DEVELOPMENT OF A MOBILE APPLICATION FOR STUDYING PHYSICS USING AUGMENTED REALITY TECHNOLOGY

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Abstract - This article discusses the relevance of the use of mobile applications in the organization of the educational process in technical universities. There are own training developments using new information technologies. The conclusions about the use of new technologies in the study of physics are provided.

Keywords - Physics, Augmented Reality, education, virtual physical laboratory, Unity.

I. INTRODUCTION

Today it is difficult to imagine our life without information technologies (IT). They become an important part of our daily life, greatly simplifying some of its moments. Moreover, this integration is increasing day by day. With the development of IT, we are gaining access to an ever-increasing number of new tools that speed up, reduce the cost and make some everyday processes more convenient. These are mobile devices and tablets.

Mobile technologies have steadily entered our lives. They dramatically improve both production processes and information consumption processes. The use of mobile technology allows to be aware of all the events in the world, making for this a minimum of effort. In education, the prospects for the use of mobile technologies are broad, ranging from mobile applications to the organization of the learning process, to applications used specifically in the framework of subjects. So, for the development of new methods of teaching using mobile technologies, recently augmented reality has been actively used, which allows visualizing various objects, phenomena and processes by introducing virtual components into the real environment.

It is known that the human brain is more able to processing visual images than plain text. There are many studies on this topic [1, 2], which show that the technologies of augmented reality in the field of education enrich visual and contextual learning, improving the content of information. If, while listening to lectures, 25% of information is retained in short-term memory, then with visual training it is 80%. In this regard, it can be noted that the use of training systems with elements of augmented reality at any level of education will positively affect the learning and understanding of the material by students.

In Kazakhstan, the International Information Technology University, which is the leader in Central Asia in training highly qualified, internationally recognized IT experts for the region, has extensive experience in developing software applications using new technologies. For example, in the discipline "Physics" classes are conducted using augmented and virtual reality technologies. Additional training tools such as virtual labs, 3D animations, educational mobile applications developed by university teachers and students are used.

For example, a virtual laboratory consists of laboratory work in such areas of physics as mechanics, dynamics, thermodynamics, hydrodynamics, electricity and magnetism, optics, atomic and quantum physics [3, 4]. This complex works in three languages (Kazakh, Russian, English), contains a theoretical description, a virtual experiment and a test of knowledge with multiple choice answers.

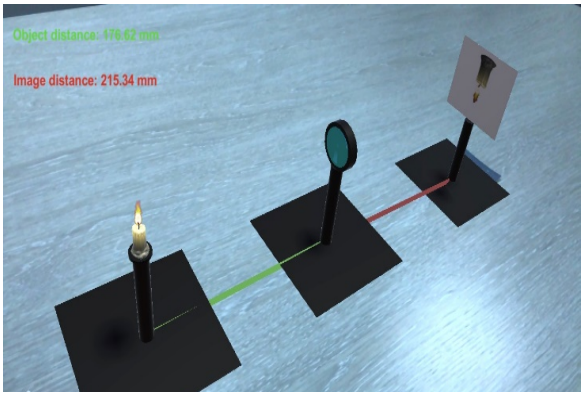
The developed mobile application for the courses “Physics-1” and “Physics-2” is implemented for devices running the iOS operating system and allows to study the theory of laboratory work, the experimental setup scheme, test knowledge by answering questions, communicate with the teacher via chat, and also have access to social networks

Another development is an electronic textbook, which is an additional material for self-study students of the discipline "Physics". This textbook presents theoretically material, tasks, tests, video tutorials and animations. Thanks to the use of hypertext, an electronic textbook reduces the time for searching and learning educational material at times. The electronic textbook also contains thematic and training tests for self-control. A feature of the developed electronic textbook is the regular update of its content and test questions.

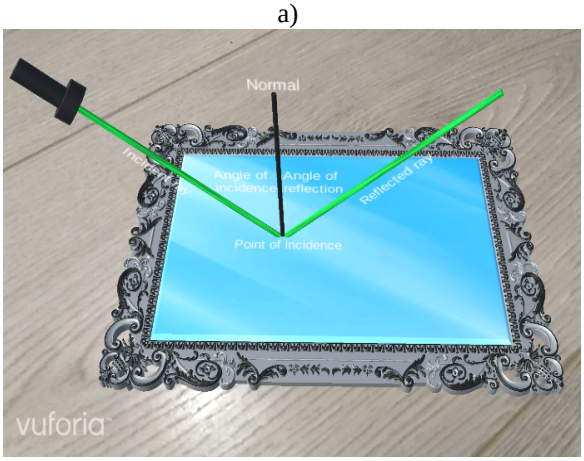
This article presents a mobile application using augmented reality technology to study physics. The virtual laboratory developed by the authors allows solving problems and observing the course of the experiment when changing the initial parameters, performing laboratory work, watching animations and testing knowledge with the help of test questions.

II. RESULTS

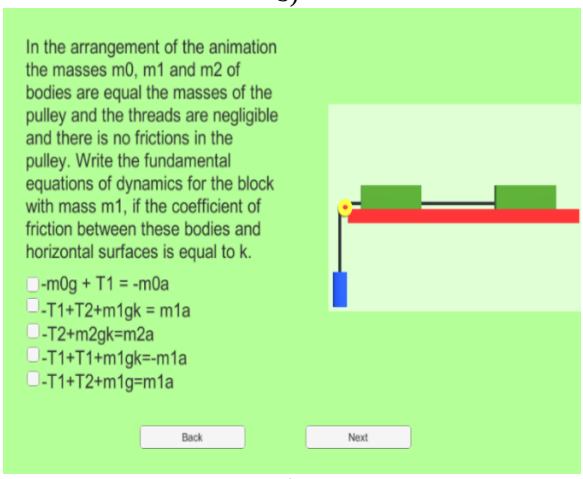
Figure 1 shows a mobile application using augmented reality technology with a set of practical tasks, experiments, animations and test questions in physics. The user is given the opportunity to move in the task space and observe its imitation from any positions or viewing angles, which in turn improves the perception and assimilation of the studied material. Such an application of augmented reality has a positive effect on the motivation, attention, concentration and discipline of students. It is also possible to test knowledge using tests with multiple choice answers.



a)



b)



c)

Figure 1 - Example of a mobile application using augmented reality technology (a) laboratory work, b) animation, c) test

As a software environment, a graphical tool was used to develop three-dimensional Unity3D applications [6], which is a cross-platform computer game development environment from Unity Technologies. It allows you to create virtual reality applications running on personal computers, mobile devices with iOS and Android operating systems, in Internet applications. Unity Editor has a simple Drag & Drop interface that is easy to configure, consisting of various windows, so you can debug the game directly in the editor. The engine supports two scripting languages: C #, JavaScript. Physical calculations are made by the PhysX physics engine from NVIDIA.

As a library for the implementation of the functions of augmented reality, the Vuforia library [7] was chosen due to qualities such as crossplatform, free work, tracking of 3D objects, visual search. The Vuforia library makes it easy to scan targets with the integrated Vuforia Object Scanner. It is also possible to enable virtual buttons and map additional elements using OpenGL. Cross-platform allows you to work on different platforms, which means a wider audience coverage and usability of the program.

In general, the operation of the application can be described using the following UML diagrams. The application consists of the components shown in Figure 2. It shows the structure of the application. The main component is the Main Launcher, which launches the camera and many scripts necessary for the application to work. The scripts are located in the Assets component, where you can also find models, prefabs, and other necessary resources.

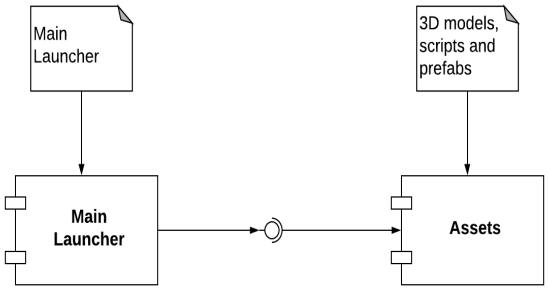


Figure 2 - Component Diagram

An example of user interaction with an application can be described by the example of performing a virtual laboratory work “Determining the focal length of a thin lens”. The use case diagram in Figure 3 describes the possible actions taken by the user. Three markers are required to complete this lab. When they are seen in the visibility zone of the camera, the following three-dimensional objects will be built on the screen of the mobile device: lens, candle, white paper. Depending on the location of each marker, the application draws an image of a candle through the lens on a virtual paper object. The distance x from the object to the lens and y from the lens to the reflection will also be displayed on the screen. As the marker moves, the x and y values, as well as the marker display, will change in real time.

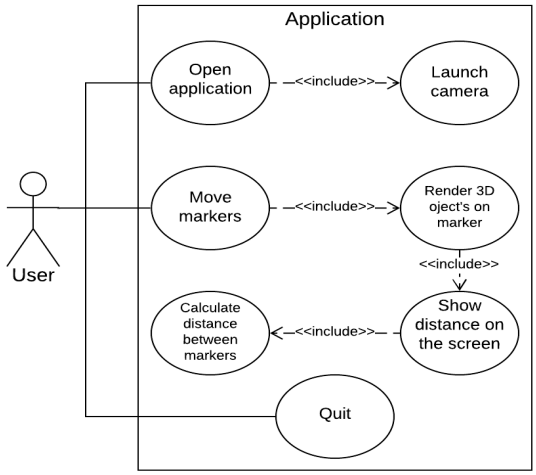


Figure 3 - Case Chart

Thus, when performing this virtual laboratory work, the user is given the opportunity to study the image building process, check the thin lens equation and independently carry out the calculation to determine the magnification of the resulting image.

CONCLUSION

Many foreign researchers call the technology of augmented reality one of the main trends in education in the next decade; therefore, domestic universities and schools should not stand aside. Today, the technology of augmented reality in education is at the stage of formation, therefore, analyzing foreign and already existing domestic experience, it is necessary to actively implement them in educational processes at all levels. Currently, the authors are constantly working to expand the functionality of the developed mobile application in the direction of creating new virtual laboratory works and physical animations and integrating them into the laboratory.

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