

CS408 Project Scope & Outline Plan

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Project Title: Configurable Virtual Reality Rendering

Overview

When developing a Virtual Reality (VR) environment, it is common to change certain aspects of the environment in order to provide users with different experiences within the environment. Some of the reasons that a developer may want to change the experience for users are listed below:

- To make a VR environment more accessible for particular user groups e.g. changing the colour scheme to assist colour blind users
- To research how user experience changes in response to different environment configurations e.g. how does the visual appearance of a VR environment change a user's enjoyment of interacting with the environment.
- To find the environment configuration that provides the desired experience e.g. what hardware responsiveness should be used to make a VR game enjoyable?

The configurable aspects of a VR environment can be classed into **rendering** and **technology** factors.

A **rendering factor** is some aspect of the visual appearance of the VR environment.

These include:

- Visual detail, which can range from low to high
- Visual style, which can be cartoony, fantastical, realistic

A **technology factor** is some aspect of how the user can use hardware to interact with the VR environment.

These include:

- The amount of user tracking, which can range from head-only tracking to full body tracking
- The responsiveness of tracking, which can range from very delayed to immediate

Configuring all of these factors manually can be time consuming, which is not desired when performing user based testing for the VR environments.

Therefore, this project aims to provide developers with an efficient way to toggle the various rendering and technology factors in real time.

In particular, the focus will be on the available VR rendering and technology factors supported by the Unity game engine (<https://unity3d.com/>) and developing a software-based solution to facilitate toggling. A VR environment will also be created to demonstrate toggling functionality.

Preliminary List of Achievable Objectives

- Basic environment of a single space (e.g. a living room) with 1 to 3 Non Player Character (NPC) models
- Present the user with the rendering and technology factors that are available to be configure
 - Visual/graphical fidelity of environment
 - Visual style of NPCs
 - Amount of user tracking
- Allow user to configure rendering factors in real time
- Allow the user to save configurations as a configuration file
- Allow the user to load a configuration file and apply it to the environment it was created for

Possible additional features

- Configure animation level of NPCs
 - No animation
 - Basic movement e.g. movement of NPC in walking path with no movement of NPC limbs
 - Sophisticated movement e.g. walking animation

Preliminary survey of related work

A tool to configure technology and rendering factors in graphical environments can be useful in a variety of different areas. One of the most common areas this is used is the field of videogame development. Videogames usually have a settings menu, which enables users to alter the responsiveness of hardware and alter the visual detail in the game environment by toggling a variety of options to improve their experience. It is possible that the setting menus used for altering rendering and technology factors in videogames can be taken into account when designing the approach to take for this project.

Another field that can benefit from a configurable environment tool is VR experience research. This field aims to find out how different VR environments affects users. This could include research such as looking at how different hardware responsiveness affects a user's level of immersion within an environment (Cummings and Bailenson, 2006), or how different visual realism levels of VR environments affect knowledge retention (Harrington, 2012). This project will be focused on creating a tool to assist with configuring environments for VR research purposes.

Methodology to be followed

Initially, all of the requirements for the project need to be mapped out in a high level manner. After this, each feature in the requirements will be developed using an Agile development methodology.

The Agile methodology will involve working in Sprints. A Sprint is a set timeframe in which to complete a collection of features. A Sprint workflow involves performing specification definition, design, implementation, and verification stages for a particular feature. An advantage of this approach is that it allows me to implement an individual feature without the need to perform the development stages for every feature in the application.

Another advantage to developing the project with the Agile methodology is that it allows me to alter my design decisions and requirements list after each feature is completed. This means that I am able to ensure that I am developing an application that best meets the requirements of the project.

How the end product will be evaluated

The end product will be evaluated on two main criteria:

User Experience

1. Is the end product easy to use? Does the user ever get stuck when trying to change some configuration or is it apparent from the design how to perform a particular operation?
2. How many configuration options does the end product provide? Are there a lot of configuration options, or is it very basic and does not provide any substantial benefit over using the standard Unity game engine settings?

A successful end product will be one that is easy to use, highly configurable, and easy to maintain.

One approach for evaluating the User Experience criteria would be to perform user based testing where users are tasked with creating a variety of environment configurations. The end product will then be evaluated based on how successful the users were in creating the required configurations and their answers to a questionnaire about the usability of the product.

Initial project plan

First Semester

25/10/2019 – 27/12/2019 Preliminary research

The first semester will be focused on learning how to develop VR environments using the Unity game engine in order to gain a good understanding of the rendering and technology factors supported by Unity.

I will achieve this by reading training resources, such as Unity's VR tutorials (<https://unity3d.com/learn/tutorials/s/xr>). I will also read over resources on best practices when developing with C#, the programming language used to develop in Unity, to ensure that I follow best practices when developing in the language.

Logs will be created to capture all of the work carried out during this phase.

28/12/2019 – 10/01/2019 Requirements Refinement & Poster Creation

This stage will be focused on using the knowledge gained from the **Preliminary Research** stage in order to make a more informed decision regarding the scope of the project. This process will involve defining all of the key requirements for the project and choosing the solution to be implemented for the end product.

Furthermore, a poster will be created for the **Poster Day** deadline to convey pertinent information regarding the project and its planned scope. The created poster will be submitted prior to the **Poster Day** deadline

11/01/2019 Poster Day (University submission deadline)

Present poster created in the **Requirements Definition & Poster Creation** phase

Second Semester

12/01/2019 – 05/02/2019 Development of Minimum Viable Product and Initial Report Write-up

This stage will involve developing the minimum viable product (MVP) for the project, which should support toggling of one rendering factor and one technology factor at the very least. This MVP will be evaluated to determine if any changes need to be made to the design for the end product.

Additionally, a report will be written detailing what has been carried out in the project so far to prepare for the **Project Submission Deadline**.

06/02/2019 – 09/03/2019 Implementation of remaining Rendering and Technology Factors, Additional functionality, and Project Evaluation

This stage will involve implementing the remaining rendering and technology factors defined in the requirements. If any additional functionality has been defined during the stages carried out in the **First Semester**, then this will also be implemented provided there is sufficient time.

Finally, this stage will involve evaluating the success of the end product based on the criteria defined in **How the end product will be evaluated**.

10/03/2019 – 24/03/2019 Finalisation of Report

This stage will involve completing the report created in the **Development of Minimum Viable Product and Initial Report Write-up** stage.

27/03/2019 Demo Day (University submission deadline)

Demo the end product of the project.

Marking scheme to be used

The marking scheme that will be used for this project is the **Software Development Based** marking scheme. This scheme has been chosen because the main focus of the project is on developing a software-based approach to achieve the desired end product. Since there is not a major research component to this project, choosing the two experiment based marking criteria did not seem fitting.

References

Cummings, J.J. and Bailenson, J.N., 2016. How immersive is enough? A meta-analysis of the effect of immersive technology on user presence. *Media Psychology*, 19(2), pp.272-309.

Harrington, M.C., 2012. The virtual trillion trail and the empirical effects of freedom and fidelity on discovery-based learning. *Virtual Reality*, 16(2), pp.105-120.

Supervisor Comments

William has a good understanding of the project's purpose, and the overview includes motivations for having a configurable VR environment as well as which factors the environment will be configurable through. The list of objectives is clear and sufficiently detailed and what is included in the related work is well-reasoned and relevant to the project. The proposed methodology is sensible and reasoned, as is the user experience aspect of the evaluation, however, additional functional testing could also be incorporated (e.g., do certain combinations of factors cause bugs/issues). The project plan is detailed and sensible.