УДК 004.946
https://doi.org/10.47533/2024.1606-146X.28

G. N. KAZBEKOVA*, K. M. BERKIMBAYEV, N. M. ZHUNISSOV

Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkistan, Kazakhstan
*e-mail: *gulnur.kazbekova@ayu.edu.kz*

THE USE OF VIRTUAL ENVIRONMENT IN EDUCATION

The rapid development of virtual and augmented reality technologies is currently taking place in almost all spheres of a life. Elements of virtual and augmented reality are used in such areas as education, medicine, transport, gaming, tourism and others. The active spread of these technologies causes the emergence of special competencies in the IT labor market and, as a result, the formation of new professions.

Many universities train students in the field of information technology. Recently, profiling of readiness for the development of virtual reality applications and computer games has begun. The provision of practical classes is accompanied by specific real time tasks, which gives students the opportunity to improve their skills in the use of software and technological devices.

The relevance of the research is determined by the current demand for the use of the latest technologies by IT developers in the field of creating computer games. Today, technologies that provide a player's immersion in virtual reality are becoming more and more popular. One of these technologies is a suit with wearable sensors that track a person's position in space in real time. However, there are quite a few real described projects in the literature and on the Internet.

This study examines the process of developing a task for creating a game application using virtual reality technology: a suit with wearable sensors for teaching students.

Key words: *computer games, IT, virtual reality, augmented reality, suit with body sensors, VR, AR, IMU sensor*

Г. Н. КАЗБЕКОВА*, К. М. БЕРКИМБАЕВ, Н. М. ЖУНИСОВ

Международный казахско-турецкий университета имени Ходжи Ахмеда Ясави,
Туркестан, Казахстан
*e-mail: *gulnur.kazbekova@ayu.edu.kz*

ПРИМЕНЕНИЕ ВИРТУАЛЬНОГО ОБУЧЕНИЯ В ОБРАЗОВАНИИ

Развитие технологий виртуальной и дополненной реальности в настоящее время происходит практически во всех сферах деятельности. Элементы виртуальной и дополненной реальности используются в таких сферах, как образование, медицина, транспорт, гейминг, туризм и других. Активное распространение этих технологий вызывает на рынке труда IT-сферы появление особых компетенций.

Многие университеты готовят студентов по направлениям подготовки в области информационных технологий. Недавно началась специализация обучения по разработке приложений виртуальной реальности и компьютерных игр. Проведение практических занятий сопровождается конкретными заданиями, что дает студентам возможность совершенствоваться в использовании программного обеспечения и технических устройств.

Актуальность исследования определяется текущим спросом на использование новейших технологий IT-разработчиками в области создания компьютерных игр. Сегодня технологии, обеспечивающие погружение игрока в виртуальную реальность, становятся все более популярными. Одной из таких технологий является костюм с носимыми датчиками, которые отслеживают положе-

ние человека в пространстве в режиме реального времени. Однако в литературе и в Интернете существует довольно много реальных описанных проектов.

В данном исследовании рассматривается процесс разработки задачи по созданию игрового приложения с использованием технологии виртуальной реальности: костюма с носимыми датчиками для обучения студентов.

Ключевые слова: *компьютерные игры, IT, виртуальная реальность, дополненная реальность, костюм с нательными датчиками, VR, AR, IMU датчик.*

Г. Н. КАЗБЕКОВА*, К. М. БЕРКИМБАЕВ, Н. М. ЖУНИСОВ

Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті,
Түркістан, Қазақстан
*e-mail: *gulnur.kazbekova@ayu.edu.kz*

ВИРТУАЛДЫ НАҚТЫЛЫҚ АРҚЫЛЫ ОҚЫТУ

Виртуалды және толықтырылған шындық технологияларының қарқынды дамуы іс жүзінде барлық қызмет салаларында орын алуда. Виртуалды және Толықтырылған шындық элементтері Білім беру, медицина, көлік, ойын, туризм және т.б. сияқты салаларда қолданылады. Бұл технологиялардың белсенді таралуы еңбек нарығында ерекше құзыреттердің пайда болуына және соның салдарынан жаңа мамандықтардың қалыптасуына себеп болады.

Көптеген университеттер студенттерді оқытудың IT бағыттары бойынша дайындайды. Виртуалды шындық қосымшалары мен компьютерлік ойындарды әзірлеуге дайындықты профильдеу соңғы уақытта басталды. Практикалық сабақтарды қамтамасыз ету нақты тапсырмалармен қатар жүреді, бұл студенттерге бағдарламалық жасақтама мен техникалық құрылғыларды пайдалануды жақсартуға мүмкіндік береді.

Зерттеудің өзектілігі IT-әзірлеушілердің компьютерлік ойындар жасау саласындағы жаңа технологияларды қолдануына заманауи сұранысқа байланысты. Бүгінгі таңда ойыншыны виртуалды шындыққа ендіруді қамтамасыз ететін технологиялар танымал бола бастады. Осындай технологиялардың бірі-адамның нақты уақыттағы кеңістіктегі орнын бақылайтын дене сенсорлары бар костюм. Алайда, әдебиетте және интернет желісінде нақты сипатталған жобалар аз.

Бұл зерттеу виртуалды шындық технологиясын қолдана отырып, ойын қосымшасын құру бойынша тапсырманы әзірлеу процесін қарастырады: студенттерді оқытуға арналған дене сенсорлары бар костюм мысалға алынған(VR).

Түйін сөздер: *компьютерлік ойындар, IT, виртуалды шындық, толықтырылған шындық, дене сенсорлары бар костюм, VR, AR, IMU сенсоры.*

Introduction. There are very few real studies of virtual reality in pedagogy and psychology, especially with regard to didactics and the practice of educational influences. Of course, one of the main reasons for this is the complexity, high material costs of these studies not only in our country, but also abroad. A.E.Voiskunsky, emphasizing the need to expand the use of virtual reality (VR), wrote: "A large number of tasks are facing the psychology of learning, or pedagogical psychology. Currently the ways of organizing training, including professional and group, in a virtual environment are only being groped..." [1].

Since the invention of the prototype of the virtual helmet (video helmet) by Ivan Sutherland (Ivan Sutherland) in 1966, ideas about creating "fictional" or virtual worlds appeared. The term "virtual reality" (VR) in programming was used by Jaron Lanier in 1989, this concept has many meanings: from working on the Internet to creating immersive

3-D information environments with the help of complex technological devices – helmets, virtual reality, rooms, sensors, trackers, gyroscopes, servo suits, etc. In pedagogy, VR is mainly used as a special information space where a student can get certain information, make contacts, elements of scientific, educational and project activities. For example, the experience of creating a virtual museum-library, which presents scientific works, articles, creative materials, photo and video materials, memoirs of scientists in different historical periods, modern interactive information resources (forums, video conferences, interactive models, training courses) [2]. The creation of such information resources (such as "databases") with elements of interactivity is a significant direction of modern education, allowing students to master the modeling of ideas of scientists and scientific directions.

Virtual Reality Content. Research methods. In our study, the essence of virtual reality is understood to a greater extent in the traditionally cybernetic (software) sense and is consonant with the opinion of S. Karelov [3]. The essence of VR is reduced to the following main characteristics:

1) creation by means of programming of three-dimensional images of objects as close as possible to real ones, models of real objects similar to holographic ones;

2) the possibility of animation (a subject in virtual space can move, look at an object from different sides, "fly" in the universe, "move" inside a biological cell and etc.);

3) parallel data processing carried out in real time (the actions of the subject, for example, his movements, changing the tilt of the head, changing the image of the object, etc.);

4) the creation of a presence effect by means of programming (a person feels the illusion of assistance in an artificially created information reality with objects and/or subjects).

In general, virtual reality is a technology of human-machine interaction that provides user immersion in a three-dimensional interactive information environment. It should be noted that the objects of this environment are not just qualitatively drawn three-dimensional pictures (scenes), they have certain properties similar to real objects and manifest themselves when interacting with other virtual objects. For example, you can set the density of the material and other characteristics, so if you throw a virtual ball into virtual water, it will float…

In this sense, we do not adhere to the interpretation of virtual reality which S.S.Horuzhnev gave. He says that VR is an "unborn being", i.e. some incomplete, defective [4], although such a moment is present in virtualism. VR acts simply as a special, separate, informational reality, which is designed to simulate ordinary reality. Depending on the goals of the researcher, appropriate properties are introduced into the virtual environment, this determines the degree of saturation of VR, but, of course, it does not fully reproduce the parameters of the objective world (to which the human psyche also belongs).

It should be noted that the VR in question is closely related to psychological developments in the field of visual, tactile, auditory perception, based on them and models the polymodal nature of human perception and the system structure of intelligence (starting with a mental image, working memory, perceptual hypotheses, actions, in general, - a perceptual event or system [5]. A.E. Voiskunsky writes: "Virtual reality (VR), created by visualizing three-dimensional objects using computer graphics, animation and programming methods, is a product of not only information, but also psychological technologies" [6.7]. Probably, for the first time, the influence of super-images created with the help of the Z 800 3D

Visor helmet on human thinking was studied, VR methods were singled out as methods of psychological science [6, 7]. Today, in most of the extremely few VR developments in our country, the authors support the fact that VR technologies act as methods, means and methods of studying and forming psychology [8, 9, 10, 11, 12].

Is it possible to use VR in pedagogy, in particular, in didactics? To date, we do not know of any systematic developments in this area. The publications that exist are of an overview, theoretical nature, in which the possibility of using VR technologies in education is recognized as appropriate. This position is legitimate, although it requires some comments.

1. VR technologies that are currently used in teaching are environmentally friendly, as a rule, even more environmentally friendly than those traditionally used multi-media tools. For example, in our experiments, the Z 800 helmet, in which two monitors placed directly to the eyes consist of an oled material that does not emit any particles at all (except photons of light) and the image is created by changing the crystal lattice of the screen (even liquid crystal computer monitors have, albeit insignificant, radiation), is used.

2. It is common to treat VR with caution, because it is identified with a special world that "takes" the subject away from the real reality, forms virtual addiction, etc. It is necessary to note the brilliant comparative analysis conducted by A.E. Voiskunsky regarding the difference between altered states of consciousness and the state of presence, the basics of VR [7]. A.E. Voiskunsky showed that staying in VR, unlike state of consciousness (caused by hypnosis, chemicals, etc.), does not cause inadequacy of thinking, does not reduce the degree of reflection, is not characterized by the presence of a sense of duality, "alienation of one's own self", "exit from the body", "separation of the body and souls", does not lead to the loss of arbitrariness and purposefulness of activity, does not provide a sense of fictitious acquisition of an interlocutor, a sense of the presence of "another", "higher intelligence", "cosmic informational will". These and other features of VR indicate its advantages (in relation to the traditional, desktop-printed presentation of the content of education), the possibility of using skills in training, education, and other areas, starting from primary school age.

Virtual reality as a tool and technology of learning. VR, in our opinion, also can be considered to be learning tools. In the classical sense, teaching tools are didactic tools of the teacher and student, educational equipment, visual aids [10]. These tools are information carriers that implement learning goals. In this regard, VR involves rather complex technical devices, special equipment, therefore, devices for the implementation of VR are considered as a tool. Unfortunately, to date, there are few training programs in a real virtual environment. This is the reason why virtual reality formally has not yet become a learning tool in the full sense of the word. According to the classification of teaching aids by S.G. Shapovalenko, (natural objects, images and displays, descriptions and TTT – technical training tools), VR is obviously included in the TTT. These provisions relate to the narrow meaning of the concept of "learning tool".

Currently, in pedagogy, especially in the theory of education, it is quite an original approach, where the learning tools are interpreted in a broad sense. For example, work (as an activity) can act as an instrument of personality formation, i.e. education. This happens when labor activity is used not so much for the production of consumer goods, but primarily as an educational instrument which influences on the formation of personality: at the same time, the analysis of labor results is carried out, the determination of ways to correct mistakes made by students in work, reflection on ways to create more perfect products [11]. In this approach, the educational tools are various types of activities (play, study, work, communication), without which it is impossible to form certain personal qualities of the students, which are the subject of the educational process. Therefore, the tool is not so much the material object itself used in the process of education, but the activity of the students, in which this subject is included.

It is the nature of the student's activity with a particular subject causes him to have certain experiences, feelings and relationships. These experiences and relationships, generalizing, become the basis of character traits, will, personal and subjective qualities. It turns out that the pupil's activity is a means of another, more general activity – educational activity.

With this understanding of the tools of learning, VR also refers to the tools of learning. Work in VR can be considered as a certain type of activity, the subject of this activity is information or information models of real situations. Such activity is not identical to the student's activity with real objects. Probably, the greatest didactic effects will be achieved using the most sophisticated equipment. These are VR - CAVE rooms, consisting of several screens arranged in the shape of a cube, on which images are projected, a student, wearing special glasses, enters the room and sees nothing but the virtual objects surrounding him, which creates the effect of maximum presence. Interpretation of VR as an activity that implements didactic goals, involves training programs for creating avatars – information models in the VR of a person's body or its parts with which he identifies himself and can control them [9,10]. In teaching, this is used inefficiently so far, for example, in distance education, learning environments for joint communication are created, like lecture halls, where each student has his own avatar, which can be set to execute commands - raising his hand, going to the blackboard for an answer or nodding his head [11,12]. Similar VR training systems look like while naive.

Thus, it is advisable to refer to the tools of teaching, on the one hand, as various types of activities (gaming, educational, labor, etc.), and on the other hand, as a set of objects and works of material and spiritual culture involved in pedagogical work (visual aids, works of literature, technical devices, etc.) [11]. Didactic VR programs act as teaching tools in both guises and senses.

VR, used for pedagogical purposes, is also educational technology. Educational technology is a system, a sequence of actions aimed at realizing the goals and objectives of educational concepts. We agree with the opinion of V.I. Zagvyazinsky that, unlike the methodology, educational technology is built as a rigid algorithm of actions, prescriptions that ensure a guaranteed effect, the realization of the goal [8]. Actions within the training programs created by us in genuine VR, have a strictly defined sequence, are aimed at mastering the content education, guaranteed to lead to concrete results. However, the training programs have not yet been designed into a full-fledged technology. If we take into account all the main criteria of educational technologies: consistency, reproducibility and guarantee of results, the presence of feedback, then the last of the signs has not yet been implemented in didactic VR systems. In particular, there is a lack of a control algorithm. This disadvantage, however, is quite easy to overcome, and in VR it can be implemented at the highest instrumental level.

The influence of didactic programs in virtual reality on human thinking and mental states. Earlier, we obtained experimental data that VR images, when they are included as content, a component of the task, significantly affect the increase in creativity (the number of collaterals), and stimulate the procedural characteristics of thinking. There are both direct and indirect forms of interaction between the figurative and cognitive spheres of intelligence, the intermediary in this interaction is the thought processes of analysis, synthesis, generalization [26].

In these programs, the callouts have become much more dynamic, the possibility of animation has been expanded significantly.

All the objects in these training programs are made in 3D, a multiplatform tool for developing three-dimensional applications "Unity" was used for animation. The programmer is V.P. Titov, one of the first to use Unity not to create games, but to implement didactic programs.

As part of the study, the possibilities of a suit with wearable sensors were tested when creating an entertainment application in order to form practical tasks for students.

As a result, a practical task "Implementation of a computer game using a suit with body sensors" was formed and an algorithm for its implementation was proposed:

1. Creating a new game project, game scenario.
2. Character customization.
3. Development of game objects.
4. Assembly.

Below is an example of a task. The game being developed should be a linear level, during which the player standing on the platform will move towards the finish line. Game objects with a certain reaction to interaction with the player will be located on the player's path. The player's goal is to get points by interacting the sword with game objects. The sword will be located in the player's right hand. Along with collecting points, the player's goal will be to protect and evade other game objects, when interacting with which the player will lose points and health points. To protect against some game objects, the player will use a shield attached to his left hand. At the end of the gameplay, the finish line will be located, when interacting with which the game ends and the final score is displayed on the screen. The highest score value is remembered by the game and displayed on the screen as a record result. For clarity, we will display the game process in Figure 1.

Fig. 1 – Diagram of use cases for the game process

Let's describe the use cases for the player. Use cases are presented in Table 1,2.

Table 1

Application use cases

Acting person	Use case
Player	Collecting points First aid kit collection Touching the wall Rocket Touch Neutralization of the missile Touch Finish Loss

Table 2

Example of use case 2

Use case No.	Use case 1
Title	Collecting points
Acting person	Player
Prerequisites	On the player's path there are objects, for touching which the player receives points
	The player does not have zero health points
Output conditions	Some value is added to the current scores
Normal direction	The player gets closer to the object Touches an object with a sword The object is being destroyed The player is awarded points
Priority	Tall
Frequency of use	About 20 objects on the game level

Results. Let's consider the process of forming a computer game. The development was carried out on the Unity game engine version 2019.4.21f1 using Perception Neuron Unity Integration 0.2.19. The Perception Neuron motion capture system for transmitting information about the position of the suit is connected to the official ACCORDING to Axis Neuron [10], where motion sensor data is processed. If necessary, the received data can be redirected to other software, in our case it is the Unity development environment.

1. Creating a scene. Traditionally, as in any software environments for a new project, in our case scenes, in Unity Hub we select the New button. Select the type of project and give it a name. After creating the project, an empty scene will open, we use the selected development package containing scripts, models and much more by Axis Neuron [10].

2. Connecting the suit. At this stage, the suit should be connected using Axis Neuron data transfer protocols. After applying these settings, Axis Neuron software will be able

to transmit data about the position of the suit to the Unity development environment. This completes the setup of the working environment [11].

3. Character customization. To create a 3D humanoid model character, a model from the Perception Neuron development package was used. Next, the Neuron Animator Instance. CS component was applied to refine the settings. In order for our model to interact with other objects, we connected a Collider component for each individual part of the body [12]. Figure 2 shows an example of the resulting character.

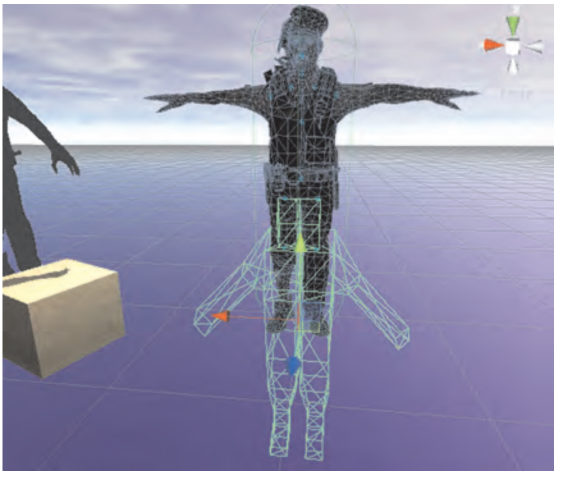

Fig. 2 – Model with Collider components

4. Development of game objects. For drawing game objects, you can use, for example, Blender or 3D-max software.

5. Assembling. If there are already created elements, they can be taken from other projects by importing. Depending on the complexity of a given game scenario, several costumes may be involved, additional sensors and virtual reality glasses may be connected. Integration with various software has been carried out.

The application being developed as part of the laboratory work by students will demonstrate the main capabilities of the costume for creating entertainment elements on the Unity 3D game engine.

A potential user of the application being developed should be provided with free access to the product at a convenient time for him, The main criterion for success may be statistics on views and downloads of implemented application projects, for example, on the platform of the official Unity 3D store. This will indicate an interest in using such technology as a suit with neural sensors.

Placement in the official store will allow the user, if necessary, to purchase additional game components for Unity, such as 3D models, sounds, UI kits, shaders, particles, and more. When visiting the application page and uploading it to their storage, the user will be able to import the necessary components to their project and use them already for their own development.

Students will be able to develop their competencies in this area and start offering their business solutions not only in game development.

Conclusion. The research was carried out as part of laboratory work by students, as well as at a real enterprise as a project in order to gain experience.

The proposed version of the practical task of developing a game application using a suit with IMU sensors establishes the competence of selecting and configuring software, using technical devices, structuring and programming game elements.

Based on the research materials, it is planned to write a textbook on the use of VR/ AR technologies, a suit with wearable sensors for the development of gaming applications or a multimedia training system for students in the field of IT. It is planned to train students in other fields and in the framework of additional training programs.

REFERENCES

1 Smolin A.A., Zhdanov D.D., Potemin I.S. et al. Sistemy virtual’noy, dopolnennoy i smeshannoy real’nosti = Systems of virtual, augmented and mixed reality [Internet]. Saint Petersburg: NIU ITMO; 2018. 59 p. Available from: https://e.lanbook.com/book/136468. (In Russ.)

2 Torn A. Osnovy animatsii v Unity = Fundamentals of animation in Unity [Internet]. Tr. from Eng. R. Ragimova. Moscow: DMK Press; 2016. 176 p. Available from: https://e. lanbook.com/ book/73075. (cited 10.10.2021). (In Russ.)

3 Larkovich S. N. Spravochnik UNITY. Kratko, bystro, pod rukoy = UNITY Handbook. Briefly, quickly, at hand [Internet]. Saint Petersburg: Science and technology; 2020. 288 p. Available from: https://e.lanbook.com/book/175387. (In Russ.)

4 Kornilov, A. V. Unity. Polnoye rukovodstvo = Unity. Complete guide [Internet]. Saint Petersburg: Science and technology; 2020. 432 p. Available from: https://e.lanbook.com/book/175394 (cited 10.10.2021). (In Russ.)

5 Rebus N.A., Romanova Ye.V., Kan D.V. The use of game mechanics in training systems. Distantsionnyye obrazovatel’nyye tekhnologii. Materialy II Vserossiyskoy nauchno-prakticheskoy internet-konferentsii = Distance educational technologies. Materials of the II AllRussian Scientific and Practical Internet Conference. 2017: 68-74. (In Russ.)

6 Dzhonatan L. Virtual’naya real’nost’ v Unity = Virtual reality in Unity [Internet]. Tr. from Eng. R.N. Ragimov. Moscow: DMK Press; 2016. 316 p. Available from: https://e.lanbook.com/ book/93271. (In Russ.)

7 Ostroukh A.V. Sistemy iskusstvennogo intellekta = Systems of artificial intelligence [Internet]. Saint Petersburg: Lan; 2021. 228 p. Available from: https://e.lanbook.com/book/176662. (In Russ.)

8 Dikinson K. Optimizatsiya igr v Unity 5 = Optimization of games in Unity 5 [Internet]. Moscow: DMK Press; 2017. 306 p. Available from: https://e.lanbook.com/book/90109. (In Russ.)

9 Gavrilova I.V., Maslennikova O.Ye. Osnovy iskusstvennogo intellekta = Fundamentals of artificial intelligence [Internet]. Moscow: FLINT; 2019. 283 p. Available from: https://e.lanbook. com/ book/115839. (In Russ.)

10 Borovskaya Ye.V., Davydova N.A. Osnovy iskusstvennogo intellekta = Basics of artificial intelligence [Internet]. Moscow: Laboratory of Knowledge; 2020. 130 p. Available from: https://e. lanbook.com/book/151502. (In Russ.)

11 Chusavitina G.N., Davletkireyeva L.Z. Analysis and establishment of the maturity level of the organization’s information infrastructure for business continuity management. Sovremennyye informatsionnyye tekhnologii i IT-obrazovaniye = Modern information technologies and IT education. 2012; 8: 529-544. (In Russ.)

12 Mike Walker. Hype Cycle for Emerging Technologies, Gartner Group, 2017. Virtual Expertise at Real Disposal. Metals & Mining. 2009; 3: 100-114. Available from: https:// www.gartner.com/ smarterwithgartner/toptrends-in-the-gartner-hype-cycle-for-mergingtechnologies -2017.