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Methods Toward E-learning and Innovative Education Using Virtual Reality

Phan The Hung
Pham Minh Viet
Nguyen Thanh Nghi

Abstract

In this paper, we introduce concepts and analyse methods which create applications used for innovative education based on Virtual Reality (VR) technology. VR, a technology to create an imaginary world by using 3D graphics and computer simulation has been used in many fields and recently education has been recognised as one of remarkable VR application areas. The use of VR systems increase the efficiency of educational processes particularly in being aware, understanding, learning and turning information to knowledge. We examine different approaches that create interactive materials for teaching: VRML a programming language for web-based education and Virtual Studio - a media tool to create a learning studio and environment that engages students in an active and interactive way. We also analyse an approach called Edutainment which combines traditional education method and entertainment industries, bringing progressive trends from the domain of narrative environments for the human-computer interface and underpinning these results with technologies from digital, interactive storytelling, mixed reality and multimodal interfaces and finally, present the fundamental three-dimensional (3D) game approach in this Edutainment section.

Introduction

The recent growth in personal computing and the Internet has generated many software tools for easy and practical development of interactive environment including graphics and visualization tools. Virtual reality and computer graphics components consist of methods and tools for the generation of virtual objects and scenes that simulate real systems and landscapes.

One new programming tool, the Virtual Reality Modelling Language (VRML) [1] is presented in applications and possibilities in the development of computer visualization tools. One aspect of VR programming languages is their ability to create virtual representation of physical systems on a computer display. With VRML it is possible to illustrate complex, expensive, or dangerous systems safely and economically on a computer screen. For a long time, science and engineering education have relied on drawings and pictures to describe a variety of systems and objects sometimes accompanied by laboratory experiments with real systems for hands-on practice. It is also possible and easy to generate virtual models of systems. VRML makes the development of virtual reality and visualization aids for education not only affordable but easy and accessible to all. VRML is being used very effectively in the development of web documents of increasing its scope and quality for e-learning systems. The graphics capabilities of this tool, particularly in the development of virtual reality displays can be of great assistance in teaching, learning, and experimenting.

Virtual Studio is a media tool that uses personal computer for easy creation of educational video with the full illusion of interaction. Virtual Studio technology is based on the idea of combining audio-video data of real objects with 3D scene in real-time. This method gives

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an opportunity to create multimedia courses for achieving any area of knowledge in the shortest possible time.

Edutainment includes software that should be both entertaining and instructive. It can be classified somewhere between real application software and pure entertainment and not only focus on children but also adolescents and adults. VR technology has penetrated into Edutainment field and made it livelier, more realistic, spirited and dynamic resulting from a combination human-computer interface and digital interactive storytelling, mixed reality and multimodal interfaces. Thus Educative softwares also become one of the valuable tools that can be used for training purposes and education. 3D game nowadays is not purely used for entertainment but its application in has also education is started to be recognised.

The remainder of this paper is organized as follows. In section 2 we examine VRML applications in Education. Section 3 presents a media tool, Virtual Studio that can be applied to create interactive and lively training materials. Section 4 analyses Edutainment approach. Finally, in section 5 we offer some closing remarks.

VRML Applications in Education

Applications of VR have been seen widely in education. Evidences of different VR simulation systems have shown educator's efforts in a variety of areas to use VR development tools in education. These include complex and expensive simulation systems such as a 747 flying simulator at British Airways, simulator for astronaut training at NASA, maritime simulator at Warsash Maritime Center [2] (see Figure 1).
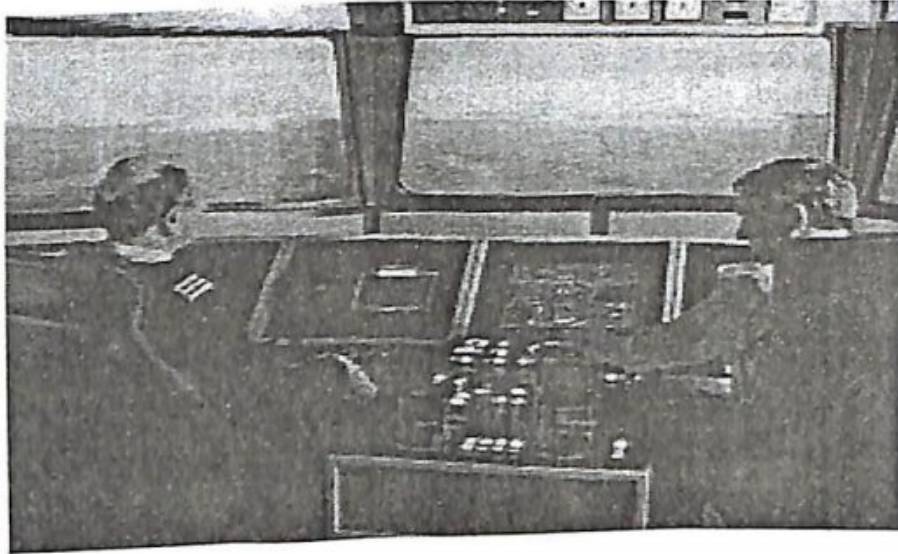
Figure 1. Ship bridge simulator at warsash maritime centre.

VRML is a text based programming language for the description of 3D objects on a computer display. The text source file is interpreted by an Internet browser equipped with a VRML-viewer plug-in. Since its appearance in the mid 1990s, several viewers have been developed and most of them, if not all, are available for free download from their makers' websites such as Viscape SVR viewer from the National Geographic Virtual Solar System website [3], Cortona Viewer from the Parallel GraphicsTM website [4].

As mentioned, VRML has evolved in recent years into a computer tool for easy generation of 3D objects, scenes, and models that can effectively illustrate and help explain various science and engineering systems. VRML-generated graphics can be embedded in web pages to produce high quality visualization in web-based education or in a wider term in e-learning. The Virtual Worlds created by VRML are particularly well suited for travelling to and discovering interesting places that are either too far away or unreachable, that existed long ago, that model our future, or that are as small as a molecule or as large as a universe.

For people interested in astronomy, the national geographic society's virtual solar system [1] is an example of the practical value of virtual reality in science education. Live interactive physics simulations let you explore the Solar System (orbits, seasons, gravity, tides, comets and satellites), and many other features of the solar system can readily be illustrated and visualized. With this virtual reality model, every student can experience the view of Jupiter, IO and EUROPA as shown on Figure 2, or navigate through the solar system from one planet to the next by using the Viscape SVR viewer.
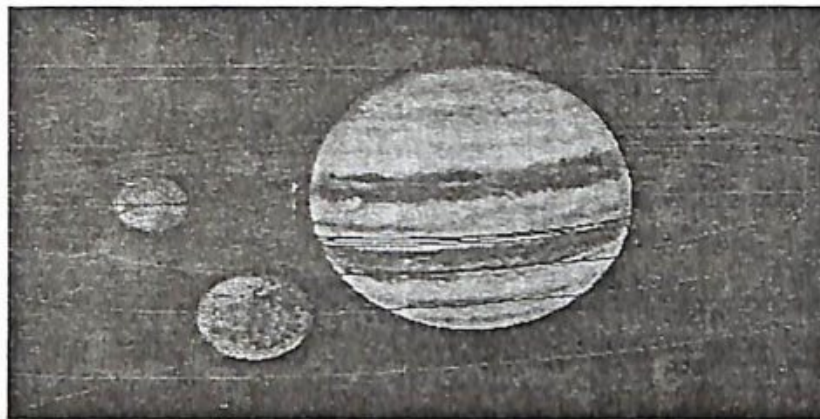

Figure 2. View of jupiter, io and europa on the virtual solar system

Virtual Studio

The term Virtual Studio [5] is a highly-integrated multimedia complex based on computer. The aim of usage virtual reality technology is the imitation of the lecturer's (and maybe the student's) interaction with modelled objects and phenomena. The illusion of submersion in virtual environment results in profound understanding of 3D materials. The environment means a combination of the real and virtual objects which is represented to the auditorium as educational video by various channels, including TV.

Virtual Studio is used to produce training media, including the creation of the general script, creation of objects for a virtual environment (virtual illumination and cameras, animation tracks), preparing of elements for scene control, rehearsals for tutor and realization of the lesson as the result.

General working scenario must include instructions for the 3D designers, the animators, the studio operator, and describe lecturer behaviour in the teaching process.

Production of the described technology is the movie where the lecturer is encircled with studied objects environment. The advantages of virtual studio in education are:

- Being able to get more information from the explanation due to the technology's possibility to demonstrate 3D objects and a number of geometric operations;
- The possibility to change 3D materials for an illustration as well as studied objects and phenomena interactively during the lecture;
- The possibility to create the storing of recorded lectures and other materials for teaching in virtual environment in the library;
- The ways for broadcasting and publication of educational materials, which are created with help of virtual studio, and can be divided into publication of recorded video (on CD, cassettes, Internet), TV broadcasting and real-time online contact.
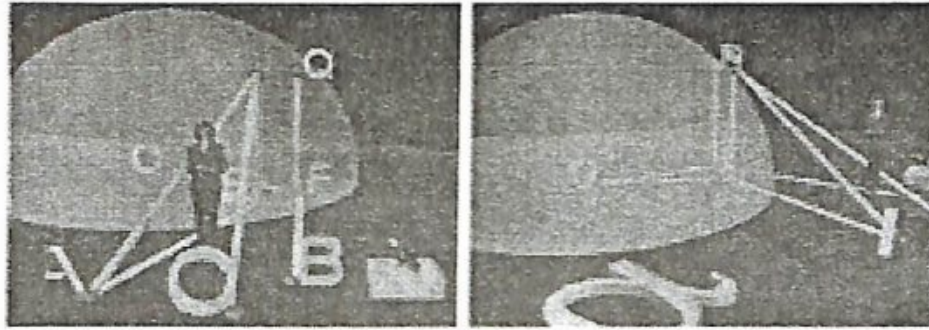- Figure 3 is an example of a training material in geometric mathematic.

Figure 3 : Stereometric Drawing: Frontal And Side Viewpoints

Virtual Studio is a cheap solution but effective in making educational materials.

Edutainment

Children learn mainly through play. Edutainment goes beyond children's learning. It includes persons from all ages and involves numerous variations and fusions of education end entertainment. Edutainment ranges from interesting information software to learning and narrative oriented software. It consists of simple application software to support computer-oriented creatively for making objects as well as simulation with relevant content such as flora or ecosystems. Children love to learn if they are not pressed to learn within the boring definition of adults but rather as a part of their own gaming world. The same holds true for adults, even if they deny it. The fun factor is an essential element of learning that is no longer questioned.

Computer game developers have huge resources to bring to their research and development and as a consequence their products offer performances that rivals commercial virtual reality software [6]. We also provided one prototype game for students to play in the 3D environment: a recycling game. (see Figure 4 and Figure 5).

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Figure 4 : A screenshot in 3d racing game for recycling

We have been researching on the development of 3D games for education especially in recycling. We developed a game framework to develop 3D games using DirectX. The scenario of this game is when a student plays and to win the game, he can go around in 3D scene, looking for recyclable items, gathering it as many as possible, and go to the finish in the shortest time. If the student is a winner of the game, he can access and watch the recycling material process for the item that he gathered. After playing the game, students know about what material can be reproduced and how we recycle it.
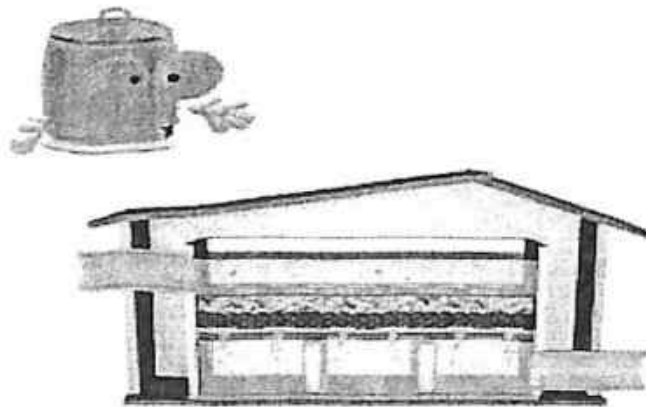

Figure 5 : One step of water processing

When students play 3D games, they can go inside a virtual world and get much knowledge there.

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Conclusion

We have shown the value of the two approaches VRML and Virtual Studio that bring to teaching methods education in a new and innovative way. VRML with its ability to create virtual representation of physical systems on a computer display has made the development of virtual reality and visualization aids for education affordable, easy and accessible. Moreover, embedding VRML into web documents increases its scope and quality for web-based education e-learning systems. Virtual Studio is used to producing the training media included creation of the general script, creation of objects for a virtual environment (virtual illumination and cameras, animation tracks), preparing of elements for scene control, rehearsals for tutor and realization of the lesson as the result. And last but not least applying VR in Edutainment is one approach that makes students have a passion for study.

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