

Sphere of Application of Virtual and Augmented Reality in Education and their Further Prospects

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Annotation: This article discusses the aspects of using the technology of virtual, augmented reality in the system of higher education. The advantages and limitations of using this technology are given. Directions and examples of the use of augmented reality technology in the educational environment are proposed.

Key words: virtual reality, AR, VR, innovative education, augmented reality, Augmented Reality, interactive technologies, mobile applications.

The training of highly qualified specialists who have adopted the latest developments in the digital industry needs to review the teaching technologies used and to apply innovative. Such technologies will increase the efficiency of education and speed up the learning process, make it practice-oriented, solving applied problems.

Augmented Reality (AR) and virtual (Virtual Reality - VR) realities are rapidly developing technologies, the purpose of which is to expand the physical space of human life with objects created using software. Unlike virtual reality, AR interfaces allow users to see embedded virtual objects in the real world and manipulate them in real time [2].

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

Currently, VR technology is becoming expensive and used - this is in specialized areas: a full-fledged VR kit has a high cost, difficult to use for the average user and there are no massive VR projects due to the high costs of content production. The ability to deploy an AR application to smart phones and tablets makes augmented reality technology more accessible and contributes to its rapid growth.

Augmented reality is an interactive technology that allows you to accumulate digital content on objects of the real world. Overlaid digital content can be computer graphics, text information, electronic links, videos and 3D objects. The ordered virtual objects are read using digital devices: smart phones, tablet computers, multi-scale augmented reality glasses or a virtual reality helmet and specialized software products.

Consider the advantages of using AR technology for educational purposes [3-4]:

- the lightness, portability and relatively low price of a mobile device, the ability to learn with your favorite digital device;
- conciseness and clarity of educational content;
- the transition from information-reporting learning to interactive interaction with learning content in real time;

- practice-oriented training;
- individual training - everyone who uses their own gadget or a gadget provided by the educational institution;
- expansion of ideas about ongoing processes in the surrounding world, expansion of the possibilities of modeling atypical educational tasks;
- conducting scientific experiments and experiments, studying technical devices, etc., various processes and phenomena without using regular 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 vocational retraining.
- The use of AR technology for educational purposes has a number of limitations [3, 5]:
- 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 possess the skills to protect personal data;
- lack of control over mobile phone activity, distraction to information of an entertaining nature;
- lack of educational applications with augmented reality, most of which are in a foreign language;
- not for all disciplines you can choose 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
- the complexity of creating an application with augmented reality and a high level of financial costs;
- poor response quality of models in applications with augmented reality and other problems associated with the imperfection of developing technology.

Recklessness to the above limitations, the widespread use of mobile gadgets among newlyweds invites teachers to use the BYOD technology (Bring your own device - bring your device) and to actively use portable digital devices in the educational process. Here are the directions and examples of the use of various mobile investments with augmented reality in educational activities [6-7].

1) Learning foreign languages:

- Tagme3D Book1 - English dictionary with SD images. Consists of 100 words grouped into 11 thematic categories;
- Alphabets Planet - learn english and arabic alphabet using text, sd objects and sounds;

2) Anatomy, medicine:

- FLARE Atma - a deeper study of the brain and its functions;
- AR Eye - study of the human eye in two modes: animation mode (explains how the eye functions) and interactive mode (allows you to study the composition of the eye);

- Arloon Anatomy - the study of human anatomy. Combination of realistic SD models with augmented reality;
- Humanoid 4D+ - study of body parts: skeletal, muscular, respiratory, digestive systems and skin;
- Anatomy AR, Anatomy 4D - study of the human body and heart, selection for the study of various organs or systems separately;
- Diagram of human anatomy - the study of the organs of the human body (their structure and functionality) using the interactive diagram Popar;
- UC Irvine Samueli School of Engineering - diagnostics and DNA analysis based on the results of the study of fluids of the human body;
- AR Liver Viewer - 3D tool with detailed 3D anatomical models;
- Chemistry:
 - Sparklab - interactive lessons and experiments in AR/VR, interactive periodic periodic table;
 - Arloon Chemistry - learning to write non-organic chemical formulas;
 - Elements 4D-converts any of the 36 elements of the periodic table into a 4D representation, shows information about the Day element, invites you to combine two elements together and see how they react, including a catalyst, as a result-to get the alignment of the chemical reaction;
- 3) Physics:
 - AR physics is a sign with physical processes and phenomena without the use of standard laboratory equipment, without risk to life and health;
 - Atom Visualizer - research of atomic models;
 - Nikola Tesla - introduction to the inventions of Nikola Tesla;
- 4) Geometry:
 - Arlon Geometry - 3D models of most geometric shapes;
- 5) Geography:
 - Geography and pages-complete information about countries, including economic and political Danish, geographical location, culture, a 3D model of countries that shows major cities and rivers;
- 6) Space, astronomy:
 - Spacecraft AR-3D models of spacecraft and detailed in-formation about their missions;
 - Space 4D+ - facts in augmented reality modes about space: about the solar system, planets, space objects, satellites, lunokhods, space missions, etc.;
 - Gagarin-3D reconstruction of Yuri Gagarin's first flight into space in 1961, 3D model of the Vostok spacecraft, Yu. B. Levitan's historical communication about the first human flight into Space;
 - Armolan Solar System - three-dimensional celestial bodies, Earth, solar system, eclipse, Earth trajectory, etc.;
 - AR Solar System - information about the Sun and other planets;

- Giant Moon-the opportunity to view the Moon from a distance of 408 km from Earth;
 - Solar system-animated rotation of the planet of the Solar system in orbit in the present and future;
 - Pocket Universe - information about planets, names of constellations, bright stars, etc.;
 - PlayAR Solar System 4D-Exploring planets on an interactive augmented reality poster;
- 7) Biology:
- Animal 4D+ - facts about animals in augmented reality;
 - Froggipedia - demonstration demonstration of a frog by layers without dissection;
 - ZooAR - volumetric SD-and-images of tiny animals and insects;
 - Kidcar A-Ya - Live 3D animal models;
- 8) Botany:
- Powerful plants - information about plants and their role in human life;
- 9) Technique:
- Rolls-RoyceTrent 1000 - Boeing 787 Dreamliner engine;
 - Cars 4D+ - different types of cars, their history. The opportunity to actually ride and test your driving skills, overcoming various obstacles provided in the application, look at the complex details of cars;
 - Physics Playground - simulation of physical experiments in the field of mechanics;

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

Digitalization of education requires teachers to take on new roles, such as innovator, designer, researcher and curator of educational resources, creator of digital educational content, etc. Systems for the development and creation of AR projects are becoming increasingly simple and do not require special knowledge about programming, which allows you to involve in the joint creation of educational content with augmented reality.

Let's look at examples of platforms that allow you to independently create your own applications in augmented reality format using ready-made components [8-11].

- AR Tool Kit (<http://www.hitl.washington.edu/artoolkit/>) - a free tracking library, i.e. determining the location of moving objects during time using cameras, for open source augmented reality. Focused on creating an AR application for Android, iOS, Linux, Windows, OS X and smart glasses.
- Kudan ARSDK(<https://www.kudan.io/>) - payment platform for the development of augmented reality add-ons with 2D/3D recognition of objects. The free version is intended only for testing attachments. There are problems with installing the license key. Focused on creating an AR application for Android, iOS, together with Unity.
- Cat choom (<https://catchoom.com/>) It offers three tools for developing augmented reality content: the Craft AR Content Creator editor -an augmented reality software development kit; AR SDK-for mobile applications; Cloud Image Recognition - a cloud service for image recognition. Focused on creating an AR app for Android, iOS.

- Augment (<https://www.augment.com/>) - augmented reality application development platform for e-commerce.
- Aurasma (<https://www.aurasma.com/>) - a free platform for creating educational projects in augmented reality. Interested in a leading position in this area. Focused on creating an AR application for Android, iOS.
- Infinity AR (<https://www.infinityar.com/>) - an area for the construction of three-dimensional scenes of the surrounding expanse. In this case, the scenes can be supplemented with virtual elements. It has high detail of objects, including lighting, reflection, breathability, Tenni, etc..
- Vuforia (<https://vuforia.com/>) - one of the most popular software platforms for the development of augmented reality. Implements the possibilities of recognition and more accurate understanding of images, text and objects detected in reality, performs 3D reconstruction of the surrounding and detectable space in the real world. Invites you to create augmented reality applications in the field of industry, for example, interactive workplace instructions, branding materials, service manuals, etc. One of the main advantages of the platform is the development of scenes and scenarios based on models practically without programming.

Focused on creating AR applications for Android, iOS, GCC, compatible with Unity.

- Easy AR (<https://www.easyar.com/>) - a free and easy-to-use alternative to Vuforia, which, in particular, supports image recognition and 3D objects, taking advantage of the environment, cloud recognition. Focused on creating an AR application for Android, iOS, UWP, Windows, OS X, together with Unity.
- AR Core (Google) (<https://developers.google.com/ar/>) - platform for creating augmented reality applications
Technologies used: motion tracking, environmental recognition, environmental lighting assessment. Focused on creating AR applications for Android, Android NDK, iOS, compatible with Unity and Unreal.

To learn how to create projects in the field of augmented reality, you can use, for example, online courses presented on the educational platforms of Soigsegai Udemy:

1. We start with augmented reality. <https://www.coursera.org/learn/augmented-reality>) - a course on the basics of developing mobile applications using funny and augmented reality technologies for Android smart phones and tablets without programming descriptions.
2. Build12 Augmented Reality (AR) apps with Unity & Vuforia (<https://www.udemy.com/develop-augmented-reality-book-ar-business-card-with-unity/>) - a course on the basics of developing augmented reality applications from scratch for Android and iPhone using Unity and Vuforia, codes in the programming language C#.

Conclusions

Summing up, we can say that augmented reality technology is rapidly developing and becoming more accessible. Unlike virtual reality, it does not have to rely on expensive specialized devices. The AR application could successfully be deployed on one of the most common digital devices-smart phones. At the same time, AR projects can independently design and develop without knowledge and programming skills.

The integration of augmented reality technologies into the educational process requires multiplication of changes and improvements not only on the part of engineers and AR experts, but also on the part of teachers and students. With the correct application of this technology, one can be able to create an effective modern educational environment, individualize the learning process, and expand learning opportunities.

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