Initial Plan –

Investigating Factors Affecting User Immersion in Virtual Reality Applications

Module CM2303 –

One Semester Individual Project

40 Credits

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Project Description

Virtual Reality has made major strides in the years that it has been available for consumers, both in terms of ease of adoption, and demonstrating new and novel ways to allow users to interact with media, such as games, films, and more. When focussing on how games present themselves, there are many great examples of transferring traditional gameplay loops from modern titles and translating them to suit the interactivity of the medium. However, with more titles experimenting and more variations of headsets coming to market, there is a greater number of complaints as well as praise with respect to the level of immersion a user may experience in these applications.

For example, the software title "Boneworks" is often touted by more experienced users as the "must-have" VR game due to the "full" physical representation of the player and the way it attempts to obey the regular laws of physics that affect our real bodies. On the other side of the argument, there is the software title "Half-Life: Alyx", which users have cited as being one of the most immersive applications since VR headsets released to the public market, but only represents the user as a disembodied pair of hands, and instead relies on narrative and environment to immerse the user.

The divisive arguments on both sides regarding the medium and its immersion factors are greatly varied, but one often recurring factor is how the user is physically represented in the application, and how the medium regards the player as an entity.

This project aims to focus on this most central aspect of the discussion regarding immersion and assess how changing this aspect will affect user's experiences, and collect user provided data for analysis with respect to how the changes alter their experience, and how this data could be applied to other applications.

Aims and Objectives

The overall aim of the project is to create an application that provides a short and immersive gameplay experience and deliver a relevant questionnaire to complete once the experience is finished. The experience and following questions are to be centred around investigating the user's thoughts on their experience and their immersion within it.

The application will present and progress users through different forms of physical representation and provide distinct physical states in order to complete a series of short tasks, each task being best suited to the current representation of the user. The final task will be designed to be completable by all forms of representation and allow the user to determine which they would like to select to complete the final task. This selection will be the focal point of the questionnaire provided once the task is completed if the user wants to complete it.

The application itself will be created in Unity and utilise the SteamVR SDK, and will include a mixture of custom created assets and prefabricated assets provided by Unity, the Unity Asset Store and the SDK. The application will be scripted in C++ for movement and interaction with the created environments, and the primary headset used for testing will be the Valve Index, but the application will be designed to maintain compatibility with the native SDK controller mapping system to allow for other SteamVR compatible headsets to be used.

A breakdown of the aims of this project are as follows:

- Basic Aims –
    o Creation of a Unity based application offering basic interactivity and user representation in VR
    o Basic Environment, Lighting and Level design with some progression
    o A relevant optional questionnaire provided alongside the application for users to complete after finishing
    o Some predictions made about result outcomes
- Intermediate Aims –
    o Thematic consistency in design and presentation within the application to keep the user engaged, and focused on gameplay mechanics
    o Integration of questionnaire into application with relevant disclaimers and consent forms provided
    o Moderate analysis and observations of results
- Advanced Aims –
    o Engaging design, theme and clear progression with well thought out mechanics
    o Modular design to allow for expansion of application to determine responses to other immersive factors or further progression of current factor
    o Good analysis of collated results versus predictions and how this data could be used as feedback for other applications

Ethics and Risk Management

Risk Management

Undertaking this project, the biggest risk is regarding the current situation with COVID-19 and how that is affecting the ability to travel, socialise and undertake studies in person. The widespread sharing of VR headsets could be considered unsanitary before the pandemic, and so in-person testing at the university is out of the question. I have instead decided that online distribution and participation recruitment through forums is likely the best way for me to be able to collect data from users during testing. Self-isolation requirements will likely not affect the progression of the project unless suffering from severe complications from COVID-19, as all planning and development is being undertaken at home, and testing will not require presence or remote presence to supervise. If COVID-19 does prove to be disruptive in ways not accounted for here, it will be noted in the final report.

Ethics

Ethical approval is necessary because I currently intend to distribute an open-source version of the final application to friends and forums, to collect anonymous data in a questionnaire built into the application and collate the data for analysis. The time involved to receive approval will be accounted for all relevant tasks will be complete before the project reaches the distribution and data collection stage.

The first key ethical issue is making sure that there is a level of transparency with any users who choose to participate in the research, and make it clear on starting the application that there is a data collection aspect to the application for research purposes and allow the user to either opt in or opt out and provide them with a consent form and the full list of disclaimers.

The transparency is double layered with making the application an open-source release, as I would likely be unable to release such a project on a software distribution platform with a large audience such as Steam due to the costs involved. I may consider releasing the application on a more independent focused platform as well as open source to potentially assist traction and potential collection of data.

The second issue will be determining what metrics to collect from users. Providing metrics such as time spent in the application and headset used could be very useful as determining factors to establish which users may be more experienced with the medium or could be used for weighting the usefulness of the response data but might make it slightly more difficult to obtain consent or keep the data blatantly anonymous by not allowing identifiers or not allowing the user to deviate from scaled responses, by excluding items like custom text fields.

The third biggest issue is managing how user data, anonymous or not, is stored for analysis. This will need to be clear in the agreement before the user partakes in testing, as well as the issue of storing the data securely and maintaining that security. If I choose to gather data and store it in a file-based method, I would use a cloud-based secure storage platform, to prevent it from being compromised on a local machine via unauthorised access or through a malware attack.

Work Plan

To assist the forecasting and tracking of the development process laid out in the project, the process has been broken down into the following categories and subcategories, each with a list of what will likely be focused on when that area is in development. Tracking of project progress will be undertaken by a project management tool such as Trello.

These subcategories are listed as guidelines for what areas will be worked on and are subject to change.

Design and Visualisation
- Environment/Scene Design
    o Pre-Visualisation
    o Colour palettes
    o Lighting and Shading
    o Planned User interactivity
    o Models used
    o Thematic consistency(?)
- Player Controller Design
    o Comfort options
    o Movement options
    o Menu design
- Level/Puzzle Design
    o Clear and achievable goals
    o Visual progress indications
    o Positive progress feedback
    o Clear core progression loop
- Report Work
    o Construct preliminary questionnaire and predictions for results

Implementation
- 3D Design
    o Manual creation of necessary assets determined in design process
    o Collect and list prefab assets to be used
    o First draft of the environment design using the prefab and custom assets
    o Implementation of lighting
- User Representation
    o Creation and programming of the VR camera
- Scripting
    o Progression of scripting scene by scene
    o Scripting user interaction and movement models
        ▪ Basic interaction model, intermediate interaction model and advanced interaction models
    o Environment Scripting
    o Implement framework for questionnaire in advance

Testing and Revision

- Initial Testing
    - o Once all interaction models are working attempt an end-to-end test of the application
- First Revisions
    - o Document all glaring design and programming issues found in first full test
    - o Begin applying fixes and document all changes made
- Subsequent revisions
    - o Attempt an end-to-end test and document which issues persist, and which have been fixed
    - o Progress through revisions once end-to-end experience is acceptable
    - o Explore peer review options for bug fixing revisions

Documentation and Distribution

- Documentation
    - o Create and implement final questionnaire and disclaimers
    - o Gather bugs remaining from last revision and document them in a known bugs list
    - o Create a quick start guide for the application to incorporate in to open source release
    - o Collect feedback from peers on interface and experience and make changes where necessary
- Distribution
    - o Push application as open source release
    - o Collect bugs and feedback from initial user experiences
    - o Push a hotfix build and broadcast release
- Report Writing
    - o Write Final Report
        - ▪ Draw analysis from questionnaire results from distribution
        - ▪ Compare initial predictions to results from distribution
    - o Finishing touches to documentation

Gantt Chart

Below is a Gantt chart detailing the categories set out above to provide a visual representation of the time planned to be spent in each area. As with the above categories, the sections are subject to change, and deviations from this initial prediction will be documented as they occur.

Task Category	Task Name	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Documentation	Initial Plan Writeup	▓											
Design and Visualisation	Environment/Scene		▓	▓	▓								
Design and Visualisation	Player Controller		▓	▓	▓								
Design and Visualisation	Level/Puzzle				▓								
Implementation	3D Design					▓	▓						
Implementation	User Representation					▓	▓						
Implementation	Scripting							▓					
Testing and Revision	Initial Testing								▓	▓			
Testing and Revision	First Revisions								▓	▓			
Testing and Revision	Subsequent Revisions									▓			
Documentation	Documentation	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓	▓
Documentation	Distribution										▓		▓
Documentation	Report Writing										▓	▓	▓