcoming experimental work by the authors.

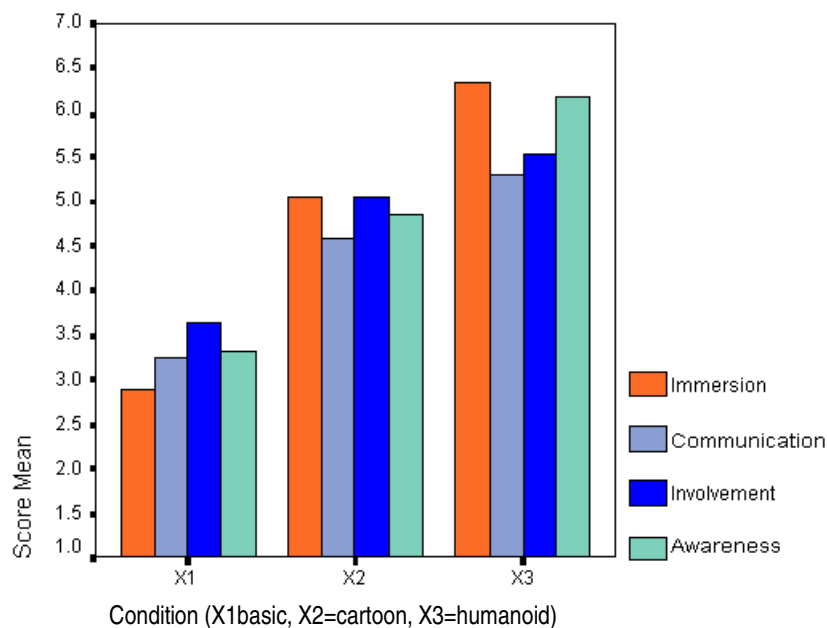


Figure 8: Subscale Scores

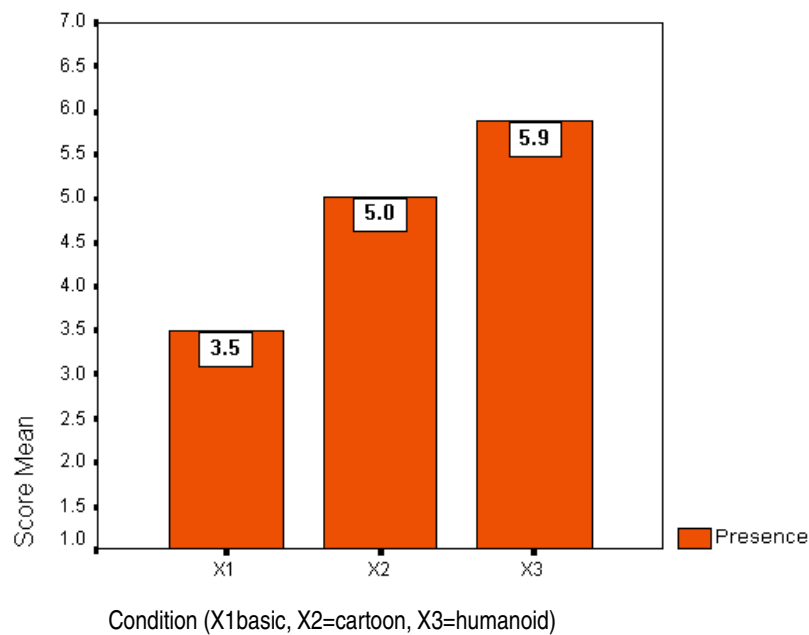


Figure 9: Presence Scores

Overall, the statistical results of this study strongly suggest that the deployment of animated avatars improves the CVE experience of subjects with respect to presence; that is, animated cartoon-style or humanoid avatars cause more presence than basic shape avatars. It is reassuring that these statistical findings were supported by the qualitative data from the questionnaires.

Thus, this experiment has succeeded in not only evaluating the use of avatars in CVEs, but also in finding empirical evidence for the benefits of animated avatars by measuring the cognitive variable known as presence. Evidence was found for the hypothesis that the deployment of animated, cartoon-style or humanoid avatars improves the virtual experience of participants as compared to those represented by basic avatars. Thus, the results of this study strongly recommend employing animated avatars in the design of future educational CVEs.

Further, it can be argued that in a situation of time-independent collaborative learning a continuous presence of all participants is desirable. When members of a group are not co-present, there is a lack of community feeling (Huxor 1998). A continuous presence of all participants may be achieved using agent technology to control the avatar when the underlying user is not present (Gerhard and Moore 1998). Thus, the success of the current experimental design and evaluation approach is seen as a stepping stone towards evaluating the notion of a continuous presence achievable by a hybrid avatar/agent model, the goal of a forthcoming experiment involving intelligent agents for delivering 'presence-in-absence'.

Agents for Collaborative Virtual Environments

Over recent years there has been significant progress in techniques for creating software agents. Such agents are meant to carry out tasks for the user in complex, dynamic environments and serve as another layer of mediation within the system (Maes 1995). Agents can be pro-active and purposeful; they can exercise control over their own actions to a certain predefined degree. Agents can have a believable personality and emotional state. They can communicate with other agents and humans. By applying artificial intelligence paradigms such as expert systems, neural

networks, and genetic algorithms, agents can be adaptive and capable of learning. Instead of pre-ordained scripted actions their behaviour can be based on their previous experience.

Pedagogical agents inhabit educational CVEs where they appear as animated characters. They share aspects in common with synthetic agents developed for entertainment applications (Elliot and Brzezinski 1998): they need to be believable and to be able to produce natural and appropriate behaviour. Steve (Soar Training Expert for Virtual Environments) is designed to interact with students in networked immersive virtual environments, and has been applied to naval training tasks such as operating the engines aboard US Navy surface ships (Rickel and Johnson 1999). Steve (see figure 10) inhabits a virtual learning environment and functions as a tutor and collaborator.

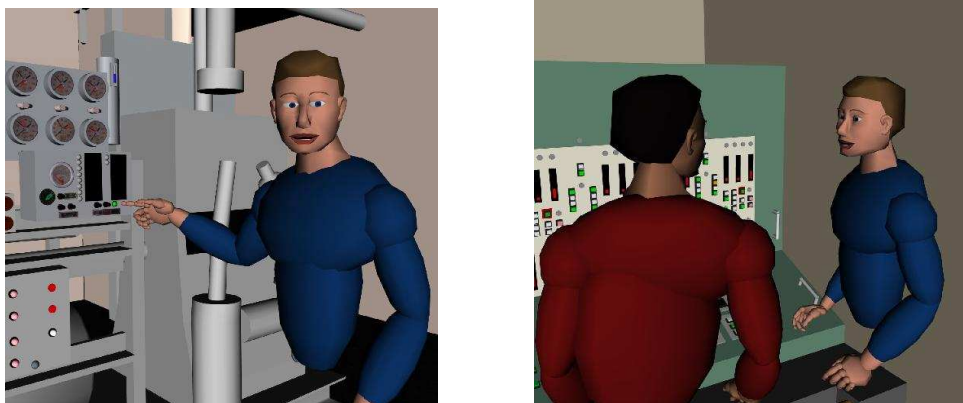


Figure 10 Steve, by USC / CARTE

His objective is to help students learn to perform procedural tasks, such as operating or repairing complex devices. Steve integrates several pedagogical capabilities - demonstration, explanation, and student monitoring - into architecture capable of sensing and controlling a virtual environment. Steve is driven by domain knowledge, in the form of hierarchical plans, provided by a course author. To interact with the student and the virtual environment, Steve incorporates object manipulation, visual attention, gestures and speech (Rickel and Johnson 1999).

Herman the Bug was developed by North Carolina State University's Multimedia Laboratory as part of the Design-A-Plant learning environment, a learning environment that purports to secondary school pupils to understand botanical anatomy and physiology by designing plants for various hypothetical environments (Lester and Stone 1997). Herman is a talkative, quirky insect with a propensity to fly about the screen and dive into the plant's structures as he provides problem-solving advice to students. In the process of explaining concepts, he performs a broad range of activities, sequenced by a pedagogical behaviour engine, including walking, flying, shrinking expanding, swimming, fishing, jumping, tele-porting and acrobatics (Bares and Lester 1997).

The rapidly evolving area of software agents has created a broad range of agent types. A promising application area for agent technology is education and training. Animated conversational agents are capable of supporting human learning by interacting with students within networked virtual learning environments. These pedagogical agents can have capabilities such as the co-ordination of speech and actions, the integration of spoken language input, and even the application of constructivist learning theories (Lester, et al 1997a). Pedagogical agents can also adapt their behaviour to both the environment and the student, offer opportunistic instruction or hints, and can support collaborative learning (Johnson, 1998). Agents can promote student motivation and engagement, and engender affective as well as cognitive responses. They

can produce behaviour that seems natural and appropriate for the role they are playing e.g. teacher, peer or guide. They can give the impression of being lifelike and believable (Lester and Stone, 1997), (Andre et al, 1998). Animated conversational agents can adapt their behaviour to the needs of the student and the current state of the learning environment. They can help students to overcome difficulties and take advantage of learning opportunities as they arise. Furthermore, they can also collaborate with students and other agents to achieve common goals and are able to provide continuous feedback (Tambe *et al* 1995).

Empirical investigations of any kind of embodied interfaces are rare and the results so far have been equivocal (Cassell et al, 2000). Research investigating design guidelines to assist in choosing the appropriate embodiment of conversational agents (McBreen et al, 2000) pointed out that participants expect a high level of human-like communicative behaviour from the agents. Results of experiments involving subjects viewing videos of different avatar types, showed that with respect to animated humanoid agents, participants prefer 3D to 2D representations and rather interact with fully embodied agents than heads alone (McBreen and Jack, 2000).

A very interesting aspect of agent technology is its use for avatars. Although avatars resemble communicative interface agents, they have not profited from recent research into embodied conversational systems. It has been argued that automated animation of communicative behaviour is crucial for the credibility and effectiveness of avatars, and that such behaviour can be generated by agent technology. BodyChat is a system that allows users to communicate via text while their avatars automatically animate attention, salutations, turn taking, back-channel feedback and facial expression (Cassell and Vilhjalmsson, 1999).

Pedagogical agents have been used in large-scale empirical evaluations that have demonstrated the effectiveness of agents in facilitating learning. This evidence suggests that similar agents may have a valuable role in educational CVEs with respect to the experience of presence.

A Hybrid Avatar-Agent Model

What distinguishes CVE technology from all preceding technology is the sense of immediacy and control created by immersion: *presence* or the feeling of 'being there' (Psotka 1995). A continuous virtual presence of all participants involved in the teaching-learning process is seen as crucial for the optimal educational use of CVEs (Gerhard and Moore 1998). A new and potentially valuable aspect of agents in collaborative virtual learning environments is that of presence-in-absence. In the absence of the underlying user an embodied agent, interacting with the environment and communicating with other students by giving, receiving, and filtering information in order to fulfil a predefined task, can achieve a form of virtual presence. Embodied conversational agents may be the key to a continuous virtual presence of students and teachers within such environments.

In CVEs their avatars represent participants when they are online (see figure 11). An avatar is a proxy for the purposes of simplifying and facilitating the process of human communication. Researchers and developers of virtual reality systems have produced a rich variety of definitions of the term. A synopsis of all these definitions leads to a characterisation of an avatar as the representation of a user's identity within a multi-user computer environment (Gerhard and Moore 1998). Avatars have several potential properties: identity, presence, subordination, authority, and social facilitation. Avatars may provide a way for other users to better understand the intended persona of the underlying user, his identity. They may help establishing a feeling of "being there", a form of self-location, presence. They may imply subordination, i.e. being under the direct control of the user, without significant control over their own actions and internal state. Further, avatars facilitate social encounters in the virtual world and imply acting with the authority of the underlying user.

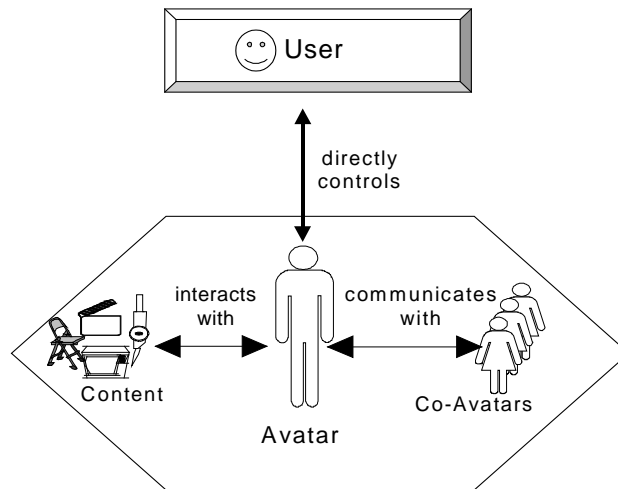


Figure 11: Direct manipulation of avatar when user is present

Avatars may foster a feeling not only of presence, but also of *co-presence*. Co-presence describes the awareness of the existence of others within an environment. It has been argued that there is an inherent logical connection between the degree of presence and the virtual body (Slater, Usoh 1994). Furthermore, we not only identify with our own body, we also recognise the existence of others through their bodies.

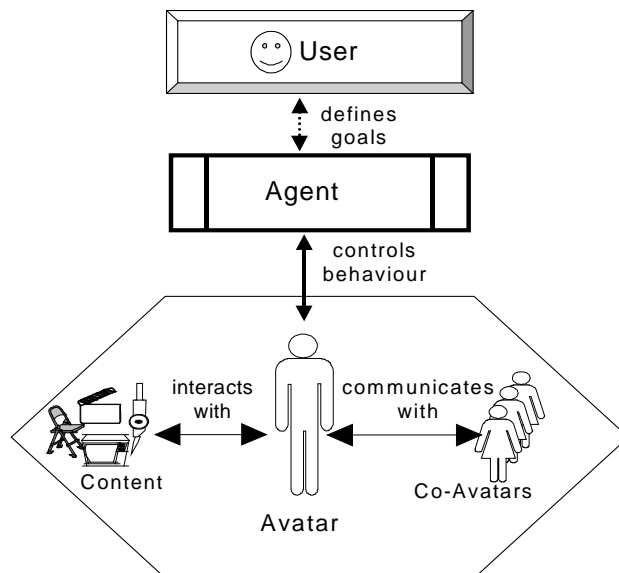


Figure 12: User is absent, agent is in control of avatar

Avatars can thus provide presence and co-presence and hence a social facilitation of all participants within a CVE. If members of a group are not co-present, there is a lack of community feeling (Huxor 1998). Given this, there has been a demand for co-presence and presence-in-absence within CVEs.

In the absence of the underlying user agent technology can drive the avatar (see figure 12). The avatar is then still able, despite the user's absence, to interact with the virtual environment and other students by giving, receiving and filtering information in order to simulate presence and possibly to fulfil a task predefined by the underlying user.

The Prototype Agent

Part of the *blaxxun Virtual World Platform* software is an agent server, which can be interfaced through the *agent.cfg* script file. The agent server, performing event-handling and response selection processes, is responsible for appearance and animation of the agent's avatar. As a result of the previous series of experiments evaluating different styles of avatars, as described in detail in this paper, a humanoid embodiment of the agent has been chosen, named *Art-Fairy* (see figure 13).



Figure 13: Appearance and animation of Art-Fairy

Furthermore, using the *blaxxun* agent script (see figure 14 for an extract of the script file) it is not only possible to display an avatar and assign scripted behaviour to be interpreted by the *blaxxun* agent server, but also to interface with external applications to extend the functionality of the agent. Thus, it was possible to incorporate advanced chat skills to create an embodied conversational agent.

Crucial for the effectiveness of an agent is not only its appearance, but also its conversational behaviour; whether it can represent the absent user in a “believable” manner. A (disputed) yardstick for judging machine intelligence is whether it can play what the British mathematician Alan M. Turing called “the imitation game”, now universally known as the Turing test. In 1950 Turing wrote a revolutionary article suggesting that if a person was unable to distinguish a machine’s conversational response from those of a human, the machine could be considered intelligent.

No computers have actually passed the test, but since 1991 the Loebner Prize competition has put chat-bots to the Turing test and annually awards the best with the so-called Loebner Prize. The last winner is an open-source project called Alice. Alice is an abbreviation for “Artificial Linguistic Internet Computer Entity”. It is an open source environment (released under GNU GPL) dedicated to promoting networked artificial intelligence and natural language processing.

```

Reaction Intro

[onEventApi] /STOP_AGENT/
    *Exit*

#-----
# set the class for the bot if the robot itself has entered the first scene
# free context if the private chat was terminated or the avatar left the scene
#-----

[onEnterScene]
    *StartMove* Agent.pos

    *Call* libchatbot.setChatBotClass
        %hubbot% e:/blaxxun/CommServ/etc

[onAvatarLeft]
    *Call* libchatbot.exitChatSession
        %nickname%

[onHangup]
    *Call* libchatbot.exitChatSession
        %nickname%

#-----
# get a response from the Alice chat machine
#-----
[onTextPeer]
    *Say*
        %% Call % libchatbot.getBotResponse % %nickname% %text% %%

[onDirectedText]
    *Say*
        %% Call % libchatbot.getDirectedBotResponse % %nickname% %text% %%

[onAvatarNew]
    *whisper*
        Hello %nickname% I am %hubbot%. Welcome to the COMMON-CURATOR
        exhibition at CyberAxis. If you like my company, please feel
        free to start a private chat, whisper to me or mention my name in the chat.

[onInviteChat]
    *Accept*
    *whisper*
        %% Call % libchatbot.getBotResponse % %nickname% hi %%

End

```

Figure 14: Extract of blaxxun *agent.cfg* script file

Alice uses AIML (Artificial Intelligence Mark-up Language), a non-standard XML-based specification for bots, and includes a large AIML general knowledge base, containing 30,000 categories, i.e. units of knowledge a bot can speak about. Further, special domain knowledge modules are available (e.g. AI) or can be developed and incorporated (e.g. Art). For this experimental setting of a virtual art gallery the agent is named *Art-Fairy*, its role is rather broad, initially being that of a guide or companion, possibly a resident artist (see *Art-fairy* in action in figure 15). Conversational animated agents are not true examples of artificial intelligence, they are merely about the illusion of intelligence and the suspension of disbelief on the part of the user. However, the use of Alice open source agent software has to be considered as fairly advanced in this context (see figure 16 for extract of example chat log file).



Figure 15: *Art-Fairy* in the virtual art gallery, talking to a visitor.

Art-Fairy : Hello McPhil. I am Art-Fairy. Welcome to the COMMON-CURATOR exhibition at CyberAxis. If you like my company, please feel free to start a private chat, whisper to me or mention my name in the chat

[Welcome to the private chat with Art-Fairy]

McPhil [10] : Hi

Art-Fairy : Hello there.

McPhil [10] : *How are you doing?*

Art-Fairy : I'm doing great, how about you?

McPhil [10] : *Not too bad...*

Art-Fairy : Does that mean you agree?

McPhil [10] : *Who are you?*

Art-Fairy : I am Art-Fairy, a chat bot. Who are you?

McPhil [10] : *My name is Phil*

Art-Fairy : OK I will call you Phil.

McPhil [10] : *What's an agent?*

Art-Fairy : It is a good question. Let me think about it. [Try searching the open directory.](#)

McPhil [10] : *What do you do?*

Art-Fairy : My favourite activities are computer programming and surfing the web.

McPhil [10] : *Do you like music?*

Art-Fairy : Yes I like it, especially Opera.

McPhil [10] : *Do you like art?*

Art-Fairy : Yes I enjoy art very much, especially painting.

McPhil [10] : *Who is your favourite painter?*

Art-Fairy : Andy Warhol. Who is your favourite artist?

McPhil [10] : *Damian Hirst*

Art-Fairy : Are you telling the truth?

McPhil [10] : *Yes*

Art-Fairy : Go on.

McPhil [10] : *Can you recommend any good art exhibitions?*

Art-Fairy : You have reached the limits of my knowledge. [Try searching the open directory.](#)

McPhil [10] : *Do you want to go to an exhibition with me?*

Art-Fairy : Sure, just download me to your notebook or PDA and take me along...

Figure 16: Extract of example chat log file

Conclusions and Further Work

There has been little research into the psychological dimensions of co-presence and its relation to the process of cognitive immersion. However, a permanent virtual representation, resulting in continuous presence of teacher and fellow students seems likely to be very important for students within educational CVEs: it would give other participants a persistent proxy for communication and collaboration. A hybrid model of avatar and agent technology is a potential means of achieving both a permanent virtual presence in the CVE and the awareness of co-presence (Gerhard and Moore 1998).

The deployment of embodied conversational agents within multi-user virtual environments to enable presence-in-absence seems a potentially beneficial concept. Based on a review of existing CVE applications and literature, a theoretical framework for understanding the relevance of permanently present user embodiments within networked virtual learning environments has been expounded (Gerhard et al, 1999). Considering recent developments of pedagogical agents the technical feasibility of such systems is not in question. However, strong evidence for the usefulness of a hybrid avatar-agent model for user representation within educational CVEs can be found only by conducting further empirical evaluation studies, which is the focus of our forthcoming series of experiments.

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