The System for Interactive Virtual Teaching Based on "Focus" Virtual Studio

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Abstract

This paper is devoted to the application of Virtual Reality (VR) systems for increasing the efficiency of educational processes. The main principle of virtual studio functionality is shown along with advantages and restrictions being outlined

The general concepts of educational materials preparation with the help of virtual studio "Focus" are explained. The paper concludes with description of the valuable example.

Keywords: *Virtual studio, Video, Interactive, Education.*

1. Introduction

Traditional educational technology is built on live communication between a tutor and students. Herewith, tutor's role is to present the subject under studying (for example object, phenomena, regularity etc.) to his auditorium and to attract student's attention to important features of the object.

Rather than simply replacing conventional teaching methods VR could be used in support of the growing demands for educational services.

Today we do use technologies such as computer presentations, tests, audio and video records for better understanding. New possibilities to create and demonstrate different educational materials especially for distant communication would broaden this spectrum with sophisticated facilities without the high costs.

Recent advances in information technology have made it feasible to employ distant learning systems as the principally new and independent branch of education.

The aim of usage virtual reality technology is the imitation of the lecturer's (and maybe the student's) interaction with modeled objects and phenomena. The illusion of submersion in virtual environment results in profound understanding of 3D materials. The environment means combination of the real and virtual objects which is represented to the auditorium as educational video by various channels including TV.

2. Definitions

This chapter describe the main terms.

The term *Virtual Studio* is used in two meanings: 1 VS is a highly-integrated multimedia complex based on computer. 2 VS is synthesized 3D scene or actor's environment.

Trackers are devices for capturing the actor's motions for computer.

Keying or *Chroma Keying* is the process of background separation from incoming video. For example, a weather forecaster stands in front of a blue background which is replaced with a weather map image forming the scene that you can see daily on TV.

3. The problem state

Our essential objectives are:

- to develop the media tool for easy creating of educational video with the full illusion of interacting,

- to find out and describe possibilities and restrictions of technology,

- to prepare user's guide documentation and create valuable examples,

- to provide the various communication equipment and full support for broadcasting.

Also it is supposed that the very subject of teaching has meaningful 3D illustrations.

4. Virtual studio concept

Let's describe the main functionality of the systems for creating real-time virtual environment with interaction of real and virtual objects.

There are two main parts in the system: the *keyer* or keying block and the *renderer* - block for rendering of virtual environment and it's combination with keyer's output.

All real objects (such as lecturer) act in the blue room or at least in front of monochrome (blue of green) background. Keying settings are defined either automatically using static image during preparation, or manually. Video texture with the transparency instead of background certain color or a range of colors is formed after keying block.

A variety of geometric solids, some inscriptions, diagrams, virtual lights and cameras can be exploited as the virtual environment (see Fig.1).

The frame rate of the whole rendering must be close to real-time performance (i.e. 30 frames per second).

Figure 1: The virtual environment

Virtual studio allows organizing the an assortment of television programs production such as news, weather forecasts, entertainment as well as commercial video production (video clips and others) using small studio without any real decoration and minimal requirements to space and servicing personnel. Nevertheless visual quality of resulted products only slightly differs from the huge studios production.

5. Characteristics of virtual studio "Focus"

Represented work is performed on virtual studio "Focus" which is focused, first of all, on poor budgetary television studios - regional, cable, internet-studios or subdivisions of broadcasting companies. Virtual studio "Focus" characteristics are:

- multiformat video input and output;

- unique keying, with excellent processing of the fine and semi transparent objects like hair, smoke, glasses and etc. It also specially adapted to be used with lowered quality video cameras too;

- 3D rendering of scenes, preliminary created in 3D max, using live video and recorded avi as the textures for scene objects in real time without any precalculations;

- static and robotized source cameras support with switching between them in real time;

- control of any objects and parameters by the script, or interactively.

The studio is based on PC with two processors.

Specific software of studio is the set of drivers, adjusting modules and the heart of user interface - the *HotActions* program. *HotActions* allows interactive working with three-dimensional environment (i.e. to switch virtual cameras, to start animation, to replace an environment etc.).

Video texture can be assigned to any geometric object with diffuse material while one sided plane is usually for minimal distortions of the actor's image.

The detailed description of virtual studio "Focus" was published last year (see [1]).

6. The training media creation

Producing of training media includes 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 lector's behavior in the teaching process.

The virtual environment is made in *3D Studio Max* and then is exported with some restrictions.

One can control the scene either by preliminary created panel of buttons or with keyboard and mouse shortcuts from the same or remote PC. Preparation for on-air session includes loading the scene files, textures and sounds, initialization of the video textures, assignment of names to the animation tracks. All this tasks could be performed by script language of *HotActions*. Also it allows to switch virtual or real cameras, change properties of objects (for example, scale, position, color, texture, visibility etc.), as well as to create sequences with cross script calls.

Figure 2: Interaction with virtual object. Lecturer adjusting to animation track

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Adaptation or calibration in the scene is necessary for the lecturer to understand a ratio between the real sizes (in studio) and ones of the virtual space. During the teaching process the lecturer deals with an empty studio and sees a virtual environment just on the monitor he used to control the animation. The special elements allowing the lecturer to synchronize his movements with environment are described in article [2].

For more realistic interactivity it is necessary to send lecturer's motion trajectories into the scene, and to create the Virtual Double in special cases. Motion capture systems (trackers and mocaps) by various manufacturers ([3, 4]) obtain 3D coordinates of sensors attached to lecturer's body. The sample for illustrating trackers abilities to control motions of virtual character was made. Next pictures are shown using the tracker *Data Glove 5DT*.

Figure 3: The scene control with help of tracker-glove

The post processing depends on proposed video broadcasting and could be optimized for either online broadcasting or video records.

7. Using virtual studio in education

So, production of described technology is the movie where lecturer is encircled with studied objects environment. The advantages of virtual studio in education involve:
- one can get more information from the explanation due to technology's possibility to demonstrate 3D objects and number of geometric operations;
- possibility to change 3D materials for an illustration as well as studied objects and phenomena interactively during the lecture;
- the lecturer as the factor for increasing student's interest and learning ability and as effective way to show the scene deep;

- possibility to create the library storing recorded lectures and other materials for teaching in virtual environment.

The ways for broadcasting and publication of educational materials, which created with help of virtual studio, can be divided into publication of recorded video (on CD, cassettes, Internet), TV broadcasting and real-time online contact. Online contact is possible when there are good bi-directional channels.

For the efficient teaching with the recorded video it is necessary to provide student questions in scenario, to record video fragments with answers, necessary camera's zooming and flying around and movement of other objects for full stereometry perception. Then recorded fragments are structured, indexed and connected with each other by hyperlinks to provide ability to selectively look through this fragments in any sequence, to observe studied objects from the different viewpoints and etc.

For clarity the sample of using virtual studio for solving stereometric problem was created and some of its frames are below.
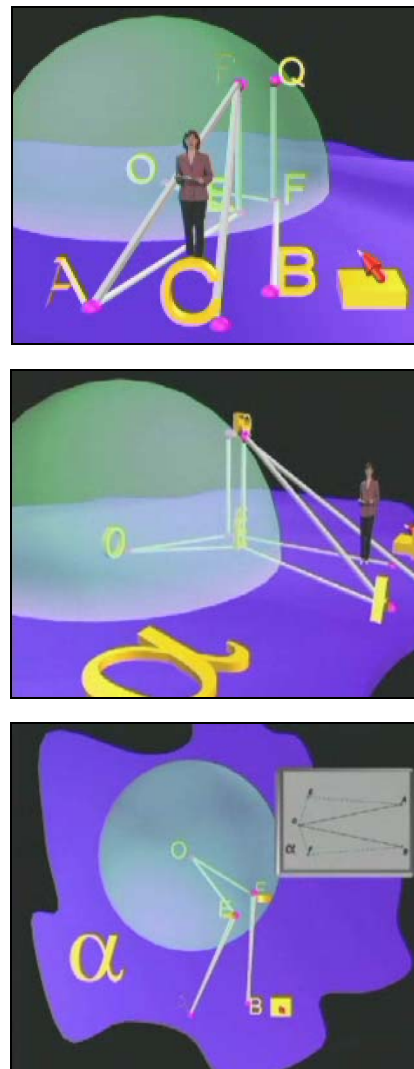

Figure 4: Stereometric drawing: frontal, side and upper viewpoints

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Let's consider volumetric representation as the main issue for increasing the efficiency of proposed technology. Examples of subjects, which are based on understanding the space or 3D data, are crystallography, stereometry and etc. To demonstrate the deepness of the scene and 3D features of virtual objects it is necessary either to have two 2D projections or to provide dynamic changes of object's position and optionally camera's viewpoint. These methods are used everywhere. But using virtual studio provides the third possibility: to emphasize the perception of scene's deepness by changing the lecturer's position with respect to studied objects.

VR system is essentially an interactive computer based model that can represent a real or abstract system or environment. This means that the application areas are almost endless. Virtual environment can be micro (for example molecular construction) as well as macro, their combination, or even some fantastic world. The lecturer presence in this environment provides the possibility to stress student's attention on some parts of environment and if it is necessary to emphasize the volume of the scene.

Now we work with proper additions to the standard documentation for virtual studio "Focus".

8. Results

So, let's sum up. Involving the virtual studio in educational technology can increase arsenal of lecturer's possibilities for all forms of education. Tutor can teach while being in dynamic environment, showing 3D models of objects under studying/ He can change location in order to stress on the scene deepness. Products of virtual studio are easy to save and circulate.

In presence of the good network channels the education process (possibly in form of teleconference) could significantly improve the quality of distant interactive videocourses used today.

9. References

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