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VR NOWADAYS AND IN THE FUTURE

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Annotation. What are VR glasses? This is an opportunity to find yourself in a non-existent, but seemingly real world, in which you can look around at 360 degrees. The result is a sense of oneness with virtual reality, which is reinforced through audio-visualizations. The user is able to touch any objects, run, look for hidden places for hiding-he will constantly be in the epicenter of events...

Keywords. VR, AR, MR, display, FPS, FOV, head tracking, motion tracking, eye tracking, HMD.

Virtual Reality (VR) represents a computer-generated environment including scenes and objects that seems to be real. It makes the users feel they are immersed in their surroundings [1]. Many people confuse and don't distinguish VR from AR. They differ from each other in the fact that VR builds the world where the user immerse himself by means of a specific headset. All things the user sees are part of an environment synthetically created using sounds, images, etc. In augmented reality (AR) a personal world becomes the framework inside which images and objects are disposed. Everything the human sees exists in reality and it may not be important to wear a headset.

However, there is also a mixed reality – combination of both realities. MR is the confusion of the real and virtual worlds to form new environments and visualizations, where material objects subsist and effect on each other in real time. MR doesn't exclusively take place in either the physical world, but is a hybrid of reality and VR [1].

VR headset or helmet is a special device that helps to perceive Virtual Reality environment. Virtual reality headsets are actually head-mounted displays (HMDs) combined with inertial measurement units (IMUs). They consist of a stereoscopic head-mounted display, head motion tracking sensors (which may comprise gyroscopes, magnetometers, etc.) and stereo sound.

An HMD is a display device worn on the head or as part of a helmet that has a small display optic in front of one (monocular HMD) or each eye (binocular HMD) [2]. There are also lenses which are placed between the eyes and the pixels, which is why the devices are often called goggles [3]. The image is focused and altered for each eye by these lenses and produces a stereoscopic 3D image by tilting the two 2D images to simulate how each of two eyes looks at the world slightly differently (stereo projection). There is an optical head-mounted display (OHMD), which feature is to allow a user to see through projected images. These head-mounted displays are important in creation a feeling of immersion and they need to display virtual worlds as realistically as possible.

One of the biggest barriers is the fact that humans natively have a much wider field of view (FOV) than what modern headsets can supply. A normal person can see the surrounding in approximately 200 to 220 degrees arc around his head. Where the eyesight from the left and right eyes overlap, there is a roughly 114 degrees arc where the human can see in 3D.

Modern headsets concentrate their attention on that 114-degree 3D space to deliver their virtual environments. And for now no headset can yet accommodate the full FOV of the average human.

It should be underlined that scientists do not have consensus on sensitive human vision in that regard. According to a physical point of view, human eyes can see up to the equivalent of 1000 frames per second (FPS). The human brain is sure never to perceive such big amount of information via the optic nerve. It is important to emphasize that some studies suggest that humans can discern frame rates up to 150 FPS, but beyond that, while translating the information is lost on the way to the brain.

The frame rate for a film in a cinema is 24 FPS. That isn't designed to simulate reality. What about VR applications, most developers have learnt that anything less than 60 FPS causes disorientation, headaches, and nausea in the user. For that reason, most developers aim for a VR content "sweet spot" of about 90 FPS and some (like Sony) won't certify software to run on their devices if they fall below 60 FPS at any point while in use. Most VR hardware developers are going to start pushing for 120 FPS or more, as that will provide a more true-to-life experience for most applications [3].

Another crucial technical aspect of VR is the way that designers use sound effects to convey a sense of three-dimensional space to the user. Today, cutting-edge VR relies on a technology called spatial audio to create a simulated audio landscape that matches the visuals created by VR. Spatial audio is a technique whereby VR designers can produce binaural (stereo) audio through a set of headphones that mimics that exact sensation [4].

To make a user feel like a “part of the game” and fully immerse him in it, VR helmets use sophisticated technologies. One of them is the head tracking. The helmet tracks the movements of the user’s head and the image turns at the same angle as his head. A system called 6DoF (six degrees of freedom) plots his head in terms of his X, Y and Z axis to measure head movements forward and backwards, side to side and shoulder to shoulder, otherwise known as pitch, yaw and roll.

The head trackings are certain to be a big advantage, but the large VR companies are still working out the motion tracking. Looking down with a VR headset on the first thing a user wants to do is to see his hands in a virtual space. In order to help to "feel" own hands in the game, there exist wireless controllers. While using VR, the controller picks up and use thumbsticks, buttons and triggers. Of course, each controller possess a matrix of sensors that can detect gestures (for example, pointing and wawing) [4].

The motion tracker calculates its position in the room relying on the infrared signals emitted by the base stations. The place and position of these received signals are tracked through an array of sensors on the device and then they are converted to an equal place and position in the virtual world.

Other input methods can include anything from hooking an Xbox controller or joystick up to the PC, voice controls, smart gloves and treadmills such as the Virtuix Omni which allow to simulate walking around a VR environment with clever in game redirections [4].

The position of the eyes is also monitored. The eye tracking system is used for this purpose. With the help of infrared rays, the system understands where the user is looking. This allows the game characters to understand and react to user’s gaze, to look him in the eye, which makes the depth of field more realistic.

VR is usually associated with entertainment. But in practice, it is not used only for it. Because VR, AR and MR are going to shape our future in so many more ways than gaming [5]. Many Universities are investing in training their students with the help of Virtual Reality peripherals. The first example that comes to mind is, of course, healthcare-related: by putting the student into a high quality represented situation, they are able to understand the dynamic of the case without risking anyone’s life (especially if it is done when studying very delicate surgeries).

Encouraging the usage of such peripherals could be a breaking point in order to better prepare surgeons and specialists in subjects and operations that are naturally delicate.

The way architects design and experiment with their work is gradually changing thanks to VR technologies. VR makes it possible to see not just what a building or space will look like but how it will feel. Home owners can experience the space before it is physically built and make changes in real time, saving the customer and architect time and money. [5].

Simultaneous Localization and Mapping is the biggest focus when it comes to development at the minute: this technology is able to instantly translate data from the real world (by using sensors) into the virtual one and vice-versa. SLAM is currently used in TESLA’s autopilot and summon, two core elements of the car’s technology that let the vehicle process the surroundings in order to avoid crashes, understand how much battery is left and other vital pieces of information.

Flight simulator, the popular game for Windows, recently announced that an entire VR-based version will come in the future, providing an experience close to the actual pilot training which is currently done by many different companies such as British Airways and Turkish Airlines. And it can be easily said that the future of such simulations will be relying on Virtual and Augmented Reality combined and not just in a video game-related scenario.

And there are a lot of industries that already use VR technology: automotive industry, tourism, gambling, education, art and design, news and journalism and etc.

VR technology involves full immersion, which means it takes control of the user's senses (sight, hearing). Thanks to this, anyone can feel and experience what is not there, with the help of imagination and VR helmet and controllers. Soon enough, these two senses may be joined by others: touch and smell. All this is done in order to deepen that sense. At the same time, VR devices will have to become cheaper and more affordable. They can become lighter and smaller in size so they won't cause inconvenience to users. Work on this is already underway with a project called FeelReal. These developers are working on two products, the FeelReal VR as well as the Nirvana VR. The FeelReal VR is wireless, and compatible with most VR headsets. It can trigger sensations of wind, vibrations, water mist, hot air and much more. Furthermore, the device can emit seven different smells. The Nirvana VR is a mask that covers the entire face, which adds further to the range of sensory stimuli [6].

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