Building Wireless VR Goggles

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1. Introduction

Virtual Reality has been among today's hottest technologies. Current VR goggles such as Oculus Rift and HTC Vive require wired connection to computers, using HDMI to transmit high-resolution video and USB to transmit tracking data, because current wireless technologies including 2.4GHz/5GHz Wi-Fi cannot meet the low latency (within 20 milliseconds) and high bandwidth (multiple Gbps) requirement. This obviously limits VR user experiences. Thus, wireless VR is an unavoidable direction, which is naturally a systems research project.

2. Objectives and goals

We propose to develop a wireless transmission system for mainstream VR goggles. There are four aspects of problems to be tackled:

Low latency high definition video transmission. Current wireless display solutions are not directly applicable, so we may turn to high frequency wireless transmission.

Tracking data transmission and power supply. The USB cord which transmits tracking data and supplies power should also be replaced by wireless transmission.

Multi-channel transmission. Dual displays require dual video signals; multiple players sharing one virtual space also require multiple links to support.

Avoiding obstacles and extending transmission distances. Problems of blockage and short transmission distance in high frequency transmission shall be addressed.

3. Methods of investigation

- We propose three levels of optimization to reduce the latency: hardware level, by trying high-frequency wireless transmission such as 60GHz; driver level, including parallelizing the compression and decompression algorithms; and network level, perhaps adapting the protocol stack of 60GHz wireless transportation.
- We shall try to supply power with mobile power banks, and transmit tracking data with either wireless USB or on the same link with video stream.
- Multi-channel transmission natively supported by 60GHz technologies such as WirelessHD will be tested first. However, to achieve better adaptability to user numbers, scaling out the transmission devices may be a way to go.
- Techniques such as *beamforming* to avoid obstacles and extend transmission distances will be further investigated, and solutions with embedded systems will also be sought for, as is done in [2].

4. Related work

[1] achieved the wireless transmission for Oculus Rift DK1 on 5GHz Wi-Fi. It adopted H.264 encoding for video compression, and USB/IP for tracking data. The average delay was 94.1 milliseconds, which far exceeds the 20 milliseconds limit.

[2] proposed a novel programmable reflector to tackle the blockage problem in mmWave VR transmission. The downside is the latency introduced by its beam aligning. The end-to-end latency evaluation has been listed as future work.

5. Timetable and milestones

Month	Objective
1	Identify potential transmission and latency-reducing technologies by further investigation
2~3	Experiment on different technical solutions, determine implementation plan and locate critical problems
4~6	Build final prototype, evaluate end-to-end performance, finish the thesis

6. References

[1] Dmitry Galkin. Design and development of hardware and software for wireless Head-Mounted Displays. Master's Thesis, University of Bremen. 2014-2015.

[2] Omid Abari, Dinesh Bharadia, Austin Duffield, and Dina Katabi. 2016. Cutting the Cord in Virtual Reality. In Proceedings of the 15th ACM Workshop on Hot Topics in Networks (HotNets '16).