

DEVICE AND SYSTEMS FOR IMAGING 3D OBJECTS IN VIRTUAL REALITY

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Abstract: *With the new, more advanced and more affordable technologies development, especially miniature cameras and displays as well as position sensors and head-mounted displays (HMD) interest in virtual reality (VR) has returned after several years. Nowadays, there are already quite a few manufacturers and developers of VR devices exists. HTC Vive and HP Reverb are undoubtedly among the most famous headsets. Mainly used software solutions for virtual reality, which we will describe in more detail there are Unreal engine and Unity.*

Keywords: HTC Vive, HP Reverb, virtual reality –VR, Unreal engine, Unity

1 INTRODUCTION

Current tablets and mobile phones offer sufficient computing power to be used in the field of virtual and augmented reality. For a full experience in VR, it is good to use not only the head display, but also a motion controller or a data glove or even some of the haptic devices. Currently, displays can be used mostly only to show a 2D image. However, such prototypes of display devices which also allow displaying spatial image have already been developed. There are stereoscopic, autostereoscopic displays which are used in head-mounted displays an even in 3D televisions as a compromise to this technology for the future. The development of these technologies was possible based on significant progress in microelectronics, because today's mobile devices, smartphones and tablets, have a computing power comparable or even higher than the powerful graphics stations and supercomputers used thirty years ago calculating and displaying a virtual image in real time.

2 HISTORICAL DEVICES FOR VIRTUAL REALITY

American cameraman Morton Heilig built the first virtual reality device in the form of a human-sized box called Sensorama American between 1957 and 1962. Sensorama projected the film using a small stereoscopic projector as well as various devices to stimulate other senses like hearing through stereo sound, touching through vibrations and airflow and even smell through aromas. However, this device did not allow any interaction with the movie being watched and ended up only in the prototype phase. Morton Heilig also constructed the first head-mounted display called "Telesphere Mask", which contained a pair of miniature television screens.



Figure 1 Sensorama.

3 HP REVERB HELMET FOR VIRTUAL REALITY

The HP Reverb virtual reality headset offers high computing power with remarkably simple setting of individual parameters to users presenting a cost-effective solutions. The HP VR helmet is a suitable solution for various technical product development as well as design modifications, AEC (Architecture, Engineering & Construction) reviews, location-based entertainment and MRO (Maintenance, Repair and Overhaul) training environments.



Figure.2 HP Reverb

4 VR HEADSET - HTC VIVE

Vive was developed under cooperation between two companies. The first is Valve, which creates gaming platforms, and HTC as an electronics manufacturer. It does have dual 3.6-inch AMOLED display with up to 1080 × 1200 pixels' resolution of per eye. Both displays are combined and creates a resolution of 2160 × 1200 pixels. The refresh rate of the display is 90 Hz and the width of the field of view is 110 degrees [21]. The product has been built-in comfortable safety features that are designed to bring an uninterrupted experience of the world of virtual reality. A 'Chaperone' guidance system alerts you if you're approaching the boundaries of the play area, while the front-facing camera merges the physical elements into the virtual world. Working together, these features allow HTC Vive to transport and fully immerse users in virtual worlds. They have 37 sensors on the headset, which is only a fraction of the total of 70, including those found in the controllers. These sensors record signals from two wireless infrared emitters located in two corners of the room. As a result, the Vive can not only track and record the movement of your head, but also track where you are in the room and record the movements of your hands by focusing the controllers in the user's hands. This technology is called "Vive's room-scale". Thanks to this system, it is possible to move in a reserved space of up to seven square meters without losing movement tracking.



Figure 3 HTC Vive

5 SOFTWARE FOR CREATING ENVIRONMENTS IN VIRTUAL REALITY

This software is used to create animations and interactive elements in VR environment. The most used software solutions for virtual reality, which we will describe in more detail there are Unreal engine and Unity. These softwares differ in their way of working and some functions. Working in these softwares requires at least basic knowledge of programming. With the help of these programs, objects are assigned their properties, the physics and lighting of individual

scenes are set up. Moreover, control elements are defined, and the scene itself is assembled.

	HP Reverb G2	HTC Vive
Display	2 x 2.89" LCD	2 x 3.5" AMOLED
Resolution	2160 x 2160 per eye	1080 x 1200 per eye
Mechanical IPD Adjustment	Yes	Yes
Frequency	90 Hz	90 Hz
Weight	Starting at 1 lbs. (w/o cable)	Starting at 17 lbs. (w/o cable)
Cameras	Camera: 4 for tracking	Outside in SteamVR
Face Mask	Replaceable magnetic fabric face cushions, Velcro adjust	Ratchet adjust, foam cushion, Vive wireless adapter opt.
Cable	Cables Included: 6 M Desktop Cable	Cables Included: 5 M Desktop Cable

Figure 4 HP Reverb G2 vs. HTC Vive

6 UNREAL ENGINE

Epic Games, Inc. is the modern software which is very popular among users. The first version of this engine was released in 1998. Unreal engine supports multiple platforms, including Android, Linux, IOS, Xbox and of course Windows. The development environment is relatively simple and easy to control. There are plenty of video tutorials and quality documentation from Epic Games. A shop is also integrated directly into the application, where you can download various pre-programmed technologies, mechanics, models and effects that someone has already created before you available for free or for a fee. The Unreal engine supports the so-called Blueprint visual programming language. This means that the scene developer does not need to know a programming language to control the engine. Visual environment of the Unreal engine is sufficient. The visual environment of this engine is intuitive and fast enough to create different projections. The visual environment is not fast enough and efficient as writing the code itself, but we will notice it while creating larger and more demanding projects. Thanks to using Blueprints it is possible to create and assign functions and interactions to objects and modifying user interfaces as well as modifying input controls. The Blueprint visual programming language is one of the many additions to the Unreal Engine extends from game programming to networking and allowing developers quick creating a new prototype based on their preferences. This functionality is convenient and user-friendly, allowing even a novice scene developer to achieve great results.



Figure 5 Environment in Unreal Engine for automation

7 UNITY 3D

It is a software developed by Unity Technologies, which provides the possibility of developing 2D and also 3D applications. The first version of Unity was introduced at Apple's 2005 conference supported their OS platform. In addition to 2D and 3D game development, Unity also provides an environment for creating scripts in Java and C programming languages. Nowadays Unity supports more than 25 platforms in mobile, desktop, console, TV, VR and even web applications. Unity software is the development tool of choice for most VR creators. More than two-thirds of all applications for virtual reality are created in it and used by companies such as NASA, Google, as well as Hollywood filmmakers and, last but not least, the automotive industry. Unity also includes an editor that is a hub for creative artists and designers. The editor includes tools for the design of 2D, 3D scenes, lighting and many other settings necessary for the development and design of various scenes.

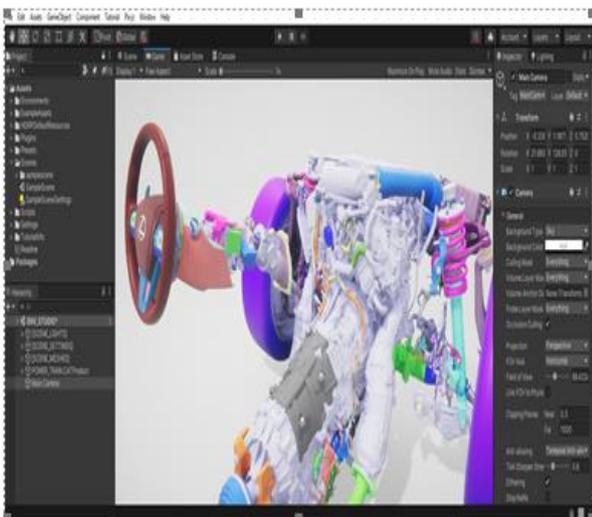


Figure 6 Environment in Unity 3D

Table 1 Comparison of Unity engine and Unreal engine

	UNITY	UNREAL ENGINE 4
Full 3D support	YES	YES
Full 2D support	YES	NOT
Free version	YES	YES
Valid version	YES	YES
PC export	YES	YES
Playstation export	YES	YES
Xbox Export	YES	YES
IOS Export	YES	YES
Android Export	YES	YES
HTML Export	NOT	NOT
Available on Windows	YES	YES
Available for Mac	YES	YES
OSX		

8 CONCLUSION

In this post, we describe the current state of some selected devices used in virtual and augmented reality, the principles of their operation, their advantages and disadvantages as well as the possibilities they offer. A number of devices that integrate displays, projectors, image sensors, data gloves and others are currently being used for a full-fledged user experience in virtual reality. The combination of various devices will allow the user not only to see and hear objects in virtual reality, but also to touch them, interact with them, and even smell or feel them. Virtual and augmented reality devices can affect almost all human senses.

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