Features of Virtual Reality Systems Development

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Abstract. The paper considers the process of creating educational virtual systems that can immerse the student in the subject area as much as possible. The possibility of developing a VR system in the context of project training of students is discussed. The results of the analysis of methods that allow effective development of modern educational environments are presented. During the experiment, it was found that the organization of VR system development is implemented by the SCRUM method most successfully. However, the methodology needs to be supplemented by the role of a game master – a specialist in training methods. The hypothesis that it is impossible to develop a high-quality educational virtual environment without the participation of a game master is confirmed. The main functions of the game master in the project activity are described.

Keywords: Educational game, VR-system, SCRUM, Game master

1 Introduction

The development of science and technology has a direct impact on learning tools. So, at the beginning of the last century, visual tutorials made on the large-format cardboard were relevant. With the development of cinema, educational films appeared: first black and white, then color. Further, educational programs became popular on television. The capabilities of high-performance GPUs and computer graphics enabled the development of educational resources at a different level. Video lectures, animated films, interactive three-dimensional workshops, virtual systems (VR-systems) and augmented reality systems maximize the visibility of information presentation. A new generation of learning tools allows you to immerse yourself in the world of the subject area, is able to simultaneously use the main organs of perception of information.

The virtual educational environment has a number of advantages:

- expands the student audience;
- increases the availability of educational materials;
- increases motivation;
- reduces training costs;
- reduces the cost of material support.

The first part of the article provides examples of 3D simulators developed for various scientific fields. The second part describes the features of developing educational VR systems at the University.

The purpose of this study is to identify the most effective method for developing educational VR systems in the context of training future developers.

2 Development of a VR-system in the educational process

The process of developing high-quality virtual reality educational resources in the University environment has its own characteristics. This paper considers not only the process of creating a virtual reality system, but also the process of training developers of VR-systems. The orientation of teaching towards experiments necessitates the creation of adequate environment and quality change for every component of the educational process in a way that reflect the development of science, technology, innovation and modern life values [1].

A virtual laboratory workshop on General Chemistry was developed at the Engineering School of Information Technologies, Telecommunications and Control Systems of the Ural Federal University. It is a simulator of a chemical laboratory (see Fig.1), in which the user can move around the entire working space, interact with objects located on tables and shelves, select and perform a laboratory work. The development of the virtual laboratory is described in detail in the article [2].

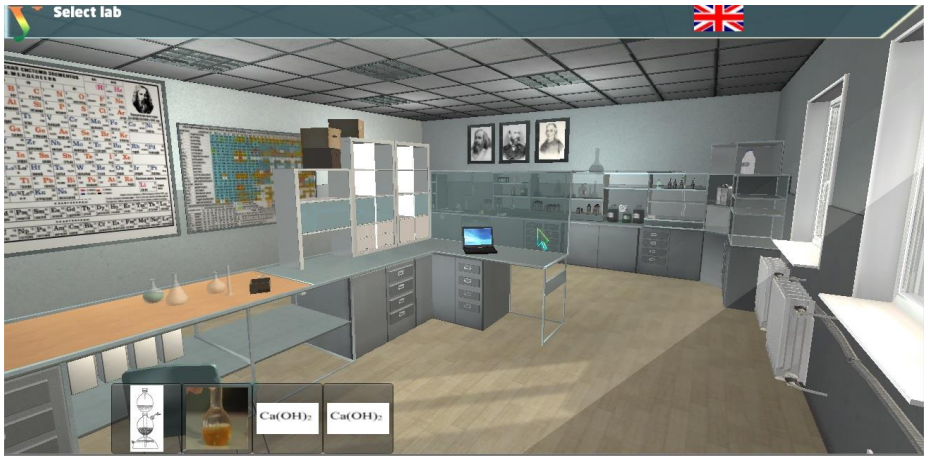

Fig. 1. Virtual chemical laboratory

The virtual laboratory simulates the interaction of chemical reagents and processes, and visualizes correct and erroneous user actions (see Fig.2). The work is considered completed if the goal of the laboratory work is achieved and the experiment is carried out correctly.

Fig. 2. Virtual chemical experience

To create a virtual chemical laboratory, the following tasks have been solved by the project executors:

1. The three-dimensional model of the chemistry laboratory has been developed.
2. The choice of laboratory works has been provided.
3. Free movement in the study of Chemistry has been implemented.
4. The ability to perform a set of chemical reagents and laboratory utensils required for a specific job has been created.
5. The users have been familiarized with the safety rules during chemical experiments.
6. The ability to perform chemical experiments has been implemented.
7. Automatic verification of the correctness of the experiment has been implemented.
8. The users are allowed repeating the lab work (a limited number of times).

The virtual lab is developed on Unity3D. Unity3D is a multi-platform tool for developing three-dimensional applications and games.

The created three-dimensional laboratory is available via the website and supports two languages: Russian and English. The implemented laboratory simulator allows you to virtually perform a laboratory workshop and learn the necessary skills distantly. Practice has shown that after working in a virtual environment, students work with reagents and laboratory utensils in a real laboratory correctly and accurately.

The paper [3] describes an intellectual complex created using modern 3D modeling technologies and infocommunication technologies. The main features of which are:

- integration of physical and 3D models of process equipment with a mathematical "plot" of their work processes;
- web-interface for automation of laboratory research report generation and provision of remote access to laboratory equipment;
- availability of 3D-simulators for working out the skills of personnel in emergency and contingency situations.

When performing a laboratory workshop in the course "Internet of Things" there was a problem of failure of microprocessor equipment after laboratory work. This problem was partially solved using the TinkerCAD graphical on-line editor (Autodesk). In this tool, there is a virtual simulator of work on the Arduino platform. The following tasks can be solved: assemble a circuit, develop an algorithm for the microcontroller, and perform testing (see Fig. 3). The main advantage of using the simulator is that the error does not cause damage to the real device and allows you to practice before performing work on a real microcontroller.

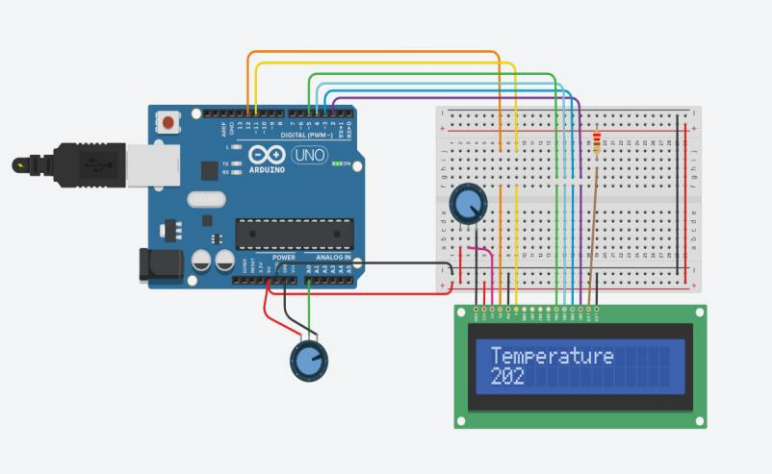

Fig. 3. Workshop in TinkerCAD (Autodesk)

However, not all necessary functions are implemented in the finished tool. The necessity of developing a more professional educational resource for simulating work with microelectronics is revealed. Similar needs arise when studying various branches of radio electronics, for example, when studying the theory of electric circuits.

Modern VR-systems in integration with educational tasks create conditions that allow students to prepare for solving urgent production problems.

3 Features of the development process

The development of realistic gaming applications in virtual reality format in the context of student groups has its own characteristics. On the one hand, the process is similar to the development of a computer game, and on the other, the development of an educational course. Hence, the hypothesis that it is impossible to develop a high-quality educational virtual environment without the participation of a specialist in teaching methods. As a result of the creation of several projects, the hypothesis was confirmed. A detailed study of the behavior of the virtual environment in its various states is required, it is required to monitor the time intervals of the user's presence in the virtual space and to record the educational results of the training. All this can be done by the game master - a specialist in the development and organization of educational games. The game

master, a new profession in the field of education, is included into the list of new professions in the atlas of emerging jobs. Specialist in developing and organizing educational games (business, history, science fiction, etc.) and game support with the use of simulators. The educational potential of games has been studied in developed countries since the 2000's (in 2001, MIT and Microsoft launched the joint project Games-to-Teach), while lately, gamification (application of game mechanics in non-game processes) has become a noticeable trend. In Russia, the development of educational games is promoted by the Russian Association for Games in Education. [4].

To create a project team for the development of educational VR-systems, you need an expert in the subject field, who creates an educational resource, a game master who possesses both the teaching methodology and technology for developing graphic applications. We need a team consisting of programmers, a 3D modeler, a system analyst, a test tester. In addition, a special organization of the educational product development process is needed.

The main stages of development of a virtual educational environment are the following:

1. To find a product owner
2. To find an expert subject.
3. To find a development team.
4. To choose development tools.
5. To develop a virtual environment in accordance with the requirements of the teacher and expert.
6. To perform product testing.

In the case, when the system is developed as a training project, it is necessary to choose a development method. There are not many team methods for developing program training. They include: Rational Unified Process, Agile, SCRUM, CMMI for Development.

It has been experimentally established that the organization of the development of a VR system is implemented by the SCRUM method most successfully [5]. In this method, each iteration of the project may be represented as a chain: planning - fixing - implementation - analysis. Due to the fixed requirements for one iteration, as to the phase of the project, as well as the lengths of the iteration, it is possible to manage the balance of flexibility and development planning effectively [6]. Unlike the classical SCRUM methodology, the roles of an expert and a game master are introduced in an educational project, one of which may be the owner of the product. The diagram of the interaction of development participants is presented in Figure 4.

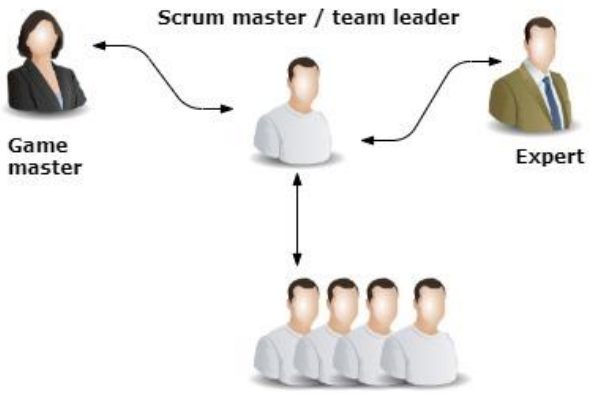

Fig. 4. Interaction of project participants

4 Conclusion

The described scenario may be implemented in the conditions of project training using the SCRUM method with the involvement of a specific specialist - a game master. The game master is able to perform the deep methodological study of the human behavior in the virtual environment, to foresee and implement all possible interactions of a student with elements of the virtual space.

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