SOFTWARE DEVELOPMENT FOR PLAYING VIRTUAL REALITY

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ABSTRACT

The paper analyzes methods of filtering data obtained from an inertial measuring device, methods of overcoming the zero drift of a gyroscope, developed a stereoscopic rendering program for a mobile phone and a wireless inertial manipulator. Which allows users to immerse themselves in the world of virtual reality for a small amount. Selected data filtering methods allow you to automatically collect, filter, and smooth data of almost any kind.

Keywords: virtual reality, noise filtering algorithms, inertial manipulator, stereoscopic rendering, Unity 3d.

Formulation of the problem. At the moment, virtual reality (VR) technologies are widely used in various fields of human activity: planning and design, mining, military technology, construction, simulators and simulators, marketing and advertising, the entertainment industry, etc. The volume of the virtual reality technology market is estimated at 15 billion dollars per year [1].

In the early 1990s, virtual reality was still in its infancy, and was limited to just a few “square” chess pieces on a chessboard. But with the development of the entertainment industry, virtual reality began to increase its pace of development. It began to be used in cinemas and to create video games. Later, with the help of VR, many architects began to create facades of buildings, even before laying the foundation itself. The customers of the project could freely travel around the virtual building, ask the architect questions and make their own changes to its design. Virtual reality gave customers much more options when choosing a building design than a miniature model with a removable roof.

Builders, architects, doctors, engineers and many other professions where they work with any material objects require excellent qualifications from students. To do this, they regularly conduct practices where they acquire all the necessary knowledge and skills [2].

But virtual reality can take the learning process to a new level. The creation of programs capable of demonstrating the structure of the human body or showing in real time how the load on individual nodes of the building changes depending on the technical solutions used will allow students to demonstrate the practical part of their work already in the first courses without wasting the time of specialists and without risking people's lives.

Better assimilation of the material becomes a plus, because the location and principle of operation of human organs is much clearer when you can look at them in 3D format, touch them with your hands and twist them from all sides, and not just by looking at them in section in a picture in a textbook and memorizing them their. At the same time, teachers will have an excellent opportunity to support the student's interest through interactive lectures filled with useful information [3-5].

Therefore, programs with virtual reality are used to train soldiers, pilots, astronauts and medics. Virtual reality contributed to the development of medicine, because in such conditions it was possible to calmly train new doctors without fearing for the patient's health. In some cases, virtual reality was used to conduct a preliminary operation, so to speak, when the doctor performed the operation in the virtual world and looked for his mistakes, so that later he could eliminate them in practice. Also, the development of VR led to the fact that operations began to be carried out with the help of robots. The first operation involving a robot was performed in 1998 in one of the hospitals in Paris. The only disadvantage of such an operation is that during the operation of the VR devices, failures or delays can occur, which can cost the patient's life.

Aerobatic simulators are a type of virtual reality system. All pilots and cosmonauts train on such simulators before the flight in order to be ready for all the difficulties that may arise during the flight. Pilots and cosmonauts try to control their virtual plane or shuttle in any weather conditions - during a thunderstorm, fog, wind, meteor shower and so on. There are special programs for this. And although such equipment for virtual reality costs several tens of thousands of dollars, an aerobatic simulator is still cheaper than if you conduct training on real aircraft [3].

The field of entertainment is increasingly turning to multimedia technologies, especially since the world has been experimenting with virtual reality for a long time. Virtual scenery is a panoramic multi-screen projection of virtual worlds. Screens are perceived by the viewer as windows to another world. They can be placed in different ways. Everything depends on the capabilities of the site, the wishes and capabilities of the customer. Virtual decorations can not only replace the interior, but also complement it. You can use them to create a completely illusory 3D space, right up to covering the floor with projections.

But the virtual reality helmets and manipulators for them used in the field of entertainment are not cheap.

Analysis of recent research and publications. Daydream is a virtual reality (VR) platform developed by Google [5]. It was announced at the Google exhibition I/O 2016, and presented on November 10, 2016 [6].

Unlike Google 's first VR platform , Google Cardboard , Daydream will be built into the Android OS starting from the release of Android 7.1 Nougat . The platform includes both software and hardware specifications for compatible "Daydream-Ready" phones. Google also announced a VR mode in Android Nougat to handle high-performance computing for virtual reality applications. It will be the first VR platform made in material design. Google plans to update some of its installed Android apps to VR versions. The cost of the Google Daydream VR headset The View is $79, which is cheaper than most of its competitors on the market.

Daydream headset comes with a wireless controller. This controller can be used to interact with the virtual world by pressing buttons or moving the device in space. The remote control is used for menu navigation, games and even virtual walks on Google Street View . The installed sensors are used to determine the orientation of the controller and the approximate position of the user's hand. The controller provides the user with six degrees of freedom in space. For the owner of Google Daydream The View controller can be stored in the headset while it is not in use [7].

The problem with this platform is that at the moment it only works with two devices - Google Pixel , Motorola Moto Z, Samsung Galaxy S8 and S8+. That is, with the most expensive flagships.

The situation is the same with helmets from Samsung called GearVR, such a helmet is compatible only with some phones of the Samsung company itself.

But Google Cardboard can work on almost all Android smartphones, but its use is limited to use only on the Android operating system .

The developed set of development tools and utilities can be compatible with all mobile phones on the Android and iOS operating systems . But there are certain technical performance limitations.

Highlighting previously unresolved parts of the overall problem. Virtual reality helmets and manipulators for them used in the field of entertainment are not cheap. Therefore, only a limited number of people can afford them in the field of entertainment. This problem is associated with high requirements for the hardware component, lack of a single standard, and a single set of development tools and utilities for all platforms.

The purpose of the article. It consists in the development of a prototype helmet based on a smartphone and the development of a wireless manipulator. Which would work with all mobile platforms such as Android and iOS .

The main purpose of this work is:

1. Investigate existing approaches to obtaining a stereoscopic image.

2. Consider the main algorithms for filtering data from sensors.

3. Explore Unity Engine as a graphics engine for developing virtual reality (VR) applications.

4. Develop an algorithm for tracking the position and rotation of the manipulator.

5. To study the basic methods and protocols of wireless connection.

Presenting main material. Gyroscopes measure angular velocity very accurately and after integration, angles can be obtained. But they have a problem - evidence emerges over time. To correct this drift, an accelerometer is used, which always (or almost always in the long run) knows where the ground is. But the accelerometer won't feel anything if it's rotated around the Z axis , so we need a magnetometer that always knows where north is. Such a combination of sensors is called an inertial measuring device [17].

The term IVP (English IMU or inertial measurement device) is widely used to refer to a device that contains three accelerometers and three gyroscopes, and may also contain three additional magnetometers. Accelerometers are located so that their three measurement axes are orthogonal to each other. They determine inertial acceleration, which is also called G -forces.

Three gyroscopes are located in the same way, orthogonal to each other, and measure the rotational position relative to an arbitrarily chosen coordinate system.

More and more manufacturers are adding as well three magnetometers in the IVP module. This improves the speed of dynamic orientation calculation in attitude and direction determination systems made on the basis of IVP.

IVP modules are used in inertial navigation systems installed on aircraft. Today, almost every commercial or military surface vehicle has such a device. Most aircraft are also equipped with IVP [19].

The main disadvantage of using IVP in navigation is that it usually has an accumulated error, including the Ebbe error. Since the navigation system constantly sums up the recorded changes to a pre-calculated position, any measurement errors, even small ones, accumulate from point to point. This leads to 'drift', or a constant increase in the difference between the coordinates the place where the system thinks it is and its actual location.

As if everything is simple - from the value along the Z axis subtract the constant 1 g to get the linear vertical acceleration. We will integrate it twice (we will actually sum it up in the measurement cycle) and get the speed and relative displacement. But here too, not everything is as good as we would like. The inclination of the device will cause a change in the projection of the acceleration vector A on the Z axis . Movement of the sensor or change in temperature can cause a "shift" in sensitivity, and our constant is 1 g will no longer correspond to reality. But even in the case of a perfectly stationary sensor and an accurately set 1 g , any sensor emits noise. After all, even a tiny error during ten seconds of double integration grows to the size of an elephant, and here we see with glasses sideways or with an inclined gaze.

The most common filters used in IVP:

1) Kalman filter.

2) Complimentary filter , the exact counterpart, is an "alpha-beta filter".

3) Majvik filter.

Kalman filters are based on time discretized linear dynamic systems. They are modeled by Markov chains built on linear operators perturbed by errors that may include Gaussian noise. The state of the system is represented by a vector of real numbers. At each discrete-time clock, a linear operator is applied to the state to produce a new state, mixed with some noise and, optionally, some information from the system controls, if known. So another linear operator, mixed with even more noise, is applied to the true ("hidden") state to produce the observed outputs.

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