

CLOUD RENDERING FOR VIRTUAL REALITY

YOUR JOB

Design and implement techniques for cloud rendering of virtual reality applications.

YOUR GOAL

To ensure that companies like Thales, The Virtual Dutch Man, Serious VR and Controllab (members of the Industrial Reality Hub) have safe, fast and distributed VR solutions as a more convenient way to deliver VR experiences to their customers.



POSSIBLE ASSIGNMENTS

1. **CloudVR system architecture**: designing a stable, safe and fast cloud rendering platform based on currently available hosting solutions (Microsoft Azure, AWS, Previder)
2. **Network optimization for latency reduction**: investigate how to optimize (minimize) the traffic being sent.
3. **Two-step rendering for latency reduction**: design techniques for servers to render complex parts of VR experience (RGB, position, BRDF variables) which the client would only slightly update.
4. **Movement prediction of latency reduction**: using machine learning, train a model that can predict the movements of a user's head, so that the server can render images beforehand.
5. **Multi-user experience**: investigate the limiting factors of collaboration in VR, considering latency and physical interaction.
6. **GPU-scaling**: design parallelization of processing of one or more VR experiences across multiple GPU instances.

ABOUT YOU

You are a CMGT or HBO-ICT graduate student who wants to learn more about cutting-edge technology related to virtual reality. You like investigating state-of-the-art research of big companies such as Nvidia and AMD, and you are eager to collaborate with researchers and fellow students to realize this technology.

YOUR CLIENTS

The Lectoraat Ambient Intelligence (Aml, saxion.nl/ami) is a research group that specializes in making our environment smart. We use sensors, data science and augmented interaction to solve all kinds of problems in the areas of health, safety and industry. We collaborate with the Industrial Reality Hub (industrialrealityhub.com) which specializes in AR and VR solutions for industry, and will support you during your assignment.

PERIOD

September 2020 – January 2021

REIMBURSEMENT

€ 230 per month

CONTACT & MORE INFORMATION (SEE NEXT PAGE)

Matthijs van Veen
m.w.vanveen@saxion.nl
06 - 190 73 976

Recent developments in the area of virtual reality (VR) offer great possibilities for virtual training. Especially the option to enter a virtual world gives users to opportunity to experience situations that cannot be simulated in the real world. Another benefit of virtual training situations is that it theoretically can be done at any time and any place. This alleviates the need for specialized locations, equipment and any actors. Example virtual reality training applications could be the maintenance of windmills on high altitude, working in very bad weather or maintenance of expensive and exclusive equipment.

However, as there are benefits to virtual training, there are also problems that still need to be solved. One of those problems involves the need for specialized computers that can render high-quality images. Since these are expensive and not easily transported, it could be a limiting factor on the availability of virtual reality training at some locations. A second problem is a security issue where it is not always desirable to have training scenarios on a local computer, especially when it involves sensitive information like military equipment or valuable intellectual property.

To solve these problems, a possible technology is that of cloud rendering. Currently there are some platforms that can do this for gaming solutions. These include Google Stadia, GeForce Now and Xbox xCloud. However, there is a difference between gaming and virtual reality when it comes to FPS and latency. To see if streaming services can also be used for virtual reality we would like to ask your help!

Within the CloudVR project, we offer you the possibility to graduate on one of the following subjects. If you are interested, please contact Matthijs van Veen (see contact information on the first page).

CloudVR system architecture

One of the basic questions for any cloud rendering platforms is that of which software and system architecture would be suitable for a virtual reality streaming solution. Here you will have to look at various available platforms and pick one that would be able to offer a solution taking into account the technologies listed below. A prototype has to be build and tested.

Latency reduction technology – Network optimization

Most platforms used above use network optimization to reduce latency within a cloud rendering system. We would like you to research how this can be done for virtual reality and how a constant speed could be achieved.

Latency reduction technology – Two-step rendering

One of the possibilities of further reducing delay is that of two-step rendering. This does not so much reduce latency but avoids it. In this situation, the servers would theoretically output the RGB, position and some kind of BRDF variables for each pixel in each frame. This would be sent to the user where, with less computation power, the images are updated based on its current (somewhat deviated) position. We would like to know what current systems like this already exist, what the theory says about this and we would like to see a prototype build.

Latency reduction technology – Movement prediction

Another method of reducing latency is that of prediction the virtual reality users' head movements. This would allow a server to render images in advance. To do this machine learning could be utilized to train a model that could be used an input for the render engine. In this assignment, you would need to research how such a system could be made and build a proof of concept.

Multi-user experience

One of the powerful features of virtual reality training is that it allows users to be in the same virtual space while physically apart. Here you can think of a situation where an instructor is based on one

place while training trainee all around the world. However, when working with a cloud VR solutions problems might arise with latency and interaction, especially since we as humans are susceptible to human-human interaction. For this assignment, you would need to research what the bottlenecks are for multi-users experiences and how they could be solved.

GPU-scaling

Given the cloud rendering setup, one of the possibilities it allows is that of GPU scaling. Here multiple GPUs could work together to render high-quality images usually not possible on single GPU machines. We would like you to research on how this can be done and what visual quality could be achieved. In the assignment, you will also have to take into account a possible two-step rendering solution.