Application of virtual reality technology based on ontology in education of aviation

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***Abstract*—Education system is continuously evolving and to make process of learning easier people may use AR and VR technologies. It has a lot of benefits and can be used either for learning in simulators via VR headset, or for designing something new. Vuforia Engine provides variety of opportunities for getting a new knowledge. To be able to get full experience while using VR and AR technologies, people should get knowledge of ontology.**

***Keywords*—Augmented reality, Virtual reality, 3D model, ontology.**

I. Introduction

In recent years, because of the formation of a powerful production base, the rapid development of science, technology and information technology and their implementation in almost all spheres of human life, new psychological and technical phenomena have emerged. They are called “virtual” or “imaginary” reality in the scientific literature. Thanks to the development and improvement of computers, programming languages, and the technical component, a number of special means of transmitting information to humans, as well as feedback, have been created, which made it possible to achieve a new quality of perception and experiences that people recognize as virtual realities.

Developing virtual environments remains a technical and time-consuming process. Usually, low-level programming languages are used to define the virtual world, the interaction of the user with virtual objects and the objects’ behaviours within the virtual environment. [1].

Virtual reality - this is a world created by technical means and transmitted to a person through his usual sensations for the perception of the material world: vision, hearing, smell and others. In addition, the term “virtual reality” means a reality that can exist both in a potential, possible state, and in an actual, existing state [2].

II. Implementation of VR and AR for Education

In practice, virtual reality is implemented in the fields of engineering and design, mining, military technology, construction, marketing and advertising, the entertainment industry, and various simulators and simulators are being created. In virtual reality systems, imitation of tactile sensations, imaging with a stereo effect, multichannel acoustic systems, and control by a certain movement of a person in space are widely used. So, a special helmet was created with displays for each eye, with headphones and sensors that provide information about the position of the head, a power vest (creates effort on the muscles of the trunk and arms of a person, simulating the illusion of interacting with objects in virtual space), gloves and boots (equipped special sensors that provide information about the movement of arms, legs and even individual fingers). Having put on such a “suit”, the observer enters the virtual world. At the same time, you can turn your head, look around, walk, touch objects with your hand or foot, lift them and feel their weight and temperature. That is, a virtual world created by a computer is capable of deceiving the senses of the observer. Another way to immerse yourself completely in the virtual world is to use a special virtual room in which the floor, walls and ceiling are equipped with screens on which images are projected. Motion and sounds are simulated (for example, a car, plane, train, or spaceship). All this is important for creating special simulators for pilots, astronauts, car drivers. Aggregates acting on the human vestibular apparatus have also been created. An example is rotating cabins for training astronauts. Moreover, data can be transmitted directly to nerve endings, and even directly to the brain through brain interfaces. This approach allows you to increase the effectiveness of "immersion" of a person in virtual space. However, such a technology is too expensive for everyday use and does not achieve the quality of data transfer acceptable for virtual reality transmission.

In addition, virtual reality should not be considered as a augmented reality [3]. Their fundamental difference is that the virtual constructs a new artificial world, while the augmented one only introduces individual artificial elements into the perception of the real world [4].

Augmented Reality (AR) allows you to enrich the world with the latest technology, creating a unique combined interactive experience. Although augmented reality is still rarely used in education, more and more teach-

ers, researchers and developers are beginning to move towards more interactive teaching methods. Many of these techniques grow into really interesting and creative projects. Augmented reality, or AR is undoubtedly a huge breakthrough in the way of presenting educational material and in the assimilation of information. AR allows you to enrich the world with the latest technology, creating a unique combined interactive experience. Virtual images that students can see right in the lecture hall make the teaching material vivid, memorable and easier to understand. The effectiveness of its use is confirmed by various tests and experiments that show excellent results. For example, a series of experiments were conducted in which teacher showed to one group of children visual material with AR during the lessons, and showed the usual group posters and diagrams to the second group. It was found that in the group where augmented reality was used, the percentage of information assimilation by children approached 90 percent, the level of discipline increased and it was possible to maintain the attention of about 95 percent of the audience, while in the group with two-dimensional benefits, all indicators were half or three times less. One of the reasons for this influence is that AR creates the effect of presence, very clearly reflects the connection between the real and virtual worlds, which psychologically attracts people and activates their attention and sensitivity to the information component.

III. THE IMPORTANCE OF ONTOLOGY BASED CONCEPT

Virtual Humans are virtual entities with a rich set of functionalities and potential, present in a VE. One of the main instruments used to lay-down the foundations of a knowledge-based system are ontologies. Ontology defines a common vocabulary for domain-users (researchers or experts in a particular area) who need to share information in a particular domain. It includes machine interpretable definitions of basic concepts in the domain and relations among them. The semantics-based representation can be enhanced by means of knowledge-management techniques and tools. One of the main tools used to lay-down the foundations of a knowledge-based system is therefore an ontology. A first one focuses on the adaptive multimodal interfaces system and a second one formalizes the knowledge related to the creation of virtual humans and serves as a basis for a general ontology for Virtual Environments. Many consider W3C'sWeb Ontology Language (OWL) the prospective standard for creating ontologies on the Semantic Web. OWL has three species: OWL Lite, OWL DL and OWL Full, in ascending order according to expressiveness. We can divide the use of ontologies in the domain of Virtual Environments into three uses; the first use: Ontologies in the context of Virtual Environments, the second use: Ontology for interactive Virtual Environments, the third use: Ontology for Virtual Human. The conceptualization step is to identify a body in the knowledge domain and to clarify the conceptual nature (concepts, relations, properties and relations of concepts, rules, constraints, etc.) The ontologization step consists in modeling in a formal language the domain properties, the objective is to obtain a model in which almost all the ambiguities inherent in natural language are lifted. Without ontology based concept people won't be able to get full experience of VR and AR In Samara Students study how an airplane works, develop an ontology of a given subject area [5]–[7], and build 3D models of airplane assemblies. The work is aimed at the application of these models. There is a class containing both decommissioned aircraft units and operating earlier aircrafts, figure 1. Such as the Yak-26, MiG-21, Su-15 and others. It helps students to get a better understanding about aircrafts. Students also create

Figure 1. Aircraft class

drawings of both units and the entire aircraft as a whole, figure 2. Aircraft drawings are taken as a marker for augmented reality.

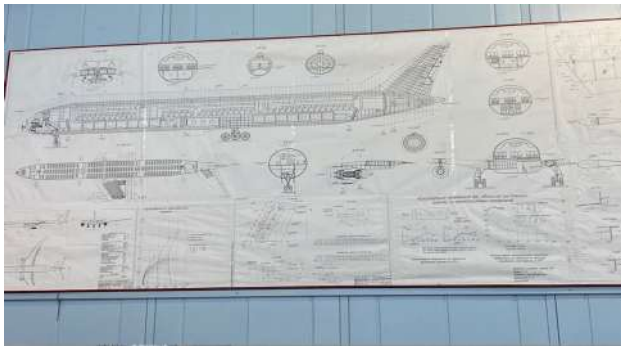

Figure 2. Aircraft drawings made by students

IV. PTC VUFORIA

There are many platforms on the market that will be useful in developing projects useful in training, and one of them is PTC Vuforia.

PTC Vuforia is an augmented reality platform and software development kit (SDK) for mobile devices developed by Qualcomm. The Vuforia project was purchased

from Qualcomm in November 2015 and has since been wholly owned by PTC Inc. Vuforia uses computer vision technology, as well as tracking flat images and simple volumetric real objects (for example, cubic) in real time. From version 2.5, Vuforia recognizes text, and from 2.6 it has the ability to recognize cylindrical markers. More than half a million developers have chosen advanced computer vision technology, incredible performance and cross-platform Vuforia Engine. This made the Vuforia project the most popular AR on the planet. Key Benefits of PTC Vuforia are:

A. Unrivaled Accuracy

The advanced computer vision technology in the Vuforia Engine provides incredible AR accuracy in a variety of environments.

B. Creative opportunities

The robust technology offered by Vuforia Engine allows developers to freely create proprietary AR applications for new or existing applications.

C. Maximum reach - multi-platform

Vuforia supports AR devices such as smartphones, tablets and headsets on leading platforms to reach the largest audience.

D. Extended Vision Concept

Vuforia Engine offers dynamic object recognition and can define images, 3D models and environments, providing development flexibility.

Augmented reality is one of the fastest growing technology segments in the corporate environment. However, its distribution is slowed by a lack of tools with which content authors could use existing 3D resources [8]. Vuforia Studio solves this problem by allowing you to develop applications for the creation, operation and maintenance of smart networking products [9]. Vuforia Studio provides all the components necessary for the implementation of augmented reality. To work with them, neither deep knowledge in programming, nor expert experience in augmented reality technologies is required [10].

Using augmented reality technology, a special educational application is being developed at the Department of Aircraft Design and Design at Samara University. The application loaded 3D models of aircraft, units of which are available at the department. Using this application, the user can point the camera at the drawing of the aircraft and receive a parameterized 3D model of the aircraft on his smartphone screen. The drawing serves as a kind of marker by which the program determines the model that needs to be shown to the user. Demonstration of the application is shown in Figure 1.

In the future, it is planned to improve and refine the application, by adding new functions to it, such as: hiding the skin of the aircraft and demonstrating its power elements, breaking it into separate units, into separate 3D objects.

Figure 3. Augmented reality, 3D-model of the Tu-154

CONCLUSION

Being able to use modern technologies correctly can significantly facilitate and diversify the education process. It also allows you to expand knowledge of both the simplest objects and planes. Learning VR and AG technologies will help to achieve significant success in all areas including education, engineering, aircraft etc.

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Применение технологии виртуальной реальности на основе онтологии в обучении авиационных студентов

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В последние годы, в образовании начали часто использовать технологии виртуальной и дополненной реальности. Это позволяет обогащать мир новейшими технологиями, порождая уникальный комбинированный интерактивный опыт. Онтологический подход определения сущности виртуальности связан с рассмотрением последней как универсального естественного феномена, одного из фундаментальных свойств бытия, бытия вообще, а не только социального. Подобный подход позволяет сделать онтологически значимые выводы, определив создаваемую в киберпространстве и мире Интернет виртуальность как один из онтологических подуровней «тонкой структуры» виртуальности вообще.

Используя технологию дополненной реальности, на факультете проектирования и проектирования самолетов Самарского университета разрабатывается специальное учебное приложение. В приложение загружены 3D модели самолетов, части которых доступны на кафедре. Используя это приложение, пользователь может направить камеру на чертеж самолета и получить параметризованную 3D-модель самолета на экране своего смартфона. Чертеж служит своего рода маркером, с помощью которого программа определяет модель, которую необходимо показать пользователю.

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