Design of VR/AR Learning on Ubiquitous Environment

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Abstract

The purpose of this research is for the establishment of VR (Virtual Reality)/AR (Augmented Reality) learning based ubiquitous environments. We focus on three aspects, ubiquitous environment, collaborative learning in virtual environment, and VR/AR learning.

In this paper, learner-focused course module, learner interface module, tutor interface module, learner module, solution problem module, curriculum module, management module, and diagnose module are designed. VR/AR learning system allows learner to be supported with a real time and non-real time. The devices used include smart phone, PDAs, mobile devices, portable computers, digital TV, web camera, AR device, game machine, DMB, and IPTV. This system is to become a more capable learner learning environment so that learner can get learner’s learning done more efficiently. The development of a VR/AR learning combines the advantages of a collaborative learning with the benefits of VR/AR technology and the flexibility of ubiquitous devices.

Keywords: virtual reality, augmented reality, collaborative learning, ubiquitous, mobile device, course module, interface module, learner module, diagnose module, management module, solution problem module, curriculum module

1. Introduction

Rapidly increased ubiquitous network and mobile devices use are extended and educational models are pursued to VR (Virtual Reality)/AR (Augmented Reality) learning in ubiquitous environment. The rapid mobile technological development and the wider accessibility of high-quality telecommunications are benefit to bring about a significant change in learning. The development of learning content based on such technology as graphics, image, voice, and video has become the media for ubiquitous learning. VR/AR technology also permits learning via remote collaboration. Collaborative learning plays an important role of within the ubiquitous learning [4].

VR/AR learning is a new stage in the progress of e-learning and that it resides within its boundaries [9]. VR/AR learning is not only wireless or Internet based e-learning but should include the anytime/any place concept without permanent connection to physical networks. VR/AR technologies can applied in many areas like learning, industry, medical, archaeology, architecture, art, commerce, military, sports, entertainment, tourism, and training. The devices used include smart phone, PDAs, mobile phones, personal computers, digital TV, car navigation, web camera and tablet PDAs [9]. The components of the VR/AR learning environment are mobile microprocessors, platform module, and telecommunication network infra, u-sensors.

VR/AR learning is more than just the latest educational idea or method. Learning occurs not just in classrooms, but in the home, the workplace, the playground, the library, and in our daily interactions with others. A learner is free to start a class at any time within a specified
time frame. VR/AR learning is to become a more capable learner learning environment so that learner can get learner’s learning done more efficiently. VR/AR is a live, direct or indirect, view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mixed reality, in which a view of reality is modified by a computer. As a result, the technology functions by enhancing one’s current perception of reality. By contrast, virtual replaces the real world with a simulated one [2].

AR is conventionally in real time and in semantic context with environmental elements, such as sports scores on digital TV during a match. With the help of advanced AR technology the information about the surrounding real world of the learner becomes interactive and digitally manipulative. Artificial information about the environment and its objects can be overlaid on the real world [25].

We focus on three aspects, ubiquitous environment, collaborative learning, and VR/AR learning.

2. Configuration of Ubiquitous Environment

Ubiquitous environment is an environment supporting learner learning using digital media in a geographically distributed environment [3]. This environment is defined with the following devices: PDA, smart phone, information appliances, wearable with electronic tag, digital TV, web camera, car navigation, augmented reality device, game machine, DMB and IPTV.

Various devices are equipped with different hardware and software constraints. Hardware constraints can be used to describe hardware capabilities such as platform, cpu speed, memory size, microprocessor, screen size and resolution. Software constraints can be used to describe software capabilities such as operating system, browser, playable media type and resolution [17]. Figure 1 shows the devices of the ubiquitous environment.

Figure 1. Ubiquitous Environment
Figure 2 shows the components of the ubiquitous technology. A component of the ubiquitous technology is defined with the following elements: ubiquitous platform, application program, ubiquitous sensors and ubiquitous network [21].

Ubiquitous platform will be embedded in every object and device. Also platform will include the server. The server manages the network resources. The embedded information of each microprocessor will be hold about the object. When an learner approaches, the sensor detects their presence and will start relaying information to the learner's PDA, smart phone, information appliances, wearable with electronic tag, digital TV, web camera, car navigation, augmented reality device, game machine, DMB and IPTV.

Application program will include the educational strategies unit and a Database. The educational strategies unit allows for the application of strategies to reinforce and aid learner understanding through interaction and feedback. It analyses learner responses to short quiz questions and returns more information or information in a different form when needed. DB stores all the data about the objects/devices, the learner and the interactions that occur.

Ubiquitous network will be in the form of Bluetooth, WiFi and Wire network. The Bluetooth has weak signal strength, uses little power and covers a relatively short distance. Its low power consumption and ability to communicate with many devices is extremely beneficial when using handheld devices. The WiFi has a range and speed which surpasses that of Bluetooth. It is compatible with any brand of Access Point and client hardware built to
the WiFi standard. Wire-less network is in charge of data transportation among mobile devices in distributed environment. Wire network and Wire-less network creates the network connection, which altogether form a collaboration work, destroys and performs the functions controlling the QOS by detaching the network load. Wire-less network simulate multiple-point connection using stream and multiple applications share the same network connection.

Ubiquitous sensors will be used to detect any changes in surroundings. These will be placed adjacent to the objects/devices and will be used to recognize the presence of learner. The sensors used will include proximity, to detect movement, and light, to detect changes in light intensity. The module tracks and locates each learner within the m-space by the use of sensors. When a learner approaches an object, sensors wirelessly access the intranet and ubiquitous environment and transmit information about the object [26].

3. Collaborative Learning in Virtual Environment

Collaborative learning is a variety of approaches in learning that involve joint intellectual effort by learner or students and tutors. Collaborative learning refers to methodologies and environments in which learner engage in a common course in which each individual depends on and is accountable to each other. Groups of learner study together in searching for understanding, meaning or solutions of their learning such as a product. The approach is closely related to cooperative learning. Collaborative learning activities can include collaborative writing, group projects, and other activities. Collaborative learning has taken on many configurations [25]. The first is collaborative learning for the self-directed adult learner, youth directed collaboration, another configuration of self-directed organizing. Collaborative learning has emerged as a new educational paradigm among researchers and practitioners in several fields, including cognitive sciences, sociology, computer engineering. Collaborative Learning also has a particular meaning in the context of Learning Management Systems. In this context, collaborative learning refers to a collection of tools which learners can use to assist, or be assisted by others. Such tools include chat, discussion threads, and application sharing among many others. Specifically relevant to e-learning where developers can share and build knowledge into courses in a collaborative environment. Knowledge of a single subject can be pulled together from remote locations using software systems [18]. Learners in an action research project are co-researchers. The principle of collaborative resource presupposes that each learner’s ideas are equally significant as potential resources for creating interpretive categories of analysis, negotiated among the learners. It strives to avoid the skewing of credibility stemming from the prior status of an idea-chair. It especially makes possible the insights gleaned from noting the contradictions both between many viewpoints and within a single viewpoint [26].

4. VR/AR Learning

In this paper, we will focus on VR/AR learning, ubiquitous devices-supported learner learning phase. Learner can never lose their study unless it is purposefully deleted. In addition, all the learning processes are recorded continuously. Learners have access to their documents, data, or videos from anywhere. This information is provided based on their requests. Therefore, the learning involved is self-directed adult learner. Wherever learners are, they can get any information immediately. Therefore learner can solve problems quickly. Otherwise, the learner may record the questions and look for the answer later. Learner can interact with experts, tutors, or peers in the form of real time or non-real time communication.
Hence, the tutors are more reachable and the knowledge is more available. The learning could be embedded in our daily life. The problems encountered as well as the knowledge required are all presented in the nature and authentic forms. It helps learner notice the features of problem situations that make particular actions relevant. Learner can get the right information at the right place with the right way [2].

4.1. VR Learning

Through the use of technologies such as VR and instant communication, learner can be more visually aware of their classmates and can converse in real-time with them. Learner can also receive immediate feedback from their tutors and gain a sense of being present in the same place as their peers despite their remote physical locations. These shared virtual environments also facilitate simultaneous viewing of learning materials by the whole class and allow them to actively partake in group discussions about the learning content at the same time.

In addition, the benefits of VR for learning have been explored. Many VR resources have already been developed in this area. VR models are very useful to familiarise learner with features of different shapes and objects, and can be particularly useful in teaching younger learner. Many games for learning develops using VR technology that the learner must interact with in order to learn a certain course. Interactive models increase a learner’s interest and make learning more fun. VR environment can be used to teach learner different procedures and mechanisms for carrying out specific tasks. VR is also be used extensively for simulations and visualization of complex data. VR is represented complex structures and increasingly scientists are using this technology for visualization and in particular as a teaching aid. The use of VR and 3D graphics for e-learning is now being further extended by the provision of entire VR environments where learning takes place. This highlights a shift in e-learning from the conventional e-learning environment to a more immersive and intuitive one. Since VR is a computer simulation of a natural environment, interaction with a 3D model is more natural than browsing through web pages looking for information. These VR environments can support multiple learners, further promoting the notion of collaborative learning where learners learn together and often from each other.

As with a real class, learners are aware of each other within the environment and they can partake in courses, group meetings and informal chats. We feel that social interaction is vitally important within any learning scenario and so VR provides many communication facilities in addition to learning content. We recognize the importance of pedagogy in any learning scenario, pedagogic issues relating to learning strategies. Usability of a VR interface for learning, socializing and communicating online, and on providing adequate support for a variety of learning tasks.

VR can also increase the social presence of learner by providing interactive and visually appealing ubiquitous environments where learning and collaborating can take place. Computer games for learning often use this kind of multimedia to create interactive and stimulating game environments, which give learner a social presence and an opportunity to collaborate and communicate with others [2].

4.2. AR Learning

AR applications can complement a standard curriculum. Text, graphics, video and audio can be superimposed into a learner’s real time environment. Textbooks, flashcards and other educational reading material can contain embedded contents, when scanned by an AR device, produce supplementary information to the learner rendered in an AR format.
Learner can participate interactively with computer generated simulations of historical events, exploring and learning details of each significant area of the event site. AR can aide learner in understanding chemistry by allowing them to visualize the spatial structure of a molecule and interact with a virtual model of it that appears, in a camera image, positioned at a marker held in their hand.

Augmented reality technology also permits learning via remote collaboration, in which learner and tutors not at the same physical location can share a common virtual learning environment populated by virtual objects and learning materials and interact with another within that setting [25].

4.3. Module of VR/AR Learning System

This VR/AR learning system designs a course module, learner interface module, tutor interface module, solution problem module, curriculum module, management module, and diagnose module to develop an inspecting and participating technology in an VR/AR learning environment [4, 8]. Indeed it seeks to enhance it by providing the audio/video/chatting for real time collaboration and on-going interaction. It needs to be properly guided or monitored in order to produce the preferred results.

Learner's interface module monitors the learner's actions, notifying other modules when needed and giving access to system resources. This module controls the access to the learner model and brings to the learner information about the whole VR/AR learning environment. This module has the course contents, which is distributed at the beginning. Course content is shared and each learner draws.

![Diagram of VR/AR Learning System](image)

**Figure 3. Module of VR/AR Learning System**

Tutor’s interface module is a module associated with the tutor’s interface. This module controls the access to the tutor’s KB and brings to the learner information about the whole learning environment. This module mediates interface modules related to: communication...
with other tutors, update of new activities to the learner, distribution of such activities to learner, and supervision of work done by learner. Information KB is responsible for retrieving and filtering information from specified sources that can range from the learning materials and experiences available in the system. The communication module controls the communication with other modules, including determining message, sending out messages, and receiving and interpreting messages [20].

Course module proposes the most suitable problem/situation to the learner, including learning goals and the level of learning. Also this module decides on a specific strategy. Furthermore, its didactical decisions are based on learner’s conceptions. To accomplish tutoring goals it is able to launch the lower-level module whenever a diagnosis is needed and, once diagnosis phase is over, it plans interactions with other learners. The tutor prepares a course using the various a course note is kept in the server. There is the course manager that five buttons of top are course frame, model course frame, course registration, course delete and course start button. The list box is registered learning subject list.

In management module, learners choose operators, validate actions, and validate the final result. Control elements are perceptive when attached to the fact that the learner makes assertions based on something on the screen and uses this information to take and validate decisions. This module controls the use of VR/AR environment’s audio and video resource to recognize tutor/learner and also assigns who is the turn of speak, decides and manages appropriate resource assignment according to request of resources.

Diagnose module is responsible for answering other module’s queries. The strategy module considers complete solution paths and offers advice only when the learner completes the problem. The most obvious issue that arises when tutoring module exists in a system is what to do when the tutoring module disagrees. In the module presented here, we might have a situation where tutor strategy module wants to present a message at the same time.

Learner module is aims to meet the needs of the learner. The learner module is also used to see if the information has already been taught to the learner. VR/AR DB includes a management component which is responsible for managing the learners, for example assigning login names and passwords, and managing two databases existing in the system, namely the learner’s history database and the database with the recorded learning experiences. A third database contains the learning profile of the learner, but this database is accessed by the learner modules of each learner. KB includes a realistic knowledge base and associated exercises to enable an effective evaluation of the potential use of the system within a curriculum. Each tutor has its own specific tutor’s knowledge base and also inherits global knowledge from a common knowledge. Learner progress phase will be stored in a database to show learner progress and adequate completion.

Solution Problem module becomes satisfied when the category of problems it represents is present in the ubiquitous environment. The combination of the different values these didactical variables could take, leads to more or less complex problems, allowing to focus on different aspects of the learning of reflection and most important, allowing the expression of different conceptions.

Curriculum module has curriculum information which represents the target skill and its constituent sub-skills, and depicts how they are related. The tutor’s general strategy is to present instruction, ask questions, and evaluate answers. It creates and updates a learner model based on a learning of the learner’s natural language answers to assessment questions [26].
5. Conclusion

In this paper, we describe the development of a VR/AR learning system that uses ubiquitous environment and the concept of collaborative learning. The learner with PDA/Smart phone store and share the useful expressions that are linked to any place in everyday life. Then, the system provides each learner the right expressions at the right place. Each learner interacts with many embedded devices. Learner move around ubiquitous space and interact with the various devices [6]. A ubiquitous computing environment enables people learning at any time and any place. But the fundamental issue is how to provide learner right information at the right time in the right way [7].

We have always been able to learn in diverse settings other than the formal classroom, and often in a more pleasant, memorable, and useful way. Nevertheless, mobile learning serves to remind us of the need to continually re-examine how learning occurs and to attend to the affordances of new technologies [24].

VR/AR learning system becomes the most viable solution. This system is suitable for distributed multimedia learning environment because it provides of audio/video functioning and VR/AR technology. The system have a various communication type, a question and an answer, multi-learning session, high degree of efficiency, high degree of cooperative, and time constraint. The system is to provide an easy to use interface, so that the learners are motivated to use it for their learning. We also developed a set of requirements that supported by course module, learner interface module, tutor interface module, learner module, solution problem module, curriculum module, management module, and diagnose module in order to perform an effective VR/AR learning. Also, the systems has many other advantages, which enable learning, PDA/Smart phone service, high degree of data management, and management of attendance [8]. We considered our VR/AR learning system, usability and applicability, and concluded that it can be used for the multimedia PDA, smart phone, digital TV, web camera, game machine, DMB, and IPTV in ubiquitous environment. The development of VR/AR learning combines the advantages of a collaborative learning environment with the benefits of ubiquitous computing and the flexibility of mobile devices [3]. A component of the ubiquitous technology is defined with the following elements: ubiquitous platform, application program, ubiquitous sensors and ubiquitous network.

In this paper, we focus on VR/AR learning as an application domain of learning. Collaborative learning is an educational approach to teaching and learning that involves groups of learner learning together to solve a problem, complete a task, or create a product [11, 12]. There are many approaches to collaborative learning [15, 16]. In the collaborative learning environment, the learners are challenged both socially and emotionally as they listen to different perspectives, and are required to articulate and defend their ideas [1]. The development of VR/AR learning combines the advantages of a collaborative learning with the benefits of VR/AR technology and the flexibility of ubiquitous devices [14].

An ongoing version of this research is to become a more capable learner collaborative learning using VR/AR technology so that learner can get learner’s learning done more efficiently.

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