APPLICATION OF VIRTUAL REALITY TECHNOLOGY IN THE LEARNING PROCESS

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Abstract

The advantages of using virtual reality technologies in the learning process are the following:

- the use of the full range of human receptor systems ensures the coordination of transferring information through several channels;
- the possibility of full immersion in the created environment;
- the possibility of creating flexible training programs;
- the possibility to interactively consolidate the acquired knowledge and to master the skills.

Virtual reality based training allows educators to visually deliver lectures and seminars, display the trainees all aspects of a real object or process. Virtual reality technologies make it possible to take full advantage of the fact that a person receives 80% of information from the outside world through vision, while people remember 20% of what they see, 40% of what they see and hear, and 70% of what they see, hear and do.

The most popular devices (helmets and glasses) of virtual reality are HTC Vive, Sony Play Station VR, Oculus Rift, Samsung Gear VR, Microsoft HoloLens .

The research laboratory of the Institute of Distance and Further Education of the Ulyanovsk State Technical University (UlSTU) has been developing virtual work places for the following specialties: a radio assembler, a radio fitter and a radio adjuster.

The developments use the virtual glasses HTC Vive. The HTC Vive includes a headset, a pair of hand-tracking controllers, and a pair of wireless base stations. The Vive headset has a built-in front-facing camera, due to which at any time, by pressing a special button, the user can look at the real world while still wearing the headset, and talk to the people in the room, looking at them on his/her virtual screen.

The Unity platform is used as the basic software. It provides the possibility of creating projects for virtual reality glasses.

In order to program operations of interaction between game objects and controllers, the SteamVR SDK software package is used. Its advantage is that it contains a game scene in which the possibilities of using the package are demonstrated. As a result, projects for virtual reality are developed and modified more quickly. The SteamVR SDK software package also contains a standard player object with customized camera and game controller settings. The key scripts are: Interactable, containing the event handlers associated with touching the subject with the controller; Throwable, which processes the physical interaction of the object and the controller (this script automatically connects Interactable, Velocity Estimator and the Rigidbody component).

The algorithm for modifying the application, therefore, consists of the following steps.

1 To diagram user's interaction with objects.

2 To create a three-dimensional scene and objects in the visual editor Unity.

3 To import the SteamVR SDK package.

4 To develop logic in C #.

5 To modify the camera and control scripts of the camera object during the testing process.

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The developed virtual workplaces are used in the educational process of the College of Economics and Informatics of UlSTU in practical classes for students of radio engineering specialties. The use of such workplaces have allowed educators to increase the students' motivation, the quality of knowledge of technological processes of assembling, adjusting and fitting instruments and devices, and to reduce the time of mastering operations on real equipment by 50%.

Keywords: virtual reality technology, virtual workplaces, learning process.

1 INTRODUCTION

The advantages of using virtual reality technologies in the learning process are the following:

- the use of the full range of human receptor systems ensures the coordination of transferring information through several channels;
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Virtual reality based training allows educators to visually deliver lectures and seminars, display the trainees all aspects of a real object or process. Virtual reality technologies make it possible to take full advantage of the fact that a person receives 80% of information from the outside world through vision, while people remember 20% of what they see, 40% of what they see and hear, and 70% of what they see, hear and do.

The use of innovative virtual technologies is actualized in the educational environment in order to optimize the study of disciplines, to enhance the students' professional adaptation.

2 DEVELOPMENTS IN VIRTUAL REALITY

The most popular devices (helmets and glasses) of virtual reality are HTC Vive, Sony Play Station VR, Oculus Rift, Samsung Gear VR, Microsoft HoloLens.

In 2015, Samsung Electronics in collaboration with Cheil Worldwide launched the global Launching People compaign [2] aimed to help people cope with two main fears: public speaking and the fear of heights. Participants from many countries took a course using the Samsung Gear VR virtual reality glasses in order to see if the simulation of stressful situations in virtual reality helps them to cope with their fears in real life. At the end of the training, all 27 participants were ready to fully reveal their potential, and some of them subsequently even demonstrated their achievements in real life [3].

Game developer Nival released a 10-minute VR-game demo, intended for Oculus Rift virtual reality helmets. This VR game allows a player to make a journey through the patient's brains and treats mental disorders [5].

Virtual reality is also used in medicine [6] to help treating brain disorders: troubled thinking and perception disorders. SnowWorld is a very interesting program example, designed specifically for burn victims. Patients with severe burns are placed in virtual reality, where they walk along the snow-covered space and throw virtual snowballs.

3 VIRTUAL WORKPLACE DEVELOPMENT

The research laboratory of the Institute of Distance and Further Education of the Ulyanovsk State Technical University (UlSTU) has been developing virtual work places for the following specialties: a radio assembler, a radio fitter and a radio adjuster.

The developments use the virtual glasses HTC Vive. The HTC Vive includes a headset, a pair of hand-tracking controllers, and a pair of wireless base stations. The Vive headset has a built-in front-facing camera, due to which at any time, by pressing a special button, the user can look at the real world while still wearing the headset, and talk to the people in the room, looking at them on his/her virtual screen.

The Unity platform is used as the basic software. It provides the possibility of creating projects for virtual reality glasses, as it is shown in Fig.1.

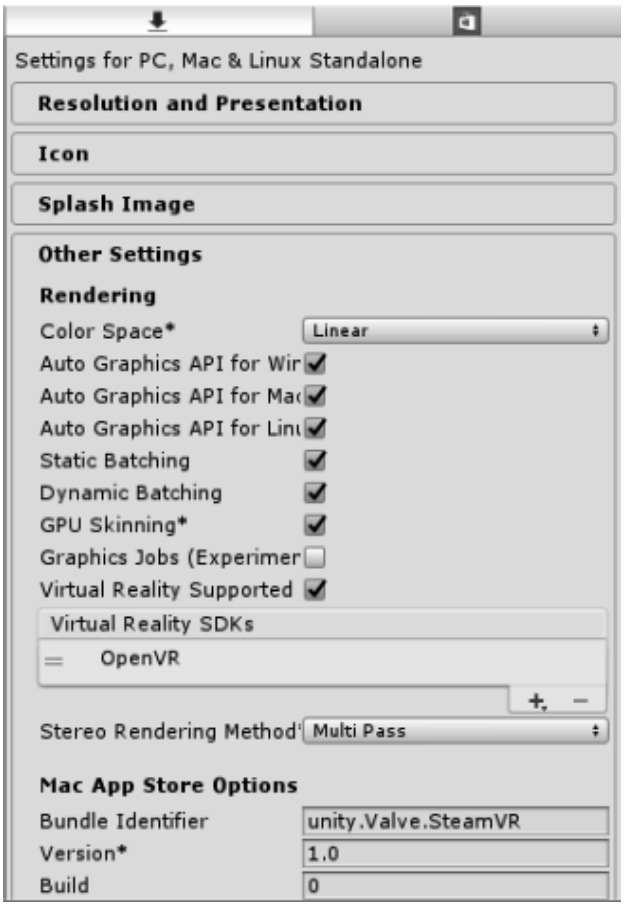

Figure. 1. Setting up virtual glasses for the Unity project: the Virtual Reality Supported option is enabled, OpenVR is added to the SDK list

In order to program operations of interaction between game objects and controllers, the SteamVR SDK software package is used. Its advantage is that it contains a game scene in which the possibilities of using the package are demonstrated. As a result, projects for virtual reality are developed and modified more quickly. The SteamVR SDK software package also contains a standard player object with customized camera and game controller settings. The key scenarios are:

- Interactable, containing the event handlers associated with touching the subject with the controller;
- Throwable, which processes the physical interaction of the object and the controller (this script automatically connects Interactable, Velocity Estimator and the Rigidbody component).

The structure of a sample unit in a VR-project is shown in Fig. 2.

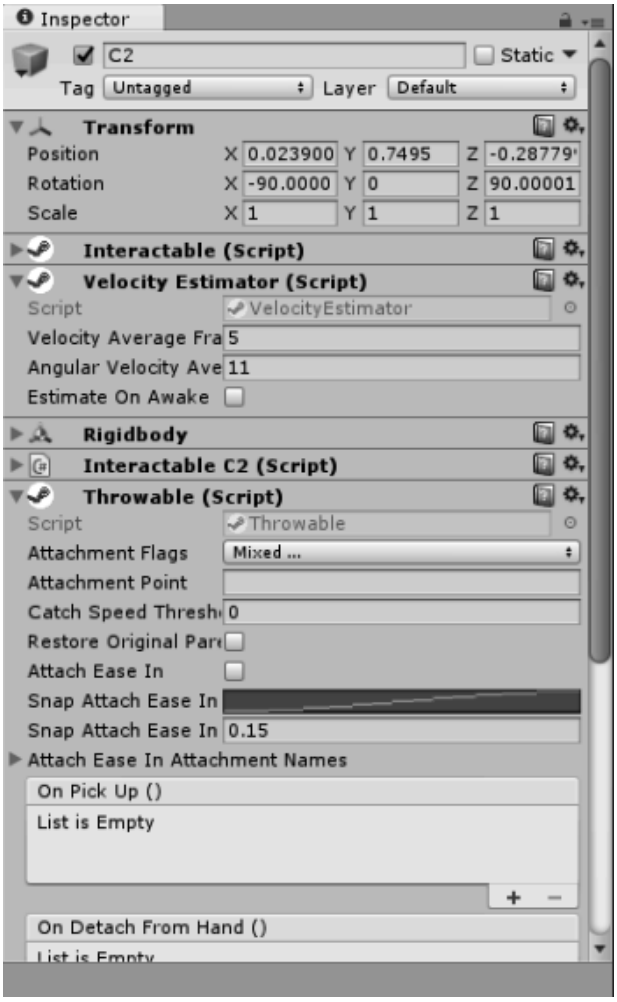

Figure 2. Basic components of game units in a VR-project

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4 THE EXPERT SYSTEM DEVELOPMENT FOR THE USER'S ACTION EVALUATION

In order to analyze trainee's actions, an ES was developed. It is a separate service that receives a record of trainee's actions, analyzes it and makes the necessary recommendations [2, 3].

The analysis of data is based on the production model of knowledge with a direct inference. This model allows us to present knowledge as the following type of sentences: "IF condition, THEN action1, OTHERWISE action2". The expert systems of the production type include a rule's (knowledge's) base, working memory and a rule's interpreter (solver) that implements a certain technique of logical inference. The direct inference realizes the strategy "from facts to conclusions".

Several examples of the expert system' rules are given below.

6 You cannot solder without a soldering iron. If you want to solder a part, take a soldering iron in your hand. The rule is defined as:

snap (0) .object_action = 'soldering' && snap (0).state.hand <> 'soldering iron' => puts "You cannot solder without a soldering iron. If you want to solder a part, take a soldering iron in your hand".

7 You can skip 2 steps if you set the voltage using a new value input instead of bitwise change. The rule is:

snap (-6).object='5' && snap (-6).action='click' && snap (-6) .state.shiftUp = true && snap (-6) .object == '1' && snap (-5) .object == '1' && snap (-3) .object == '2' && snap (-1) .object == '3' => puts '...'

The ES structure is shown in Fig. 3. The ES has a "Rule's editor" web interface for making, editing, deleting and checking rules.

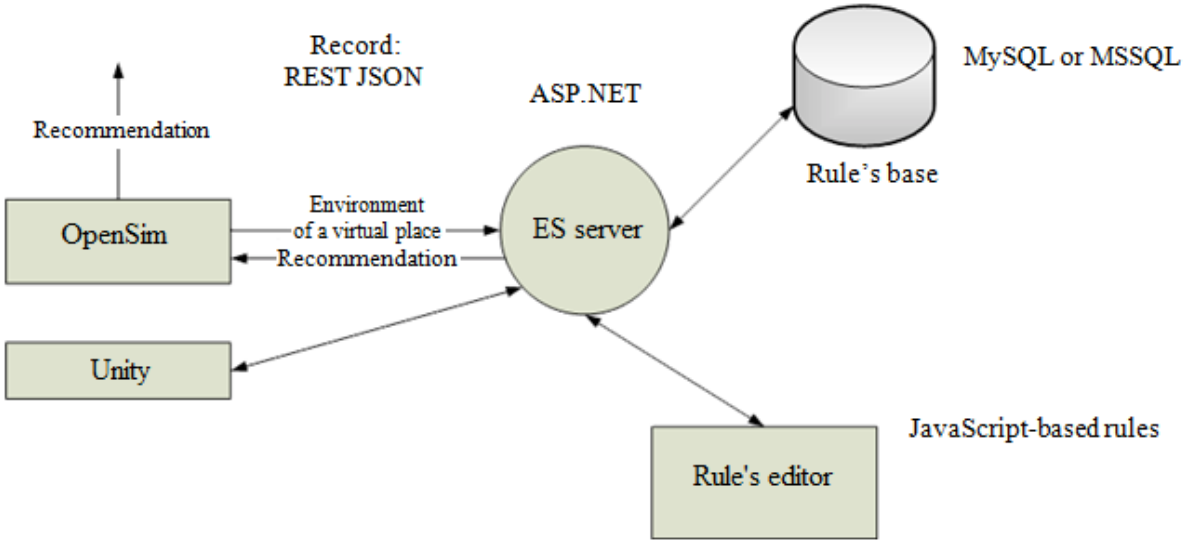

Figure 3. The structure of the expert system

A report of trainers' actions is generated during the work with the simulator. It consists of the current state of the simulator, the object with which a student interacted, and the type of interaction. The REST JSON-based report is sent to the ES server. The received data are analyzed via "Rule's base" module's rule, then a message with a list of recommendations is formed.

The mathematical support of the ES is universal and does not depend on the implementation of virtual workplaces. The introduction of ES allows educational institutions to reduce the training period by an average of 40%.

5 CONCLUSIONS

Virtual reality is not a new technology, the work on which began in the 60's and went into commerce in the 80's and 90's [8]. However, developments that seemed fantastic ten years ago are more than real today and already applicable in education. We are talking about the professional training of future specialists in the fields in which it is necessary to stereoscopically represent the learned or explored objects: from stereometry and three-dimensional graphics to aviation and cosmonautics.

The training curriculum based on virtual reality technologies are universal in the software and hardware context, they are easily "built into" the traditional educational process and allow educators to substitute real objects for their interactive simulation models that help trainees immerse themselves in a professional environment.

The College of Economics and Informatics of UISTU has adopted the developed virtual workplaces in practical training for students of radio engineering specialties. The use of such virtual workplaces has increased the motivation of students, the quality of technological process knowledge in radio assembly and adjustment of instruments and devices, and has reduced the training period of mastering operations on real equipment by 50%.

The UISTU partner enterprise uses the developed training complex as a part of the intelligent corporate educational environment to train its workers.

ACKNOWLEDGEMENT

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