

## **Preliminary Implementation Plan**

Cloud VR. Secure, Fast and Distributed Virtual Reality Solutions.

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May 2020

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## Acronyms

**GPU** Graphics Processing Unit. 2

**IRH** Industrial Reality Hub. 1, 2

**VR** Virtual Reality. 1, 2, 3

## 1 Introduction

Recent developments in the field of Virtual Reality (VR) offer all kinds of opportunities in the field of training and entertainment. For training purposes, the audiovisual entry into a virtual world is where the biggest value is. The capabilities of artificial environments allow users to manage scenarios and experiences that cannot be simulated in the real world. VR also allows users to access the virtual training at any time and less physical facilities are required for exercises. Examples VR experiences include training maintenance at high altitudes (such as windmills), working under heavy loads and weather conditions in construction (Strukton) or maintenance on naval ships (Thales). These companies (and more) form the Industrial Reality Hub (IRH), which is one of the stakeholders of this project. The IRH is an industry consortium of 17 partners in AR/VR - The European digital innovation hub for industrial applied Augmented and Virtual Reality, stimulating cooperation and innovation between companies, government and knowledge institutes, resulting in world class business, knowledge and facilities. The hub is the AR/VR Fieldlab in the Dutch Smart Industry program and is recognized by the European commission as Digital Innovation Hub for industrial AR/VR (IRH, n.d.).

## **2 Reason for Assignment**

### **2.1 Graduation Assignment**

The assignment for this graduation is to analyse the current state of cloud VR streaming. This includes existing commercial services, open source libraries/frameworks, relevant research papers and experimental technologies. The 4 research directions for this project are system architecture for a cloud VR system, Latency, Multi-User Experiences and GPU Scaling. This paper will focus on researching the system architecture and latency improvements. These findings will be presented in the form of a theoretical framework and a literature review.

Armed with the information from the initial part of the research, the student and the stakeholders will agree on a suitable research focus for the remainder of the project, including a proof of concept focused on reducing latency.

### **2.2 Client outline**

The stakeholders in this project are the student (Leon Koster), Saxion's XR Lab (Matthijs van Veen, Yiwei Jiang) and the Industrial Reality Hub (IRH).

## **3 Objectives of the client**

Together with the companies from the Industrial Reality Hub mentioned in the Client outline, Saxion wants to investigate how virtual reality can be rendered in the cloud in a safe and efficient manner. This involves looking at state-of-the-art technology in the field of virtual reality, cloud computing, rendering and machine learning for one complete CloudVR pipeline.

In the bigger picture this project is a multi phase project, with this project being the initial phase. It aims to give an overview of the current situation regarding cloud VR streaming and focus on system architecture and latency optimization. These informations will subsequently be utilized in the later stages of the over arching research project.

## **4 Preliminary Problem Statement**

One of the essentials for a good Virtual Reality (VR) experience is a powerful computer system to render semi-realistic worlds. However, there are two problems here. First, this type of system is not available in every location. Certainly if realistic images have to be rendered in the simulation, it requires specialized and expensive machines that are difficult to move.

The second problem is that for rendering the VR training scenario, all kinds of data about the scenarios need to be available on the system. This can pose a problem when it concerns sensitive information, for example about all kinds of information defence systems or business sensitive information.

The hypothesis is that both of these problems can be resolved by a cloud rendering solution.

The aim of this report is to investigate the feasibility of a streaming based VR approach with current cutting edge technology. Qualitative research methods will be used to gain in-depth insights about existing solutions and the current state of research into this topic. The data will be contextualized via a literature review of recent research papers and capabilities of existing solutions when applied to the research problem.

## 5 Time Planning

I was asked to give an overview of the time line for this project. These times are from the graduation manual, translated to the time frame of my graduation project.

**Start of Project** The project started on the 4th May 2020.

**Preliminary Implementation Plan** To be handed in at the end of week 2: 17th May 2020 23:59

**Final Implementation Plan** To be handed in at the end of week 4: ~31st May 2020 23:59

**Graduation Report Draft** To be handed in at the end of week 10: ~12th July 2020 23:59

**Final Graduation Report** To be handed in at the end of week 16: ~23rd August 2020 23:59

## References

IRH. (n.d.). *Industrial reality hub*. <https://industrialrealityhub.com/en> accessed: 27.05.2020