Embedded Selforganizing Systems

Prospects for the use of Augmented Reality in Education

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Abstract-- **Augmented Reality (AR) is an emerging form of experience in which the Real World (RW) is enhanced by computer-generated content tied to specific locations and/or activities. Over the last several years, AR applications have become portable and widely available on mobile de-vices. AR is becoming visible in our audio-visual media (e.g., news, entertainment, sports) and is beginning to enter other aspects of our lives (e.g., e-commerce, travel, marketing) in tangible and exciting ways. The aspects of the use of augmented reality technology in the system of higher education are considered. The findings reveal an increase in the number of AR studies during the last four years. The most reported advantage of AR is that it promotes enhanced learning achievement and also of interest to the younger generation Some noted challenges imposed by AR are usability issues and frequent technical problems. The advantages and limitations of using this technology are given. The prospects for the use of augmented reality technology in the educational environment are considered.**

Keywords-- innovative education, Virtual Reality, Augmented Reality, interactive technologies, mobile applications.

I. INTRODUCTION

In modern society, a favorable situation is gradually emerging regarding the integration of innovative information and communication technologies into the educational process. Teachers and students are fluent in the basic skills of using cloud text editors, as well as various presentation services. But the latest technologies appear daily, and the task for the teacher is to introduce these technologies into the educational process at the level of general use by students. Now these technologies do not improve or make our lives easier, but are being introduced into everyday use of any device that has access to the Internet. One of these areas is augmented reality.

Augmented reality is the close interaction of the surrounding world and the virtual created computer reality. This symbiosis is realized through the projection of virtually created objects onto various devices (phones, tablets). Augmented reality is one of the components of mixed reality, which also includes the opposite phenomenon as "augmented virtuality". In the latter case, real objects of the world are introduced and integrated into the virtual environment [1].

The purpose of using applications of this orientation is to "expand" or "explain" one or another real-life object using the device. This technology operates to the visual perception of the virtual addition of a real object.

Augmented Reality (AR) systems integrate virtual information into the user's physical environment so that information is perceived as existing in the environment [2]. The fundamental distinction between augmented reality and virtual reality is given by the fact that, in the case of AR, virtual content is superimposed on a real environment, whereas in the case of VR, the environment is predominantly virtual. AR consists of merging images from the real environment with virtual layers of information composed of three-dimensional (3D) models that may include content, images, sounds, and videos [3].

AR technology has quickly become viable for commercial and research projects over the past decade due to the prevalence of head-mounted devices (HMD) and smart devices such as phones, tablets and handheld game consoles, which are now intrinsically woven into everyday life [4]. AR technology is applicable in various fields, such as medicine, education and simulated training among others [5, 6], health sciences [7], tourism [8] or navigation [9].

The training of highly qualified specialists who are in demand in modern enterprises that have adopted the latest developments in the digital industry needs to revise the teaching technologies used and apply innovative educational concepts. Such technologies will improve the efficiency of education and speed up the learning process, make it practice-oriented, solving applied problems.

Augmented Reality (AR) and Virtual Reality (VR) are rapidly developing technologies, the purpose of which is to expand the physical space of human life with objects created using digital devices and programs. Unlike virtual reality, AR interfaces allow users to see embedded virtual objects in the real world and manipulate them in real time [10].

Augmented reality is an intermediate link between reality and virtual environment.

Currently, VR technology is expensive and is used in specialized areas: a full-fledged VR kit is expensive, difficult to use for the average user, and there are no mass VR projects due to the high costs of content production. The ability to deploy AR applications on smartphones and tablets makes augmented reality technology more accessible and contributes to its rapid growth.

Studies have shown that AR technology offers many advantages when used in educational settings [11]. For instance, AR helps students to engage in authentic explorations in the real world [12]. By displaying virtual

elements alongside real objects, AR facilitates the observation of events which cannot easily be observed with the naked eye [13]. Thus, it increases students' motivation and helps them to acquire better investigation skills [14]. According to Dunleavy, Dede, and Mitchell [15], AR's most significant advantage is its "unique ability to create immersive hybrid learning environments that combine digital and physical objects, thereby facilitating the development of processing skills such as critical thinking, problem solving, and communicating through interdependent collaborative exercises." A very recent study by Akçayır, Akçayır, Pektaş, and Ocak [16] revealed that AR technology both improves university students' laboratory skills and helps them to build positive attitudes relating to physics laboratory work [17].

II. IMPLEMENTATION OF AR INTO TEACHING

Augmented Reality or AR is a technology that places virtual objects that do not actually exist in our real world. To see these objects, you need a smartphone. This is how virtual content and the physical world interact in real time.

How can AR technologies be used in the educational process?

Firstly, as an auxiliary tool for maximizing the visibility and interactivity of the subject being studied, deeper immersion in it, and conducting virtual laboratory work. Secondly, the use of augmented reality and 3D modeling jointly motivates students to learn programming and 3D modeling.

Thirdly, this technology can be used to visualize the results of work on a project, making the process as interactive as possible. There is no doubt that AR technologies are raising education to a whole new level of quality.

Augmented reality is an interactive technology that allows you to overlay digital content on objects in the real world. Overlay digital content can be computer graphics, textual information, electronic links, videos, and 3D objects.

Superimposed virtual objects are read using digital devices: smartphones, tablet computers, augmented reality multimedia glasses or a virtual reality helmet and specialized software products.

Consider the advantages of using AR technology for educational purposes:

- lightness, portability and relatively low price of a mobile device, the possibility of learning from any digital device;
- conciseness and clarity of educational content;
- transition from information-communicative learning to interactive interaction with learning content in real time;
- practice-oriented training;
- individual learning - each student uses their own gadget or one provided by the educational institution;
- expansion of ideas about ongoing processes in the surrounding world, expansion of opportunities for modeling atypical educational tasks;
- conducting scientific experiments and experiments, studying technical devices, etc., various processes and phenomena without the use of standard laboratory equipment, without risk to life and health;

- increasing the motivation and interest of students through the creation of a learning environment perceived through the senses, involvement in the process being studied;
- lack of age limits, the possibility of using in professional retraining.

The use of AR technology for educational purposes also has a number of limitations:

- lack of mobile phones and tablets among some students;
- technical limitations of digital devices: small screens of mobile devices, fast battery drain, etc.;
- rapidly changing IT device market, increasing technical characteristics, outdated models of mobile devices may not support the latest technologies;
- the need to have the skills to protect personal data;
- lack of control over the student's activities on a mobile phone, distraction of students for information of an entertaining nature;
- lack of educational applications with augmented reality, most of which are in a foreign language;
- not all disciplines can be equipped with a suitable application with augmented reality and not all disciplines can be studied with the help of such applications;
- methodological unpreparedness of teachers for the use of AR technology in education;
- lack of experience in working with AR projects for both students and teachers;
- the complexity of creating an application with augmented reality and the high level of financial costs;
- poor response quality of models in augmented reality applications and other problems associated with the imperfection of the developing technology.

III. METHOD

The approbation of the use of augmented reality in the educational process was carried out by the questionnaire method. The participants were students of the Tashkent University of Information Technologies (the total number of respondents was 80 people). The questionnaire included 11 questions.

The analysis of the results of the approbation showed that all the respondents are the owners of smartphones, but it is used for various purposes: for calls, the Internet, etc. For educational purposes, it is used by 50% of respondents.

The term "augmented reality" is familiar in one way or another to almost every respondent. Only 1 person out of 80 (0.8% of the total number of respondents) replied that he was not familiar with this term at all, but the reason for this answer was most likely inattention or incorrect interpretation of the concept. 78% know exactly what the term "augmented reality" means and the principles of operation of this technology, 22% know this term, but they find it a little difficult to explain the principles of technology implementation.

When answering the question whether augmented reality technologies could improve the quality of the educational process, 90% of respondents answered this question positively. Only 10% of the survey participants found it

difficult to answer this question, but no one made a categorical answer "no". The majority of respondents (86%) had no difficulties when using the app with augmented reality elements, however, there were difficulties at the very beginning of using the app. These difficulties were resolved through a more careful reading of the instructions for installing and using the application. Almost all respondents – 90% – agreed that the developed elements of augmented reality could increase the visibility of educational material and its understanding. The others also did not give a categorical answer "no" to this question. On the question of whether it is possible to develop elements of augmented reality based on the example given, opinions were divided: 55% of respondents answered in the affirmative and 24% found it difficult to answer (as it turned out – because they do not know how to answer this question, since they have not tried to develop similar applications at all). They also clarified that it was difficult for them to find solutions to these problems. Note that among the survey participants there were 17% who were able to develop a similar application without using detailed instructions. Only 1 person replied that for him the development of any elements of augmented reality, even using instructions, is too difficult a task. For 93% of respondents, augmented reality technology is promising in the field of education. Also, 93% of respondents expressed the opinion that the use of augmented reality technologies helps to increase the interest of students in educational activities.

The last question to the survey participants was the question of the availability of the presentation of methodological recommendations for the development of the application. The created methodological recommendations were mostly understood by 100% of the respondents, 79% of them fully understood all the methodological recommendations and instructions for the development of augmented reality elements, while the rest turned out to be clear about everything, except for some individual points. In general, the results of the testing showed a positive attitude of the participants to the use of augmented reality elements in teaching computer science to schoolchildren and a fairly high potential of AR technology in didactic, methodological and technological aspects. The results of the survey can also be presented in the form of a diagram (Fig. 1).
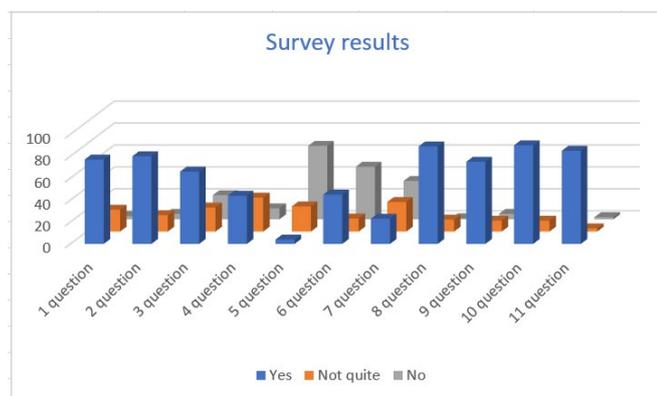
Fig. 1 Survey results

IV. CONCLUSION

As a result of the testing, it was revealed that the most respondents believe that the use of augmented reality technology would help to increase the interest of students in the subject, since there is a visibility and novelty of using this

technology. The wide popularity of gadgets among middle and high school students contributes to an increase in interest in using them in the educational process. Placing virtual objects in a specific environment in which they are initially absent allows you to simulate unusual educational practices.

Despite these limitations, the widespread use of mobile gadgets among young people allows educators to use BYOD (Bring your own device) technology and actively use portable digital devices in the educational process.

The advantages of using augmented reality in the educational process are obvious, but the introduction of this technology is associated with a number of limitations. One of the most significant difficulties is the lack of educational applications with augmented reality.

The digitalization of education requires educators to take on new roles, such as innovator, designer, researcher and curator of educational resources, creator of digital educational content, etc. Systems for developing and creating AR projects are becoming simpler and do not require special knowledge of programming, which allows to involve students in the joint creation of educational content with augmented reality.

In this way, rapidly developing technology of augmented reality is becoming more accessible. Unlike virtual reality, it does not have to rely on expensive specialized devices. AR applications can be successfully deployed on one of the most common digital devices - the smartphone. At the same time, AR projects can be independently designed and developed by both teachers and students without programming knowledge and skills.

REFERENCES

[1] Zilberman M.A. Using Augmented Reality in Education: From Work Experience // Christmas Readings. Materials of the XVIII Regional scientific-method. conf. on the use of ICT in education. Perm, 2015, pp. 22–25.

[2] Höllerer, T., Feiner, S., Hallaway, D., Bell, B., Lanzagorta, M., Brown, D., and Rosenblum, L., 2001. User interface management techniques for collaborative mobile augmented reality. Computers and Graphics, 25(5), pp. 799-810.

[3] Vogt, F. P. A., and Shingles, L. J., 2013. Augmented reality in astrophysics. Astrophysics and Space Science, 347(1), pp. 47–60.

[4] Challenor, J., and Ma, M., 2019. A Review of Augmented Reality Applications for History Education and Heritage Visualisation. Multimodal Technologies and Interaction, 3(2), 39

[5] Yilmaz, R. M., 2016. Educational magic toys developed with augmented reality technology for early childhood education. Computers in Human Behavior, 54, pp. 240-248.

[6] Yu, D., Jin J.S., Luo, S., Lai, W., Huang, Q., 2010. A Useful Visualization Technique: A Literature Review for Augmented Reality and its Application, limitation and future direction. In: Huang ML, Nguyen QV, Zhang K, (eds.). Visual Information Communication: Springer US. pp. 311-37.

[7] Moro, C., Štromberga, Z., Raikos, A., and Stirling, A., 2017. The effectiveness of virtual and augmented reality in health sciences and medical anatomy. Anatomical Sciences Education, 10(6), pp. 549-559.

[8] Lee, L., Ng, G., Tan, K., Shaharuddin, S., and Wan-Busrah, S. (2018). Integrating interactive multimedia objects in mobile augmented reality for sarawak tourism. Advanced Science Letters, 24(2), 1017-1021

[9] Chen, X., Xu, L., Wang, Y., Wang, H., Wang, F., Zeng, X., Egger, J., 2015. Development of a surgical navigation system based on augmented reality using an optical see-through head-mounted display. Journal of Biomedical Informatics, 55, pp. 124-131.

[10] Zakirova, F., Saidova, F., Zakirova, M. Blended learning for the development of teacher creativity: The experience of advanced training of pedagogical staff in the Republic of Uzbekistan // ACM International Conference Proceeding Series, 2018, P. 64-70. https://doi.org/10.1145/3284497.3284501

[11] Khan, Tasneem The Impact of an Augmented Reality Application on Learning Motivation of Students / Tasneem Khan, Kevin Johnston, Jacques Ophoff // Advances in Human-Computer Interaction. – 2019. – Article ID 7208494. DOI: https://doi.org/10.1155/2019/7208494.

[12] K.-H. Cheng, C.-C. Tsai Affordances of augmented reality in science learning: Suggestions for future research Journal of Science Education and Technology, 22 (4) (2013), pp. 449-462.

[13] C. Dede Immersive interfaces for engagement and learning Science, 323 (5910) (2009), pp. 66-69

[14] H.-K. Wu, S.W.-Y. Lee, H.-Y. Chang, J.-C. Liang Current status, opportunities and challenges of augmented reality in education Computers & Education, 62 (2013), pp. 41-49

[15] S. Sotiriou, F.X. Bogner Visualizing the invisible: Augmented reality as an innovative science education scheme Advanced Science Letters, 1 (1) (2008), pp. 114-122

[16] M. Dunleavy, C. Dede, R. Mitchell Affordances and limitations of immersive participatory augmented reality simulations for teaching and learning Journal of Science Education and Technology, 18 (1) (2009), pp. 7-22

[17] M. Akçayır, G. Akçayır, H.M. Pektaş, M.A. Ocak Augmented reality in science laboratories: The effects of augmented reality on university students' laboratory skills and attitudes toward science laboratories Computers in Human Behavior, 57 (2016), pp. 334-342