

Visualization 3D Augmented Reality

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Abstract—Explored technologies of augmented and mixed reality, libraries for working with these technologies. A comparison of augmented reality with adjacent technologies such as virtual and mixed reality has been performed. A client application for the Android operating system on the Unity 3D gaming engine, as well as the server part on Node.js, has been developed using the MongoDB database management system. Created application AR Assistant used for additional information and 3D-models according to the marker reader.

Index Terms—Keywords-component; augmented reality; mixed reality; visualization; 3D graphics.

I. INTRODUCTION

Augmented reality (AR) is the supplementation principle of the physical world with any virtual items in real time using digital devices: smartphones, tablets, augmented reality glasses. Nowadays this area of technological world is developing rapidly and used in various fields such as education, medicine, aviation, marketing, tourism and entertainment [1-4]. At the moment, there is a large variety of tools for working with the added reality and tools for developing applications using this technology. There are several different technologies used for AR work.

Augmented reality-based markers sometimes called image recognition. This type of technology uses a camera and a special passive visual marker, such as a QR code, that shows the programmed result only when the sensor reads it. This way it is possible to distinguish virtual objects from the real world.

The coordinate or GPS-based augmented reality uses the Global Positioning System (GPS), digital compass, speed sensor, or accelerometer that your device is equipped with to provide your location information. Due to the massive spread of smartphones and tablets, this technology is used most often. Frequent use cases are directions markup, searches for specific places, such as cafes or offices, or location-based applications.

Augmented reality is based on projections. It works by projecting projections of light on the physical surface. Special applications help to interact with a person and a projection, identifying the moments of the human touch to the projected light. This is accomplished by the comparison of the expected projection and altered by certain obstacles, for example by hand touch.

Visual Inertial Odometry is a technology that helps to track the position and to navigate through sensors and cameras. This

makes it possible to create an accurate 3D model of the space around the device, update it in real time, determine its position, transmit this data to all applications, and apply additional layers over it. The features of this technology are unique: you can measure distances, insert various objects into the interior and interact with them. VIO promises to be the most promising technology in AR, currently used by Google in its Project Tango and Apple in ARKit.

II. COMPARISON OF VIRTUAL AND MIXED REALITY

Many believe that all these technologies are essentially the same, but in the reality, this is not the case. Consider the definition of Virtual Reality (VR) described as a computer-simulated reality that reproduces a particular environment and simulates the physical presence in this environment, allowing the user to interact with this world. The modern industry emits head-mounted displays, HMDs, from Google Cardboard to HTC Vive. An interesting direction for the development of virtual reality is the so-called "360° video". This video is a virtual reality version created with the help of real-world content, and with special cameras for such shooting, such as Nokia OZO or GoPro Odyssey. There is also a computer-generated virtual reality. As can be understood from the title, it is fully generated using certain software and graphics support.

Mixed reality (MR) is a hybrid reality that combines real and virtual worlds to create new environments and visualizations where physical and digital objects co-exist and interact in real time. A key feature of mixed reality is that artificial and real content can respond to each other in the real time. The hardware, which is associated with mixed reality, includes HoloLens from Microsoft.

Thus, all these realities differ in a way of representation and integration of digital content and, also, an equipment necessary for their reproduction. All these technologies are developed very fast. However, some are ahead of the others in development, due to the simpler implementation and greater interest of users.

III. TECHNOLOGY AR

Several things are needed to start developing applications using augmented reality technology: a device for which the application will be developed (smartphone, tablet or smart glasses) and the development environment - the most popular Unity 3D, Android Studio, and XCode. The choice of

development environment depends on the operating system of the target device. The final step is to select the library to work with the augmented reality.

At the moment, software companies that develop AR environments collaborate with libraries developers. Thus, many environments already have integrated tools for working with these technologies. Nonetheless, you can connect other tools for application development. The most popular SDK (software development kit) for developing applications with the addition of reality are:

- Wikitude
- DeepAR
- EasyAR
- ARToolKit
- Kudan
- Maxst
- Vuforia

There are differences in which a certain development tool can be evaluated - a set of available features and the price of their use. Important parameters of library functions are maximum recognition distance, recognition stability, recognition stability of a moving tag, minimum recognition angle, minimum visibility of the recognition tag, 2D or 3D recognition, binding of the label to the geolocation, cloud recognition. There are many tariff plans (including free open-source options), both for single and corporate development. Since it is now a trend, the price categories are in a great variety.

IV. CREATING PROGRAMS WITH AUGMENTED REALITY

The Node.js platform has been chosen to develop a web server because of the ease and speed of development. In addition, the Express framework facilitates simplifying the process of writing code even more. Express provides a thin layer of basic functionality for web applications that does not distort the familiar and convenient functionality of Node.js.

To ensure processing of a large number of concurrent requests Node.js uses an asynchronous model of code execution based on the processing of events in non-blocking mode and determining callback handlers. The methods of multiplexing of connections are supported by epoll, kqueue, / dev / poll and select. For multiplexing of connections, libuv library is used to create a thread pool involved libeio library, to perform DNS-requests in non-blocking mode integrated c-ares. All system calls that cause blockage are performed inside the thread pool. And then, as signal handlers, transmit the result of their work back through unnamed channels (pipe).

To extend the functionality of applications based on Node.js a large collection of modules is produced. In which the implementation of HTTP, SMTP, XMPP, DNS, FTP, IMAP, POP3 servers and clients, modules for integration with various web frameworks, WebSocket and AJAX handles, connectors to DB (MySQL, PostgreSQL, SQLite, MongoDB), template

creators, CSS drives, implementation of cryptographic algorithms and authorization systems (for example, OAuth) and XML parsers can be found. For the Node.js environment, NPM (Node Package Manager) is the default package manager. Includes a command line client, also called NPM, as well as an online database of public and private packages known as the NPM registry. Since the client is programmed with Unity, the server does not return any representations, but only a set of necessary data in the JSON format.

The architecture of the program is a classic n-layered architecture: there are controllers on the server that accept the request and return the response from the server. Controllers use the Data Provider from the data access level, which knows how to obtain data from the database.

For communication with Node.js was selected document-oriented database management system MongoDB. This connection provides data processing speed since Node.js operates in JSON format, which is converted into JavaScript objects, and those converted to BSON (binary JSON) when transferred to the database. In the database there are two collections: schedule, session. The first is responsible for maintaining schedules and everything connected with it. The second contains documents describing the schedule of tests and examinations for groups.

The web server cannot do without the means to protect against Internet attacks, so the npm package Helmet was used. This collection of 12 functions works before returning the response from the server. This module adds http headers in response from the server.

Placing an application in cloud services took place using Heroku-cli. This is a set of tools for working in the command line interface. After the deployment on the service is allocated a work process called "dyno". If there are no service queries within 30 minutes, the process is turned off and payment for the use of resources does not occur. To use the database, the mLab application was installed.

The Unity 3D gaming engine was chosen to create the client program since it provides handy development tools with augmented reality and support for mobile platforms. The latest versions of Unity editor appeared built-in tools to work with the platform Vuforia.

Vuforia uses computer vision technology for flat imagery and simple bulk objects in real-time. Recently, it is possible to recognize text and cylindrical markers. The SDK supports the development of native AR-applications for iOS and Android, while providing for development on Unity, the results of which can be easily transferred to both platforms.

To set up an action when you click the virtual button, you need to attach the script to the recognition token. The script is a class that implements the IVirtualButtonEventHandler interface. Interface contains signatures of two methods that are responsible for recognizing the moment of entry of an object in the virtual button zone and the moment when the object leaves this zone.

To create a .apk file that can be installed on a smartphone, we select the target platform and add all the scenes that must be launched on the mobile device.

An application requires a smartphone with Android OS version 5+. For the first run, an application authorizes the use of cameras and access to the Internet to communicate with the Web server.

The program interface consists of several windows. The first and second windows in Fig.1 load the application and allow you to select a menu item to solve different types of tasks and markers.

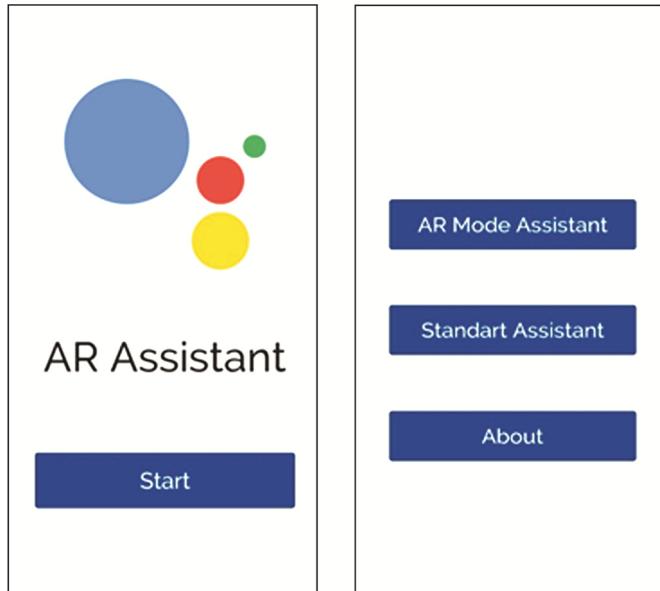


Figure 1. Program interface

The program finds a marker in a real video stream through the mobile device camera. According to the marker, the program displays additional objects simultaneously with the video stream.

When the program recognizes the marker of the auditorium number, the schedule of classes in the auditorium is shown on the screen Fig. 2. When a program recognizes a SHEMA marker, the 3D model is displayed on the screen Fig.2. The 3D model is oriented in space in a way that gives a user an impression of a real-world image.

As a result of the program, we get additional information and 3D objects in real-world environment through viewing through mobile cameras.

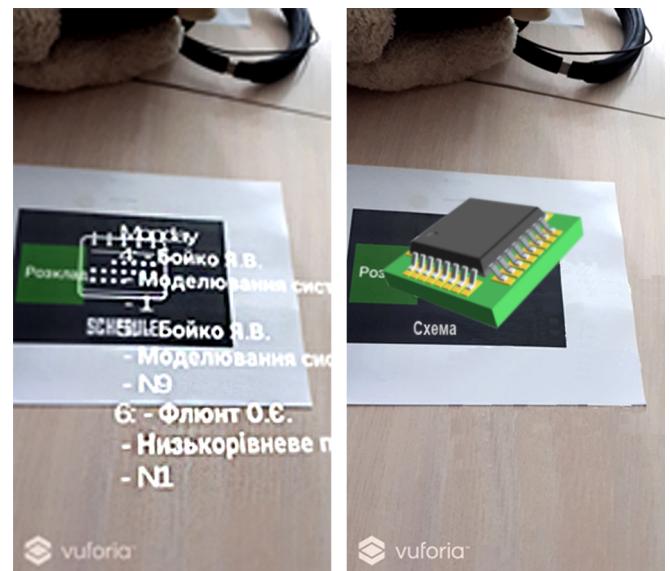


Figure 2. Example of augmented reality

V. CONCLUSION

Created a mobile application using AR technology, which implements interactive interaction with the real world. The program recognizes different markers and provides the user with additional information in the augmented reality.

For the educational process, this information refers to the schedule of the employment of audiences, the timetable of examinations and credits, as well as the demonstration of 3D models in electronics. The possibilities of using AR technology are virtually limitless and can be applied in almost all aspects of our lives. In the future, they will qualitatively change the way we communicate, consume information and do business.

REFERENCES

- [1] A. L. Kečkeš, I. TomičićG. “Augmentad reality in tourism – reaseach and application ovaerview” Interdisciplinary Description of Complex Systems 15(2), 2017, pp.157-167.
- [2] M. Mekni, AJ. Lemieux “Augmented Reality: Applications, Challenges and Future Trends” 13th, Applied computer and applied computational science; 2014; Kuala Lumpur, pp.205–214.
- [3] C.Hansen, J.Wieferich, F.Ritter, H.-O.Peitgen “Illustrative visualization of 3D planning models for augmented reality in liver surgery” International Journal of Computer Assisted Radiology and Surgery 5(2):133-41, 2010.
- [4] S. M. Land and H. T. Zimmerman, “Synthesizing perspectives n augmented reality and mobile learning,” TechTrends, vol. 58,1, 2014 pp. 3-14.