



BSc (Hons) Computer Games Development

An investigation into the effect of flow and immersion on time perception in first-person shooters.

**Mohammed Hassan Latif
B00333837**

29th April 2022

Supervisor: Dr Gavin Baxter

Moderator: Dr Thomas Hailey

Declaration

This dissertation is submitted in partial fulfilment of the requirements for the degree of Computer Games Development (Honours) at the University of the West of Scotland.

I declare that this dissertation embodies the results of my work and that it has been composed by myself. Following normal academic conventions, I have made due acknowledgement to the work of others.

Name: Mohammed Hassan Latif

Signature: Mohammed Hassan Latif

Date: 29/04/2022

Form to accompany Dissertation

To be completed in full

Surname:	Latif
First Name:	Mohammed Hassan
Initials:	MHL
Borrower ID Number:	B00333837
Course Code:	COMP10079
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COMPUTER GAMES HONOURS PROJECT SPECIFICATION FORM
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Project Title: An investigation into the effect of flow and immersion on time perception in first-person shooters.

Student: Mohammed Hassan Latif

Banner ID: B00333837

Supervisor: Dr Gavin Baxter

Moderator: Dr Thomas Hainey

Outline of project: Individuals who play video games frequently describe the experience of flow and immersion whilst gaming. A certain characteristic of flow and immersion which is often reported is a sense of time passing quickly which can be seen as both a helpful and unhelpful aspect of the overall gaming experience. In this study, we examine if the level of flow and immersion in a video game influences individuals' time perception.

Previous studies have not systematically found a relationship between flow and immersion and its impact on time perception (Nuyens, 2020). As research to date has provided mixed results they therefore do not allow conclusions to be drawn about the effects of flow and immersion on time perception (Luthman, 2009). Consequently, further examination of the topic is warranted, and this study hopes to add to the limited available research literature. Specifically, we aim to examine if there is a relationship between increased levels of flow and immersion and time perception namely the experience of time loss. It is hypothesis that increased subjective levels of immersion correlates with increased subjective levels of time loss in video gaming.

Flow and immersion: Flow is commonly approached from a radical standpoint, wherein all its nine proposed dimensions must be present for the experience to qualify as flow. These dimensions include a balance between the abilities of a private and the activity's demands; merging of action and awareness; clear goals; immediate and unambiguous feedback; concentration on the task; perceived control over the activity; loss of self-reflection; distorted perception of time; and intrinsic motivation toward an activity (Csikszentmihalyi, American Psychological Association., 1975).

Immersion is more popular than flow among academics and non-academics equally (Smith, 2016), and it has a lengthy history of interpretations (Smith, 2001). However, the argument isn't only about which term is more suitable (Cairns P. C., 2016), but also concerning the sensory, cognitive, and emotional outcomes of an immersive encounter.

Time Perception: Time distortion is a phenomenon that is frequently reported in both the negative and positive events of daily life. For example, waiting for a bus whilst already running late, time is likely to be subjectively experienced as passing slowly. In comparison, engaging in an activity that we enjoy such as gaming contributes to the subjective experience of time passing quickly. Furthermore, it is predicted in accordance with Vierordt's Law, that short time intervals tend to be overestimated and long ones underestimated. This is named after

the German physiologist Karl von Vierordt who formulated it in 1868. Therefore, in accordance with Vierordt's Law, it is predicted that individuals will significantly underestimate long gaming sessions and overestimate short ones.

Details about the game and its development: Alongside our investigation into the relationship between immersion and time perception, the purpose of the project is to design and implement a 3-dimensional game written in C# using the Unity game engine. The game that will be created is a first-person zombie shooter. The objective of the game is that the player needs to survive for as long as possible without dying. The project includes a complete level of the game with documentation. The level will include everything that should be available in a first-person shooter game. The game will be a single-player game. The team members do not aim to develop an instructive game; instead, the aim is action, action, and more action.

The proposed Games Hons Project will include practical work related to games development

Project Deliverables:

- Project Plan
- Game Design Document
- Test Plan
- Test Report
- Final Report
- Product
- User Manual

In the game's design and development, flow and immersion are important factors to take into contemplation to create player engagement. I will look at how this style of game will accommodate the aims of the study. Below is a list of fundamentals that will be considered and impact the flow and immersion in the game.

Rewards: Intrinsically rewards such as gaining experience and cash are regularly obtained by the player as real and instant rewards.

Clear goals: The player has clear goals, and they know what to achieve. The game is an endless survival game where the zombies will be getting faster and stronger whilst the player will be gaining experience and cash regularly. This element is important for player progression through the game.

Loss of consciousness: The flow works well in this game as the player does not have to concentrate on what they're doing to achieve an action. The state of the player is to combine action and awareness.

Loss of sense of time: The player is enthralled by the activities that they're doing such as upgrading their health or weapons, consequently, they are unlikely to realise the passing of time whilst they are playing.

Direct and immediate feedback: The player is guided by the direct feedback of the game, and they are aware what they need to do to succeed in the game.

The balance between player skills and challenge: The level of the game is neither too easy nor too difficult. The difficulty of the game is constantly adapted to the player's skill and ability.

The player controls the situation and the activity: The player needs to survive for as long as possible to beat the challenge. As it is an endless survival game, the objective for the player is to beat their previous best score.

Materials

A Plain Language Statement Information Sheet will provide information about the study.

A Participation Consent Form will provide participants information about the research area so that the participants are aware what the study is about, why they were taking part, and to ask their permission to use their data in the study.

A Demographic Questionnaire will ask about participants age, gender, occupation, and participants' gaming history which includes frequency of play, average playing duration, and the number of years they have been playing.

The Immersive Experience Questionnaire (IEQ) developed by Jennett et al. (2008) will be utilised to subjectively measure how immersed the participants were and their time perception in terms of losing track of time.

The ethical approval process

Ethical codes are designed to protect the safety and best interests of those who participate in research. As human participants will be involved in the proposed Hons Project, ethical approval will be sought through approved mechanisms of the School of CEPS Ethics Committee. Some key ethical components that will be followed are voluntary participation, informed consent, and confidentiality.

Participants will be sent a Plain Language Statement Information Sheet which will provide information about the study, including that their participation is voluntary and that they can withdraw this at any time. Participants will then be presented the Participation Consent Form has to request permission for their data to be used for the research and analysis purposes. This will be fully anonymous; no username will be recorded, and participants can agree or disagree with the study at this point. If they disagree, they will be greeted with a screen to close the questionnaire. If they agree, they will be greeted with a link to the game and the subsequent Google Forms Questionnaire. After they have completed the questionnaire, they will be presented with a de-brief about the study.

Resources Required:

Hardware

PC Specifications:

CPU: AMD Ryzen 7 3700X 8-Core Processor
Graphics Card: Nvidia GeForce RTX 2070 8GB GDDR6
RAM: 16GB DDR4
Storage: 1TB SSD M.2 NVMe, 1TB SSD and 2x 1TB HDD
Dual Monitors
Headset
Keyboard & Mouse
Webcam

Software

3D Assets: Adobe Photoshop CS6
Audio Editing: Audacity Version 3.1.3
Backup: Local Hard Drive Backup, Microsoft OneDrive, and Google Drive
Code Editor: Visual Studio 2019
Communication: Microsoft Teams
Documentation: Microsoft Office 365
Game Engine: Unity Engine 2020.3.26f1
Language: C#
Modelling: Maya, Mudbox and Blender
Operating System: Windows 10 Pro Version 21H2
Task Organisation: Microsoft Office 365 Excel
Version Control: Local Hard Drive Backup, Microsoft OneDrive, and Google Drive

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Marking Scheme:

	Marks
Requirements and Design	10
Literature Review	10
Requirements and Design	10
Development	50
Testing and evaluation	10
Critical Appraisal	5
Online Portfolio	5

Signed: Mohammed Hassan Latif

Student	Supervisor	Moderator	Programme Leader
X			

IMPORTANT:

- i. ***By signing this form all signatories are confirming that the proposed Hons Project will include the student undertaking practical work using games technology achieved by the creation of a game as the focus for covering all aspects of the games development life-cycle.***
- ii. ***By signing this form all signatories are confirming that any potential ethical issues have been considered and if human participants are involved in the proposed Hons Project then ethical approval will be sought through approved mechanisms of the School of CEPS Ethics Committee.***

Researcher's contact details

Name: Mohammed Hassan Latif

Address: School of Computing, Engineering & Physical Sciences, University of the West of Scotland, High St, Paisley PA1 2BE, United Kingdom

Email: Mohammed.Latif@uws.ac.uk

Supervisor's contact details

Name: Dr Gavin Baxter

Address: School of Computing, Engineering & Physical Sciences, University of the West of Scotland, High St, Paisley PA1 2BE, United Kingdom

Email: Gavin.Baxter@uws.ac.uk

An investigation into the effect of flow and immersion on time perception in first-person shooters.

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Dr Gavin Baxter

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Dr Thomas Hainey

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My family have been a huge support to me during my academic years, particularly throughout the Honours project. They have been by my side throughout and have lifted me emotionally and psychologically during the most difficult times. I would like to give a special thanks to my fiancée Faiza, my mum and dad, my brother-in-law Farman, and my sisters Misbah and Iqra, they have all been incredible throughout my time at university, and I wouldn't have made it this far without their encouragement, guidance, and support.

Classmates

I would like to extend my thanks to all my classmates in particular Fraser McAulay, Merissa Coulter, and Iona O'Donnell. They have all helped me throughout my time at the University of the West of Scotland with problem-solving, morale support, and much more. It has been a pleasure to work beside all of them. Without them, the Honours project would not be to the benchmark it is now.

Participants

Lastly, I would like to thank all the participants that took part in the study including play testing the game and completed the surveys. Without them, I would not have been able to accomplish any of the research for this project and for that I am very thankful.

Abstract

Individuals who play video games frequently describe the experience of flow and immersion whilst gaming. A certain characteristic of flow and immersion which is often reported is a sense of time passing quickly which can be seen as both a helpful and unhelpful aspect of the overall gaming experience. In this study, I developed a first-person shooter game and then examined if the level of flow and immersion the participants experienced whilst playing the game influenced the individuals' time perception. Specifically, I examined if there was a relationship between increased levels of flow and immersion and the experience of time loss utilising The Immersive Experience Questionnaire (Jennett et al., 2008). It was hypothesised that increased subjective levels of immersion correlates with increased subjective levels of time loss in video gaming. I utilised descriptive statistics and the Spearman's rank correlation. Results showed that there was a statistically significant correlation between immersion and time loss ($r_s = 0.59154$, p (2-tailed) = 0.00184) meaning that participants who experienced subjective higher levels of flow and immersion whilst playing the game experienced subjectively higher levels of time loss. Implication of these results are discussed in relation to previous research and the design, development, and evaluation of video games.

Introduction

Video games particularly first-person shooters games are a current topic of interest for a wide range of researchers. Studies have typically focused on hardware, software, and the game development process. However, in recent years, there has been a growing interest in the players themselves. Researchers of the latter are motivated to better understand the interaction and relationship between players and video games (Nacke et al., 2009).

As well as academic interest, building an understanding of players is also motivated from a business point of view. The number of video game players is increasing with time, with approximately 2.69 billion video game players worldwide in 2020. This is a sizable increase of 9.3% in 2019 (WePC, 2022). The figure is expected to rise to 3.07 billion by 2023 based on a 5.6% year-on-year growth forecast. The global games market had \$159.3 billion in revenues for 2020, almost half of which came from the Asia Pacific market according to a Finances Online report (Gilbert, 2022).

It is, therefore, difficult to deny that both the number of video game players and the profits made from video game sales are too vast to be disregarded. Thus, knowing exactly what players want from video games helps games developers to produce games that players would be interested in and enjoy playing. In turn, knowing what video game players want will also secure profits for the gaming industry.

Justification

Games design and development research such as this can help to uncover new insights, processes, and feedback about the gaming experience from players. Specifically, individual's experience of flow and immersion and the relationship between time perception in the first-person shooter game we have developed and tested. Such knowledge and understanding in

turn can contribute to and inform best practice in the design, development and evaluation of games and the experience for those playing them.

Furthermore, such research aids designers and developers of games to create more sophisticated video games. These days digital games have progressively improved their quality especially in terms of graphics (Wolf, 2003). Furthermore, accessibility has also improved drastically with controls to video games more hands-on allowing players to control using various new methods, especially in synchronising a broader variety of strategies and movements in video games. Moreover, with the internet, gamers can play video games and connect with other people in different parts of the world (Toivonen and Sotamaa, 2010). Also, video games are now available in pocket-sized devices allow players to play video games anywhere at any time. This not only benefits players on an individual level but also as mentioned previously good quality and accessible video games in turn help on an organisational and industry level with raised interest, sales, and profits.

Furthermore, previous studies have not systematically found a relationship between flow and immersion and its impact on time perception (Nuyens, 2020). As research to date has provided mixed results they therefore do not allow conclusions to be drawn about the effects of flow and immersion on time perception (Luthman, 2009). Consequently, further examination of the topic is warranted, and this study hopes to add to and extend existing knowledge to the research area.

Structure

Literature Review

To obtain a better understanding and improve my knowledge on the effect of flow and immersion on time perception in first-person shooters, I will firstly review the available literature on the subject. In this section, I will cover the components that are crucial to examine such as (1) current definitions of flow, immersion, and time perception, (2) types of flow and immersion and its impact on time perception and (3) what previous research has found about the effect of flow and immersion on time perception.

Game Design and Solution

A collective purpose of this project is to create a game that employs the theory and research of flow and immersion using a first-person shooter genre. Unity Engine version 2020.3.26 was used to develop the game, in which the player's goal is to survive for as long as possible in the game. The player is able to enhance their weapon, ammo, enemy damage, reloading speed, and recoil of their weapon. By allowing players to upgrade these certain elements, it will create and determine the player's cognitive flow and immersion. I will discuss the process used to build the proposed solution to investigate the influence of flow and immersion on time perception in first-person shooters. This section will cover environment design, concept art, visual style, game feature implementation, and other characteristics that identify the game's production.

A preliminary questionnaire was also distributed to gather information on who plays first-person shooter games and what kind of content they expect to find in them which shall be discussed further. Additionally, this section describes the quantitative questionnaire technique utilised. The questionnaire was used to investigate the research topic as well as to describe the game itself.

Findings and Evaluation

The findings and any input are presented and described such as descriptive statistics and statistical significance testing. This will be followed by a critical evaluation of the project in which the results are discussed in relation to previous finding limitations and recommendations for future research. Finally, the project will conclude with final thoughts and conclusions.

Literature Review

Flow and immersion during gaming are phenomenon often reported amongst player as the most enjoyable facets of video games because of their ability to bring about positive emotions during game play (IJsselsteijn et al, 2007). However, there appears to be tentative conceptualisations of these experiences (Michailidis, 2018). By reviewing the available literature and defining the most important aspects in the research area, I will provide the foundation for the rest of this thesis. Specifically, in this section, I will aim to focus on the following key questions:

1. What are current definition of flow, immersion, and time perception?
2. What types of flow and immersion is there and what is the impact on time perception?
3. What does previous research suggest about the effects of flow and immersion on time perception?

Flow

Defining flow state

Flow theory is a concept established by the psychologist Csikszentmihalyi in the late 1970s. He describes the experience as the "optimal psychological state or experience" where individuals are so involved in a challenge-based activity that they feel fully focused and immersed in it with little or no awareness of their surroundings or problems. Consequently, individuals become self-assured and feel rewarded within themselves leading to repetitive behavior due to internalised motivation rather than this coming from an outside source.

Other researcher also define flow similarly including (Schell, 2015, p. 138) who described flow as: *"a feeling of complete and energized focus in an activity, with a high level of enjoyment and fulfilment"*. Csikszentmihalyi (1977) goes on to highlight that flow is a delicate balance of adequate skills to cope with the challenges of an activity that is goal-directed, with rules, and involve actions guided by clear clues. Specific characteristics of flow state include a balance of challenge and skill, clear goals, immediate feedback, combining action and awareness, loss of

self-consciousness, a sensation of control, temporal distortion, and seeing the activity as intrinsically satisfying (Csikszentmihalyi, *Finding Flow: The Psychology of Engagement With Everyday Life.*, 1998). His research indicated that individuals actively seek such activities and looking forward to the sensation of flow in comparison to activities where they will feel bored, unfulfilled, or unoccupied.

Previously, flow used to describe the experience people gained from artistic performances, sports, rock climbing, chess, and a variety of other activities. However, flow is a state of mind that can be attained while engaging in any activity. The diagram below illustrates the concept of the “flow zone”. In the flow zone, the challenge of the task is balanced compared to an individual’s capability and skill to ensure that the individual remains involved with the learning progression minus anxiety or boredom. The state of flow is considered the positive experience where an individual is able to shows his or her potential. Csikszentmihalyi’s theory of flow is widely utilised in games design.

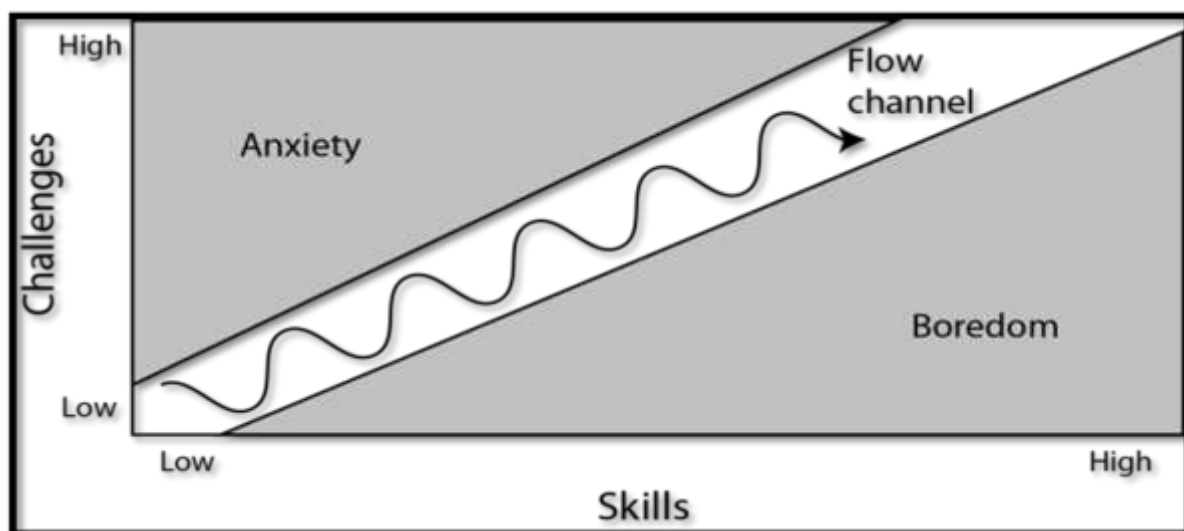


Figure 1 – Flow Channel Wave, by (Jesse Schell, 2008) From “The Art of Game Design”

Previous flow research

Several studies have been conducted that apply flow theory to video games. (Ijsselstein et al, 2007) studied flow state in video gamer and found that the occurrence of flow was partly due to the poise between the player’s ability and skill, the challenge of the game, attentiveness, clear feedback, goal, and a sense of control over game playing. Furthermore, (Chen et al, 2007) developed and designed a game called “Flow” based upon Csikszentmihalyi’s theory of flow. In the game, there was automatic adjustment in the level of challenge and responsiveness based upon the actions and skills of the player. Consequently, less skilled players stated that they experienced an increased sense of control whilst playing which in turn contributed to them feeling more immersed in the game to achieve the flow state due to the personalised balance of challenges and skills. (Cowley et al, 2008) user-system-experience model, enabled an applied understanding and mapping of flow theory to video gaming. Their method improved understanding of player’s contact with a

game providing useful insights for games designers and developers seeking to create mechanisms to adjust video game play to the individual players themselves. (Cowley et al, 2008) feel that whether a flow state is experienced during a gaming session is determined by how the player perceives the game as an activity. They believe that by seeing gaming as an important worthwhile activity, gamers are more likely to achieve flow.

Game Flow

The concept of GameFlow is one particularly relevant application of flow theory to explain the experience of playing video games. GameFlow is a paradigm established by (Sweetser and Wyeth, 2005) that tries to integrate flow as part of the gaming experience, albeit it was more focused on reviewing games than quantifying the experience. GameFlow employs flow theory to identify, characterise, and debate the features of video games that are crucial to lead to flow experiences in gaming. It is not used to explain user experiences, which (Sweetser et al, 2012) say are of a different category than GameFlow. With flow as the structural fundamental base, the GameFlow components were mapped to flow components to verify that the GameFlow model fits within flow theory. Concentration, challenge, skills, control, a clear objective, feedback, immersion, and social connection are the main components of GameFlow (Sweetser and Wyeth, 2005). GameFlow has recently been validated and augmented as a set of detailed heuristics based on the analysis of game reviews to make it more useful in the design and evaluation of games (Sweetser et al., 2012). However, in doing so, they acknowledged a gap in what they regard to be immersion, which may be on a different level than the other GameFlow features. This provides an intriguing path of investigation in which a relationship is formed between the game's analysis under GameFlow and the game's experiential outcome, with a particular focus on the function of immersion.

According to (IJsselsteijn et al, 2007), flow can be operationalised as a graded experience. They say in this argument that flow allows gamers to rate their level of flow while playing digital games. However, this makes little sense because the flow is designed to be an ideal and extreme experience rather than a partial, graded, and so sub-optimal experience. It's a case of "all or nothing." You will have either experienced flow or you do not. The development of a GameFlow model based on flow theory is therefore appropriate as a framework to examine what a video game can offer rather than articulating what player experience is while playing the game. As a result, in video games, flow could be regarded as a key component of the game play experience.

Immersion

Defining immersion

Immersion is considered to be a more prevalent concept than flow across academics, researchers, games designers and players alike as it encompasses the sensory, cognitive, and emotional facets of an immersive experience (Smith, Drowning in immersion, 1998).

Immersion is a concept that gamers may instinctively link to their sensation of "being in the game" (Brown and Cairns, 2004). Immersion is defined by (Carr et al, 2006) as a concept

with diverse features in games depending on whether it is drawn from literary theory, Virtual Reality analysis, or presence theory. They try to categorise video game immersion into two types: perceptual immersion and psychological immersion. The degree to which technology or experience monopolises user senses is referred to as perceptual immersion, whereas psychological immersion emphasises the cognitive rather than the sensory characteristics of the game, referring to immersion as incorporating the gamer's "mental absorption" in the game world. According to (Sanders and Cairns, 2010), immersion occurs when players devote their complete attention, thoughts, and goals to the game rather than being bothered with things going on around them. They namely consider the psychological experience of immersion which allows gamers to be less conscious of their surroundings, more absorbed with the task environment, and lose track of time (Cheng and Cairns, 2005). According to (Brown and Cairns, 2004)'s qualitative study utilising grounded theory, immersion is a measurement of the level of engagement gamers have with a video game.

Although immersion is widely regarded as a key component contributing to favourable experiences for video game players and assisting players in improving their skills (Seah and Cairns, 2008). Immersion as a cognitive feeling is difficult to explain objectively. Much research has been conducted to investigate immersion in video games; yet it is still unclear what is definitively meant by immersion, what it encompasses and what causes it considering the very subjective nature of immersive experiences (Jennett, 2010). Furthermore, definitions and assumptions about immersion can be connected to the type of game, the player's perception, or the interactivity of the world (Brown and Cairns, 2004). Consequently, immersion can be viewed as a vague term when used without further context.

Four categories of games immersion

In order to address this ambiguity, four categories of games immersion have been identified which can allow for a more pertinent conversation to take place (Haggis-Burridge, 2020). The four categories are shown in the table below and then discussed in more detail:

SYSTEMS IMMERSION	SPATIAL IMMERSION	EMPATHIC/SOCIAL IMMERSION	NARRATIVE/SEQUENTIAL IMMERSION
A high level of engagement with the systems and decision-making processes in the game, related to 'flow'.	A sense of 'presence' in a location. The feeling of being in that place, or of having travelled there.	An emotional connection with the characters or social context of a game.	A deep and compelling investment in the progression of events, locations, and/or abilities. The focus here will typically be 'what happens next?'
All types are likely to be non-discreet, with close relationships and overlaps of game-elements that contribute to (or subtract from) multiple forms of immersion.			

TABLE 1: THE FOUR CATEGORIES OF IMMERSION.

- Systems immersion - describes when players are profoundly enthralled with the process, challenges, and rules of a game. It is considered similar to Csikszentmihalyi's theory of flow state where contentment is attained from a progressive balance of challenges and player skills.
- Spatial immersion - describes the sense of players being aware, or present in, or transported to, the virtual gaming world. Spatial immersion therefore refers to a player's sense of presence in a virtual space and is connected to the idea of embodiment. The visual quality of a game is expected to be significant in encouraging this category of immersion to happen.
- Empathic/social immersion - describes the connectedness that players may develop towards the characters of the game or other players in the game. It therefore considers the personal and social context of a game. The emotional reactions can therefore help to create, develop, and strengthen bonds with characters of the game and other players. This can be the case for fantasy and first-person shooter games in particular. An example of this is when a character or another player's character dies after fighting alongside the player for many quests. Furthermore, playing alongside other games can stimulate a sense of social connection that is facilitated by the game. An example of this is when players regularly meet in the virtual space and bond based on the collective experience of part taking in missions. These social systems can build and strengthen a sense of community that can in turn stimulate either empathic immersion, social immersion, or both. Due to the sense of friendship and community, players may continue to return to playing a game over time.
- Narrative/sequential immersion - describes a player's anticipation to see how a sequence of events endures or unfolds. Characteristically, this is likely to be driven by story-based games that revolve around physical and/or emotional conflicts. However, can also be applied to observing progressive ability upgrades for a character, or travelling through a region of a game and wishing to find the next area to explore. No doubt, this category of immersion is a strong factor in the success of most video game genres, particularly first-person shooter games as well as many other types of games.

Hierarchical Model of Immersion

Furthermore, in addition to the 4 categories of immersion, an extensive analysis of immersion is also examined by (Brown and Cairns, 2004) They conceptualise immersion as a graded evaluation of involvement in video games within a hierarchal model containing three levels. Each level demonstrating a progressive level of immersion for players.

The first level is engagement which refers to the straightforward concept of interacting with a game. In this first stage, gamer preference is identified as the key barrier. If the player dislikes the game's genre or storyline, it will be difficult for them to connect with the game

(Brown and Cairns, 2004). Researchers discovered that it is critical to guarantee players enjoy the type of game utilised in a study otherwise the level of immersion will be very low (Sanders and Cairns, 2010); (Cox et al, 2012); (Thompson et al, 2012). The choices for the type of game players engage with assists them in becoming immersed in the gameplay.

The second level is engrossment which is achieved when players are emotionally intertwined with the game, this can be either positively or negatively. In the engrossment stage, controlling the game will feel wholly natural to the player and input devices are likely no longer consciously part of the experience. Players are tied to the game's image, audio, and controller at this level. The characteristics must be mixed in such a way that they affect the player's emotion and ability to master the game controls, with the gamer becoming less conscious of their surroundings as they grow more absorbed and involved with the game.

In the third and final level, total immersion is achieved when players are completely in sync with their characters and in the game itself. At this level, it is likely that players will lose their sense of time and their surroundings entirely. This level can be reached through the level of game mood and empathy. When players can empathise with the game character, as in a first-person game, they can become completely invested and immersed. Furthermore, the game atmosphere (story, graphics, and sound) contributes to player participation.

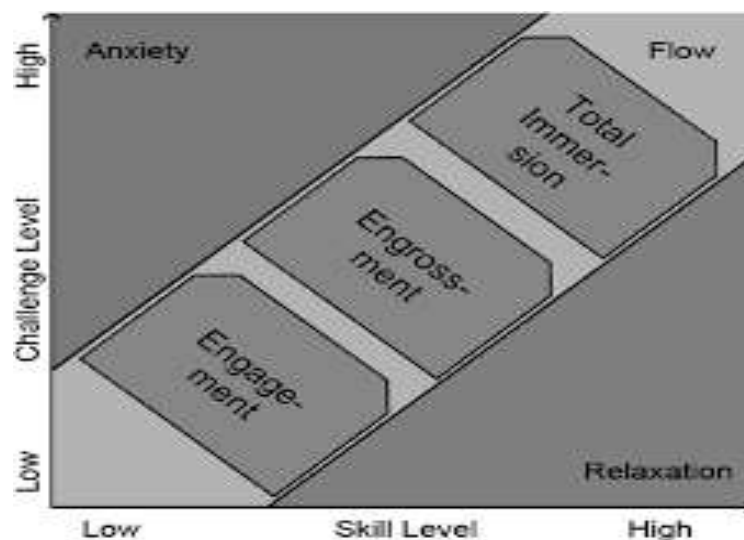


Figure 2 – Hierarchy model of immersion (Brown and Cairns, 2004)

This theory highlights a number of hurdles that exist at each level that games designers must consider in terms of the game situation and gamers themselves must overcome to boost their engagement. Below are some more in-depth examples of some of these hurdles and consideration:

Imagery

When it comes to creating atmosphere, one of the first things we can look at is imagery. (James, 2019) discusses the importance of selecting a good colour scheme for a game. Some games are well-known simply because of their colours. Because of this initial marketing, the

player is familiar with these colours. It is best to use colours that complement each other when designing a good colour scheme. “Too many clashing colours and the game will lack a distinct atmosphere. A lack of colour variation in a game might lead to player boredom.

With the use of landmarks, imagery may also be used to soothe the player and assist them in game progression. (Chunk, 2019) had the following to say about landmarks: *“Landmarks frequently indicate something of importance, with the area surrounding a landmark holding special items, unique enemies, or progressing the game’s narrative.”* There may be landmarks in games that are based on real-world places, such as the Lighthouse which appears in Alan Wake (2010).



Figure 3 – The Lighthouse Comparison: Alan Wake, 2010

There are also landmarks in video games, such as The Ring of Metal - Horizon Zero Dawn (2017), which does not exist in reality but serves as a landmark in the game and can be seen from wherever the player is in the game.



Figure 4 – The Ring of Metal: Horizon Zero Dawn, 2017

Audio

The audio in a game can have a huge impact on the mood of a player, contributing to the player feeling emotional engrossed in the game. According to (Bernstein, 1997), audio can induce *“Aspects of emotion such as surprise, frustration, admiration, and fear could easily be conveyed through an enhanced and well-thought-out object vocabulary”*. Every day, audio cues occur all around us that we do not explicitly acknowledge. However, all of these cues that occur create the atmosphere around us, and this is also true in games. A customised soundtrack allows gamers to experience a wide range of emotions in games without making them linear, like in a film. There are three types of auditory communication: direct, indirect, and environmental.

When an item communicates directly as a result of an interaction, this is referred to as direct communication. If the player leapt into water, for example, this would result in a splashing sound. Indirect communication occurs when causing something to happen in the game, something else responds sonically. This is easily seen if an enemy ‘sights’ the player and a noise is made. Finally, there is also environmental interaction, which occur when a character or item emits audio cues on its own, such as a character in game chatting to themselves.

(Huiberts, 2008) on the other hand, created the IEZA framework, a two-dimensional framework that represents the aural environment in games. It employs the idea of 'diegetic' vs. 'non-diegetic' noises. Diegetic sounds are those that occur in-game, such as a player jumping into water like previously. Background music is an example of non-diegetic sound, which the player can hear but the in-game character cannot. The framework categorises them as zones, effects, effects, and interfaces. The framework diagram is shown below:

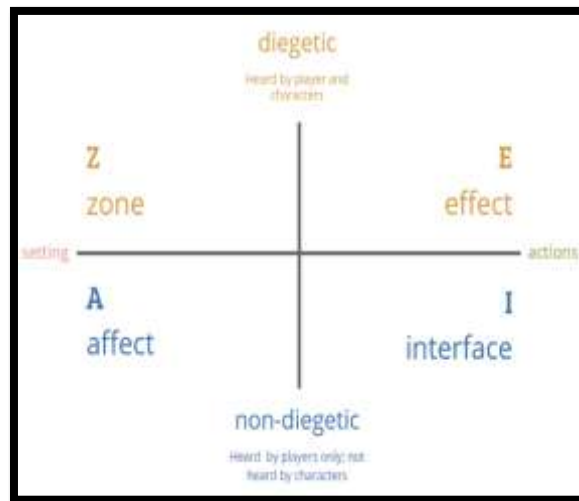


Figure 5 – IEZA Framework Diagram for Game Audio (IEZA Framework, 2008)

Effect

The effect portion is a diegetic aspect of the framework. These are noises that are considered to be created by or emanate from sources within the game environment. These sounds might be created by the character or when the character unlocks a door in the game.

Zone

The zone portion is the other side of diegetic. These noises are more related with the setting in which the game is played. These noises are often known as ambient or environmental sounds. This can be heard in a character's speech, the roar of a fast car, or the bang sound of a revolver.

Interface

The non-diegetic portion of the framework includes the interface noises. These noises belong to anything that isn't part of the audio in the game environment. They are most commonly connected with a game's HUD. Examples of these include in Grand Theft Auto, the player is thrown from a car and dies, initiating the 'wasted' sound effect, in Space Invaders, the background music increases in speed as enemies approach the player. Lastly, in the final mission of Halo 3, a section of the OST theme music is playing in the background in order to increase the tension as the Master Chief escapes the Ring.

Affect

Again, the affects are non-diegetic in nature. These noises are related to the non-diegetic environment of a game. This aids in the creation of a setting for any game through the use of background music and other such elements.

Lighting

Another important aspect of generating ambiance in games is lighting. Nothing would exist if there was no light in the world or in a game. According to (Omernick, 2004) *"Lighting plays a pivotal role in creating atmosphere and mood in a scene"* If objects within a game are not lit properly it loses the depth to the environment and makes everything look flat. Light does not only let the player see in a game it can also be *"a story-telling medium, affecting mood, form,*

colour, intensity, and movement" (James, 2019) who goes on to discuss how light in a situation may portray danger and safety. Shadows might signify the presence of danger or the need for stealth. Areas with clear light, on the other hand, can communicate safety and exploration.

Narrative

Immersion in video games is influenced by narrative and gameplay as already mentioned in the 4 categories of games immersion. It allows the user to make decisions inside the tale which has a significant influence on the player's immersion and in turn the conclusion of play. A major instance of this is the game Batman: The Telltale Series (2016). The player in this game has the ability to make decisions on conversions that occur. These decisions have an impact on the plot and characters from then on. Regarding the storyline inside games, Daniel Bormann of the University of Freiburg has this to say: *"For instance, successful game franchises offer players a spectrum of meaningful choices to shape the game's narrative and environment, provide carefully balanced challenges, or encourage players to experience social connectedness and meaningful social interactions."* (SAGE Publications, 2015) They discovered through study that incorporating story components within a game contributes to a more engaging experience. It was also discovered that with these storytelling features, the players received assistance in identifying meaningful choices and interactions while playing.

Enhanced dimensional model of immersion

A limitation of the previously discussed hierarchy by (Brown and Cairns, 2004) is that while it offerings a way to quantify immersion, it however cannot offer any insights about which stage of immersion on the hierarchy players are in at a given time. Therefore, (Cheng, 2015) enhanced this model by adding further dimensions to each of the three levels of the hierarchy. In the first level engagement, three dimensions are included including attraction, time investment and usability. Attraction is the ability of the game to make users use it. Time investment is the entry barrier of this level meaning time is required to be spend with the game. Usability is the game's ability to be practical and functioning, as non-usability would prevent user engagement and therefore immersion. The second level of engrossment contains two dimensions namely emotional attachment and decreased perceptions. As previously mentioned, emotional attachments can be either positive or negative and decreased perceptions is in reference to the loss of sense of time and loss of spatial awareness. The final and highest level of total Immersion is broken down into two dimensions also that is presence and empathy. Presence refers to the feeling of being aware of the present moment within a virtual location in spite of physically presence in the real world. However, researchers have concluded that presence seems to be dissimilar from flow and immersion in that it may be the feeling before flow and immersion meaning that presence is perhaps an *"early stage of video game engagement"* (Michailidis, 2018). Empathy is the degree of connection with players' character and defines a way if being in which the player can feel and relate to the emotions experienced by the character. Outlined below is a diagram highlighting the (Cheng, 2015) enhanced dimensional model of (Cairns P. C., 2006) three level hierarchical model of immersion.

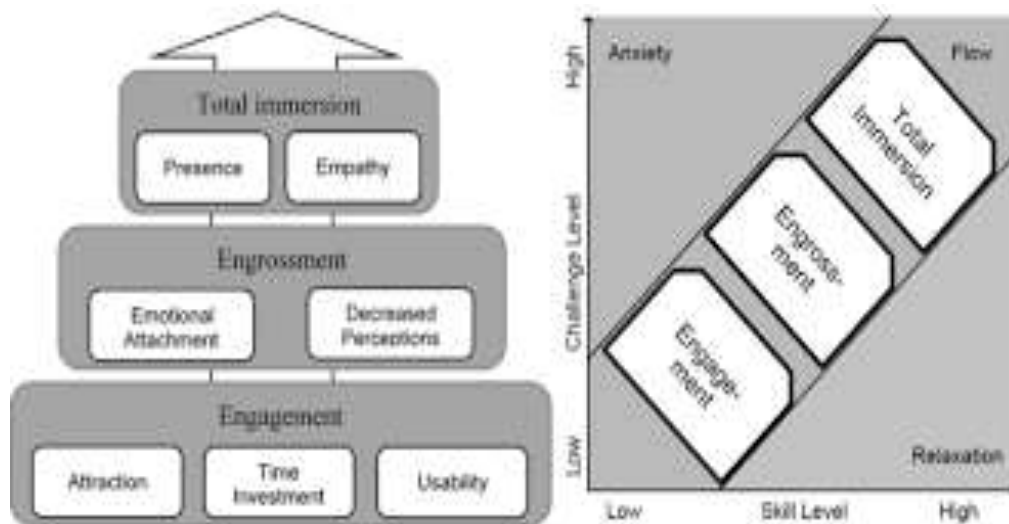


Figure 6 – An enhanced dimensional model of the three-level hierarchical model of immersion (Cheng, 2015)

Flow vs Immersion

Considering the hierarchy of immersion by (Brown and Cairns, 2004) and enhanced dimensions included by (Cheng, 2015) a significant degree of overlap can be observed with flow theory presented by (Csikszentmihalyi, *Flow: The Psychology of Engagement With Everyday Life*, 1998) and other games specific applications of flow such as Game Flow discussed previously. Overlaps include players feeling in control whilst gaming and the presentation of an adequate challenge. Both flow and the engrossment and total immersion levels of the (Brown and Cairns, 2004) model contribute to an experience of the loss of a sense of time and spatial consciousness. An interesting overlap is in the Total Immersion level where players appear to be completely unaware of the world outside of the game. This is very similar to flow therefore some researchers consider the empathy dimension (of the extended model presented by (Cheng, 2015) as flow seeing it part of the Total Immersion state (Georgiou, 2017). It seems that the main difference between flow and immersion is that flow does not take into consideration the player's emotional involvement in the game. A comparison table is presented below:

Flow

Task
Concentration
Skill/Challenge Balance
Sense of Control
Clear Goals
Immediate Feedback
Reduced sense of self and time

Immersion

The Game
Cognitive Involvement
Challenge
Control
Emotional Involvement
Real World Dissociation

Table 2 – Comparison between flow and immersion

Consequently, it has been suggested that it is not a safe assumption to differentiate between flow and immersion with the current evidence (Michailidis, 2018). Furthermore, as researchers use different games and vary the amount of playing time in their research studies it further complicates the identification of what might be flow and what might be immersion if they are indeed separate concepts (Georgiou, 2017). Accordingly, it has been suggested that flow and immersion should be considered similarly and used interchangeably as using the terms separately is not justified until and unless further evidence and support is gathered (Michailidis, 2018).

Time Perception

Time distortion is a phenomenon that is frequently reported in both the negative and positive events of daily life. For example, waiting for a bus whilst already running late, time is likely to be subjectively experienced as passing slowly. In comparison, engaging in an activity that we enjoy such as gaming contributes to the subjective experience of time passing quickly. A certain characteristic of flow and immersion which has already been discussed and seems to be often reported by players is a sense of time passing quickly which can be seen as both a helpful and unhelpful aspect of the overall gaming experience.

In the general sense, researchers have found that frequent video game players (defined as playing at least 1.5 hours 5 times a week) reported significant time loss whilst playing video games in comparison to infrequent players (Wood, 2006). However, previous studies have rarely investigated and have not found a systematically relationship between flow and immersion and its impact on time perception (Nuyens, 2020). As research to date has provided little and conflicting results they therefore do not allow conclusions to be drawn about the effects of flow and immersion on time perception (Luthman, 2009). Consequently, further examination of the topic is warranted, and this study hopes to add to the limited available research literature. Specifically, the aim to examine if there is a relationship between levels of flow and immersion and time perception namely the experience of time loss. It is predicted in accordance with Vierordt's Law, that short time intervals tend to be overestimated and long ones underestimated. This is named after the German physiologist Karl von Vierordt who formulated it in 1868. Therefore, in accordance with Vierordt's Law, it is predicted that individuals will significantly underestimate long gaming sessions and overestimate short ones. Therefore, it is hypothesis that increased subjective levels of flow and immersion is likely to correlate with increased subjective levels of time loss in video gaming.

Research Methodology

To examine the research aims and hypothesis outlined previously, research methodologies will now be considered. Firstly, I will provide an overview of the different research methods that were considered before finalising my choice and justifications provided.

Qualitative Research Methods

Qualitative research methods place emphasis on the quality of the data rather than the quantity of the data. Usually, this means that there are not as many participants required compared to quantitative methods. Qualitative research focuses in detail how the participant feels and what their opinions are. By undertaking this for every participant, it enables trends to be easily recognised from what they have communicated to us as game developers. There are three types of qualitative methods including:

Observations

The act of observation is a type of qualitative research. This strategy is watching the participant play through the game and keeping an eye out for any reactions they may have to game features. It might be tough to read people's body language and facial expressions to determine how they feel. It may also result in erroneous data based upon personal assumptions. For example, if a participant showed signs of crying, the researcher may conclude that something in the game caused the player to cry and that the section of the game is functioning properly. However, the participant could have had difficult news or a bad experience prior to the observation that contributed to how they were feeling in the moment. As a result, it is quite easy to obtain incorrect data when utilising observations (Ciesielska et al, 2021)

Interviews

Interviews are another type of qualitative research. Interviews can be helpful because they allow the researcher to ask the participant questions directly. By conducting interviews, the researcher is able to ask more detailed follow up questions about any answers supplied by the participant. This provides the researcher with greater knowledge of how the participant felt while playing the game, as well as clearing up any confusion. However, problems can develop during interviews. This is due to the fact that participants are not anonymous and may feel pushed to give answers in a specific manner in order to avoid offending the interviewer. This is known as participant bias and occurs when individuals involved in the interview may act or reply in ways which they believe corresponds to what researchers are looking for. Furthermore, the Social Desirability Effect may also occur where participants may shape their responses to present the best versions of themselves, or a description of themselves that they perceive to be socially adequate

Interviews have already been utilised in comparable studies to achieve the best possible data to work with. "Frustration and its Effect on Immersion in Games" is an example of a study that used this strategy (Nylund A. and Landfors, 2015). Nylund and Landfors conducted their research on this topic through interviews.

Ethnographic research

Ethnography is a qualitative research study that examines the social interactions of users in a specific area. This study delves deeply into the user's thoughts and activities, as well as the sights and noises they experience throughout the day. It enables the researcher to comprehend how those users perceive the world and interact with everything around them. The aim of ethnographic research within a usability project such as this is to get 'under the skin' of a design problem.

Quantitative Research Methods

Quantitative research methods are described as the assortment and investigation of numerical data to better understand patterns, examine causal relationships, make informed forecasts, and extrapolate trends to bigger group volumes.

In contrast to qualitative research methods, quantitative research methods prioritise data quantity over data quality. Quantitative research considers descriptive, correlational, and experimental research.

Questionnaires

Questionnaires are a typical type of descriptive quantitative research. Questionnaires (also known as surveys) are one of the most prevalent forms of quantitative data collection in video games research. Questionnaires are simply closed-ended inquiries in which the participant selects one of several possibilities on a rating scale such as a Likert scale. The questions can be administered on paper or electronically. However, there may be some issues with surveys; for example, the responses may lack depth and provide little information, and if the questionnaire is too long, the participant may lose interest.

Flow and Immersive experiences during video game playing are still predominantly measured with questionnaires due to the subjective nature of flow and immersion experiences (Michailidis, 2018).

Experiments

The experimental technique entails altering one variable to see if changes in one variable result in changes in another including correlational and experimental research. In order to test a hypothesis, this strategy employs controlled procedures, random assignment, and variable manipulation.

Mixed Methods Research

Mixed-methods research is connecting both quantitative and qualitative research methodologies within the same research project. Mixed-methods research can tilt towards either of the two previously mentioned main methodologies as the investigator believes necessary. The figure below highlights the spectrum of mixed method research:

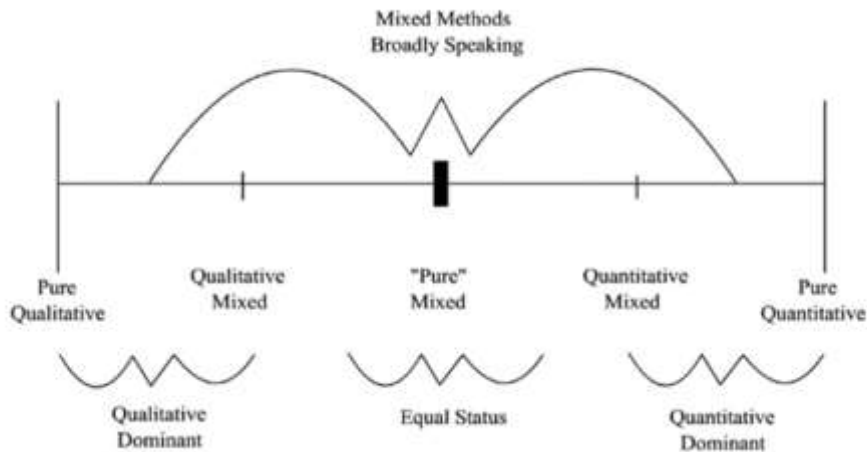


Figure 7 – Mixed Methods Research (Graphic of the three major research paradigms of mixed methods research, 2022)

Method, Design and Analysis of the Project

This study will deploy mixed methods research. Initially, ethnography is most useful qualitative method in the early stages of a user-centred design project such as this one because ethnography concentrates on developing an in-depth understanding of the design problem. Therefore, it makes sense to conduct an ethnographic study at the beginning of a project which can in turn support future design decisions of the game. Then, in order to gain insight into participants' experience of flow and immersion a quantitative methods questionnaire - The Immersive Experience Questionnaire (IEQ) developed by Jennett et al. (2008) will be utilised to subjectively measure how immersed the participants were and their time perception in terms of losing track of time. This particular method has been selected due to the subjective experience of flow and immersion we wish to capture from participants themselves. Furthermore, due to COVID-19 and the time constraints on the project the alternative method of interviews would not have been possible. Once data has been gathered, descriptive statistics will be utilised to summarise the data and describe patterns. Furthermore, inferential statistics will also be used to identify if there is a statistically significant correlation between flow and immersion and the experience of time perceptions namely time loss. Specifically, the Spearman's rank correlation which is a nonparametric measure of rank correlation was selected due to the statistical dependence between the rankings of the variables flow/immersion and time loss. It assesses how well the relationship between these variables can be described and whether the relationship is statistically significant in the data gathered from participants.

Ethical Consideration and Approval

Ethical approval was sought and obtained from the University of West of Scotland ethics committee before beginning the project (See Appendix A). When it comes to the ethical aspects of this investigation, there were numerous factors considered such as informed consent, voluntary participation, do no harm, confidentiality, and anonymity. All of these are critical for participant safety.

Informed Consent

Once the emails have been sent out for individuals to undertake the study, they will be accompanied by a Plain Language Statement Sheet. Before beginning the questionnaire, participants will be requested to read this. This Plain Language Statement provides all of the information regarding the study and what the participant is expected to complete, as well as information on what happens to the data obtained. Here are some instances of questions that have been explained. What will happen to me if I take part? *Will my taking part in this study be kept confidential? and What will happen to the results of the research study?*

Voluntary Participation

On the Plain Language Sheet, there is a question titled "Do I have to take part?" Upon this question, it is indicated that individuals are not required to participate and that they may withdraw at any time without providing a reason. If the participant does not consent once on the questionnaire, they will be taken to a section that will explain why they cannot continue with the questionnaire and will indicate that I am grateful for them taking the time to look at the study and therefore there is no concerns should they prefer to withdraw from the questionnaire.

Do no harm

It is critical that I do not inadvertently harm any participants. If things are not done correctly, psychological, and mental harm can arise. During the development of the game, I did a lot of extensive research on the target audience and the age restrictions ensuring that nothing about the game would be psychologically and harmful to anyone. Participants may take as long as they need to complete the questionnaire, ensuring that they are not anxious or overwhelmed throughout the research.

Confidentiality

All questionnaires will be 100% anonymous, and I will have no idea who filled them out. There are also no questions in the questionnaire that ask for any personally identifiable information, and it is kept as straightforward as possible in the context of the study's research. All information will be stored in a repository so only myself and my supervisor will have direct exposure to. Nobody else can access these because we utilise usernames and passwords to obtain access. The acquired data will be analysed for patterns, which will then be included with the dissertation in order to draw a conclusion. Individuals' data will be identified by an ID or letter; therefore, no names will be disclosed, and everyone will remain anonymous.

Preliminary Research

Once ethical approval was received from the university ethics committee, a preliminary survey was conducted to generate an analysis based on who plays First-Person Shooters games and the material they expect to see inside them. A total of 40 people have taken part in the survey, with no one declining to participate. The goal of the survey, as well as how long it should take, was explained to participants. They were initially asked whether or not they accepted to participate in the poll. They would start the survey if they consented to

participate. If they did not agree to participate, they were sent to a section that stated why they could not participate due to ethical rules and thanked them for looking into the study.

Demographic of the Survey

The first portion of the survey asked demographic questions to participants. This is done so that I can collect statistics on the types of people that will be playing the game, as well as their age range and gaming experience. The first question posed to the participants was, "What age group are you in?"

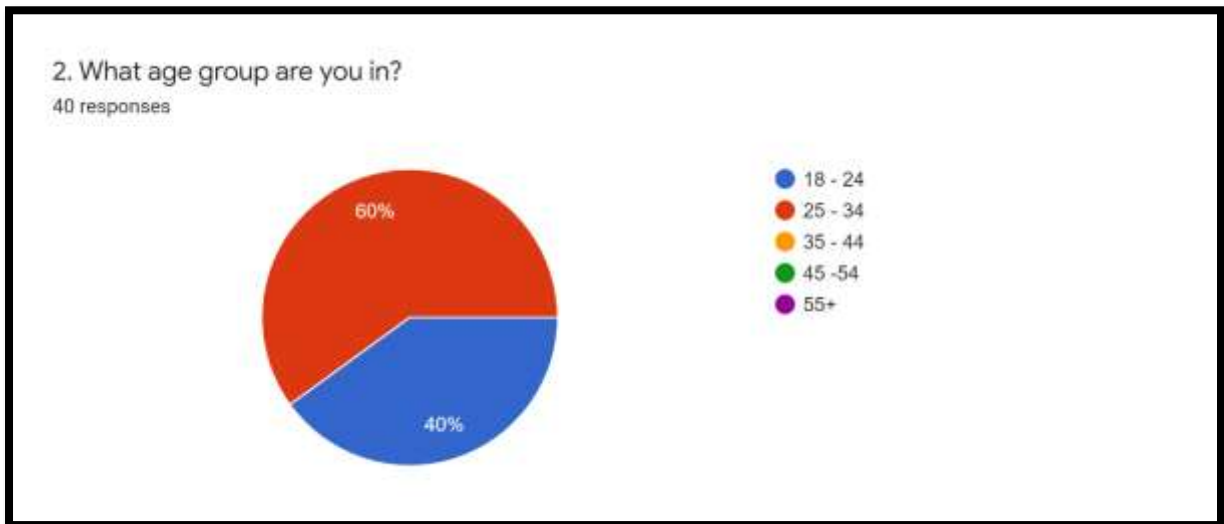


Figure 8 – First-Person Shooters Features Survey: Age Demographic

The pie chart above shows the statistics for the question one. It reveals that over half of the participants (60 percent in total) were between the ages of 25 and 34, indicating a large number of adults. This demonstrates that over half of the participants are the age of 25 or over. Another significant portion was in the (18-24) age bracket where there were 40 percent of participants. This is a large amount when contrasted to the age categories (35-44) and (55+), where there were no participants that took part in these age groups.

In question two, participants were asked, "What gender are you?" According to the answers to this question, the majority of participants (75 percent in total) identified as Male (including transgender male at 2.5 percent), accounted for 77.5 percent of the total number of participants. An additional 20 percent of participants were identified as Female (there were no transgender female participants, there was also a text box in the survey for the participant to specify what they would like to identify themselves as) this is the second largest participant group. In addition, 2.5 percent of participants also chose to prefer not to say. There were no responses for non-Binary/third gender and no responses for Prefer to self-describe.

On question five the participants were asked “Are First-Person Shooters a genre that you play often?”. The results found that more than half of the participants chose Yes, accounting for 62.5 percent of the total participants, while the remaining 37.5 percent chose No. This begs the question, is there something lacking from First-Person Shooters games that prevents people from playing them? The results are shown in the form of a pie graph below:

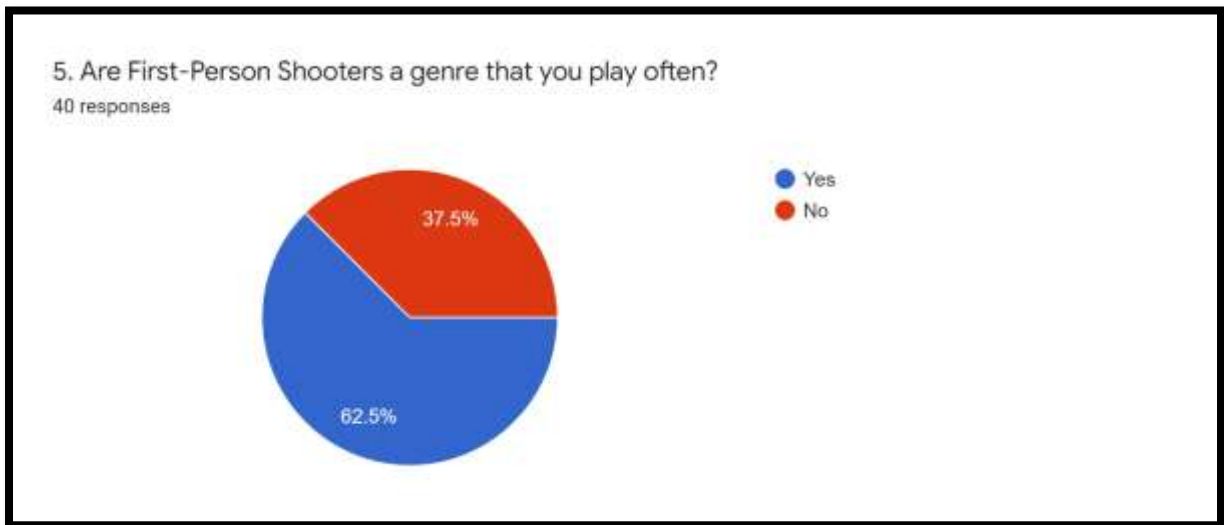


Figure 9 – First-Person Shooters Features Survey: Demographic

Question six asked participants, "On a scale of 1 to 5, how would you rate your gaming experience?" With (1 = Not experienced & 5 = Extremely experienced) Once again, the majority chose 5, which is extremely experienced, accounting for 40% of the participants. A further 13.8 percent chose option 3, which was classed as moderately experienced. Another 22.5 percent chose option 4, which was moderately experienced. Furthermore, 7.5 percent chose option 2, which was slightly experienced. Finally, 2.5 percent chose option two, which was not experienced. The participants who selected extremely experienced in gaming accounted for 40% of the total. A total of 62.5 percent of respondents in the previous question stated that First-Person Shooters is a genre they frequently play, lending credence to the notion that people may not know what they want in First-Person Shooters games. The following are the findings of this question:

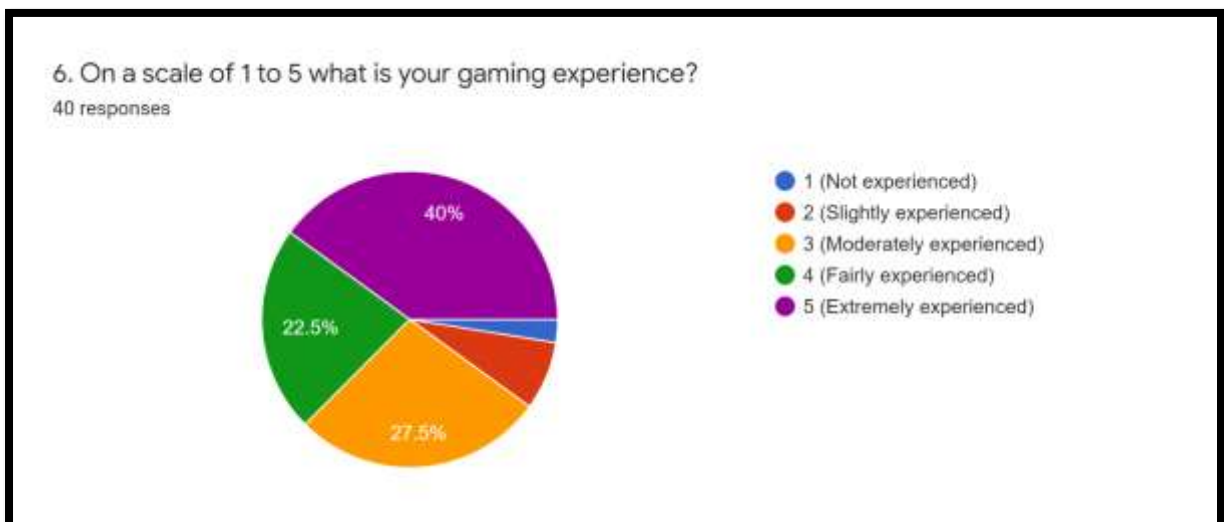


Figure 10 – First-Person Shooters Features Survey: Demographic

Game Genre of the Survey

The first question in this section asked the participants, "Which of the following elements in a first-person shooter game are most essential to you?" Participants could choose from the following options: Strongly Agree, Agree, neither agree nor disagree, Disagree, and Strongly Disagree. This question was introduced to determine if it supported what I had discovered during my literature review.

Immersion was the first element. The majority of thirty-four participants chose either strongly agree or agree, while five participants chose neither agree nor disagree and one participant chose Disagree.

The element gameplay came next. Twenty-nine respondents chose strongly to agree which is the highest so far out of all the elements. Ten participants selected agree and one participant chose neither agree nor disagree.

For the story element eleven participants selected strongly agree, thirteen participants went with Agree, twelve participants selected neither agree nor disagree and four participants selected Disagree.

The next element on the list was level design. Twenty participants selected strongly agree, fifteen participants went for Agree, four participants went for neither agree nor disagree and one participant chose to disagree.

Difficulty was third last on the list. Three participants went for strongly agree, nineteen participants selected agree, fourteen participants selected neither agree nor disagree, three selected disagree and one participant selected strongly disagree.

Graphics was second last on the list. Twelve participants went for strongly agree, eight participants selected agree, fourteen participants selected neither agree nor disagree, five participants selected disagree and one participant selected strongly disagree.

Finally, performance was the last element to cover. The majority of twenty-two participants selected Strongly Agree, seventeen participants selected agree and one participant chose to disagree.

Here are the results from this question in a bar graph:

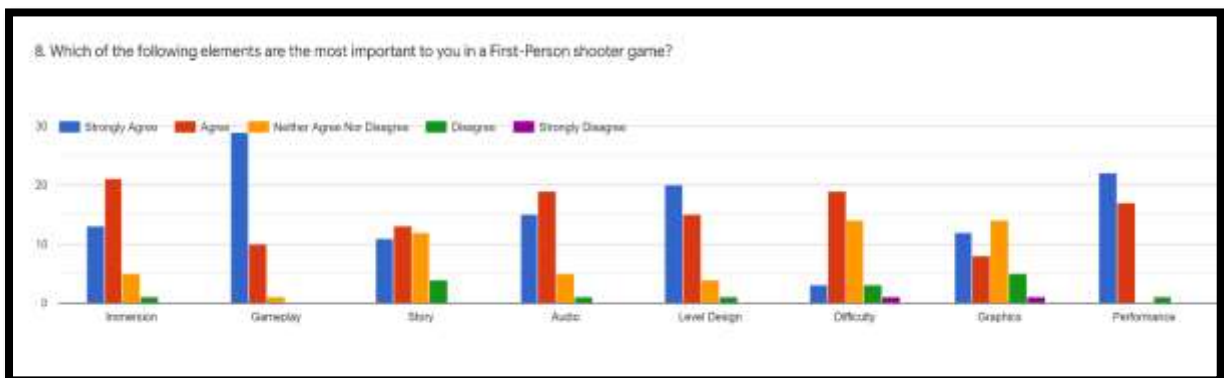


Figure 11 – First-Person Shooters Features Survey: Game Elements

As a result, these findings support the parts addressed in the literature study and demonstrate that they are critical components of a first-person shooter game.

The last question asked of the participants was “How important is the weapon behaviour for you in First-Person shooter video games?” This was an opportunity for participants to consider how important they felt the weapon behaviour is in first-person shooter games on a scale of one (being not important) to five (being very important). Three participants at 7.5% said that the weapon behaviour wasn’t that important. While two participants at 5% said that the weapon behaviour was more or less important. Twelve participants at 30% said that the weapon behaviour was somewhat important and twenty-three participants at 57.5% said that the weapon behaviour was really important.

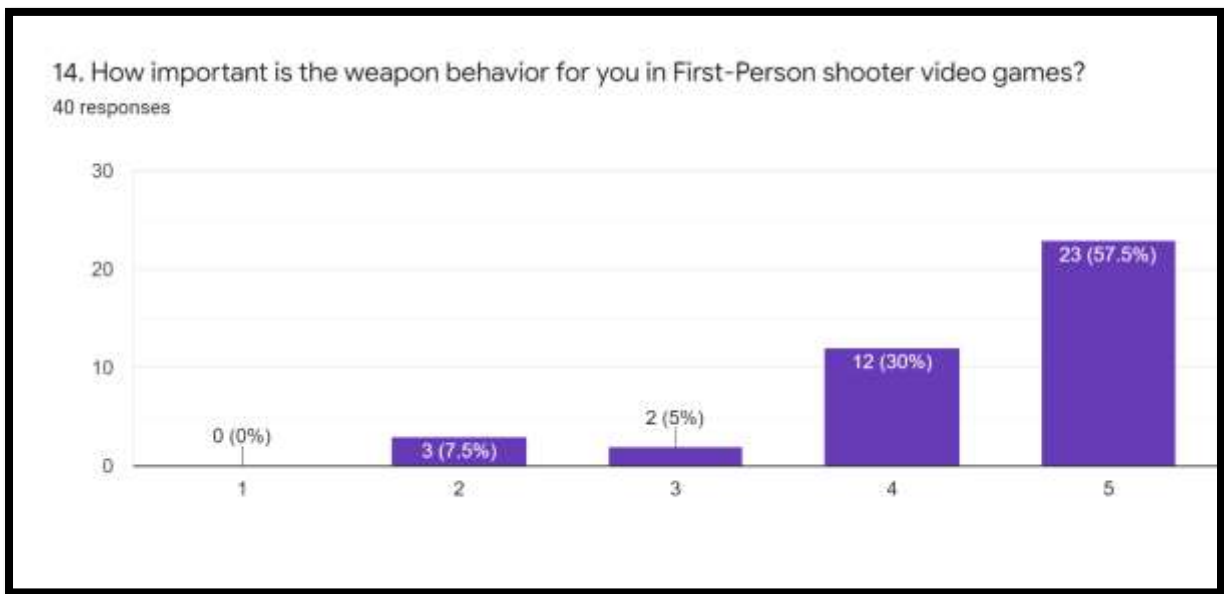


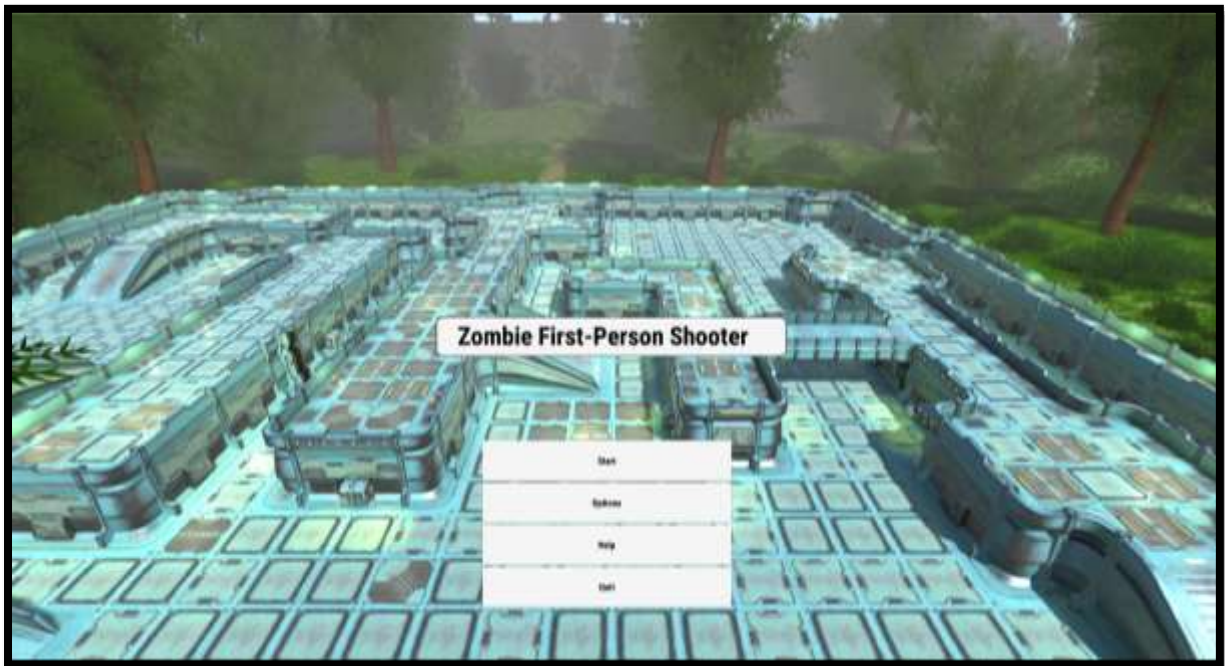
Figure 12– First-Person Shooters Features Survey: Game Elements

Conclusion of the Research Survey

Overall, the survey results were excellent and enough for gauging a reaction that would aid in the design and development of the prototype. It appears that participants were completely engaged with the topics at hand, the overwhelming majority of the feedback was positive and will undoubtedly be beneficial.

Game Design

Title



Genre

The genre of the game is a Zombie First-Person Shooter. I chose to do a First-Person shooter because for the purpose of this study having distractions of a say Role Playing Game (RPG) would pull the attention of the player away from the research area. This allows the user to pay greater attention to their surroundings while still taking their time to investigate and take everything in.

Target Audience

This game's intended audience is anyone aged 16 and over. To be on the side of caution, I decided to make it 16+. As I don't want to terrify people as they play the game since strange things will happen in the landscapes. This manner, individuals may play the game without encountering any problems. To create this grade, I examined several game content descriptors from various nations, beginning with the United States (ESRB, 2022). I then looked at the ratings for the United Kingdom (PEGI, 2017).



Figure 13 – PEGI Game Ratings

Platform

This game will be developed on either a desktop or a laptop platform. I opted to build for this platform because, in the future, I may want to include a VR element into the game, which would necessitate a higher performance system. However, while the game is still under development, I came up with the following minimal system requirements:

- **Processor:** Requires a 64-bit processor and operating system
- **OS:** Windows 10 x64
- **Processor:** Intel i3-6100 / AMD Ryzen 3 1200 or greater
- **Memory:** 8GB+ RAM
- **Graphics:** NVIDIA GTX 1050 TI / AMD Radeon RX 470 or greater
- **Storage:** GB available space

Development Environment

When it came to selecting a programming environment, I had two main options: Unreal Engine and Unity Engine. After a thorough examination, I chose Unity Engine over Unreal Engine. Both platforms would have been completely adequate for developing the game, but ultimately came down to personal preference. Because I use Unity Engine for a lot of my personal projects, I have a better understanding and experience with the engine, which makes it easier to use. I also found Unity Engine to be slightly easier to use, thanks to its native C# coding language.

Visual Style

I wanted the game's visual aesthetic to be photorealistic. The goal of this style is to make games appear as realistic as possible. When creating their games, many creators have adopted this technique. Before proceeding, it would be useful to present several examples of games created in this approach, such as Days Gone (2019).



Figure 14 – Days Gone Image, 2019

The game has a lot of detail, as shown in the image above. The lighting in this photo is really realistic and adds a lot of depth to the scene. However, the level of detail extends into the foreground with the motorbike and in the backdrop with the pickup truck, trees, and foliage. The texturing, lighting, and item placement all work together to produce a highly realistic picture.

Another game that employs the photo-realistic approach is Resident Evil 7: Biohazard



Figure 25 – Resident Evil 7: Biohazard, 2017

Here there is a lot of detail within the scene, there are different brightness's of fire as well as tones of colour making it look realistic, the reflection of light and assets are beautiful in lighting up the room that the zombie is in, there is detail in the room with the purplish room lightbar, the bricks, flooring, firewood and finally in the cloth that the zombie is wearing.

I decided to choose this style because I believed that it would contribute to the game's immersion. However, due to time constraints and the fact that I am the only person working on this project, the quality will be lower than that of the previous games. I'm hoping that by making the game look more realistic, I'll be able to keep the player engaged and, in turn, get more precise data from the players.

Inspiration and Mood boards



Figure 16 – Inspiration and Mood board

I was inspired by a few other games when developing this game idea. The most significant source of inspiration was from Dead Space series. (Dead Space Two, 2011). The environments were amazing, and the atmosphere produced in the game worked well and made me feel completely immersed. In addition, another game is the Call of Duty series. (Call of Duty: World at War: Zombies, 2009) this game has made me feel very immersed due to its atmosphere and has stayed with me. As I wanted a forest level in the game, I took inspiration from three different games. The Forest (2014), Escape from Tarkov (2017) and Halo Infinite (2021). When building the forest for the game, I adopted varied designs from these games, and there are features of these that I am particularly drawn to. I took some inspiration from the Resident Evil series (Resident Evil 7: Biohazard, 2017) as well because like the Dead Space games it features some beautiful environment design, and the colour palette employed produces a nice sensation of warmth. The other photos on the mood board are not from games I've played, but I came across them while looking for inspiration. The images aforementioned above with the forestry or sci-fi style environment is something that I would like to develop when it comes to designing my game.

Design Typology

Before implementing the level, I wanted to build a level design typology to better understand the flow. This is a useful thing to accomplish since it allows me to know where things may be put and provide the player a path or pathways to go. There is a linear pathway or numerous paths that the player can pursue in the level.

Sci-Fi Level Typology

Within this level it is overall an open world environment. There are multiple pathways the player can take making it a multiple path typology. The player can stay on the ground level or use the ramps to ascend to a higher elevation in the typology. The (S) shows the players start position and the arrows show the possible directions to take. The (D) shows the door the player can take to reach the other side of the map.

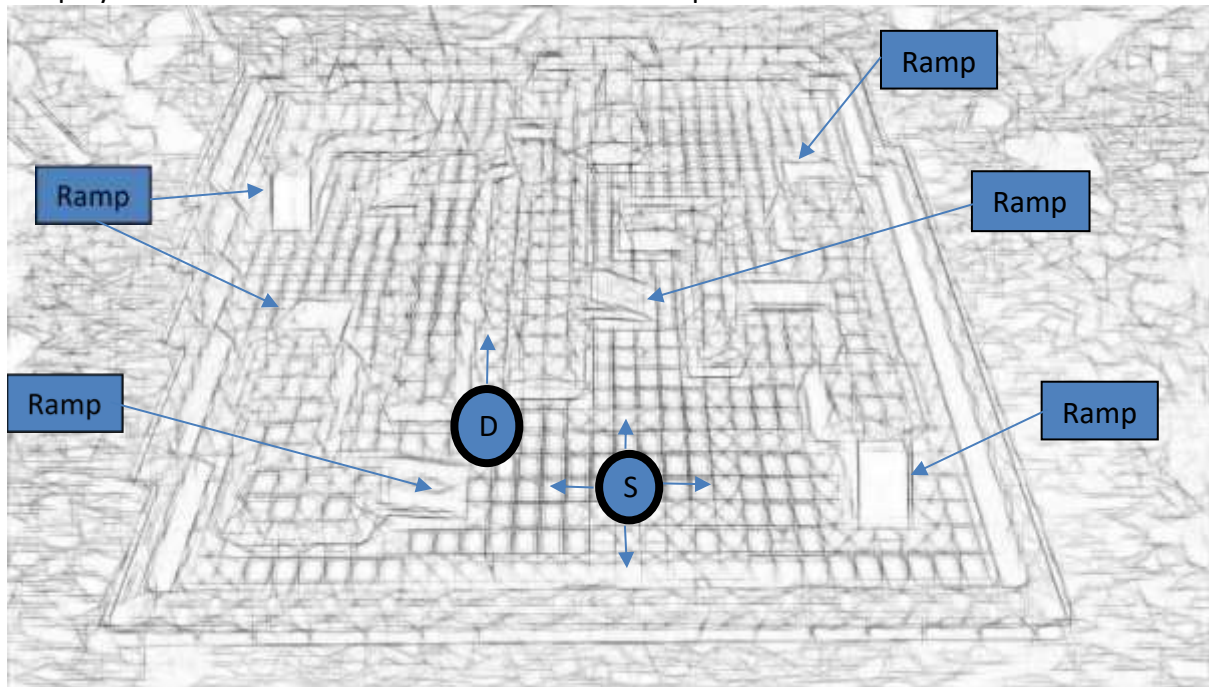


Figure 17 – Sci-Fi Level Design Typology

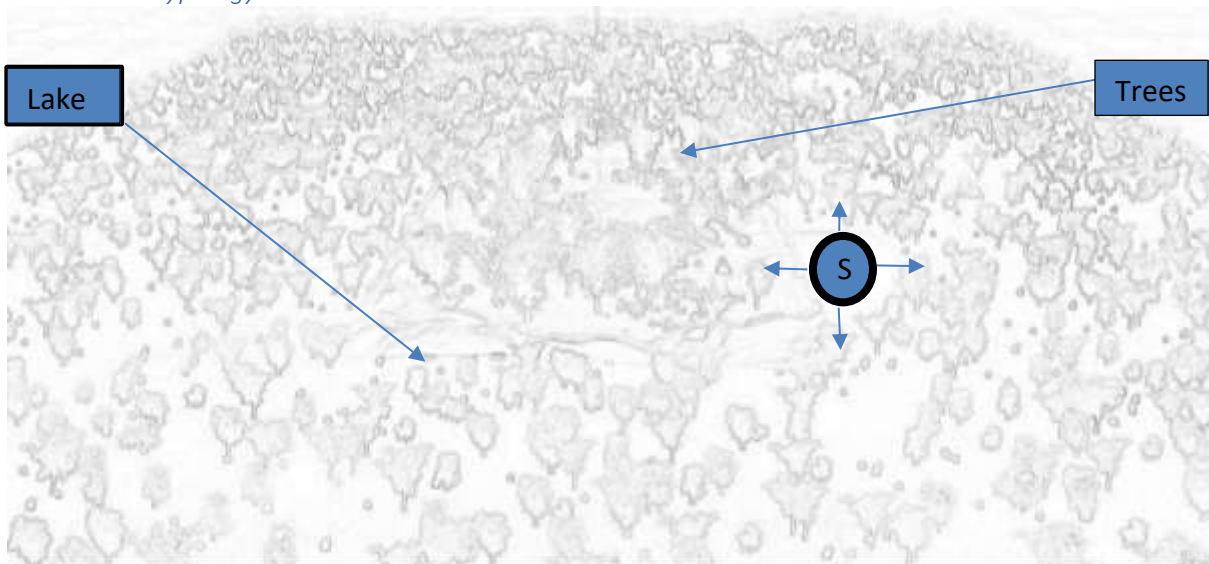
Forest Level Typology

Figure 18 – Forest Level Design Typology

The forest level, like the Sci-Fi level, has a multiple path typology. It does, however, start with a linear path and then lets the user to select alternative paths. Because this level has so much open area, the routes are a little less evident. On this level, these passageways are denoted by the usage of ruins. Again, the (S) indicates the player's starting location, and the arrows indicate the player's alternative routes.

Audio Style

There will be various types of audios in this game, and I will go over each in greater depth below utilising the IEZA framework.

Effect Sounds

Diegetic noises are used in this area and are often derived from game events. These sounds will be activated by interacting with game items in the game Zombie First-Person Shooter. These objects would be buying weapons or player upgrades from the stores in game and when opening and closing doors. All of these noises are activated as a result of the player's engagement. If these sounds are done correctly, the player will get more immersed in the game, which will improve the study.

Zone Sounds

Zone noises are used again in the diegetic segment, but this time they are found in the game's environment. These sounds would include things like the sound of a river, wind and weather, wildfire, and wildlife noises, for this game. All of these noises contribute to the game world's setting.

Interface Sounds

These noises are on the framework's non-diegetic side and are used to provide feedback to the user as well as to aid guide the player. There are several sounds available for the game's buttons, ranging from a sound for obtaining an object inside a level to a sound for confirming a button has been hit.

Affect Sounds

On the framework's non-diegetic side, affect sounds are typically employed as background music. Background music will be utilised correctly throughout the game to assist communicate the game's environment. However, for research reasons, a backing track may be intentionally placed incorrectly to investigate how it affects the players' immersion and cognitive flow while playing.

Narrative

This game's narrative is completely sequential. The story starts off when the living contained all of the undead in a single fenced-in area, they at first tried to cure the zombies, especially the biggest of them all who had endured quite a mutation. He was over seven-feet tall with muscles that could lift up a bus if needed. After cures were unsuccessful, the living together with super soldier John-117 from the UNSC Navy's Special Weapons section tried to napalm the zombies to death, but it only turned them into angry, running fireballs and the largest one of all was the first to break through the fence. He picked up the humans, tore into them and then tossed them over 20 feet away. He destroyed secondary barricades and angrily screamed to strike fear into the heart of the living. The other zombies soon rallied behind him and the path that he cleared. Will the remaining humans and John-117 be able to stop this huge, mutated zombie or will they be alone in beginning the extinction process?

Risk Analysis

When developing a game, there are always risk concerns to consider. All of them usually boil down to losing the game or making progress on it. This can happen in a variety of ways. A component in your computer fails, and if you have not saved your work, you may not be able to recover your progress. Another possibility is that files can become corrupted for any cause, which will result in an expensive break or loss of your game. There is always the possibility that a software update on your computer or the game engine may need to be updated, which could potentially break something. If file sizes are excessively huge, backup copies may be more difficult to store, and they may be too large to install on another computer.

To minimise these concerns, it is critical for me to plan ahead of time to reduce the likelihood of these occurrences. Keeping the scope of the project small should lower file size slightly and given that Unity Engine games can be extremely enormous I need to keep a close watch on this. Regularly saving backup copies of the project, whether on an external hard drive or in the cloud, should mitigate the other hazards.

A post on TechRepublic examines the vulnerabilities of cloud computing in terms of customisation and authorisation; this takes a different approach to risk analysis. (Whitney, 2019).

Software Development Methodologies

It is necessary to investigate several software developments approaches that may be employed for the project, or any project that requires development. These techniques are critical because they specify how work is done, such as a clear and cohesive framework of events that will make it simpler to study, plan, create, and test. Some software development approaches will be examined, and the one picked for the project will be selected in the conclusion.

Agile Methodology

Agile development is a team-based approach that allows for rapid component creation and delivery. Rather than producing "tasks and timetables," all of that "time" is converted into "sprints" (Lotz, 2018) Each "sprint" is a period of a week or a few weeks during which a "running list of deliverables" is established and adhered to, which is normally created before the start of the sprints.

"Deliverables are prioritised by business value as chosen by the client" (Lotz, 2018), which indicates that the customer decides which components are the most critical to accomplish first. In the absence of any shareholders or outsiders, this implies that the members of the team, primarily the project manager if indeed the team has one, will prioritise what another sprint will consist of. As each delivery is finished, "it may be analysed and appraised," providing insight into what is happening as well as what remains to be done. If any of the work is unable to be done, it will be "reprioritized and the knowledge will be used future for sprint planning."

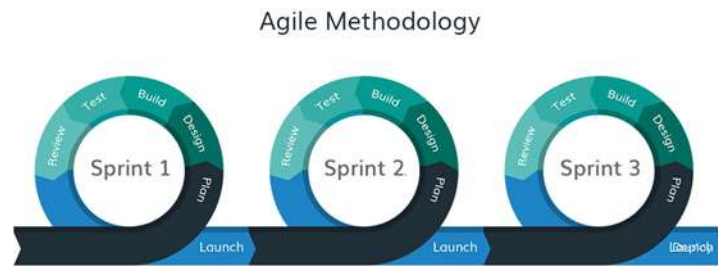


Figure 19 - Appinventiv (2018) Agile Methodology Image of the Sprints

The Agile technique has benefits and drawbacks, some of which are detailed below.

Advantages:

One of the primary benefits of Agile development is "transparency" (Segue Technologies, 2015), which provides for a "unique chance for customers to also be engaged throughout the project," which means they may request modifications prior to sprints and comment on how effectively particular tasks are being completed. It is also an excellent strategy if your team is developing a videogame through with an early access programme. This "transparency" implies that your early release clients will be able to observe how things are progressing and provide valuable input to the group. Customers will already be aware "that they are viewing a work in progress" if it is an early release game.

Another benefit of the Agile technique is that it allows for "Early and Predictable Delivery," as stated by (Segue Technologies, 2015). This implies that with sprints, "new features are provided rapidly and regularly," which may be beneficial for a project with limited time. It may also enable for an early "beta test" if the team is satisfied with the existing status of the project.

Lastly another advantage is that it "allows for change" (Segue Technologies, 2015), which is ideal for a product that the developers wish to evolve. The project would never be a linear series of processes, and as a result, developers are allowed to update the product or consumers can request changes to the product. Due to sprints, these improvements would likewise not take long to implement and could be implemented "within a few weeks."

Disadvantages:

One of the downsides of the Agile technique is that, as (Lynn, 2020) states, it can have "no finite finish." This is because, because the project is constantly evolving with new features being added, it might appear as if there is no end. This can lead to becoming "sidetracked" by trying to add new features that may or may not be as vital as others that would need to be introduced. It might also be due to the fact that "there is never a clear picture of what the ultimate result" will be. This is a significant drawback that can seriously impede a project since it can lead to morale concerns and irritate developers who are continually adding or modifying features.

(Lynn, 2020) highlights another drawback as "limited documentation" because the project has things like design and technical development papers being produced during the software development, which can lead to not a lot of effort really being saved for this

"documentation." This might be problematic when a client or a new team member needs to see how well the project is progressing as a whole in order to gain a better understanding, since it can lead to uncertainty among team members about what should be included. This is not something you want for a project since it might lead to issues in the future.

A final drawback of Agile would be that it necessitates "tight working connections" (Lotz, 2018), which necessitates the group existing in the "same physical area." That would also allow for greater group discussion, however with the current world evolving on a daily basis, this is no longer an issue. With the development of "webcams" and "collaboration tools," programs such as Microsoft Teams and Zoom enables anybody with internet to interact with each other in order to accomplish projects and can sometimes allow for more to be done because individuals do not have to travel.

Waterfall Methodology

The waterfall approach of software development dates back to the "1970s." It operates in a fairly linear series of steps, much like a waterfall, and continues to flow downhill in phases. According to (SDLC, 2016), it "emphasises that a logical progression of steps be taken." However, because to the arrival of Agile, it has not been utilised as much recently. Despite this, "it remains a common design process in the industry." The Waterfall technique consists of six steps, which are frequently referred to as "The Six Stages of Falling Water." The titles and descriptions of these stages are as follows:

Requirements:

This is generally the initial step, where the "potential requirements" for the programme are gathered and debated. This would be written or typed in a "requirements document," which would show "what the application should do, but not how it should do it" (SDLC, 2016). This will be the initial document for the application that will exist for the purposes of "development" of the complete project/software.

Analysis:

Typically, the analysis step comes after the first. "The system is analysed," allowing the development of "models and business logic" for use inside "the application" (SDLC, 2016). This signifies that the initial requirements document is being analysed at this stage, this is more of a research study. Everything is double-checked to ensure that the project is feasible and that the expenses are reasonable. This is the first step, however, where it is demonstrated that the project might fail, and if it does, the group must return to the requirements phase.

Design:

The design stage is where design documents, such as the Game Design Document and the Technical Design Document, begin to be generated. That instance, if a game rather than software is being developed. If just software is being developed, the Technical Design Document will most likely be all that is produced. According to (SDLC, 2016), the "programming language, data layers, services, etc." are discussed and described in the technical documentation. This allows for a demonstration of how it "will be technically implemented".

Coding:

The coding step is the heart of the project and may take the longest. During this stage, the "actual source code" (SDLC, 2016) is written. The team creates the application, programme, or game, which incorporates everything addressed in the previous three stages.

Furthermore, if something goes horribly wrong or if something doesn't work out during this stage, you must return to the previous stage owing to the waterfall process.

Testing:

This is the point at which "QA, beta testers," as well as other testers join the project and begin to "discover and report issues" (SDLC, 2016) with the application that has been produced. This and the Coding step are the two most important stages because if testing fails, you will return to coding and the process will be repeated until it has been perfected. This, however, may reduce most "bugs" as well as making the software/game highly stable, which does not appear to happen quite often in the world of gaming owing to testing typically being done way too near to the game's release.

Operations:

Operations is generally the last phase of Waterfall, however it can also be considered as maintenance, as can be seen in the steps on the diagram below. Each programme or game is "ready for deployment" (SDLC, 2016) at this point, whether to consoles, retailers, or anywhere else. This is not to say that everything is perfect. "Support and maintenance" are all still expected to maintain the programme "functional and up-to-date." This would be especially critical if your programme would be a lifelong service or will be "deployed" on current generation hardware, as many games currently need software updates that must be applied both before and after the game is published.

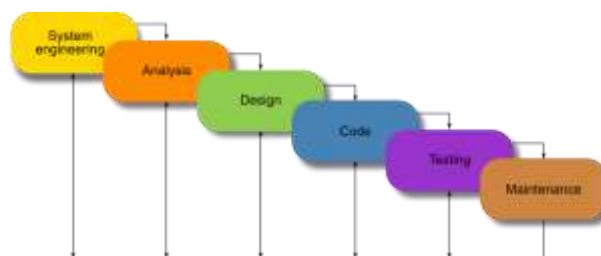


Figure 20 - 11.wp.com (2016) Waterfall Model Image

Advantages:

One major benefit of the Waterfall technique is that "the full scope of the work is known in advance (Lotz, 2018). This is a significant advantage since it implies that it would be clear what can and cannot be done and when. Everything about the project should already be understood because it is very well planned and has numerous sorts of documentation concentrating on all of the major topics at hand. As a result, the Waterfall technique is quite regimented.

An additional advantage of the Waterfall methodology is also that, apart from "reviews, approvals, status meetings, etc.," there is no need for "a customer presence" after the "requirements" stage is done. This helps the programmers or teams to focus on the job and project at hand rather than continually interacting with consumers.

A final advantage of the Waterfall approach is that it is "Suited for Milestone-Focused Development" (SDLC, 2016). This is significant since it implies that owing to the arrangement of the Waterfall approach being utilised in a project, there is no surprise when a milestone needs to be fulfilled. Because of this framework, the team should never have to be concerned about any unexpected surprises in development along the road.

Disadvantages:

The Waterfall methodology also has drawbacks, one being the "Delayed Testing Period" (SDLC, 2016), in which the Testing stage sometimes doesn't reach the project until approximately the fifth stage, implying that there may be no testing till the project is nearly completed. It appears exclusively before even the Operations phase. Since of the nature of this, the organisation may adopt "lackadaisical coding practises" because "testing is only an afterthought" which is a huge concern because errors in software are nearly always the result of either human mistake or an actual flaw in the programme utilised.

Although it is an advantage that customers are really not required as until well after the Requirements stage, it is also a disadvantage because, as (SDLC, 2016) mentions, "user or client feedback" is not accessible until "late into the development cycle," which tends to mean that this feedback may be "too little, too late." This might imply that clients or users are dissatisfied as to how the project has panned out since their conception has evolved along the development phase, and that it would require having to go back stages to modify it.

A final downside of the Waterfall methodology is that when an error has occurred, you must therefore repeat the step or return to the previous step to correct the error. For instance, if somehow the Testing phase fails, the team must return to the Coding phase, and thus the cycle begins again, as previously mentioned. The similar thing could have happened between both the stages of Analysis and Requirements. If indeed the project is assessed and therefore cannot be completed within in the time period or at a reasonable cost, the team may have to go through the Requirements step again, which would also take even more time.

Spiral Methodology

The Spiral software development methodology is a type that (Martin, 2022) says "is a risk-driven software development process model" and "It is a combination of waterfall model and iterative model". The Spiral technique is seen in the graphic below.



Figure 21 - Peter Hermes (2010) Spiral Model diagram image

As can be seen, the first stage determines what needs to be done, and then, similar to Waterfall, an analysis has been performed to ensure that the expenses are reasonable and that the consumers are satisfied. Third, development and testing begin, which distinguishes it from Waterfall by enabling testing and development to happen concurrently. This is a beneficial thing since it allows problems to be discovered throughout the development process. Finally, the fourth step is the review and assessment, which allows the project's conclusion to be examined and, if necessary, revised. These stages are known as "loops," and according to a (TechTarget Contributor, 2019), "the project manager" is in control of the loop, and they are "identified" by the person who is "the project manager."

According to a (TechTarget Contributor, 2019), spiral approach allows for "gradual releases" as well as changes and improvements towards the software with "each phase"; also, "prototypes" may be built for each of the phases. It is also stated that one of the most important aspects of the Spiral technique is its ability to "handle unanticipated risks once the project has begun," something the Waterfall method cannot readily do.

Spiral, like some of the other two approaches thus far, has pros and limitations, which are discussed more below.

Advantages:

One of the main benefits of Spiral is its "Flexibility" (TechTarget Contributor, 2019), which means that changes can be made "to the requirements after development has begun." This is a great thing because it will be easier to change anything after the project has begun because you will not have to go back multiple stages.

Another advantage of the Spiral method is "customer satisfaction" according to a (TechTarget Contributor, 2019). The customer always has the opportunity to participate to see what is happening and being developed "in every phase." As a result, the customer will know what is going on and can "voice dissatisfactions" if they are not satisfied with how things are going, or they can ask the group to "make changes before the product is fully built." This allows cash to be directed to various sectors or to a different project completely.

Disadvantages:

One of Spiral's drawbacks is the amount of money it can consume. According to (TechTarget Contributor, 2019), it has a "high cost" and "is pricey," and shouldn't be used "for little projects" since it is not "appropriate" for that sort of development. Spiral should only ever be employed by large corporations that can manage to accept these risks, because a small company might quickly abandon the project or go into bankruptcy owing to a lack of cash.

Another disadvantage of spiral development is its "complexity" (TechTarget Contributor, 2019). This can be a good or bad thing because it is stated that it is already "more complex" than some other methodologies like Waterfall or Agile, but it could also mean that there is a much higher demand for "documentation because the model involves intermediate phases." This also implies that it must be followed meticulously if everything is to run smoothly for the organisation.

Justification of Chosen Methodology

The Agile development technique has been chosen for the project because it enables a significantly quicker development process with rapid and efficient outputs. Although this is an individual project, Agile allows the user to work efficiently on their own since they may determine what is required and when it is required. If something can't be finished in a specific time frame, it can be rescheduled until a later date when it can be developed more effectively.

If the Waterfall technique was used, anything important that went wrong during the prototype's creation would create a lot of damage. This would imply returning to a prior level and beginning over. This is not necessary with Agile. Agile also makes prototype development much easier since if anything at all in the prototype changes, the design document can always be updated to reflect this.

Choosing Agile also enables for the avoidance of the majority of the difficulties with the downsides stated above. There is no group creating the prototype, which means that close relationships are not a problem. Any contact with the supervisor may be done online using Microsoft Teams. There may be some issues with the above-mentioned no finite end issue, even though the project already has a deadline and will be in a very playable form owing to the prototype being continuously developed during the duration of the project.

There is also no need to be concerned about a lack of documentation because the Games Design Document may be amended at any time for anything that could be added or deleted, but the initial project specification is already set in stone and therefore can and would not be changed. This eliminates the need to stress about what ought to be done. Changes will occur solely from a design standpoint, not from a project standpoint.

Finally, the Spiral approach would be a waste of time and money if used in a project with just one person building the prototype since it requires a huge group with a lot of funds, which is not imaginable for a project of this sort. Spiral would cause a variety of complications; Waterfall might cause some if things went wrong late in development; and

Agile will not produce as many issues and is largely employed in game development because to its ease of usage.

Project Scope

In my opinion, a project scope is the whole amount of time available to finish the project, the deliverables that must be completed within that time period, and the overall aim of the project. However, some people consider a project scope to be too much more than that, such as Pratt, who mentions that a “Project scope is the part of project planning that involves determining and documenting a list of specific project goals, deliverables, tasks, costs and deadlines.” (Pratt and Lebeaux, 2021)

From my previous experience with many other projects, it is quite easy to underestimate a project scope's time limit and overestimate one's skills by taking on a heavy task. To prevent this and ensure that the project's objective is met, I prepared prototypes of the features to be produced and ready so that constructing the level would be easy. These elements were given a deadline to complete so that there would be enough time to develop the level. To help keep the project on track, I produced a project plan which I could reference during the game's development to determine if the project is on schedule for the next milestone. Underneath is an image taken of the project plan:

Project Management

Due to the scale of the project and to ensure that time was handled to the best of the researcher's ability, project management was necessary. Below is an excel document with a list of the essential tasks that must be completed.

WBS	Task Name	Start	Finish
1	Planning Stage	20/09/2021	08/10/2021
1.1	Prepare a project specification	20/09/2021	08/10/2021
1.1.1	Create a project outline	20/09/2021	08/10/2021
1.1.2	Summary of the gameplay	20/09/2021	08/10/2021
1.1.3	Research methodology's	20/09/2021	08/10/2021
1.1.4	Setup version control	20/09/2021	08/10/2021
1.1.5	Resource gathering	20/09/2021	08/10/2021
1.1.6	Ethical consideration	20/09/2021	08/10/2021
1.2	Project specification completed	08/10/2021	08/10/2021
1.3	Project Plan	11/10/2021	17/10/2021
1.3.1	Make a schedule for the project's stages and overall completion	18/10/2021	25/10/2021
1.3.2	Deliverables and milestones anticipated	18/10/2021	25/10/2021
1.3.3	Create list of primary tasks	18/10/2021	25/10/2021
1.4	Project plan completed	18/10/2021	25/10/2021
1.5	Set up file repository and version control	15/11/2021	15/11/2021

Figure 22 – Project Plan Stage 1

2 Development Stage	22/11/2021	20/04/2022
2.1 Throughout the development stage, start writing dissertation	15/11/2021	20/04/2022
2.1.1 Literature review	15/11/2021	06/12/2021
2.1.2 Make a pregame survey	13/12/2021	20/12/2021
2.1.2.1 Analysis of the initial Pre Game survey	24/02/2022	24/02/2022
2.1.3 Create Game Design & Technical Design Document	10/01/2022	10/02/2022
2.1.3.1 Define the main gameplay loop, as well as any additional mechanics, level design, and player progression.	10/01/2022	10/02/2022
2.1.3.2 Make Use Case Diagrams, UML Diagrams, and Pseudocode for the game.	10/01/2022	10/02/2022
2.1.3.3 Platform Specification, Engine Used, Programming Language, Functional and Non Functional Requirements	10/01/2022	10/02/2022
2.1.3.4 Game Audio Requirements	10/01/2022	10/02/2022
2.1.3.5 Creation of Storyboards, Concept Art, MoodBoards and Level Maps	10/01/2022	10/02/2022
2.1.3.6 Design a Test Plan for both Black Box Testing and White Box Testing (If possible)	10/01/2022	10/02/2022
2.1.3.7 Design a plan for User Testing along with a questionnaire to do with the initial Specification Requirement	10/01/2022	10/02/2022
2.1.3.8 Milestone: GDD and TDD Complete	10/02/2022	10/02/2022
2.1.4 Main Development updates in Dissertation	10/02/2022	01/04/2022
2.1.5 Maintain Online Presence for Portfolio	08/10/2021	29/04/2021
2.1.6 Write Conclusion for Dissertation	21/04/2022	29/04/2021
2.2 Milestone: Dissertation Complete	29/04/2021	29/04/2021
2.3 Implementation Stage	01/12/2021	01/04/2022
2.3.1 Using existing knowledge, create a prototype of the initial Specification Requirement, complete with core gameplay loop etc.	01/12/2021	01/04/2022
2.3.2 Produce and complete final art and sound assets for the prototype	01/12/2021	01/04/2022
2.3.3 Milestone: Art and Sounds Assets Complete	01/12/2021	01/04/2022
2.3.4 Build further upon the game with completed assets	01/12/2021	01/04/2022
2.3.5 Game Balancing	20/03/2022	01/04/2022
2.3.6 Milestone: Source Code Completion	31/03/2022	31/03/2022
2.4 Game Testing Commences	01/04/2022	16/04/2022
2.4.1 Utilise the previously completed test plan	16/04/2022	16/04/2022
2.4.2 Milestone: Testing complete with bugfixes if any are still apparent	21/04/2022	16/04/2022
2.5 Evaluation Stage	21/04/2022	30/04/2022
2.5.1 Complete the evaluation of the entire project	21/04/2022	30/04/2022

Figure 23 – Project Plan Stage 2

3 Submission Stage	29/04/2022	29/04/2022
3.1 Milestone: Prototype & Dissertation Complete	29/04/2022	29/04/2022

Figure 24 – Project Plan Stage 3

Objectives

In the game's design and development stage, flow and immersion are important factors to take into contemplation to create player engagement. I will look at how this style of game will accommodate the aims of the dissertation. Below is a list of fundamentals that will impact and affect the flow and immersion in the game.

Rewards: Intrinsically rewards such as gaining experience and cash are constantly obtained by the player as real and instant rewards.

Clear goals: The player has clear goals, and they know what to achieve. The game is an endless survival game. Zombies will be getting faster and stronger; the player will be gaining experience and cash constantly. This element is important for player progression through the game.

Loss of consciousness: The flow works well in this game as the player doesn't have to concentrate on what they're doing to achieve an action. The state of the player is to combine action and awareness.

Loss of sense of time: The player is hooked by the activities that they're doing such as upgrading their health or weapons, and they don't realise the passing of time while they're doing it.

Direct and immediate feedback: The player is guided by the direct feedback of the game, and they know what they need to do to succeed.

The balance between player skills and challenge: The level of the game is neither too easy nor too difficult. The difficulty of the game is constantly adapted to the player's skill.

The player controls the situation and the activity: The player needs to survive for as long as possible to beat the challenge. As it is an endless survival game, the objective for the player is to beat their previous best score.

Characters

I opted to utilise a TurboSquid model for the main character in the game. I chose this because of time constraints and a lack of modelling ability. Attempting to model each character by hand would have consumed all of my time in order to complete the project, and the results would not have been as nice as those produced by the Unity asset store, TurboSquid or CGTrader. The rigging element to the models is another time saving with TurboSquid. All of the models have already been rigged, and a variety of animations are included.

I wanted to create a figure who resembled a young adult for the main character John-117. This is due to the fact that John-117 is a super soldier of the UNSC Navy's Special Weapons section and one of the most prominent players in the Human-Zombie War. Because the game is in first person, the player can only see the character's hands and legs. I settled on the following character model below:

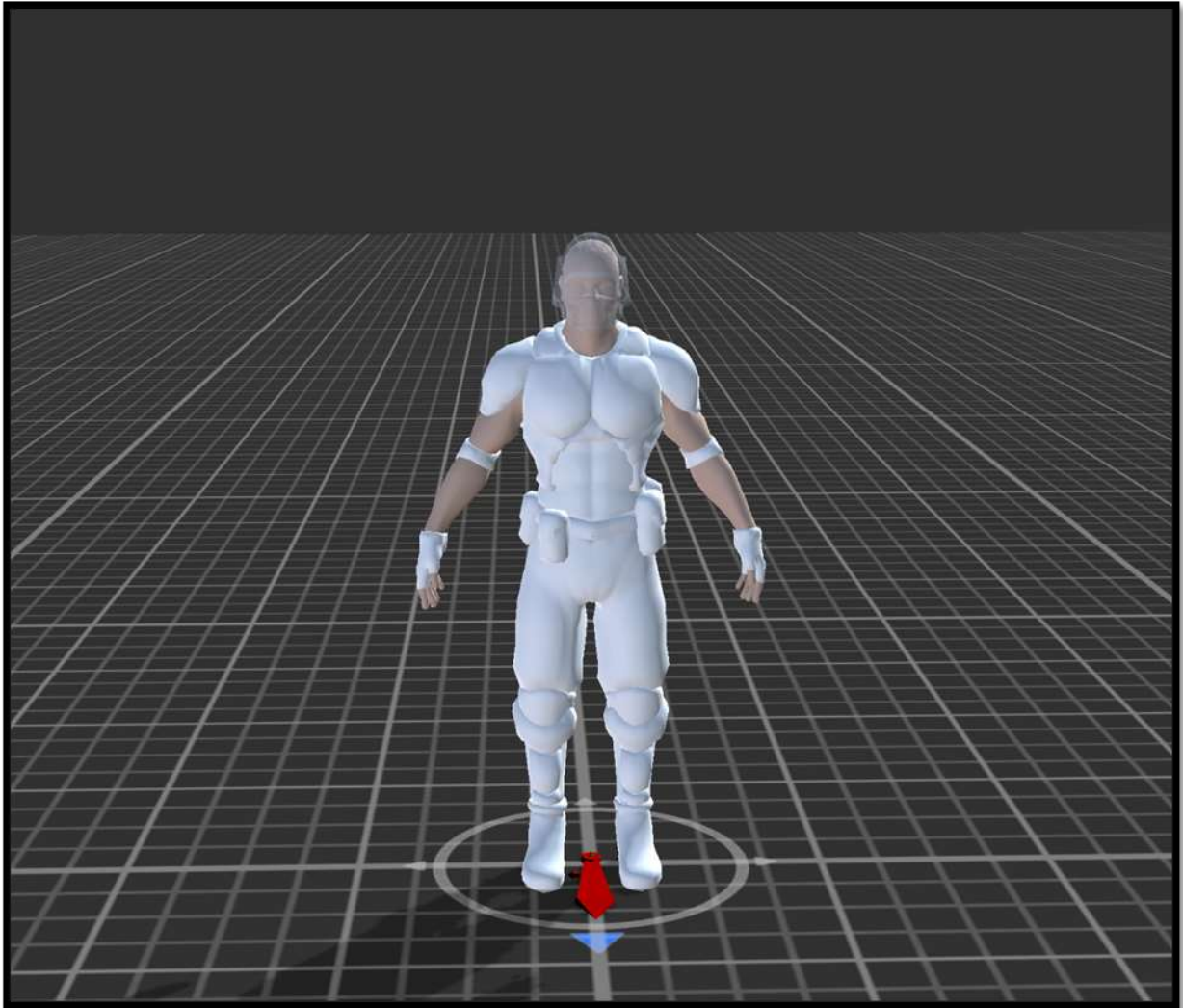


Figure 25 - Doomguy FanMade1 3D model (by Luiz Hatanaka on TurboSquid store)

I decided to choose the zombie model from the Unity asset store for the main enemy in the game as a character model. I chose this option primarily due to time constraints and a lack of modelling skill. Attempting to model each character by hand would have taken up all my time to complete the project, and the results would not have been as good as those from the Unity asset store, CGTrader or TurboSquid. The rigging element to the models is another time saver with the Unity asset store. All models are already rigged, and a variety of animations are included. I settled on the following zombie character model below:

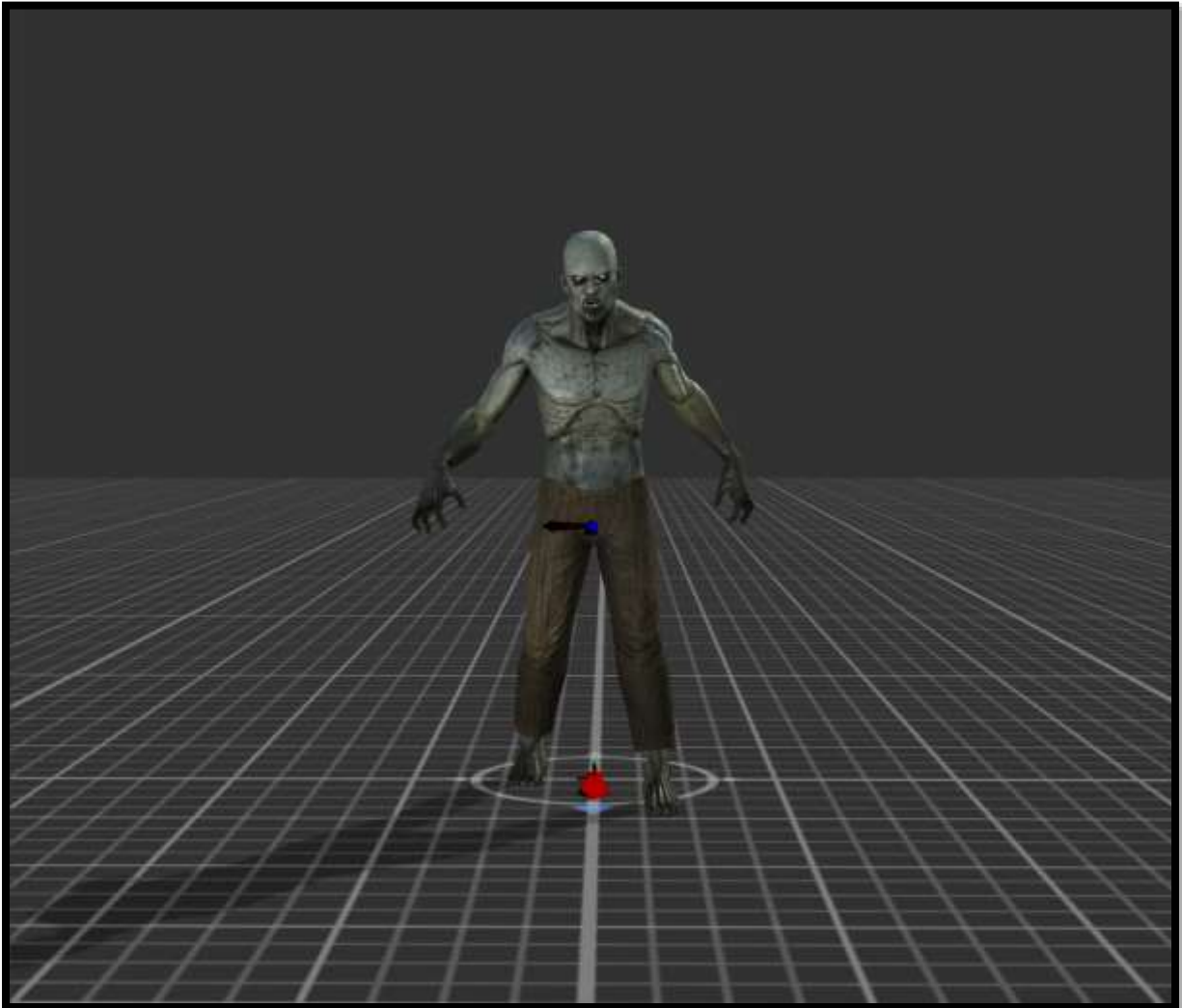


Figure 26 - Zombie (by PxlTiger on Unity asset store)

Weapons

AKM weapon

I decided to choose the AKM weapon model from the TurboSquid store for one of the weapons the player can upgrade to in the game. I chose this option primarily due to time constraints and a lack of modelling skill. Attempting to model this weapon by hand would have taken up all my time to complete the project, and the results would not have been as good as those from the Unity asset store, CGTrader or TurboSquid. The rigging element to the models is another time saver with TurboSquid store. All models are already rigged, and a variety of animations are included. I settled on the following AKM weapon model below:

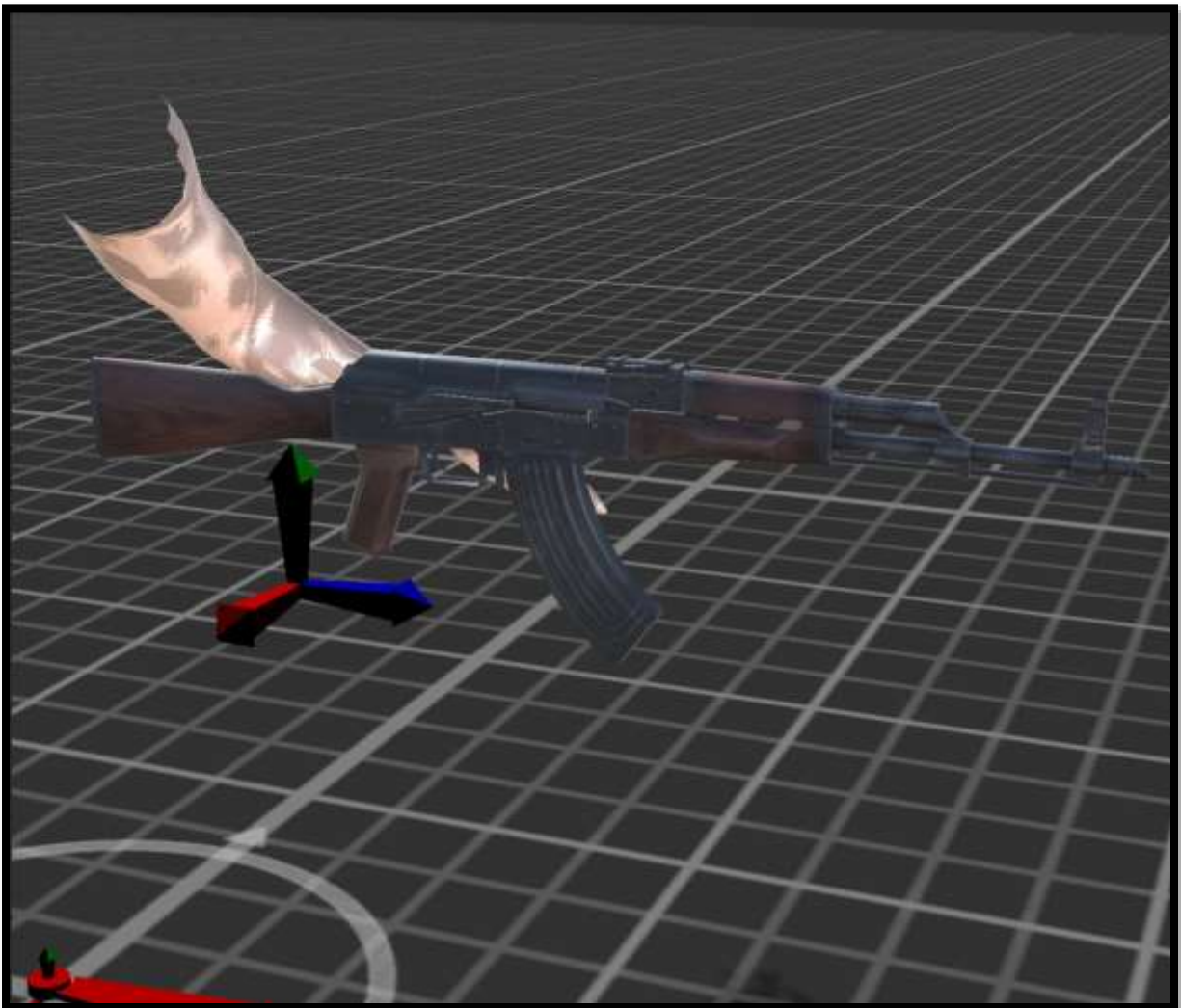


Figure 27 - FPS AKM - Model & Textures (by ChamferZone on Unity asset store)

Glock-19 weapon

I decided to choose the Glock weapon model from the TurboSquid store for primary weapon the player starts off with in the game. I chose this option primarily due to time constraints and a lack of modelling skill. Attempting to model this weapon by hand would have taken up all my time to complete the project, and the results would not have been as good as those from the Unity asset store, CGTrader or TurboSquid. The rigging element to the models is another time saver with TurboSquid store. All models are already rigged, and a variety of animations are included. I settled on the following Glock weapon model below:

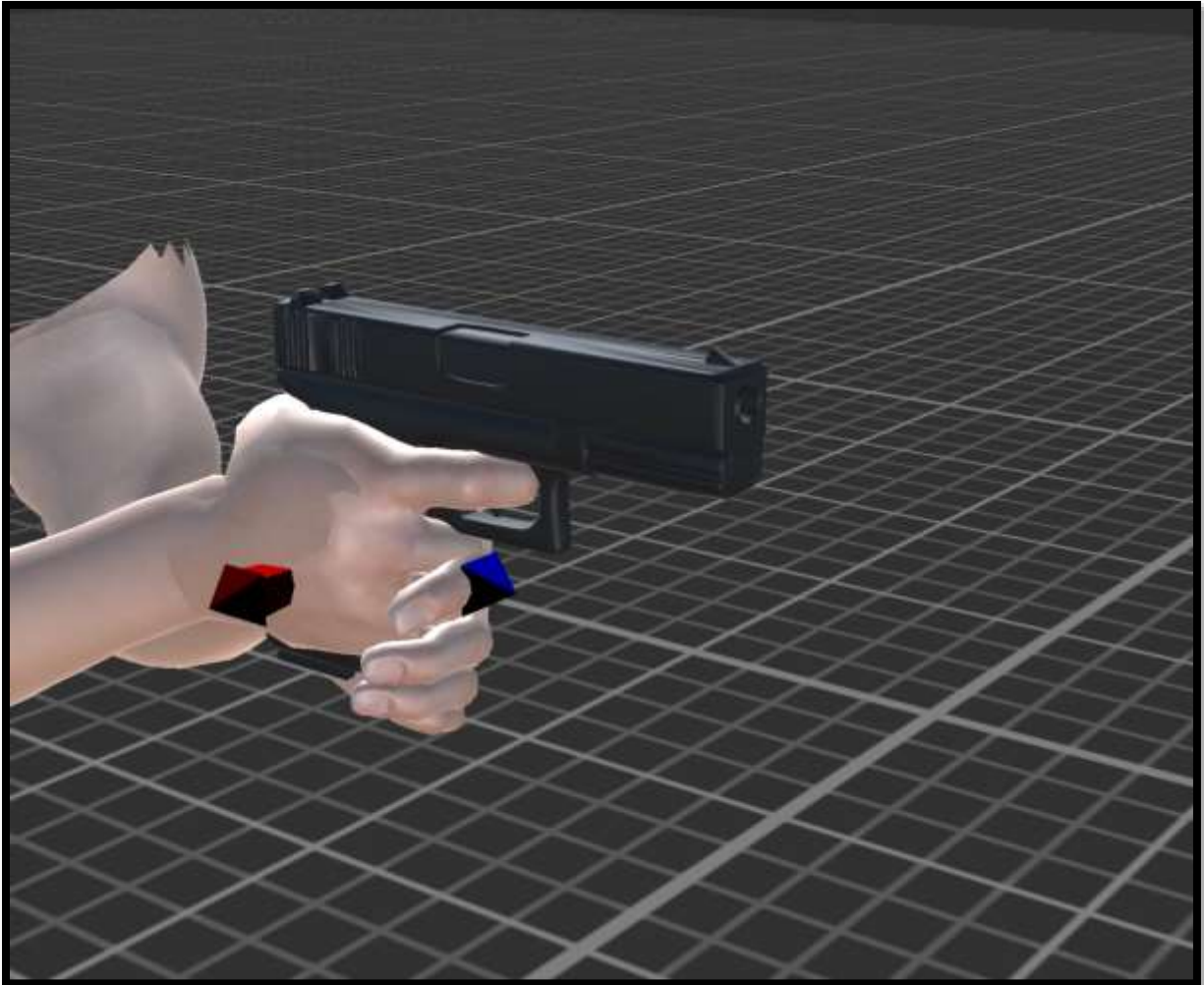


Figure 28 - Glock-19 (by Simon2499 on TurboSquid store)

M870 Shotgun weapon

I decided to choose the M870 shotgun weapon model from the CGTrader store for one of the weapons the player can upgrade to in the game. I chose this option primarily due to time constraints and a lack of modelling skill. Attempting to model this weapon by hand would have taken up all my time to complete the project, and the results would not have been as good as those from the Unity asset store, CGTrader or TurboSquid. The rigging element to the models is another time saver with TurboSquid store. All models are already rigged, and a variety of animations are included. I settled on the following M870 shotgun weapon model below:

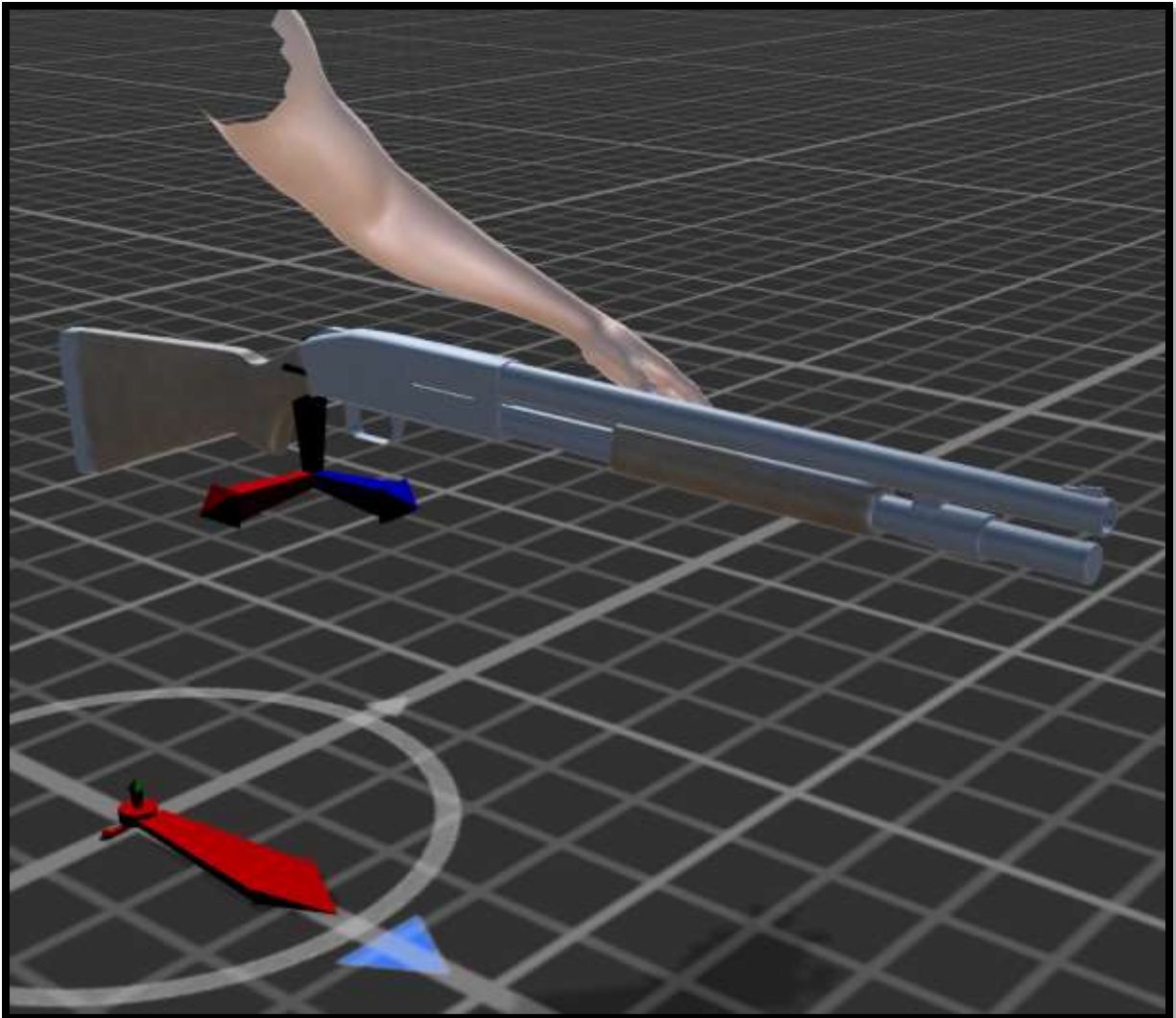


Figure 29 - M870 shotgun (by IvanSN on CGTrader store)

MP5K weapon

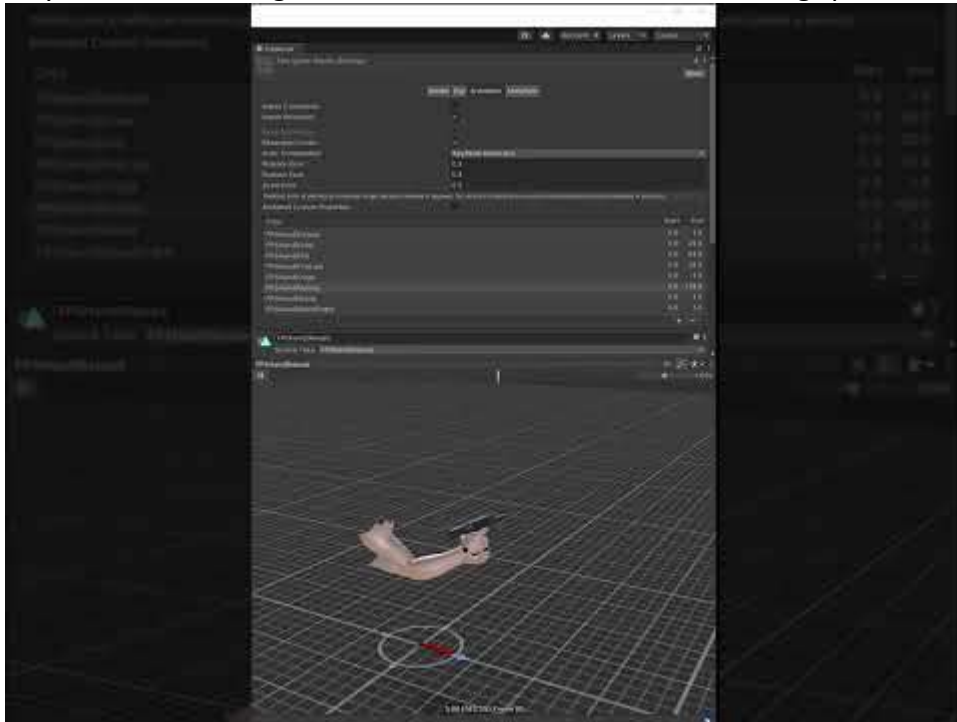
I decided to choose the MP5K weapon model from the CGTrader store for one of the weapons the player can upgrade to in the game. I chose this option primarily due to time constraints and a lack of modelling skill. Attempting to model this weapon by hand would have taken up all my time to complete the project, and the results would not have been as good as those from the Unity asset store, CGTrader or TurboSquid. The rigging element to the models is another time saver with TurboSquid store. All models are already rigged, and a variety of animations are included. I settled on the following MP5K weapon model below:



Figure 30 - MP5K (by 3Dia on TurboSquid store)

This is the animation state of each gun in the video below. Please note if the video does not play below, please right on video and choose open in browser option. Alternatively, the video can be seen on my YouTube channel by following this link: <https://youtube.com/shorts/wBjM-dlpUog?feature=share>

As you can see each gun has its own recoil state and reloading speed.



Environment Design

As the culmination of the study, the environment design for this game is one of the most crucial elements. In this section, I wanted to walk through the game's sole core level and discuss the decisions made inside it. There are a few features in this level that attempt to disrupt the players' cognitive flow while they play. Aesthetics, lighting, and audio are examples of features that might have been improved.

The sci-fi level is the first and only environment the player will encounter. Originally, I assumed I'd have to make this level from various horror house packs I owned. However, I had a sci-fi kit that I bought from the Unity asset store that was ideal for what I needed. Instead of having to construct everything from scratch, the example level saved me a lot of time. To begin, a few sections of the level were removed. I intended the player to start at the centre of the environment, but there wasn't much room due to the numerous obstacles and ramps in the environment, so I increased the area by removing obstacles, ramps, and other features. I had to remove the level's doors since they were not working properly, which caused a lot of issues for the player and the zombies because they would get stuck passing through the doors and the floor beneath the door. After finishing the sci-fi level, I added a number of audio and sound elements to bring the environment to life.

Here is a look at what the sci-fi level looks like below:



Figure 31 - Top-Down Sci-Fi modular Environment (by Asset Maiden on Unity asset store)

I knew I wanted to change the only level within the game's sci-fi level to be accurate from a design standpoint. I also wanted this level to be quite compact in order to create an enclosed feeling. Because it was made small, players would not have a big area to search for upgrades, weapons, and zombies needed to survive in the sci-fi level.

When designing the sci-fi atmosphere, I chose to include a forest environment in the player's backdrop. This was an excellent chance to change several aspects of the game's atmosphere. I chose a fog and hazy setting for the aesthetics outdoors. After I finished this, the landscape still seemed quite sparse, so I decided to add some additional green trees. A sort of tree from another nature asset bundle I used had a texture problem where nothing showed up. I had the choice of replacing them with a textured tree that would function, but I opted to keep them as they were since they may disrupt a player's cognitive flow. The audio was also changed in this level. The levels' music felt like a nice fit for this, so I decided to include music that would go into any sci-fi level in general. The overall setting ended out good, and here's a look at it with fog, mist, and tree shadows:



Figure 32 - Nature Starter Kit 2 (by Shapes on Unity asset store)

Here is a look at what the sci-fi level looks like below from the players perspective:



Figure 33 - Top-Down Sci-Fi modular Environment (by Asset Maiden on Unity asset store)

Game Controls

Player controls

Because the game is a first-person shooter, there aren't too many controls. I wanted the controls to be extremely similar to other games in this genre so that the user was not confused or hindered while playing. I used the conventional movement controls of WASD to allow the player to wander around and the mouse to allow the player to look around.

Because the game is about interacting with AI, upgrades, and weapon items, I wanted the interaction key to be simple to find, thus I picked the F key. I wanted the weapon reloading key to be easy to find as well, which is why I picked the R key. The weapon inventory can be accessed by pressing the number 1 and number 2 keys to swap between main and secondary weapons. The game also has a pause option that can be used while playing by hitting the ESC key. During the gameplay scene, the left mouse button may be used to fire the weapon and the right mouse button can be used for precise aiming and shooting.

Item Observation Controls

I wanted the user to be able to quickly glance around each object because there is such an emphasis on interacting with them and purchasing them in the game. To do so, the player may use the F key to purchase upgrades and weapon items, and the WASD keys to slowly move around the object. There is also a text box that shows up when the player interacts with the upgrade or weapon that tells the player what the upgrade or weapon is they are purchasing, how to purchase the upgrade or weapon and if they are purchasing a weapon, it will replace the primary weapon in their primary weapon slot.

Here is a glimpse of how the player interacts with purchasing an upgrade in the game:



Figure 34 - Interacting with upgrades and weapons in the Sci-Fi environment

Here is a glimpse of how the player interacts with purchasing a weapon in the game:

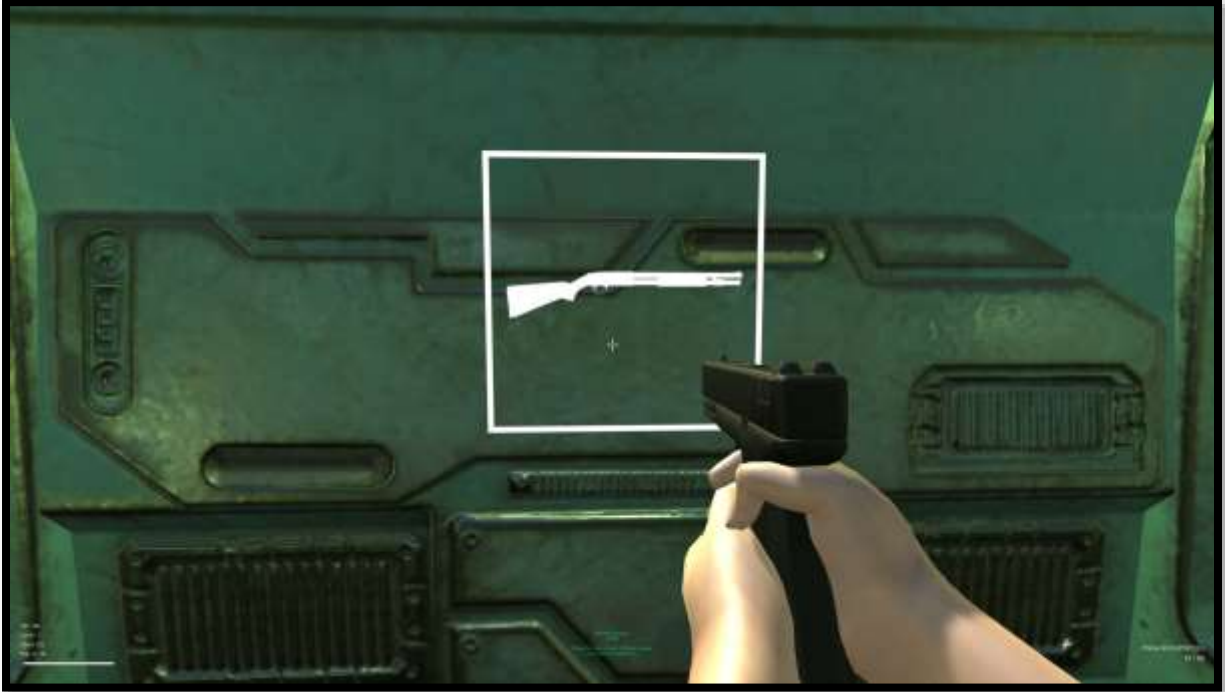


Figure 35 - Interacting with upgrades and weapons in the Sci-Fi environment

Main Menu User Interface

The main menu user interface was created using the Game Jam Menu Template from Unity Technologies from the Unity asset store. I downloaded this from the asset store, and it has remained in my Unity package manager for some time. I chose to use this as I felt that it would reduce the time limitations that I had for this project, and it would speed up the development of the whole game. The Game Jam Menu Template asset has been deprecated and is longer available on the Unity asset store. All of the buttons, texts etc. were easy to position through anchors and it was easy to create the main menu user interface functionality this way.

Main Menu

The main menu is the first thing the user sees when they launch the game, therefore I wanted it to look excellent and simplistic. When the user hovers their mouse over the buttons in the main menu the buttons change colour to show the user which button or option they would like to choose. The game's background is a snippet from the game's forest level. The game's name and four buttons are displayed on the menu. These are the 'Start' button, which launches the game, the 'Options' button, which takes the player to the Audio settings page, the 'Help' button, which takes the player to the controls page and guides the player on how to play the game and the 'Quit' button which exits the game.



Figure 38 - Main Menu

Options Menu

The 'Options' button consists of two settings the player can change, and these are the 'Music Volume' for the music levels and 'Effects Volume' which are any sound effects outside of the gameplay's music volume. Below is a snippet of the options menu:

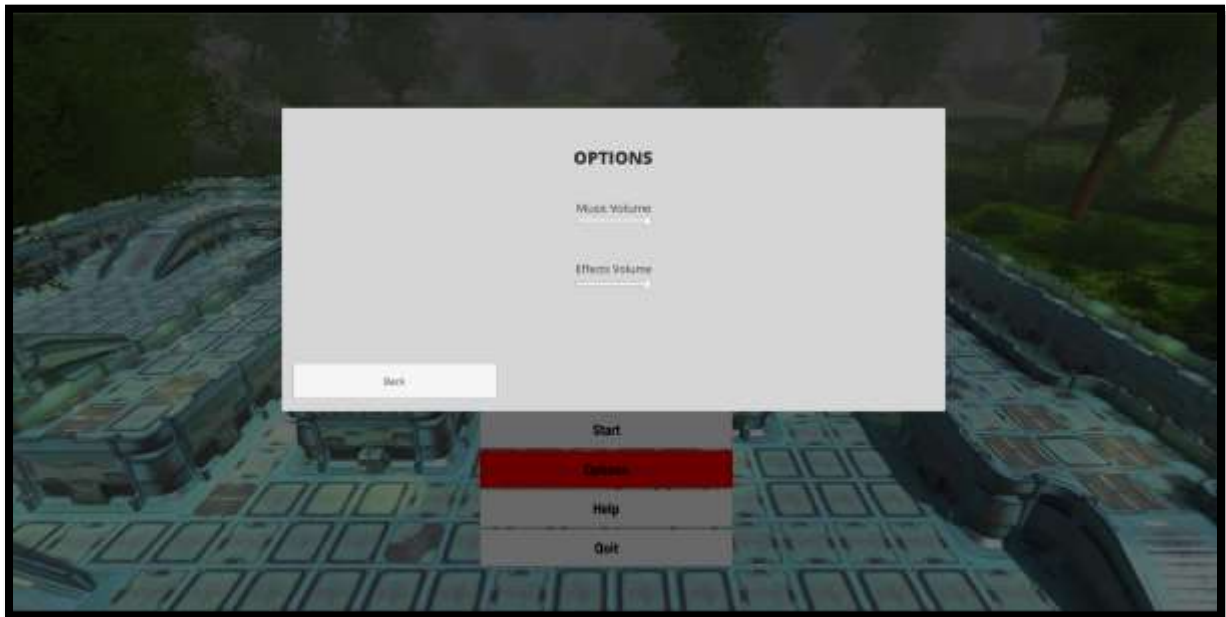


Figure 39 - Audio Settings

Help Menu

The 'Help' button, which takes the player to the controls page and guides the player on how to play the game. Below is a snippet of the help menu:

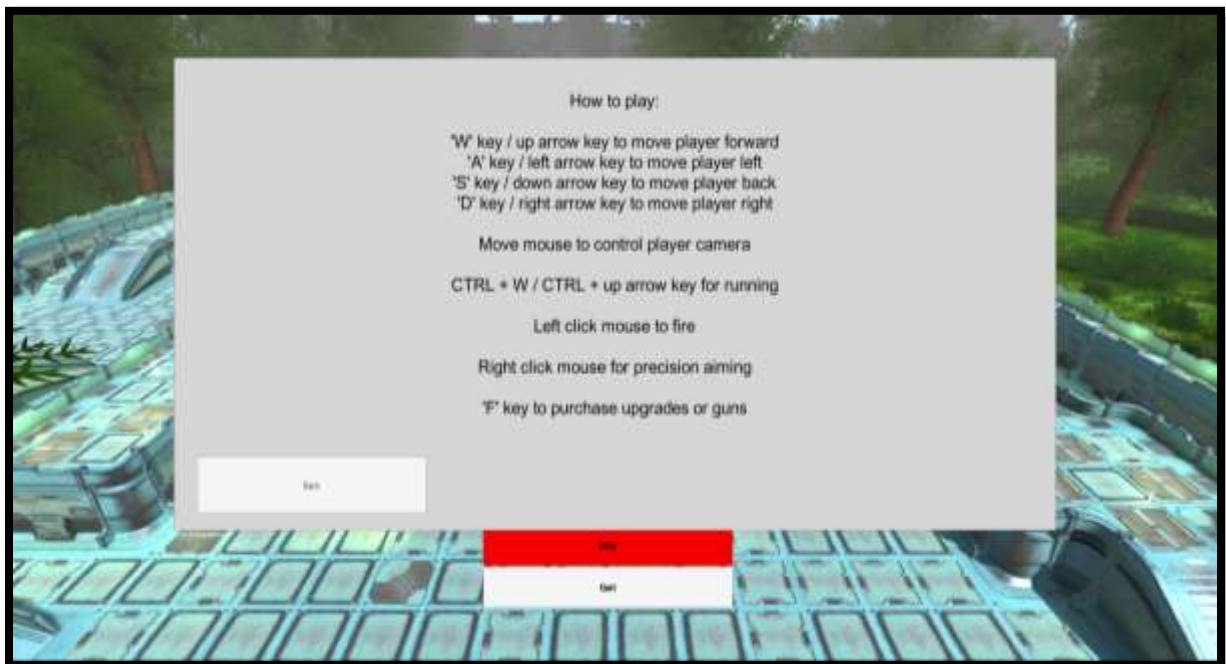


Figure 40 - Help Menu

Pause Menu

The pause menu has some more options than the game's actual main menu. The pause menu can be accessed by pressing the 'ESC' key. It has five buttons: 'Resume' button to return the gameplay, 'Restart' button allow the player to restart the game again, 'Video' button which allows the player to adjust the game's video settings, 'Audio' button which allows the player to adjust the game's audio levels and lastly the 'Quit' button which allows the user to quit back to the game's 'main menu', 'quit to desktop' and completely leave the game or 'cancel' and return back to the game.

The pause menu in its current form has some problems due to not actually pausing the game properly when the player clicks on any of the options the actual character still fires the weapon, and the player's camera pans upwards. A workaround to this problem is to press the 'ESC' key and return back to the gameplay, then press 'ESC' key again and to use the keyboard arrows to navigate the menu and pressing enter to access any of the menu options. The player's mouse can still be used in options such as Video and Audio to adjust the game's video and audio settings.



Figure 41 - Pause Menu

Video Settings Menu

The video settings menu consists of main graphics options and advanced graphics options. In the main graphics options, there are: Presets, VSync, Field of View, Model Quality, Terrain Quality, High Quality Trees and Resolution. In the Advanced options there are: Render Distance, Terrain Density, Shadow Distance, Shadow Cascades, Texture Quality, Aniso Textures, Ambient Occlusion, Depth of Field, MSAA, Fullscreen and Simple Terrain. Below are some snippets of the video settings:



Figure 42 - Video Settings

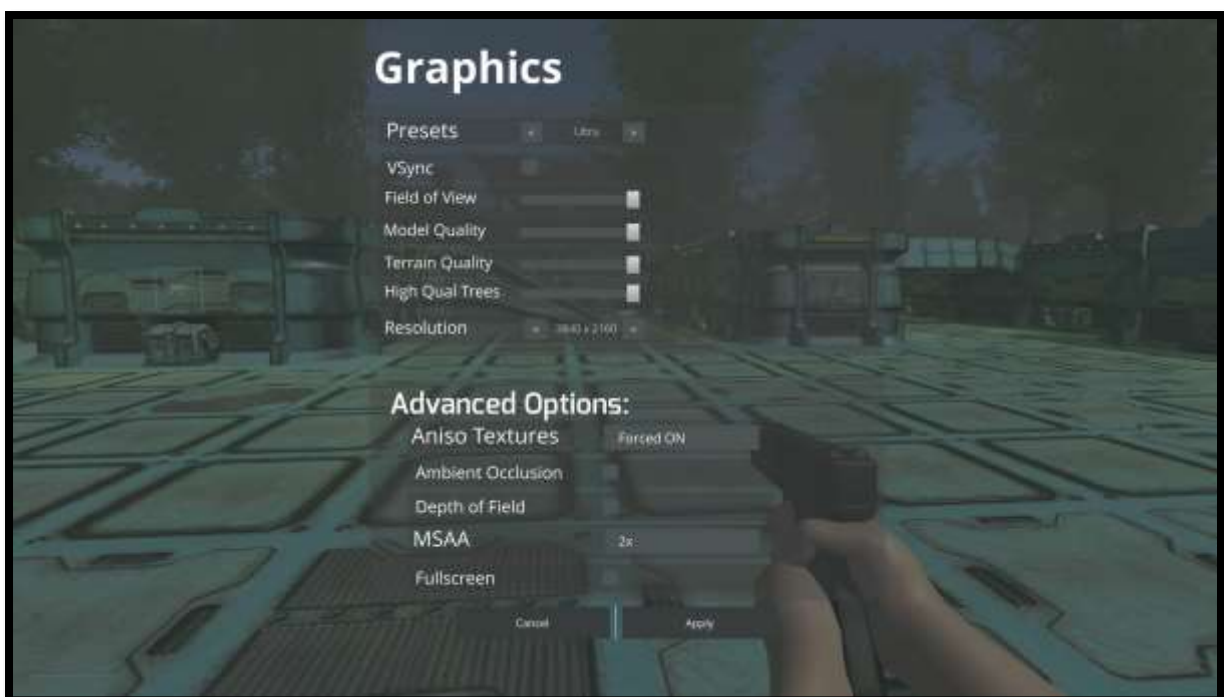


Figure 43 - Video Settings Cont.



Figure 44 - Video Settings Cont.

Audio Settings Menu

The audio settings menu consists of three settings the player can change, and these are the 'Master Volume' for the volume levels in whole game, 'Music Volume' for the music levels in the game and the 'Effects Volume' which are any sound effects outside of the gameplay's music volume.



Figure 45 - Audio Settings

Technical Design

Implementation

The game is to be developed using the Unity IDE (specifically version 2020.3.26f1 this is the most recent as of the start of development) as the development environment for this project. This engine was chosen for a number of reasons. Because the game is a first-person shooter, I knew the game would have to look well graphically, and Unity is an excellent engine for creating high-quality visual settings.

Zombie First-Person Shooter will take particular advantage of the following Unity Engine features:

- Audio system
- Physics engine
- Universal Render Pipeline

Player Functionality

As the game is a first-person shooter game, I recognized that the player's perspective would be first person, so I didn't need to be concerned as to how the player moved. As a result, I used the first-person controller asset from the Unity standard assets pack to control the player's basic movement controls in Unity Engine. This saved me a significant amount of time because it simply required me to develop the character model plus the animations. In the future, I'd want to work on refining the character's mobility. Below is a look at the FirstPersonController script:

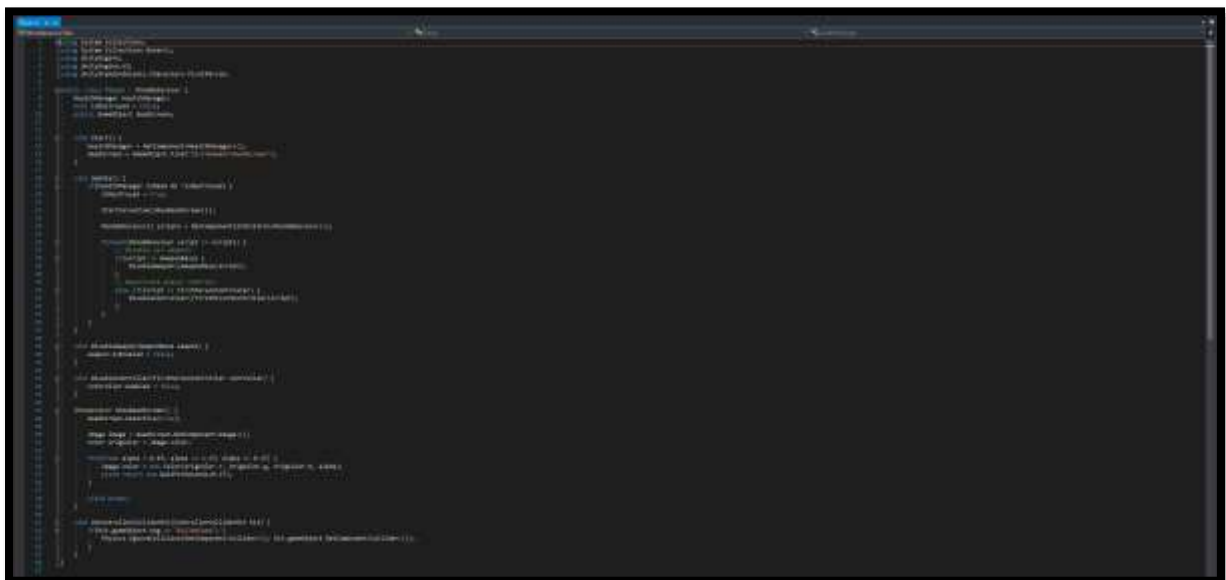


Figure 46 - Player script

AI Functionality

For interacting with the AI in the game there needed to be an interact function using the F key. I created a ShopDetector script that checks to see when the player is near an upgrade or weapon shop in the game. This would then present the player with the name of the shop, the shop's description, and the price of the item at the shop. In the game the player will be upgrade the damage inflicted on the zombies and the reloading speed of the players weapon etc. Below is a look at the ShopDetector script:

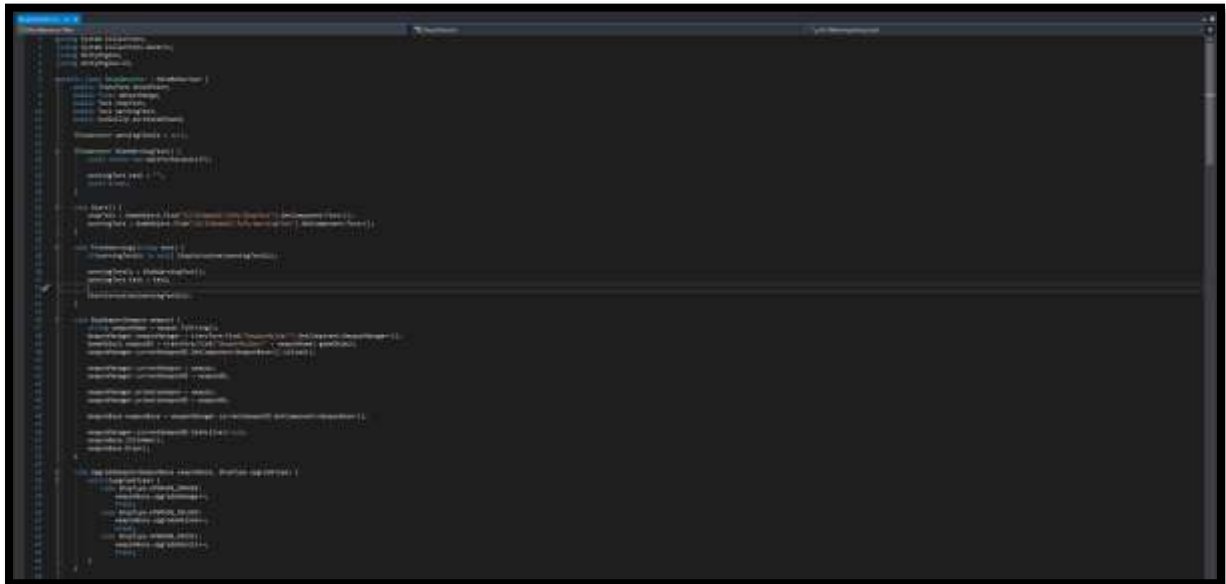


Figure 47 - ShopDetector script

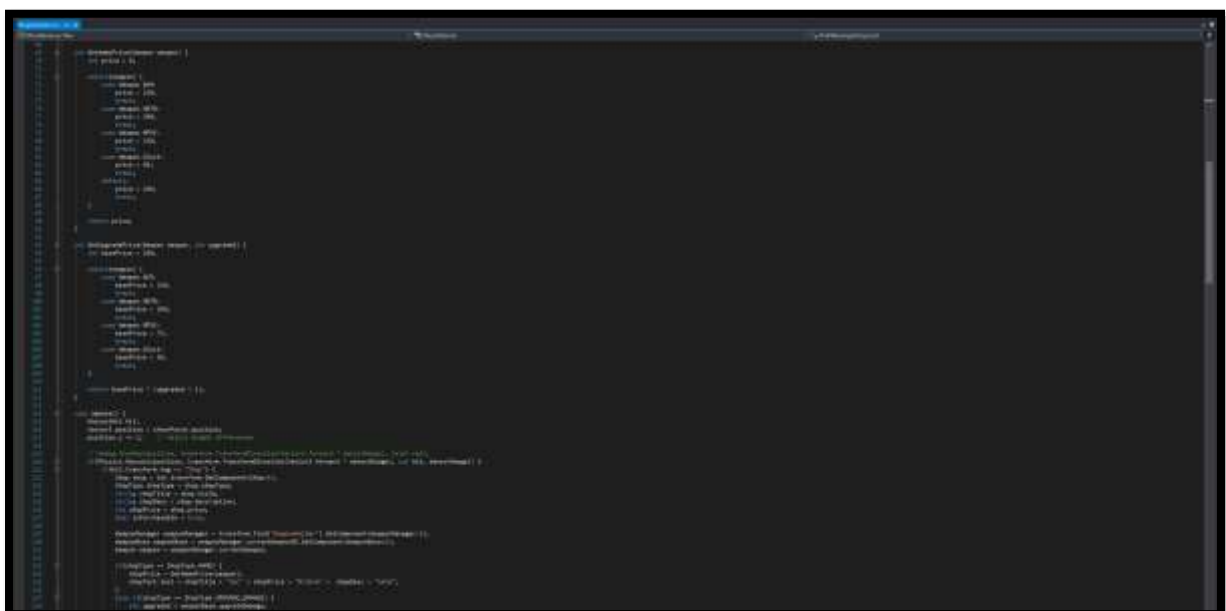
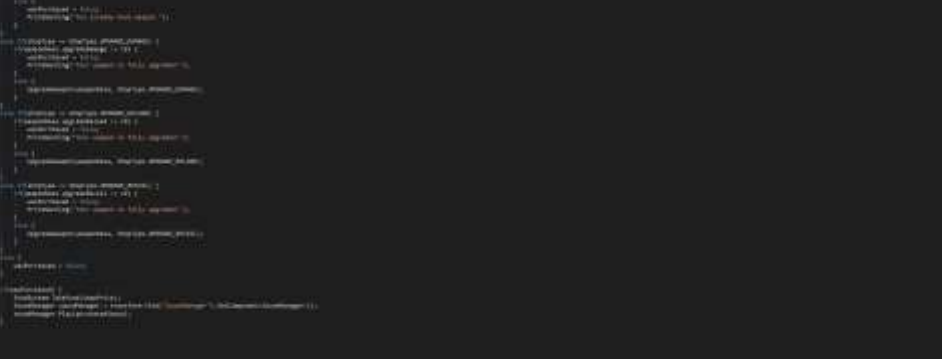


Figure 48 - ShopDetector script cont.



```

#include <iostream>
using namespace std;

int main()
{
    int n = 100;
    int sum = 0;

    for (int i = 1; i <= n; i++)
    {
        sum += i * i;
    }

    cout << "Sum of squares of numbers from 1 to 100 is: " << sum << endl;

    return 0;
}

```

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Enemy Functionality

For the enemy functionality in the game, I created two scripts one that would control the zombie attacking and chasing the player in the game and another that would control how often the zombie spawns into the game, moving speed, health, damage etc. Below is a look at the Chasing and EnemySpawner scripts:

Chasing script

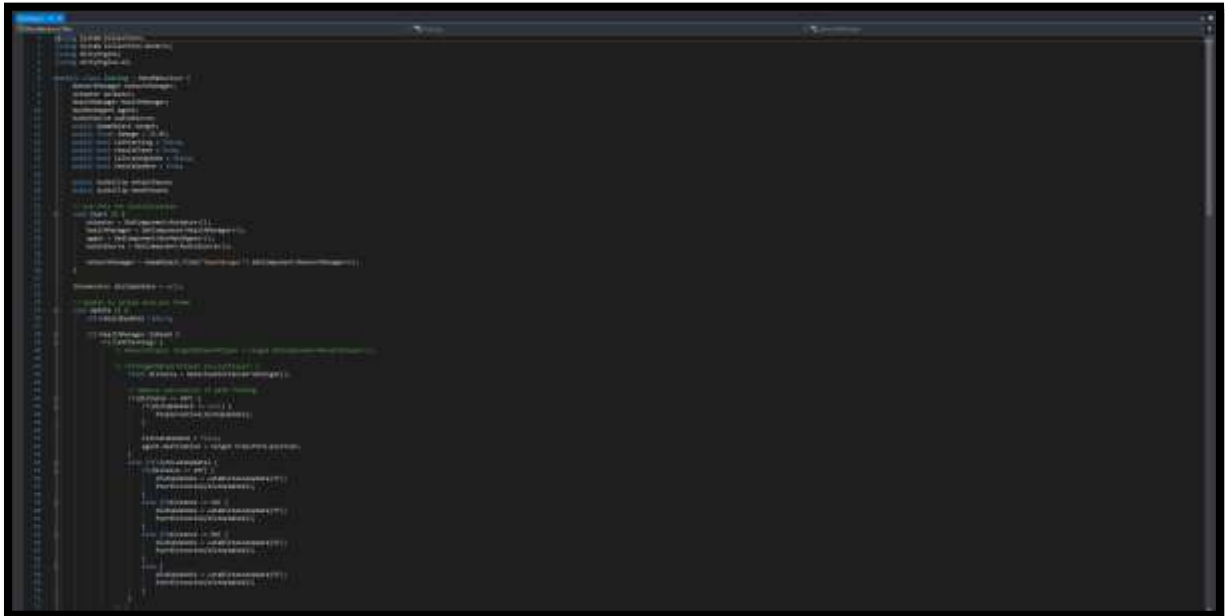


Figure 51 - Chasing script

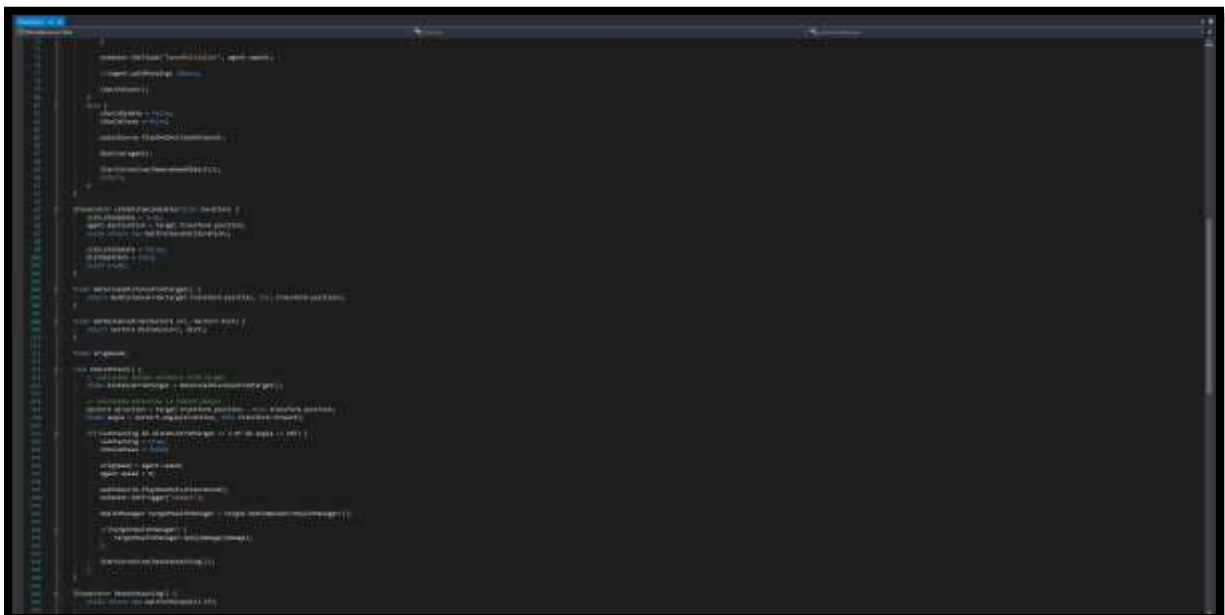


Figure 52 - Chasing script cont.

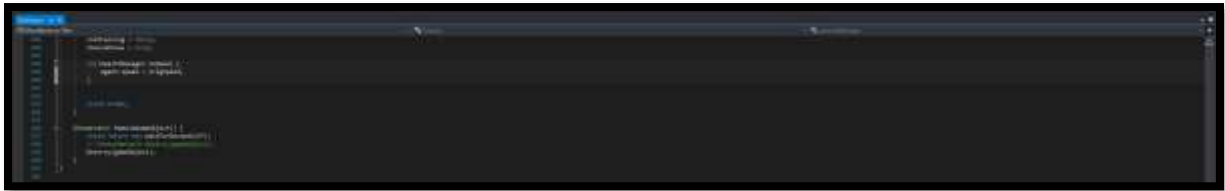


Figure 53 - Chasing script cont.

EnemySpawner script

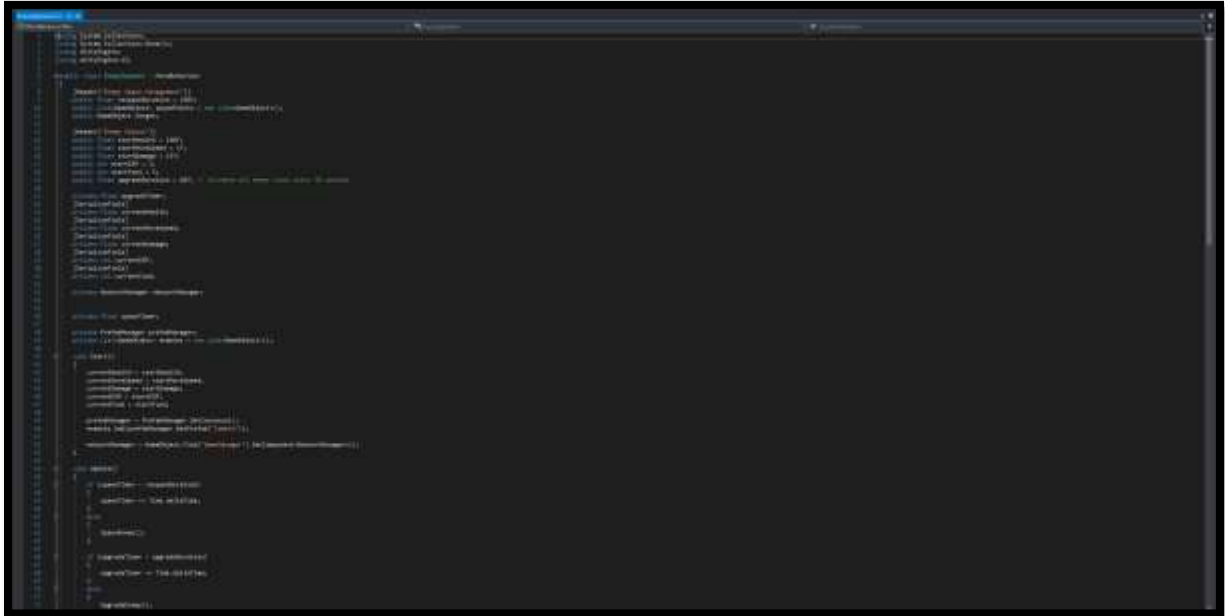


Figure 54 - EnemySpawner script

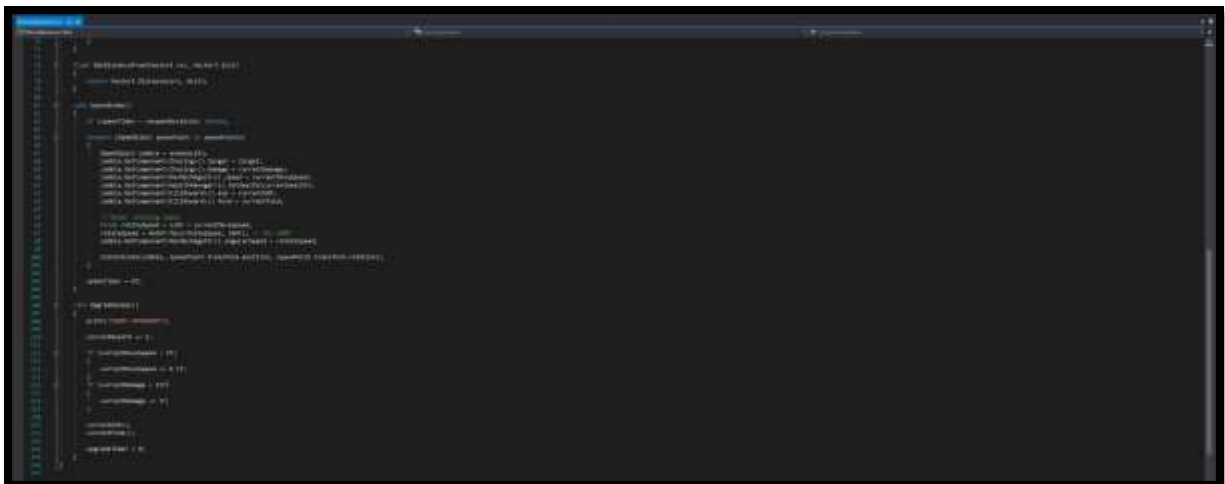


Figure 55 - EnemySpawner script cont.

Weapon Functionality

For the player's weapon functionality, I created a WeaponManager script that manages the player's weapons. The player starts off with a Glock pistol weapon as the primary weapon in the game. The player can then purchase another weapon given that they have enough money to purchase the weapon, once the player purchases another weapon the primary weapon is replaced with the weapon the player has purchased and the weapon the player starts off the game with the Glock pistol weapon is now the player's secondary weapon. The player can switch between primary and secondary weapons by pressing the number 1 and number 2 keys on their keyboard. Below is a look at the WeaponManager script:

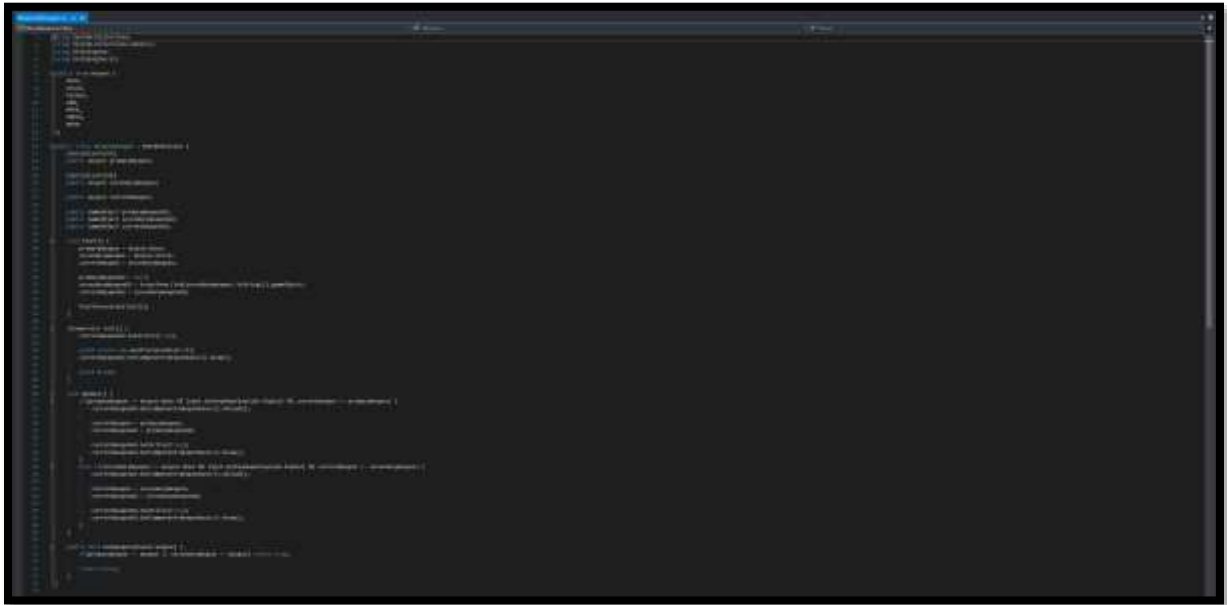


Figure 56 – WeaponManager script

Pseudocode

Here are some instances of pseudocode that were created prior to the construction of the prototype. It should be noted that this does not include everything the game will have.

quitApplication:

```

IF Button Pressed IS Quit THEN
    IF UNITY_STANDALONE
        Quit the application
    END IF

    IF UNITY_EDITOR
        Stop playing the scene
    END IF
  
```

Figure 57 - Quit Application Pseudocode

mainMenu:

```
IF Button Pressed IS Start THEN
    BeginLoadingMainGamePlayLevel
    IF MainGamePlayLevel IS Loaded THEN
        Begin MainGamePlayLevel

IF Button pressed IS Options THEN
    DisplayOptionsScreen

IF Button pressed IS Settings THEN
    DisplaySettingsScreen

IF Button Pressed IS Quit THEN
    QuitCurrentGame

END IF
```

Figure 58 - Main Menu Pseudocode

startUp:

```
IF remainSeconds IS Less than five
    Play Beep sound
Until remainSeconds IS zero

Then displayText "FIGHT"
    Play gameBegins sound
```

Figure 59 - Startup Text Pseudocode

Version Control

For version control, Microsoft OneDrive was the dominant pathway for backing up everything. However, because the game's file size was so big, I was unable to upload it to Microsoft OneDrive. To address this, I decided to make backups of the game on an internal hard drive just in case something went wrong. A preview of the game versions is shown below:

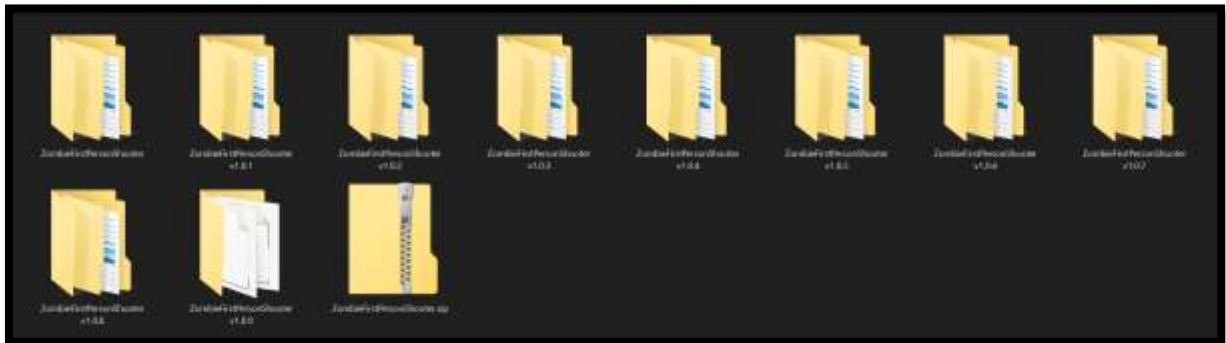


Figure 60 - Internal Hard Drive Game Versions

I was able to upload all of the game-related materials to Microsoft OneDrive. The dissertation, references, and read me files are examples of these materials. It was quite simple to maintain version control with Microsoft OneDrive since you could examine each document's prior copy. An example of these can be found below:



Figure 61 - Microsoft OneDrive: Dissertation backup folder



Figure 62 - Microsoft OneDrive: Dissertation versions

I didn't put up as many videos on my YouTube account. However, I believe it is similar to LinkedIn in that it reaches a large spectrum of individuals, and I believe it was still a wonderful way to showcase what I had been working on. Due to its size, it was also very beneficial for having the playthrough of the game uploaded. An example of the video uploads can be found below:

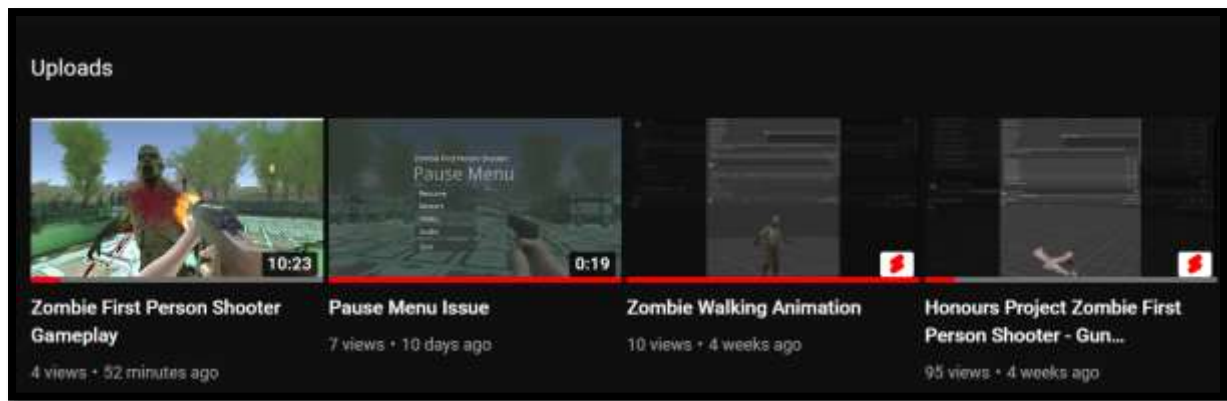


Figure 63 - YouTube Uploads

Hardware

Nothing was added to my previous expectations of the hardware I would need for this project in terms of hardware. The computer specifications did not alter during the course of the project and remained as follows:

CPU:	AMD Ryzen 7 3700X 8-Core Processor
Graphics Card:	Nvidia GeForce RTX 2070 8GB GDDR6
RAM:	16GB DDR4
Storage:	1TB SSD M.2 NVMe, 1TB SSD and 2x 1TB HDD

The dual displays, headset, mouse, and keyboard remained unchanged. All of this not only aided in the creation of the game, but also in its testing.

The webcam was utilised at supervisory meetings with Gavin to provide progress updates throughout the year. The webcam made it possible to have face-to-face conversations and made the meetings feel more realistic and true-to-life.

When it came to the monitoring the audio and music in the game, a Logitech G Pro Headset was also required. I was able to monitor the necessary audio and music using the Logitech G Pro Headset and Audacity.

My laptop was the final piece of hardware that was added. I needed to use my laptop for testing purposes before releasing the game to participants for testing. The following specifications are the laptop's specifications:

CPU:	Intel Core i5-7300HQ 4-Core Processor
Graphics Card:	Nvidia GeForce GTX 1050 4GB GDDR5
RAM:	8GB DDR4
Storage:	128GB SATA3 SSD and 1TB HD

External Assets

Multiple asset packs were used to construct the game throughout this project. These asset packs would have been used for either specific objects, audio requirements, or some kind of landscape creation tool. I would not have been able to construct the game to the standard it is today without the asset packs listed below.

Asset Name	Link	Use
Top-Down Sci-Fi modular Environment	https://assetstore.unity.com/packages/3d/environments/sci-fi/top-down-scifi-modular-environment-100524#description	Used as the main environment the player will be in throughout the game.
Nature Starter Kit 2	https://assetstore.unity.com/packages/3d/environments/nature-starter-kit-2-52977#description	Used as the outside environment that player will see be able to see in the game.
Standard Asset Pack (for Unity 2018.4)	https://assetstore.unity.com/packages/essentials/asset-packs/standard-assets-for-unity-2018-4-32351#description	Used for and to control the first-person controller prefab and script in the game
Doomguy FanMade1 3D model	https://www.turbosquid.com/3d-models/doomguy-fanmade1-3d-model-1739510	Used as the main character in the game placed inside the first-person controller prefab. Player will be able to see the players arms.
Zombie	https://assetstore.unity.com/packages/3d/characters/humanoids/zombie-30232#description	The game's animated zombie adversaries may be encountered all across the game.
AKM-gun from PUBG 3D model	https://www.turbosquid.com/3d-models/akm-pubg-3d-model-1377603	Used as a replica gun that the player purchase in the game
Glock-19	https://www.turbosquid.com/3d-models/free-3ds-mode-glock-19/885511	Used as the main firearm weapon that the player starts off with in the game.
Shotgun M870 3D model	https://www.cgtrader.com/3d-models/military/gun/shotgun-m870	Used as a replica gun that the player purchase in the game
MP5K Gun 3D model	https://www.turbosquid.com/3d-models/mp5k-gun-3d-model-1723875	Used as a replica gun that the player purchase in the game
Unity Pause Menu	http://unitypausemenu.weebly.com/	Used for the games Pause Menu in the game

Unity Game Jam Menu Template (now deprecated)	https://www.assetstore.unity3d.com/en/#!/content/40465	Used for the games Main Menu scene. The first screen the player see's loading when the game.
"Wicked Dreams" music by Eric Matyas	https://soundimage.org/wp-content/uploads/2017/10/Wicked-Dreams.mp3	Used as the main music source in the game
StarCraft Corsair ready for battle sound effect	http://soundfxcenter.com/download-sound/starcraft-corsair-ready-for-battle-sound-effect/	Used when the player first spawns into the game to announce to the player the game is about to start
Warning Alarm	https://www.myinstants.com/instant/warning-alarm/	Used when the countdown has finished to warn the player that the zombies have now spawned into the game
Atari Breakout wall beep sound effect	https://www.myinstants.com/instant/wall-beep-64610/	Used as five continuous beeps to warn the player of the countdown prior to the zombies spawning into the game
Shop sound effect	https://www.myinstants.com/instant/cash-register/	Used as the player purchases an upgrade or weapon in the game from any of the shops.
Zombie Groan	https://www.myinstants.com/instant/zombie-groan-51010/	Used as the player shoots and kills the zombie
Zombie Bite sound effect	https://www.myinstants.com/search/?name=Zombie+Bite	Used as the zombie attacks the player and when the zombie has killed the player
Roblox footstep sound effect	https://www.myinstants.com/instant/roblox-footsteps-75387/	Used as the player's footsteps in the game when walking or running

Table 3 – External Assets

Testing

To be able to draw conclusions from the research, I distributed a questionnaire that included a link to the game's installer as well as the plain language statement. I was able to use Google Forms' summary tool to analyse the questionnaire findings. I wanted to include a couple questions about the game in general, as well as ones about the study specifically. Here are the questionnaire's questions and how they were organised.

How long have you spent playing the game just now?

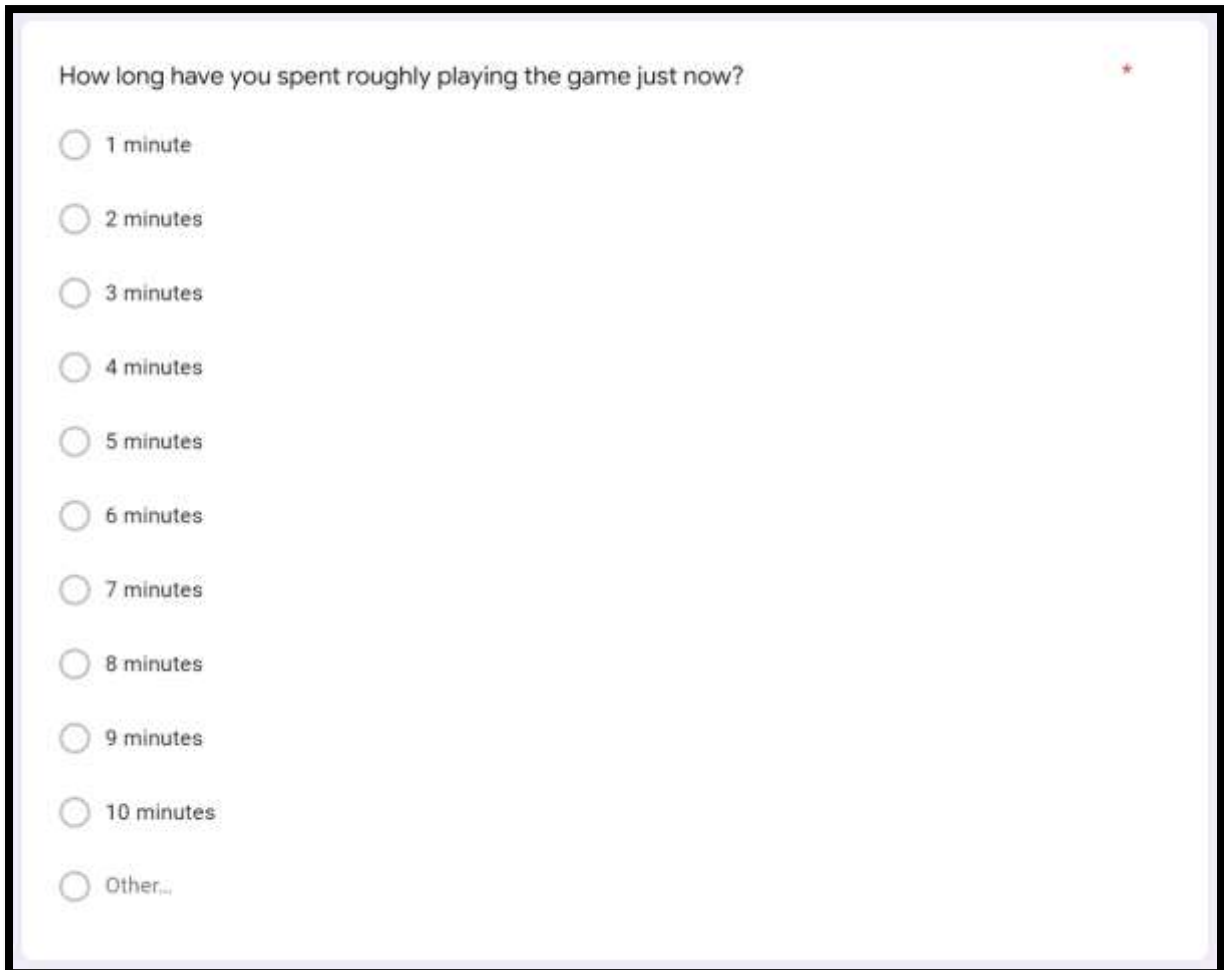
A screenshot of a Google Form question. The question text is "How long have you spent roughly playing the game just now?". Below the question are eleven radio button options: "1 minute", "2 minutes", "3 minutes", "4 minutes", "5 minutes", "6 minutes", "7 minutes", "8 minutes", "9 minutes", "10 minutes", and "Other...". The form is displayed within a black rectangular border.

Figure 64 - Playtesting Questionnaire: Question 1

The Immersive Experience Questionnaire (IEQ) developed by Jennett et al. (2008) was utilised to subjectively measure how immersed the participants were and their time perception in terms of losing track of time. See questionnaire attached below.

Please circle in one of the boxes below:

1. To what extent did the game hold your attention?

Not at all 1 2 3 4 5 A lot

2. To what extent that did you feel you were focused on the game?

Not at all 1 2 3 4 5 A lot

3. How much effort did you put into playing the game?

Not at all 1 2 3 4 5 A lot

4. Did you feel that you were trying your best?

Not at all 1 2 3 4 5 A lot

5. To what extent did you lose track of time?

Not at all 1 2 3 4 5 A lot

6. To what extent did you feel consciously aware of being in the real world whilst playing?

Not at all 1 2 3 4 5 A lot

7. To what extent did you forget about your everyday concern?

Not at all 1 2 3 4 5 A lot

8. To what extent did you aware of yourself in your own surrounding?

Not at all 1 2 3 4 5 A lot

9. To what extent did you notice events taking place around you?

Not at all 1 2 3 4 5 A lot

10. Did you feel the urge at any point to stop playing and see what was happening around you?

Not at all 1 2 3 4 5 Very much so

11. To what extent did you feel that you were interacting with the game environment?

Not at all 1 2 3 4 5 Very much so

Please see next page

12. To what extent did you feel as though you were separated from your real world environment?

Not at all 1 2 3 4 5 Very much so

13. To what extent did you feel that the game was something you were experiencing, rather than something you were just doing?

Not at all 1 2 3 4 5 Very much so

14. To what extent was your sense of being in the game environment stronger than your sense of being in the real world?

Not at all 1 2 3 4 5 Very much so

15. At any point did you find yourself become so involved that you were unaware you were even using controls?

Not at all 1 2 3 4 5 Very much so

16. To what extent did you feel as though you were moving through the game according to your own will?

Not at all 1 2 3 4 5 Very much so

17. To what extent did you find the game challenging?

Not at all 1 2 3 4 5 Very difficult

18. Were there any times during the game in which you just wanted to give up?

Not at all 1 2 3 4 5 A lot

19. To what extent did you feel motivated while playing?

Not at all 1 2 3 4 5 A lot

20. To what extent did you find the game easy?

Not at all 1 2 3 4 5 Very much so

21. To what extent did you feel like you were making progress towards the end of the game?

Not at all 1 2 3 4 5 A lot

Please see next page

22. How well did you think you performed in the game?

Very poor 1 2 3 4 5 Very well

23. To what extent did you feel emotionally attached to the game?

Not at all 1 2 3 4 5 Very much so

24. To what extent were you interested in seeing how the game's events would progress?

Not at all 1 2 3 4 5 A lot

25. How much did you want to "win" the game?

Not at all 1 2 3 4 5 Very much so

26. Were you in suspense about whether or not you would win or lose the game?

Not at all 1 2 3 4 5 Very much so

27. At any point did you find yourself become so involved that you wanted to speak to the game directly?

Not at all 1 2 3 4 5 Very so much

28. To what extent did you enjoy the graphics and the imagery?

Not at all 1 2 3 4 5 A lot

29. How much would you say you enjoyed playing the game?

Not at all 1 2 3 4 5 A lot

30. When interrupted, were you disappointed that the game was over?

Not at all 1 2 3 4 5 Very much so

31. Would you like to play the game again?

Definitely not 1 2 3 4 5 Definitely yes

End of questionnaire

Thank you for your participation.

The prequestionnaire is available to access online here:

<https://forms.gle/3BAqpLcWQaiRunjm8>

The playtesting questionnaire can be accessed here: <https://forms.gle/3Dv7zp2L46WhpdGS6>

The final playthrough of the game can be found here: <https://youtu.be/IOT3geuQTq4>

The game can be installed from Itch.io online here: <https://hassan-latif.itch.io/zombie-first-person-shooter>

The game can also be installed from Google Drive here:

<https://drive.google.com/file/d/1uuAZej558QhDq6BGe0oMPdxxraoFFiBK/view?usp=sharing>

The source code of the game can be found here: <https://drive.google.com/file/d/1fenuvKfW-VL5SKPUPj-jYvo6D5YFxoAd/view?usp=sharing>

Access to the full documentation for the dissertation can be found here:

https://studentmailuwsac-my.sharepoint.com/:f:/g/personal/b00333837_studentmail_uws_ac_uk/EtTtHCAr60lCqX5GzI5VKGsBgROCOviyBVRkOyEN8K8RFw?e=5DyccC

Questionnaire Analysis

The game was sent out for testing which took place on 10th of April 2022. This took a few weeks, but in the end, I was able to collect significant data on the Zombie First-Person Shooter prototype. It was enormously difficult to do in person testing at the university this year due to the COVID 19 outbreak and guidelines that are currently in place. However, I was able to gather a total of 25 people to test the game and fill out the questionnaire. The testing participants were largely family and friends and fellow game development students with a range of gaming experience.

The first, and most significant, question presented to the participant was “I confirm that I have read and understand the Plain Language Statement above and have had the opportunity to ask questions.” This is a critical question since the research is conducted in accordance with ethical guidelines and standards, and thus the participant must have read and understood the Plain Language Statement as shown in the survey in order to participate. All 25 individuals confirmed and understood the Plain Language Statement.

In addition, the next three questions “I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason (If at any point you wish to abandon this survey simply close your browser tab and no responses will be saved)” also “I understand that I will be asked questions and my responses will be recorded, but that I will not be identified by name in any resulting published work.” Lastly “I agree / do not agree to take part in the above study.” These questions were also critical also since the research is conducted in accordance with ethical guidelines and standards, and thus the participant

needed to have read and agreed to these questions as well in order to take part in this survey. Out of the 25 participants all of them agreed to participate.

If the participants did not agree to participate, they were sent to a section in the questionnaire that stated why they could not participate due to ethical rules and thanked them for looking into the study.

If the participants agreed and consented to all the questions above, they would move onto the next section in the survey. The first question asked the participants “How long have you spent roughly playing the game just now?”

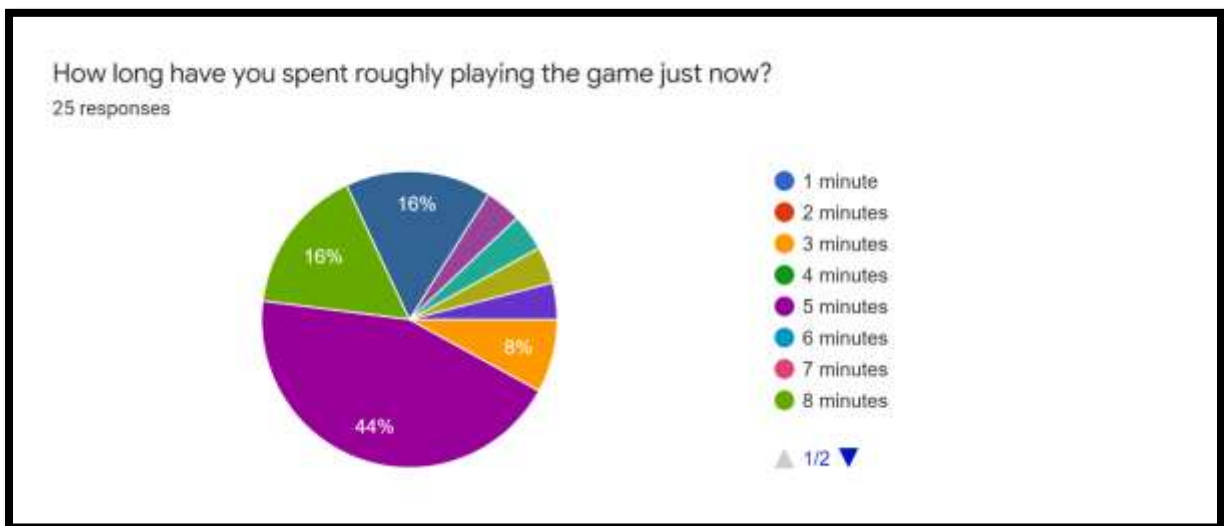


Figure 65 - Zombie First-Person Shooter Playtesting Questionnaire: Time spent playing the game

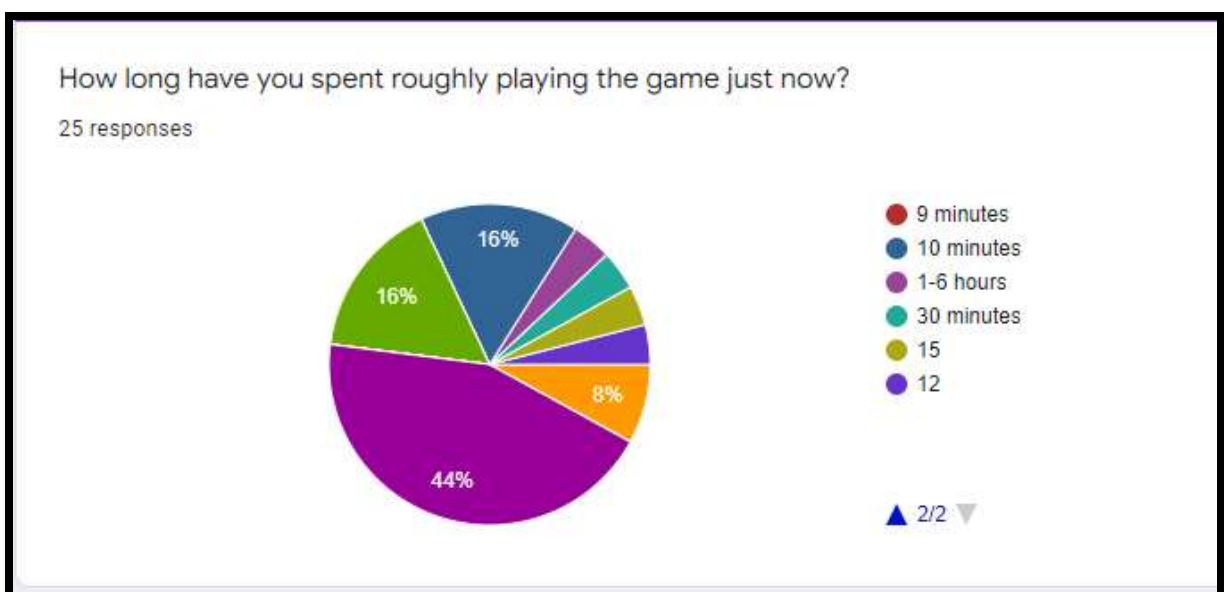


Figure 66 - Zombie First-Person Shooter Playtesting Questionnaire: Time spent playing the game cont.

As you can see from the pie chart above out of the 25 participants. 44% of the participants played the game for 5 minutes, 16% of the participants played the game for 10 and 8 minutes

and 8% of the participants played the game for 3 minutes. The rest of the participants at 4% played the game for 12, 15, 30 minutes and lastly one participant played the game for between 1 to 6 hours.

The rest of the questions in the questionnaire were mostly focused on asking the participant about flow and immersion on time perception during their overall experience of the game.

The first of these questions asked the participants “To what extent did the game hold your attention?” On a scale of 1 to 5, with 1 being the least and 5 being the most. The bar graph below shows that 56% of the participants felt that the game found that the game mostly held their attention mostly really well. 24% of the participants felt that the game somewhat held their attention mostly. 12% of the participants felt that the game held their attention a lot. Lastly 8% of the participants felt the game somewhat didn’t hold their attention a lot.

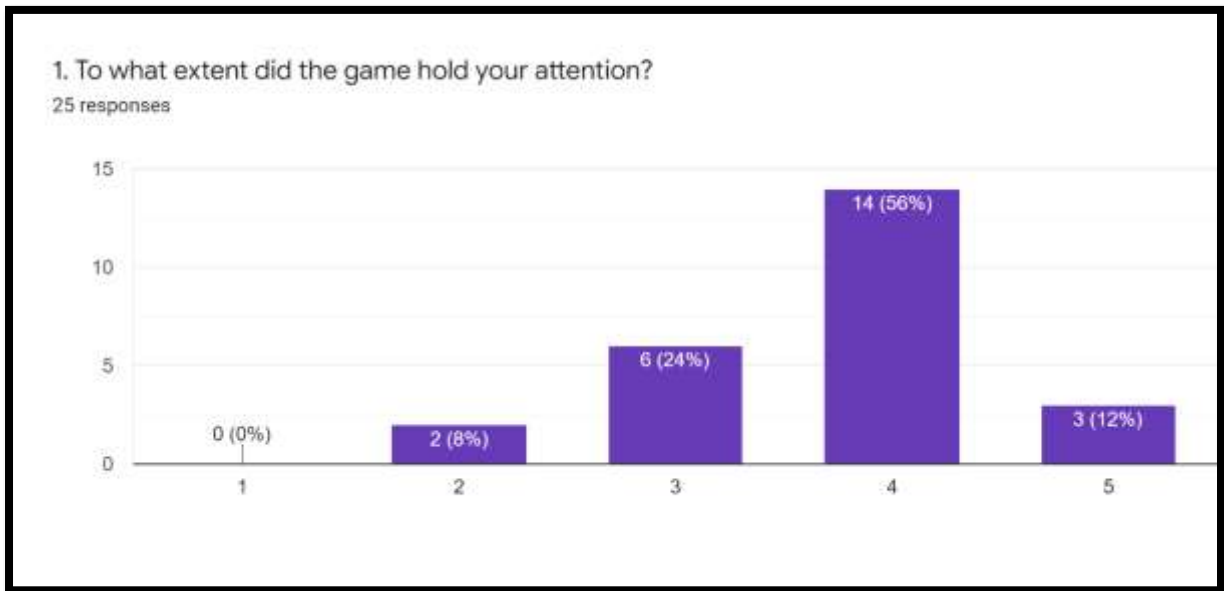


Figure 67 - Zombie First-Person Shooter Playtesting Questionnaire: Question 1

The second question asked the participants “To what extent that did you feel you were focused on the game?” The bar graph below shows that 60% of the participants felt that they were mostly focused on the game. 20% of participants felt that they were somewhat focused on the game. 16% of participants felt that they were really focused on the game. Lastly, 4% of participants felt that were somewhat not really focused on the game.

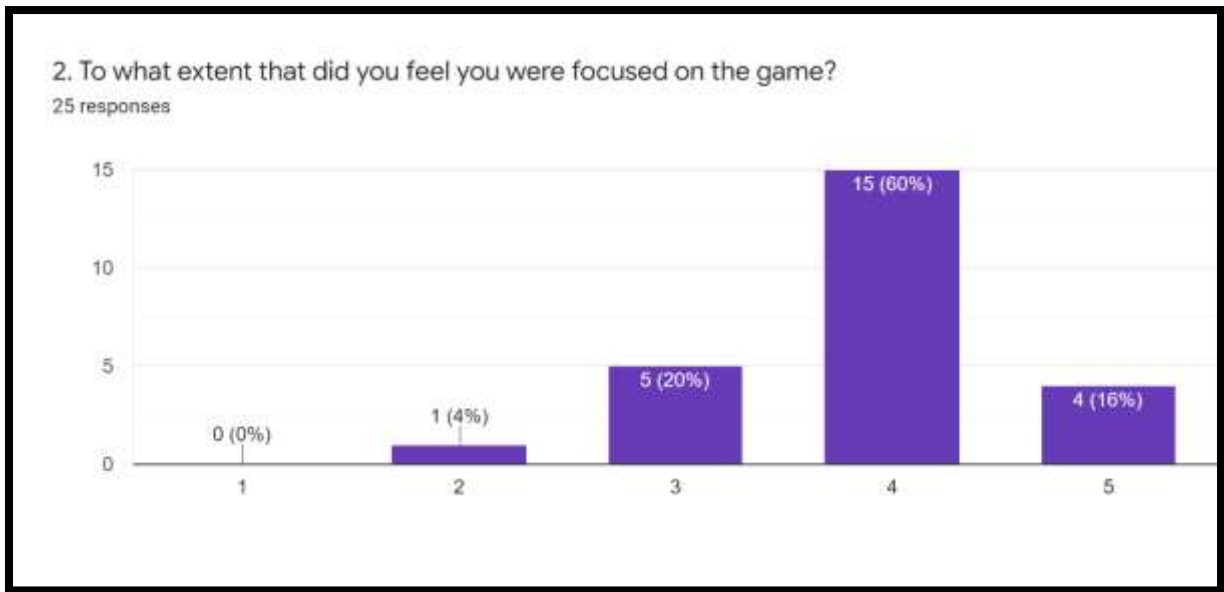


Figure 68 - Zombie First-Person Shooter Playtesting Questionnaire: Question 2

The third question asked the participants “How much effort did you put into playing the game?” 52% of participants said that they were mostly putting some effort into the game. 36% of the participants said that they were somewhat putting effort into the game. Lastly, 12% of participants said that they were putting a lot of effort into the game.

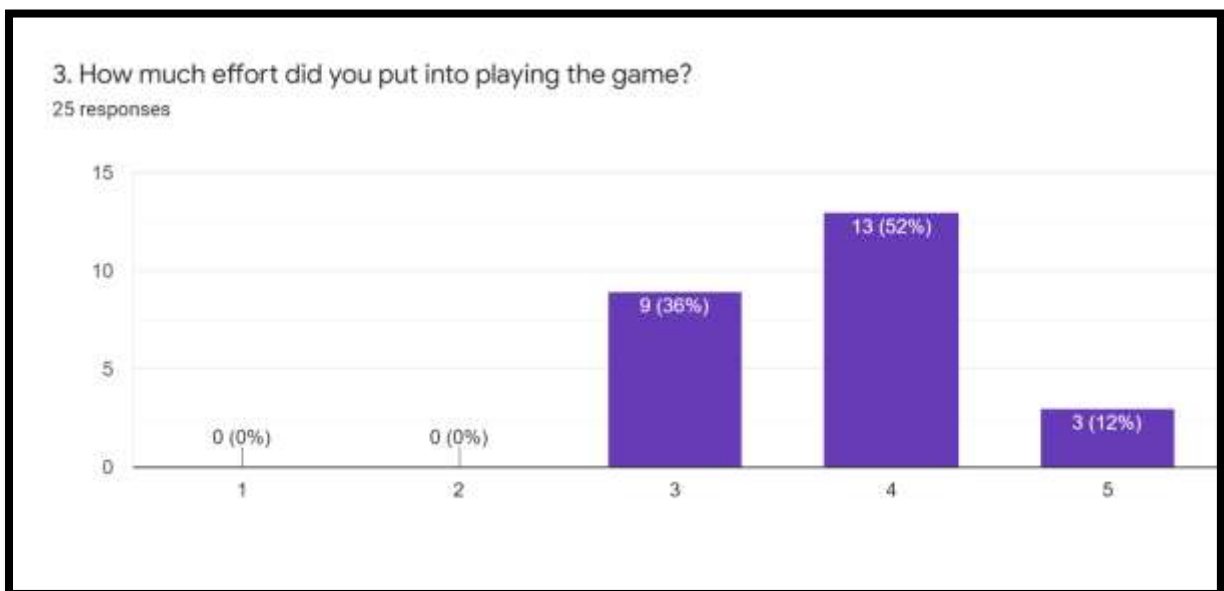


Figure 69 - Zombie First-Person Shooter Playtesting Questionnaire: Question 3

The fourth question asked the participants “Did you feel that you were trying your best?” 56% of participants said that they were mostly trying their best. 28% of participants said that they were somewhat trying their best. 8% of participants said that they were somewhat not trying their best and also 8% of participants said that they were trying their best in game the most.

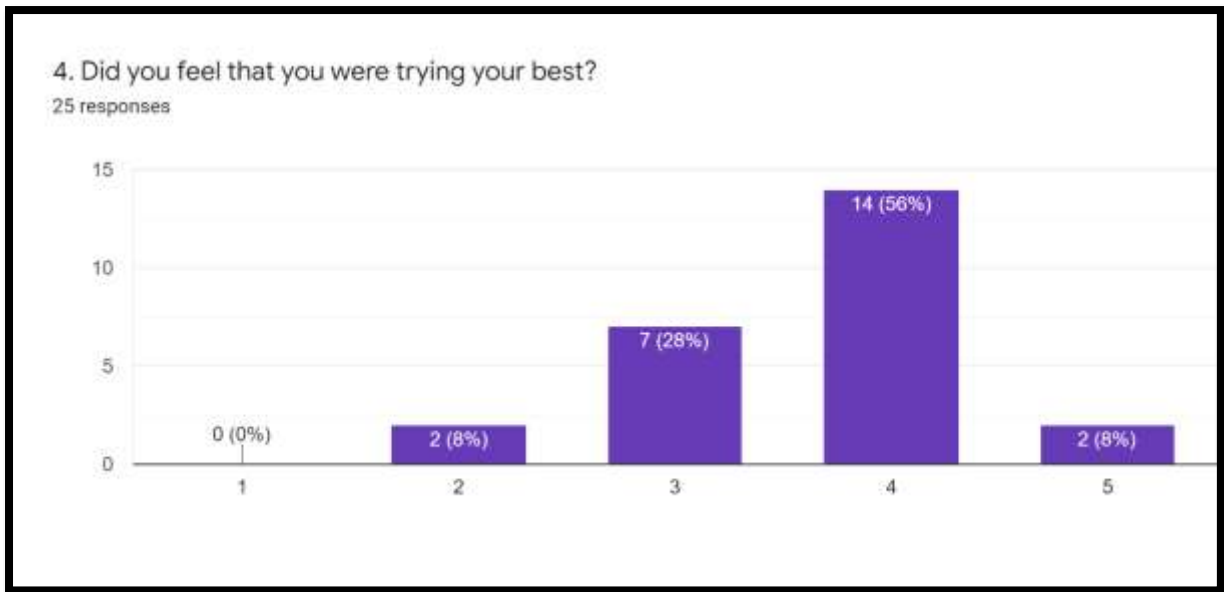


Figure 70 - Zombie First-Person Shooter Playtesting Questionnaire: Question 4

For question five the participants were asked “To what extent did you lose track of time?” The bar graph below shows that 44% of participants felt they mostly lost track of time. 28% of participants felt that they somewhat lost track of time. 16% participants said that lost track of time a lot. Lastly, 3% of participants said that they somewhat didn’t really lose track of at time at all.

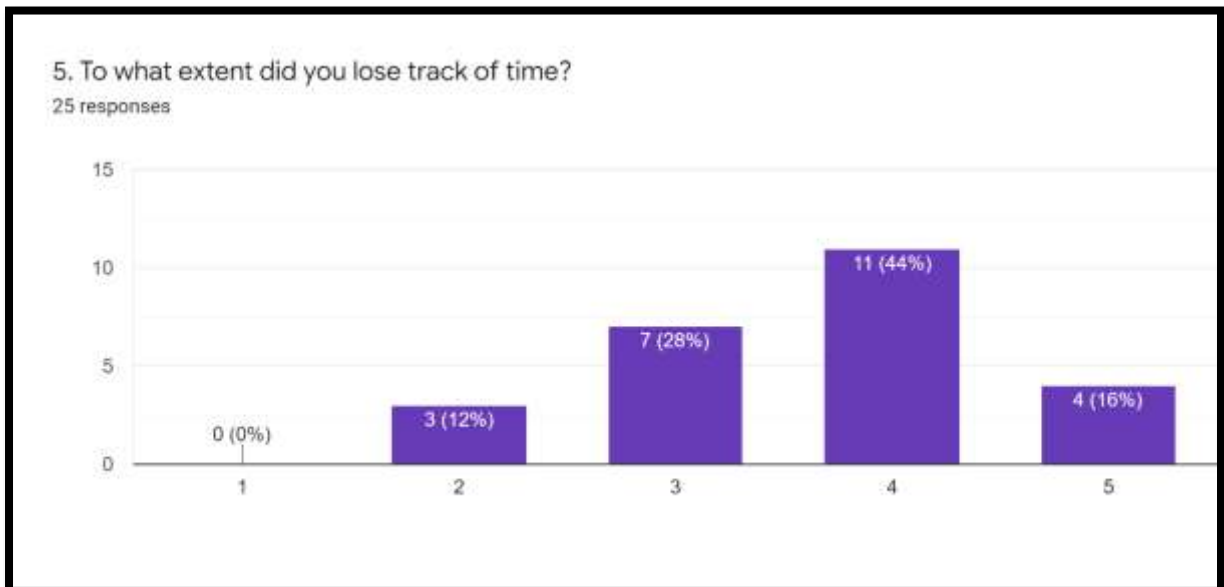


Figure 71 - Zombie First-Person Shooter Playtesting Questionnaire: Question 5

For question six the participants were asked “To what extent did you feel consciously aware of being in the real world whilst playing?” The bar graph below shows that 40% of participants felt they were more or less consciously aware of being in the real world whilst playing the game. 32% of participants felt that they were mostly consciously aware of being in the real world whilst playing the game. 24% of participant said that they were somewhat not consciously aware of being in the real world whilst playing the game. Lastly, 4% of participants felt that they were consciously aware of being in the real world whilst playing the game a lot.

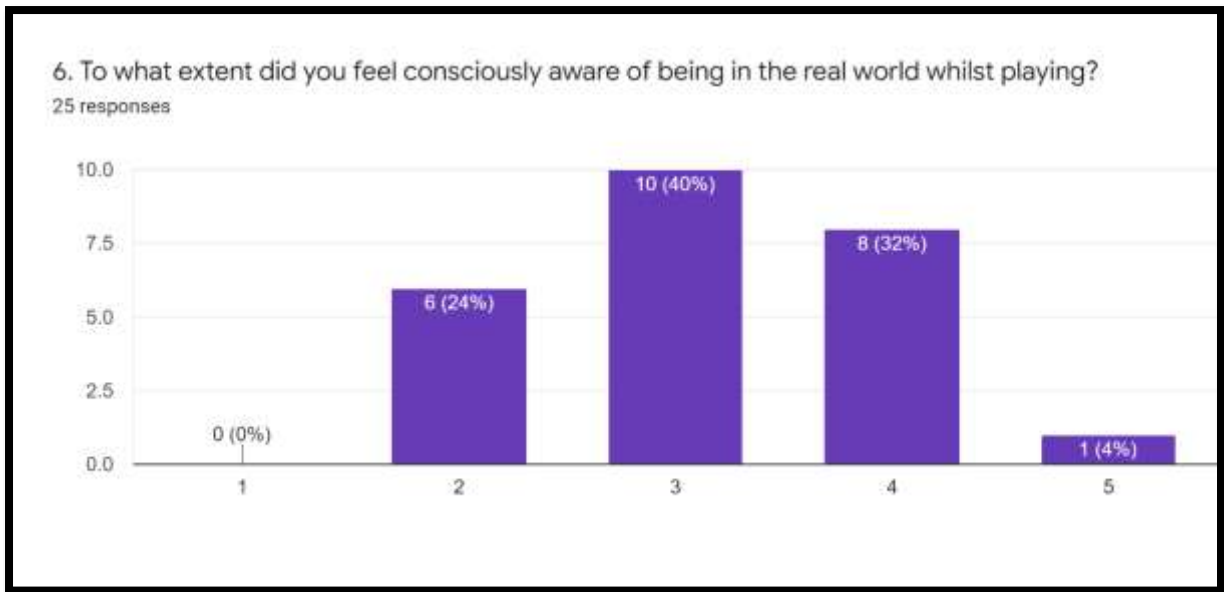


Figure 72 - Zombie First-Person Shooter Playtesting Questionnaire: Question 6

For question seven the participants were asked “To what extent did you forget about your everyday concern?” 72% of participants said that they mostly forgot about their everyday concern. 20% of participants said that they somewhat forgot about everyday concern. 4% of participants said that they somewhat didn’t forget about everyday concern. Lastly, 4% of participants said that they forgot about everyday concern a lot.

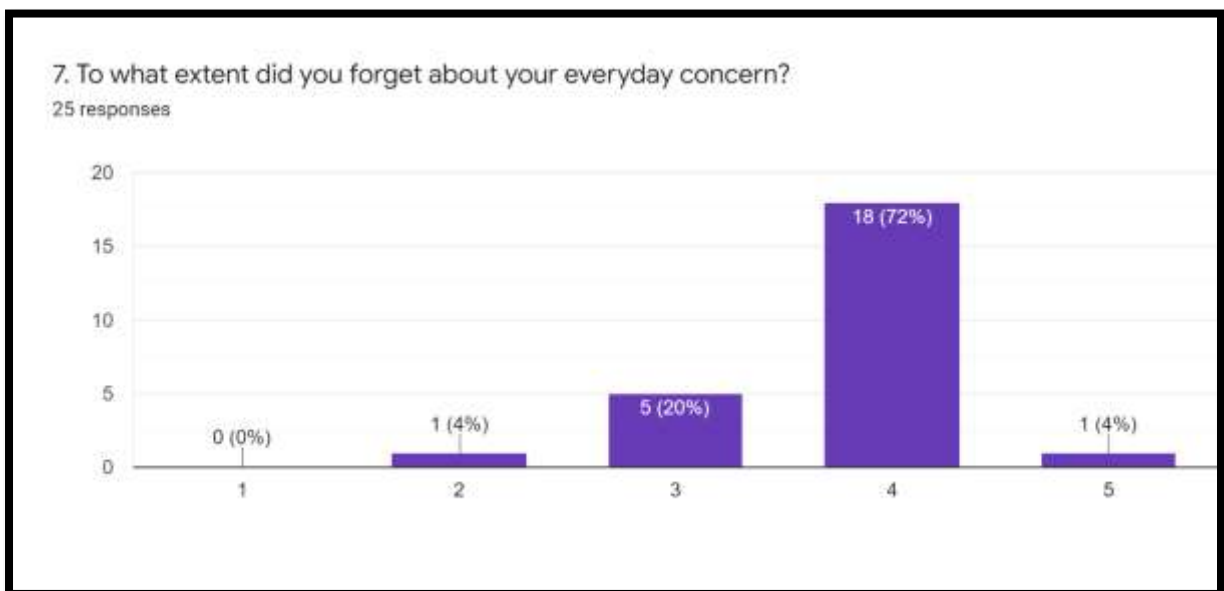


Figure 73 - Zombie First-Person Shooter Playtesting Questionnaire: Question 7

For question eight the participants were asked “To what extent did you aware of yourself in your own surrounding?” The bar graph below shows that 60% of the participants felt that they were more or less aware of themselves in their own surrounding. 24% of participants felt that were mostly aware of themselves in their own surrounding. 12% of participants said that they are somewhat not really aware of themselves in their own surrounding. Lastly, 4% of participants said that they were really aware of their own surrounding.

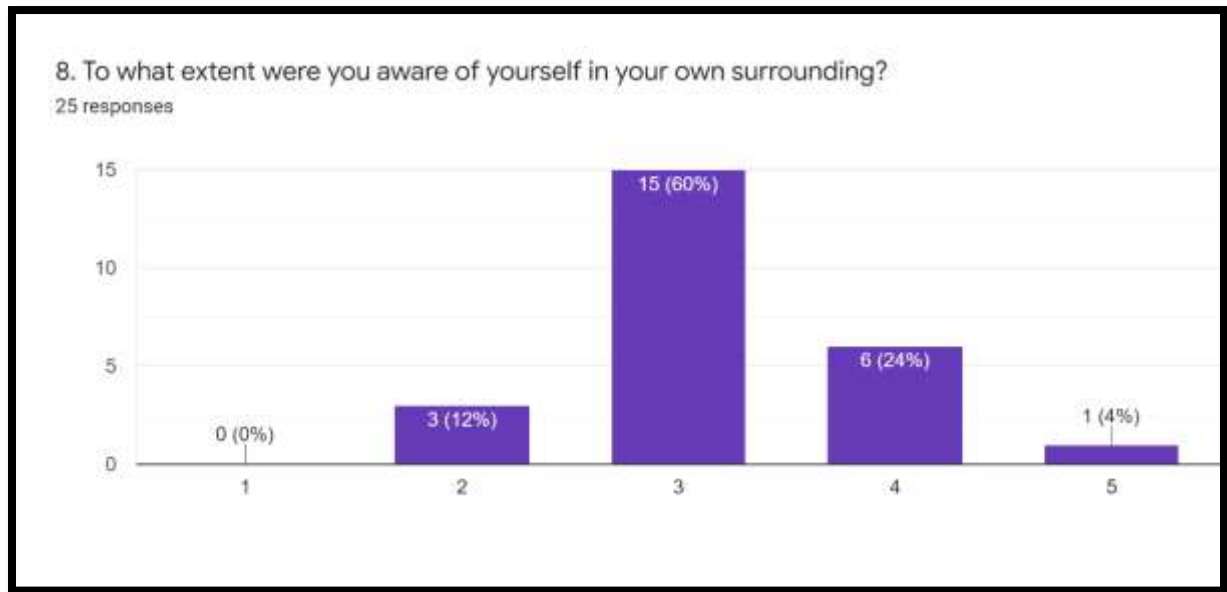


Figure 74 - Zombie First-Person Shooter Playtesting Questionnaire: Question 8

For question nine the participants were asked “To what extent did you notice events taking place around you?” 44% of participants said that they more or less aware of the events taking place around them. 32% of participants said that were somewhat not really aware of the events taking place around them. 12% of participants said that they were somewhat aware of the events taking place around them. 8% of participants said that they were definitely least aware of the events taking place around them. Lastly, 4% of participants were most definitely aware of the events around them.



Figure 75 - Zombie First-Person Shooter Playtesting Questionnaire: Question 9

For question ten the participants were asked “Did you feel the urge at any point to stop playing and see what was happening around you?” 56% of participants felt somewhat that they didn’t feel the urge to stop to see what was happening around them. 32% of participants felt that they more or less felt the urge to stop to see what was happening around them. 8%

of participants said that definitely didn't feel the urge to stop to see what was happening around them. Lastly, 4% of participants said that they somewhat did have the urge to stop to see what was happening around them.

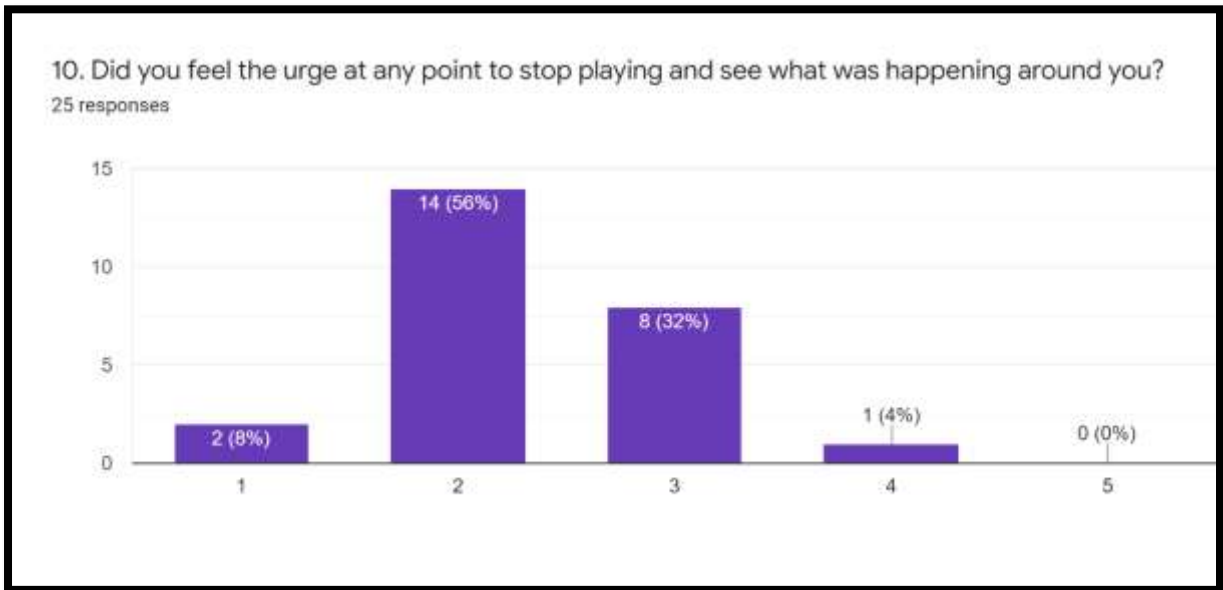


Figure 76 - Zombie First-Person Shooter Playtesting Questionnaire: Question 10

For question eleven the participants were asked "To what extent did you feel that you were interacting with the game environment?" 80% of participants said that they were mostly interacting with the game environment a lot. Lastly, 20% of participants said that they were somewhat neither interacting with the game environment or they were interacting with the game environment.

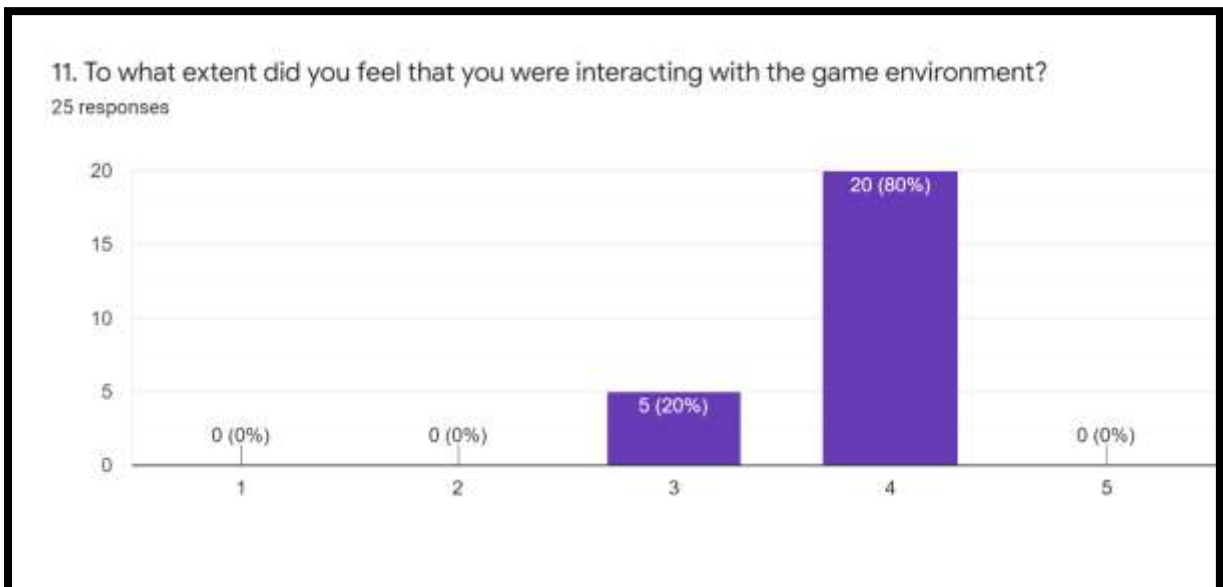


Figure 77 - Zombie First-Person Shooter Playtesting Questionnaire: Question 11

For question twelve the participants were asked “To what extent did you feel as though you were separated from your real-world environment?” 68% of participants said that they somewhat did or did not feel separated from the real-world environment. 16% of participants felt that they were not really feel separated from the real-world environment. 8% of participants felt that they were somewhat separated from the real-world environment. Lastly 4% of participants on both ends of the scale said that they were most definitely not separated from the real-world environment and that they were most definitely separated from the real-world environment.

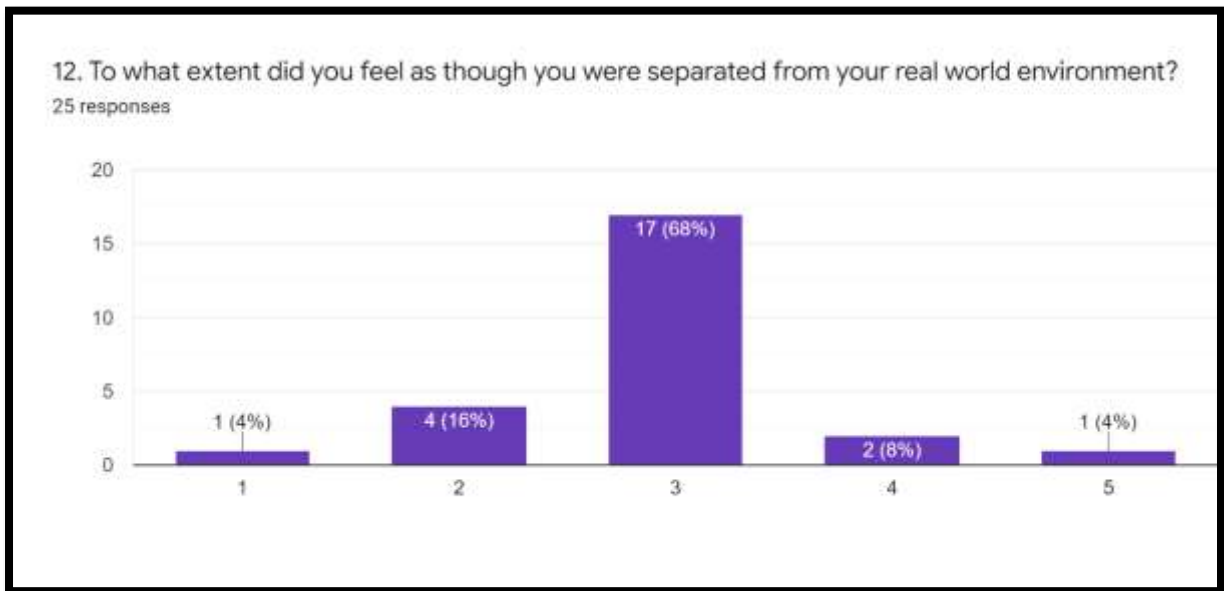


Figure 78 - Zombie First-Person Shooter Playtesting Questionnaire: Question 12

For question thirteen the participants were asked “To what extent did you feel that the game was something you were experiencing, rather than something you were just doing?” 52% of participants said that the game was or was not something that they were experiencing, rather than something they were just doing. 36% of participants felt that the game was mostly something that were experiencing, rather than something they were just doing. 4% of participants said that the game was mostly not something that they were experiencing, rather than something they were just doing. Lastly 4% of participants on both ends of the scale felt that the game was most definitely not something that they were experiencing, rather than something that they were just doing and that the game was most definitely something that they were experiencing, rather than something that they were just doing.

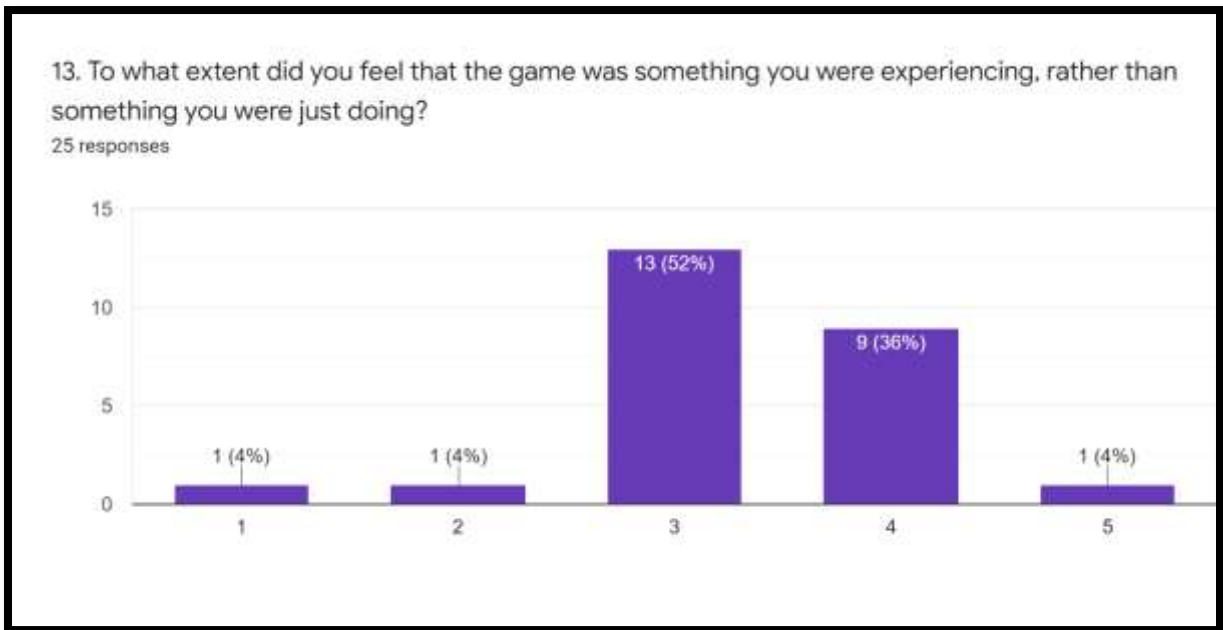


Figure 79 - Zombie First-Person Shooter Playtesting Questionnaire: Question 13

For question fourteen the participants were asked “To what extent was your sense of being in the game environment stronger than your sense of being in the real world?”

As you can see from the chart below. 60% of participants said that they did feel or did feel not feel that their sense of being in the game environment was stronger than their sense of being in the real world. 24% of participants said that they did mostly feel that their sense of being in the game environment was stronger than their sense of being in the real world. 12% of participants felt that they most definitely did not feel that their sense of being in the game environment was stronger than their sense of being in the real world. Lastly, 4% of participants said that they most definitely did not feel that their sense of being in the game environment was stronger than their sense of being in the real world.

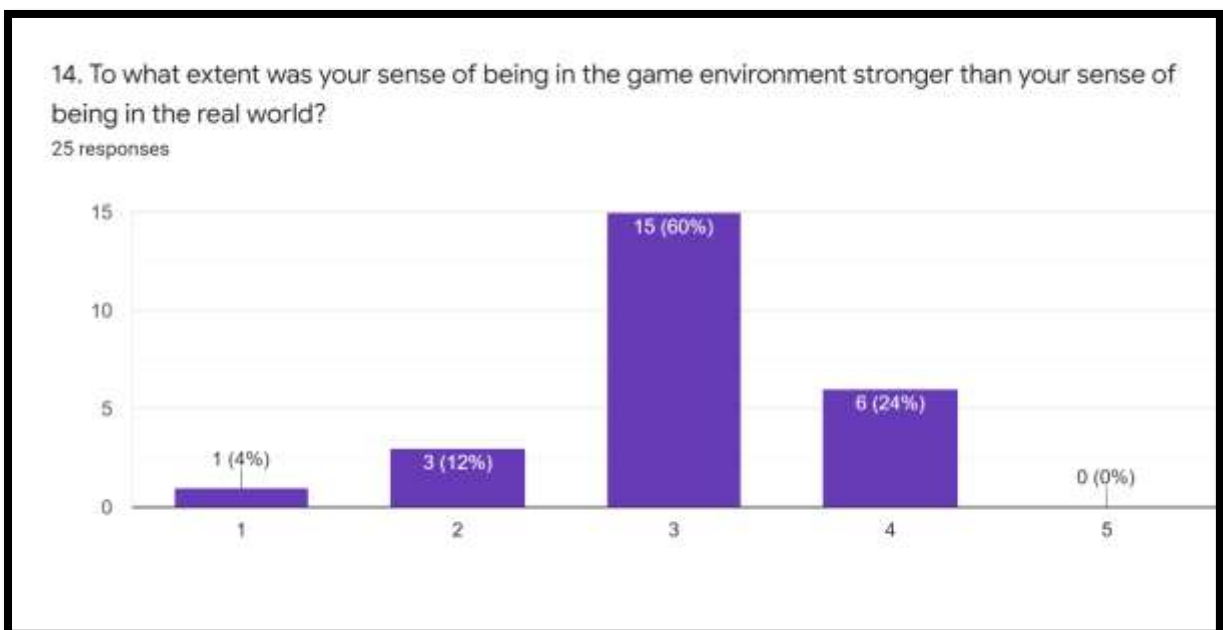


Figure 80 - Zombie First-Person Shooter Playtesting Questionnaire: Question 14

For question fifteen the participants were asked “At any point did you find yourself become so involved that you were unaware you were even using controls?” 64% of participants said that they found themselves more or less so involved that they were unaware that they were even using controls. 16% of participants said that they somewhat mostly found themselves involved that they were unaware that they were even using controls. 12% of participants said that they somewhat did not find themselves involved that they were unaware that they were even using controls. Lastly 4% of participants on both ends of the scale felt that they were most definitely not involved that they were unaware that they were even using controls and that it was most definitely something that they were unaware that they were even using controls.

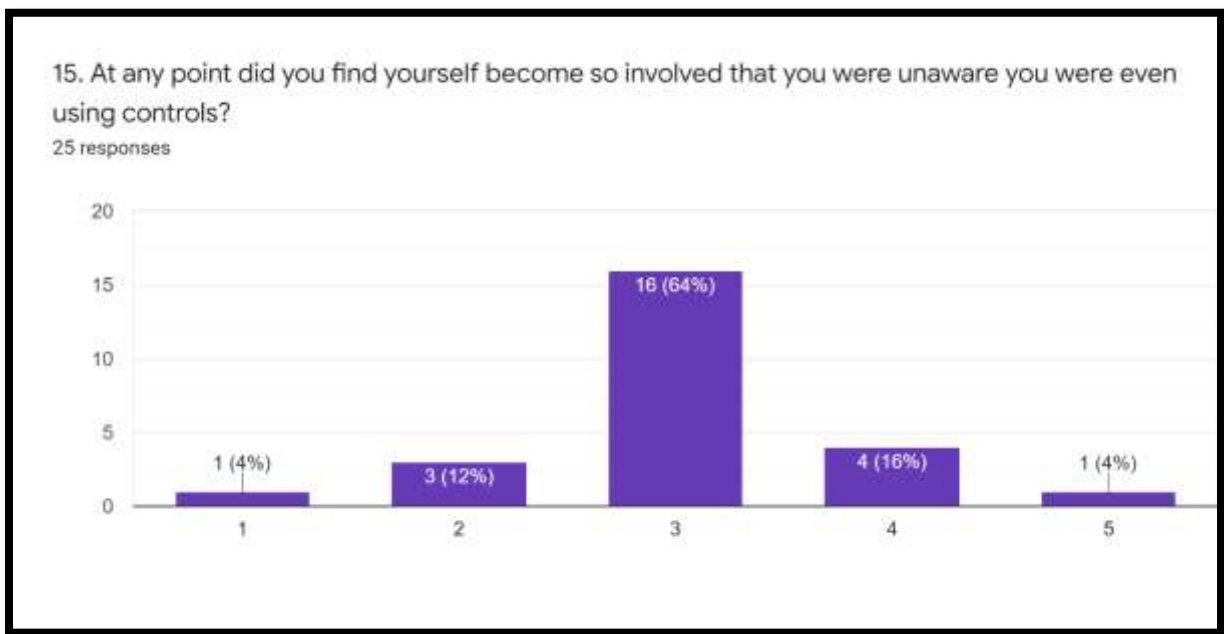


Figure 81 - Zombie First-Person Shooter Playtesting Questionnaire: Question 15

For question sixteen the participants were asked “To what extent did you feel as though you were moving through the game according to your own will?” 64% of participants said that they mostly felt that they were moving through the game according to their own will. 28% of participants said that they more or less were moving through the game according to their own will. Lastly, 8% of participants said that they were somewhat mostly not moving through the game according to their own will.

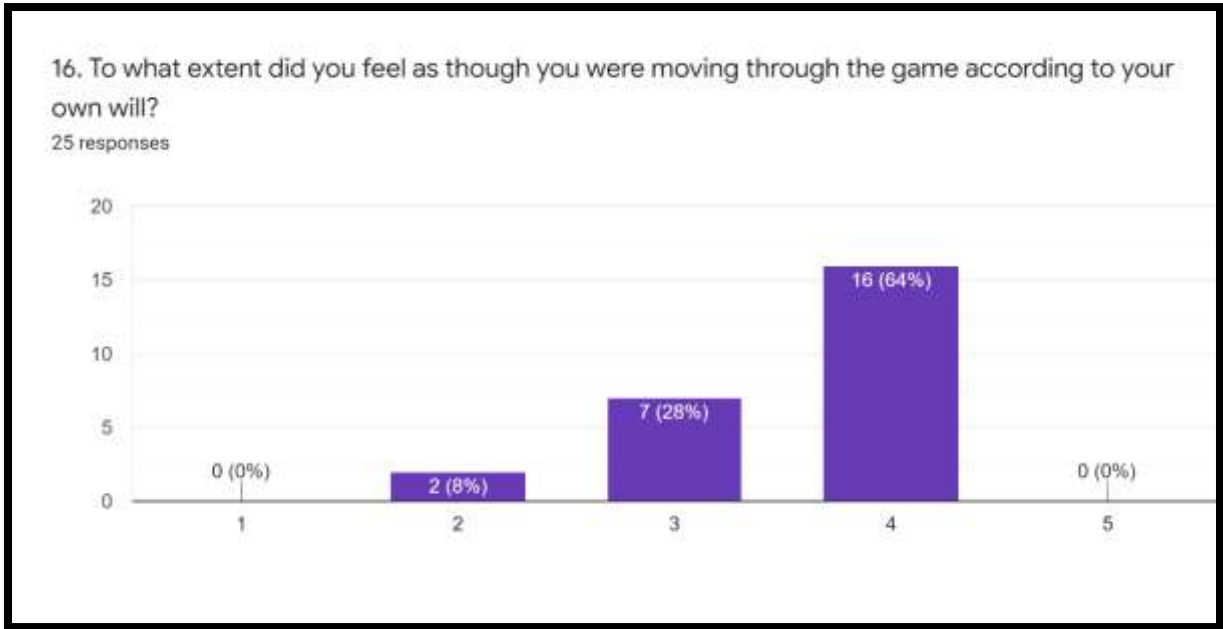


Figure 82 - Zombie First-Person Shooter Playtesting Questionnaire: Question 16

For question seventeen the participants were asked “To what extent did you find the game challenging?” 76% of participants felt that they found the game more or less challenging. 12% of participants said that they somewhat mostly didn’t feel that the game was challenging. 8% of participants said that they somewhat did find the game challenging. Lastly, 4% of participants said that they most definitely did find the game really challenging.

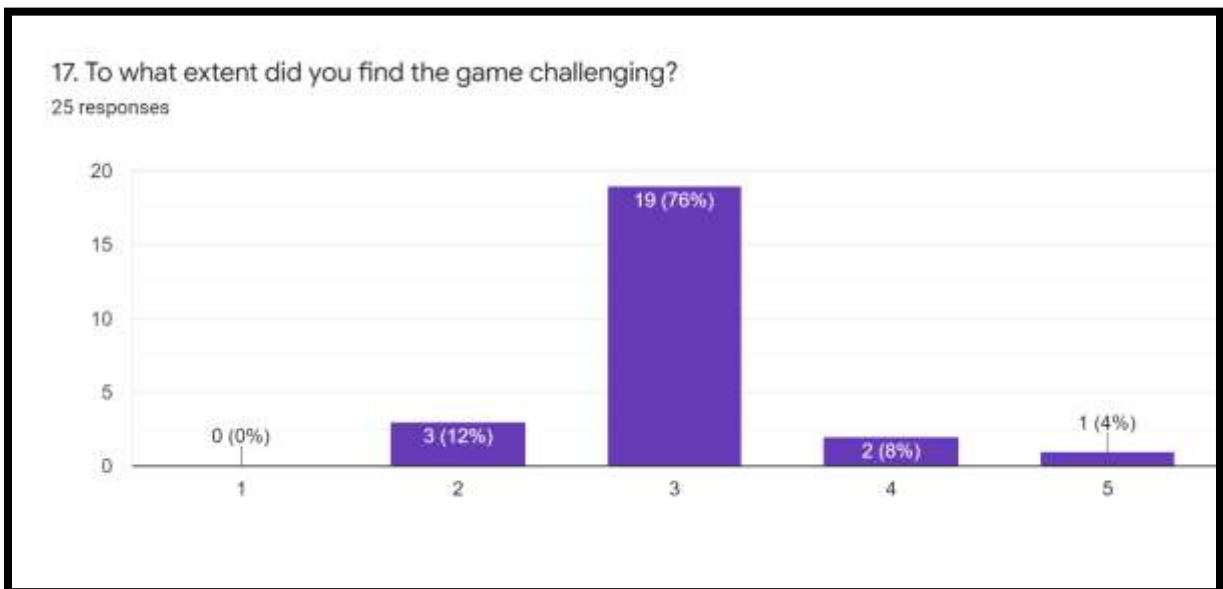


Figure 83 - Zombie First-Person Shooter Playtesting Questionnaire: Question 17

For question eighteen the participants were asked “Were there any times during the game in which you just wanted to give up?” 56% of participants said that they somewhat mostly found that there weren’t any times during the game in which they wanted to give up. 36% of participants said that they did or did not find any times during the game in which they wanted to give up. Lastly, 4% of participants found that they somewhat mostly found times during the game in which they wanted to give up and they most definitely did not find times during the game in which they wanted to give up.

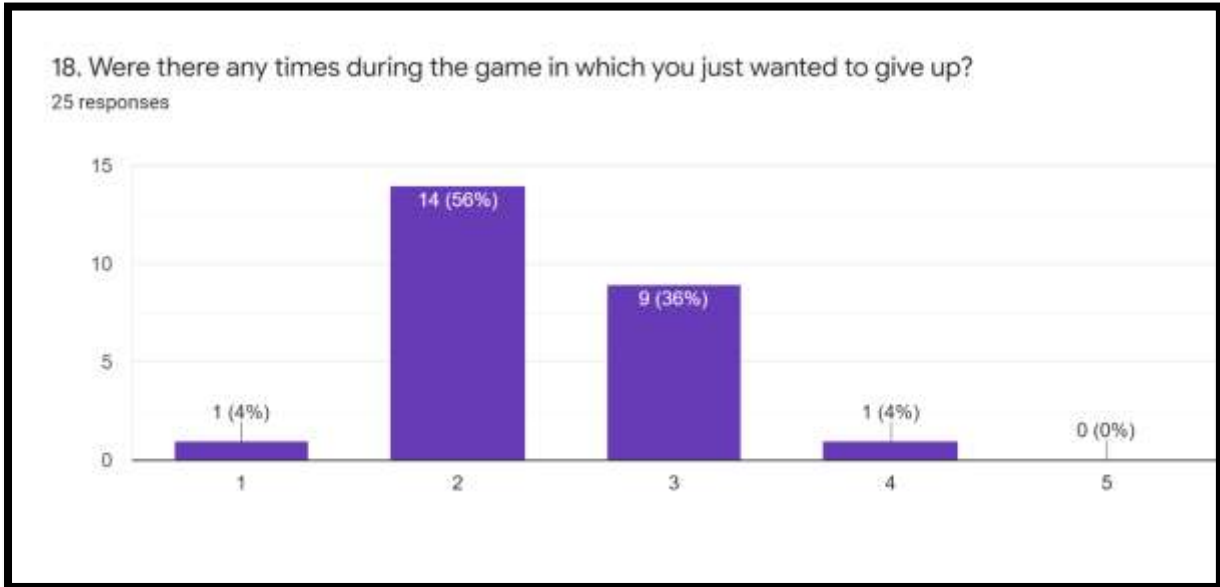


Figure 84 - Zombie First-Person Shooter Playtesting Questionnaire: Question 18

For question nineteen the participants were asked “To what extent did you feel motivated while playing?” 68% of participants felt that they were somewhat mostly motivated while playing the game. 24% of participants said that they were more or less motivated while playing the game. Lastly, 4% of participants said that they were somewhat mostly not motivated while playing the game and that they were most definitely motivated while playing the game.

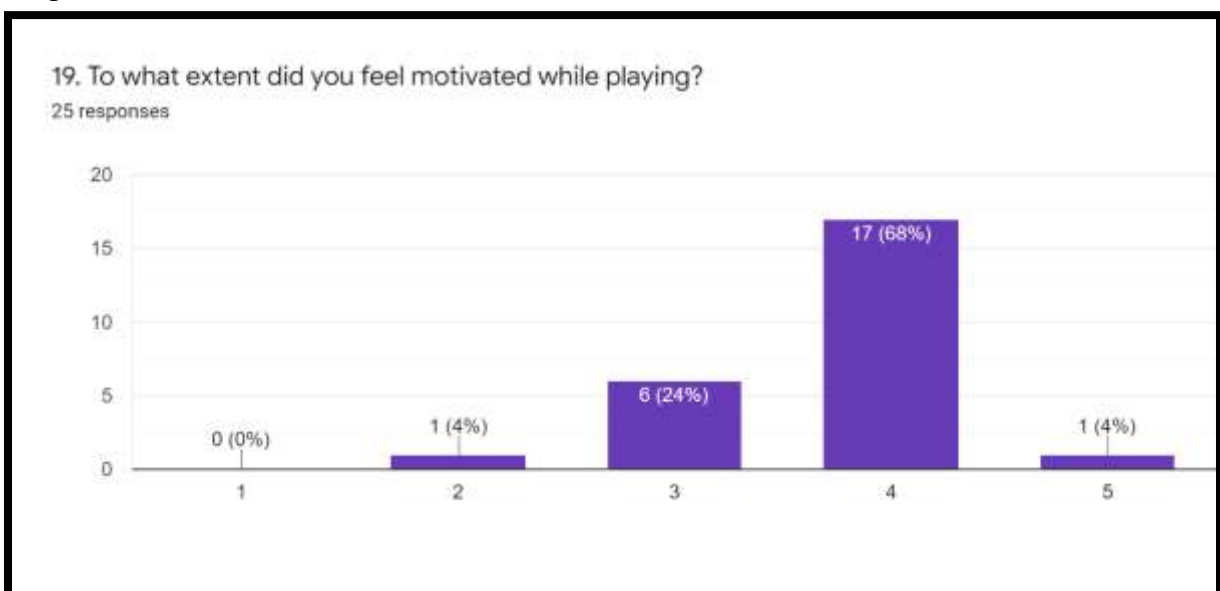


Figure 85 - Zombie First-Person Shooter Playtesting Questionnaire: Question 19

For question twenty the participants were asked “To what extent did you find the game easy?” 52% of participants felt that the game was neither easy nor too difficult. 40% of participants felt that the game was somewhat quite easy. Lastly, 8% of participants felt that the game was definitely easy to play the game.

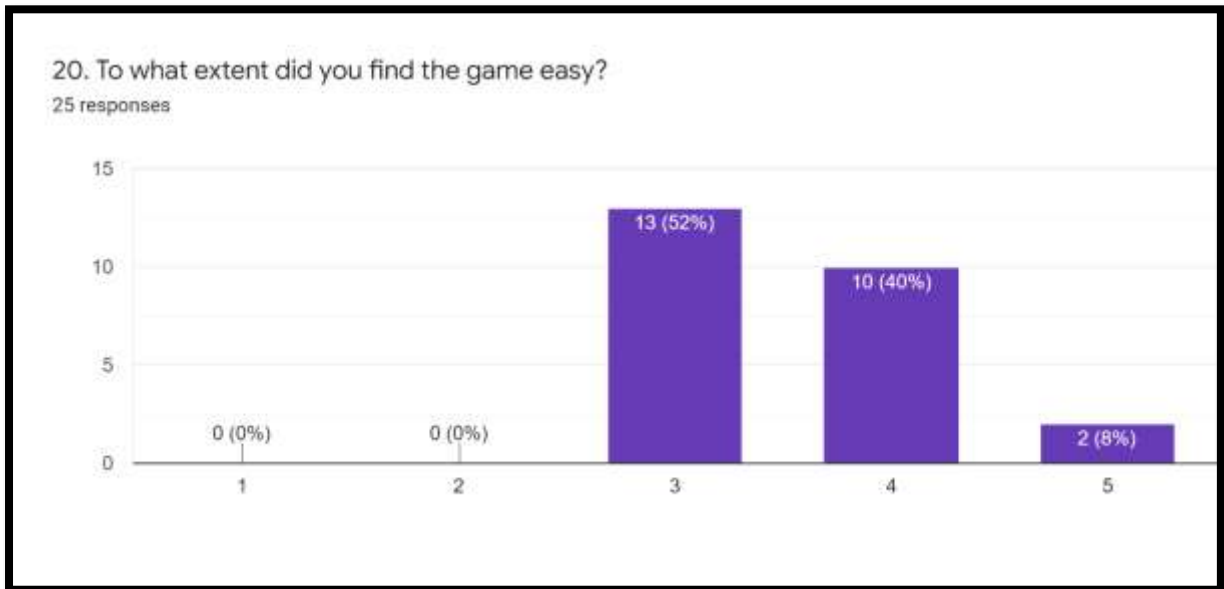


Figure 86 - Zombie First-Person Shooter Playtesting Questionnaire: Question 20

For question twenty-one the participants were asked “To what extent did you feel like you were making progress towards the end of the game?” 56% of participants felt that they were more or less making progress towards the end of the game. 40% of participants felt that they were somewhat making progress towards the end of the game. Lastly, 4% of participants felt that they were somewhat not making progress towards the end of the game.

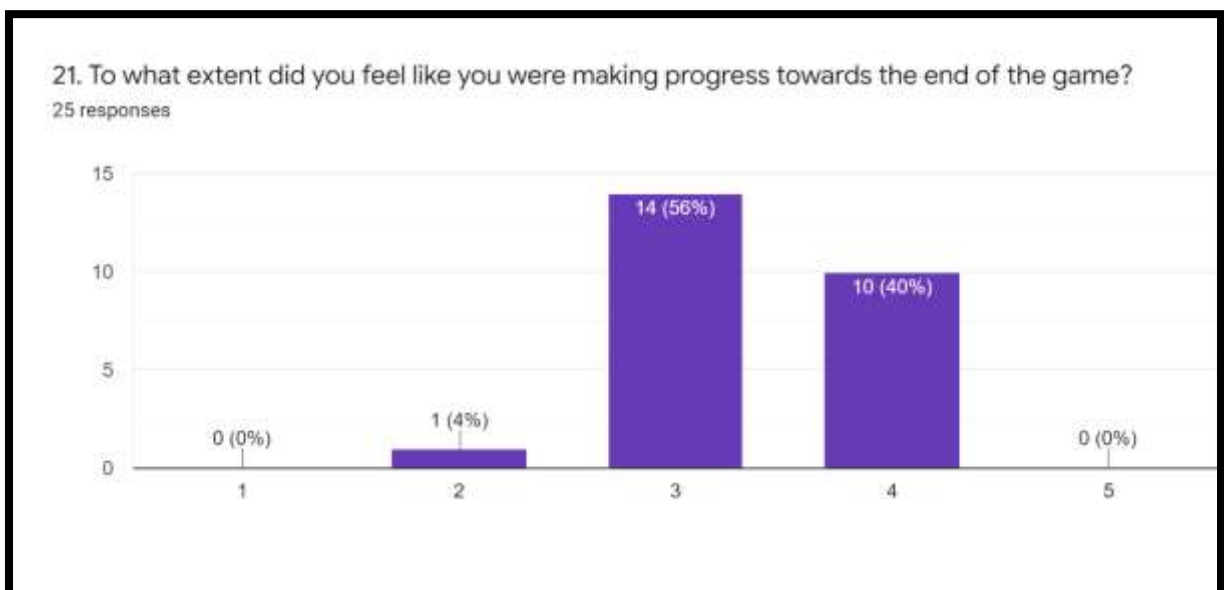


Figure 87 - Zombie First-Person Shooter Playtesting Questionnaire: Question 21

For question twenty-two the participants were asked “How well did you think you performed in the game?” 68% of participants said that they performed somewhat really well. 16% of participants said that they more or less performed adequately in the game. 12% of participants said that they somewhat didn’t perform too well in the game. Lastly, 4% of participants said that they performed really well in the game.

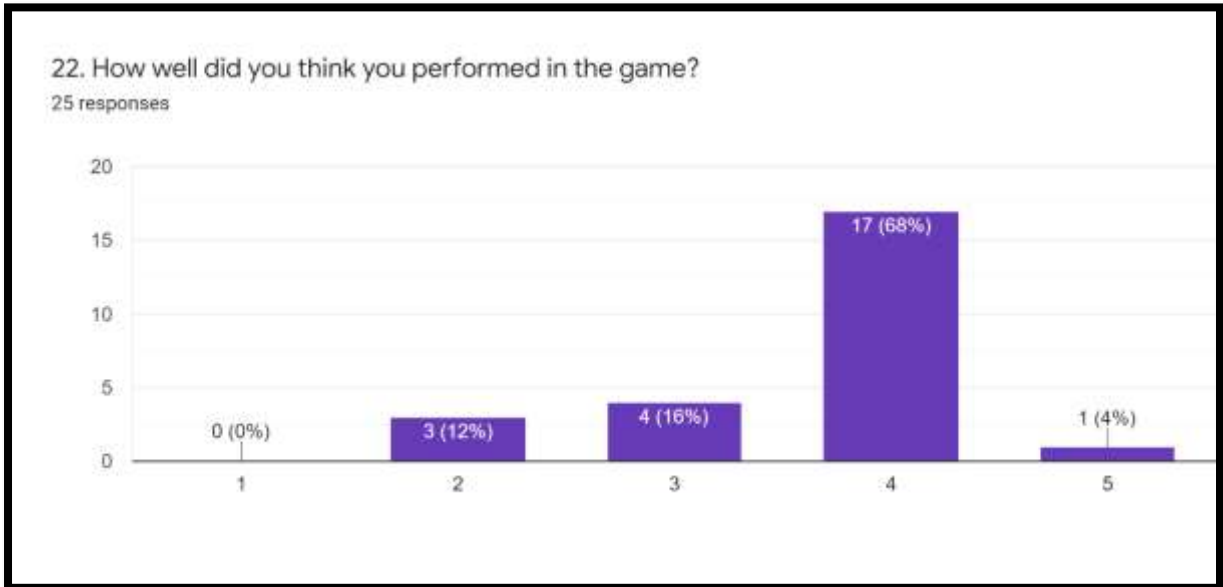


Figure 88 - Zombie First-Person Shooter Playtesting Questionnaire: Question 22

For question twenty-three the participants were asked “To what extent did you feel emotionally attached to the game?” 60% of participants felt that they more or less emotionally attached to the game. 20% of participants felt that they somewhat not emotionally attached to the game. 8% of participants said that they were definitely not emotionally attached to the game. 8% of participants also said that they were somewhat emotionally attached to the game. Lastly, 4% of participants said that they were definitely emotionally attached to the game.

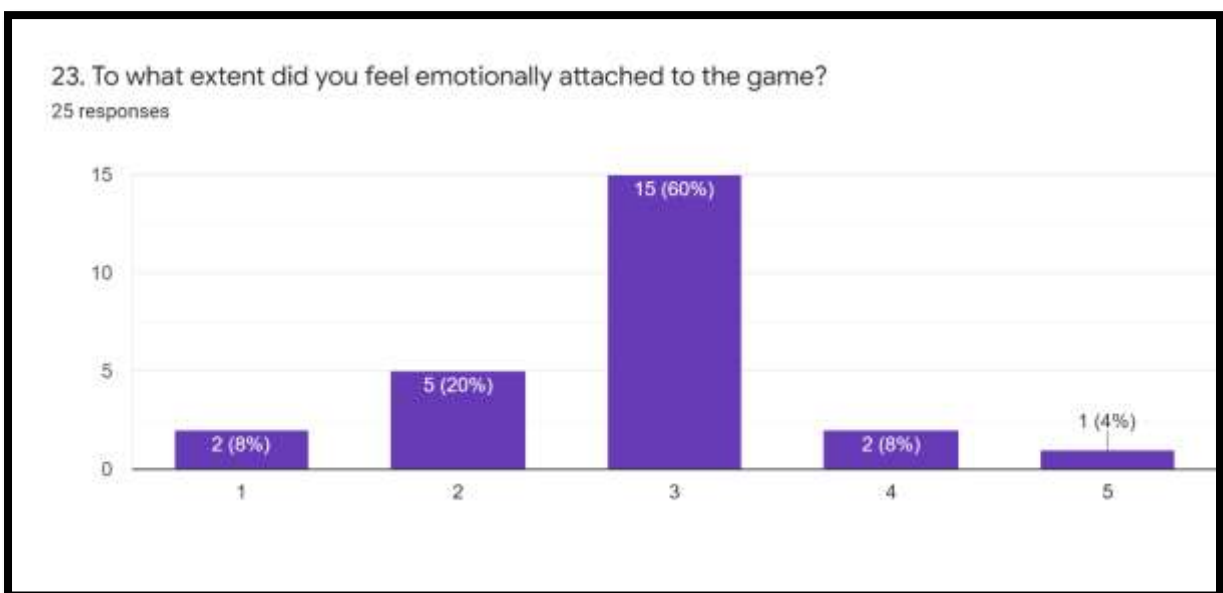


Figure 89 - Zombie First-Person Shooter Playtesting Questionnaire: Question 23

For question twenty-four the participants were asked “To what extent were you interested in seeing how the game’s events would progress?” 60% of participants said that they were somewhat definitely interested in seeing how the game’s events would progress. 24% of participants said that they were more or less interested in seeing how the game’s events would progress. 8% of participants said that they somewhat not interested in how the game’s events would progress. 8% of participants also said that they were definitely interested in seeing how the game’s events would progress.

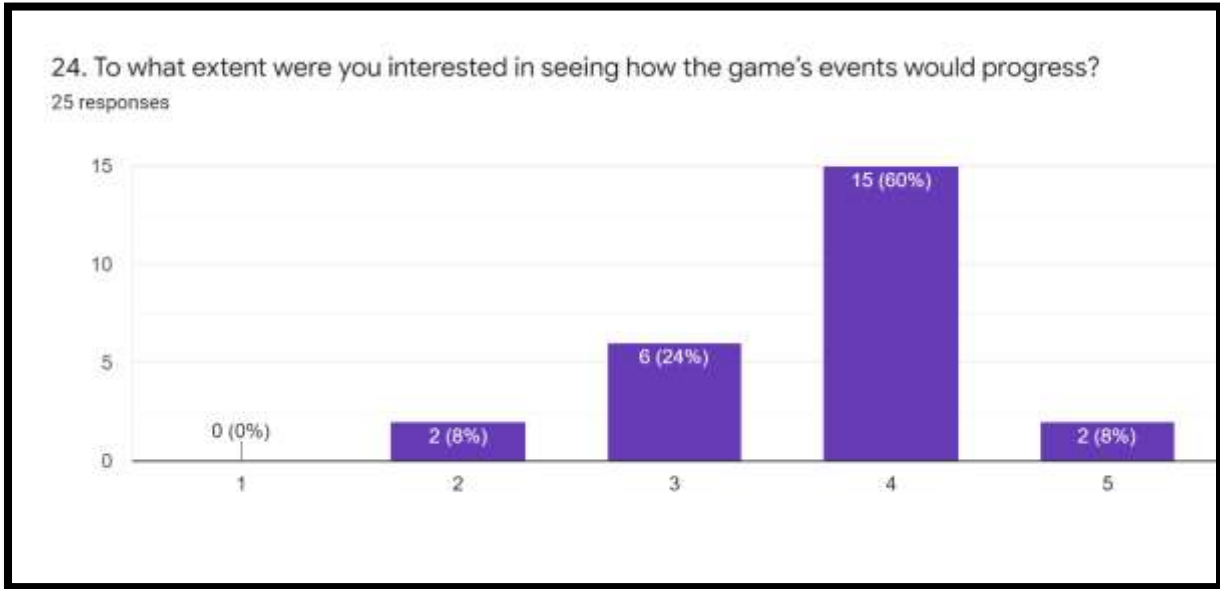


Figure 90 - Zombie First-Person Shooter Playtesting Questionnaire: Question 24

For question twenty-five the participants were asked “How much did you want to “win” the game?” 68% of participants said that they were somewhat mostly wanted to win the game. 20% of participants said that they most definitely wanted to win the game. 8% of participants said that they more or less wanted to win the game. 4% of participants said that they somewhat did not want to win the game.

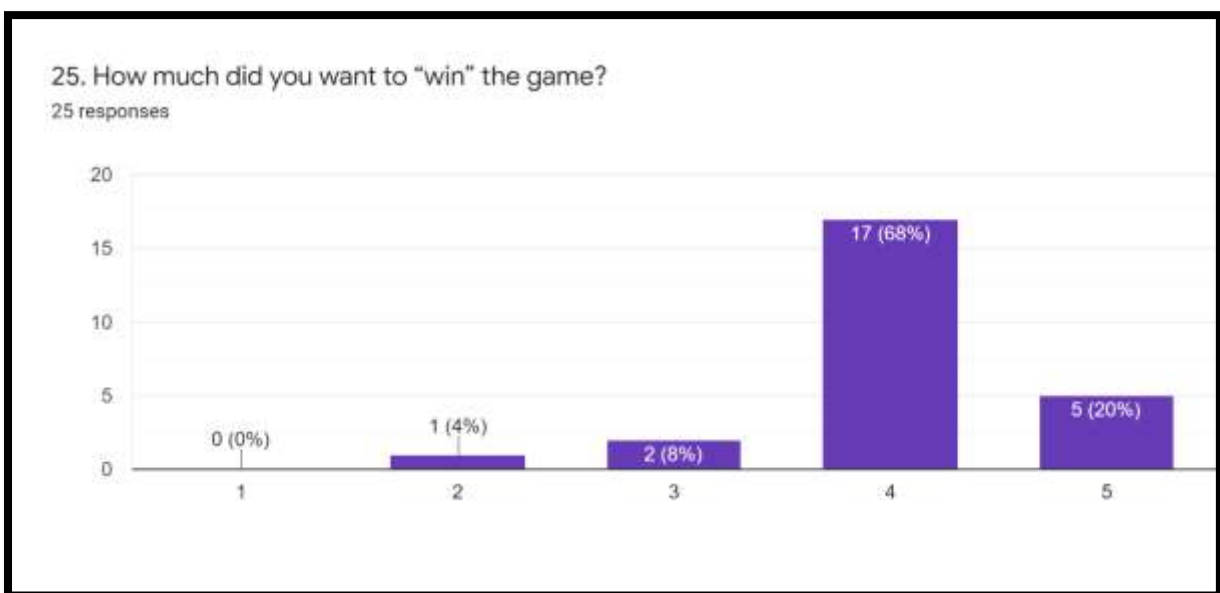


Figure 91 - Zombie First-Person Shooter Playtesting Questionnaire: Question 25

For question twenty-six the participants were asked “Were you in suspense about whether or not you would win or lose the game?” 56% of participants said that they were most definitely in suspense about whether or not they would win or lose the game. 24% of participants were more or less in suspense about whether or not they would lose the game or not. 12% of participants were definitely in suspense whether or not they would win or lose the game. Lastly 8% of participants said that they were most definitely not in suspense whether or not they would win or lose the game.

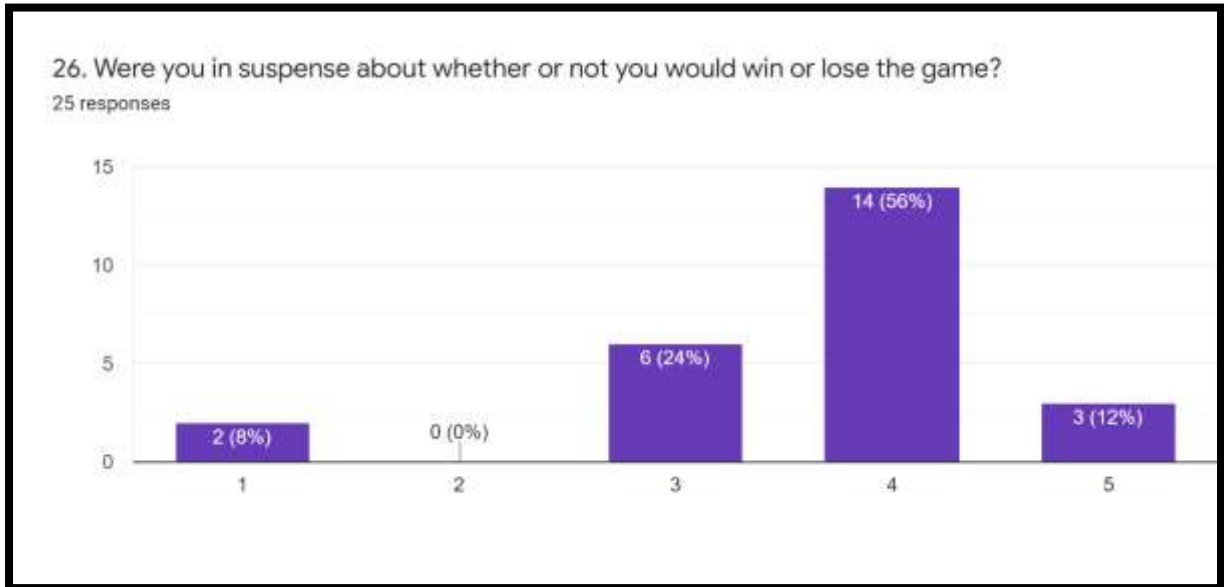


Figure 92 - Zombie First-Person Shooter Playtesting Questionnaire: Question 26

For question twenty-seven the participants were asked “At any point did you find yourself become so involved that you wanted to speak to the game directly?” 40% of participants said that they found themselves more or less so involved that they wanted to speak to the game directly. 36% of participants said that they mostly somewhat didn’t find themselves so involved that they wanted to speak to the game directly. 16% of participants said that they somewhat mostly did find themselves so involved that they wanted to speak to the game directly. Lastly, 8% of participants said that they wanted definitely didn’t find themselves so involved that they wanted to speak to the game directly.

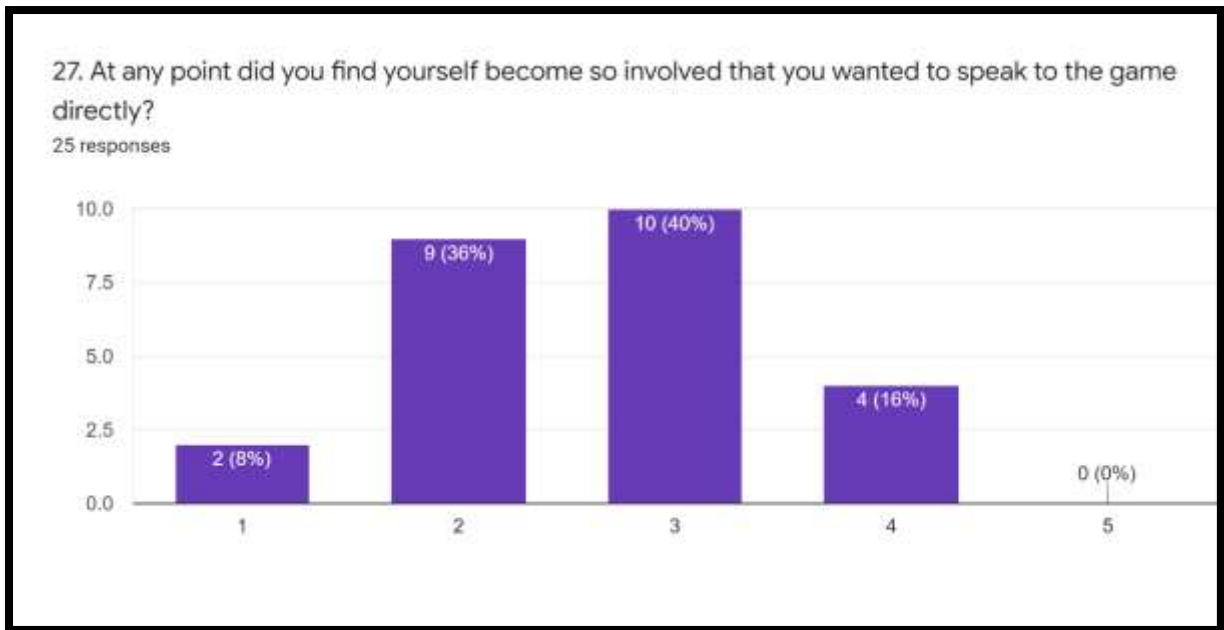


Figure 93 - Zombie First-Person Shooter Playtesting Questionnaire: Question 27

For question twenty-eight the participants were asked “To what extent did you enjoy the graphics and the imagery?” 52% of participants said that they most definitely enjoyed the graphics and imagery in the game. 28% of participants said that more or less enjoyed the graphics and imagery in the game. 20 of participants said that they definitely enjoyed the graphics and imagery in the game a lot.

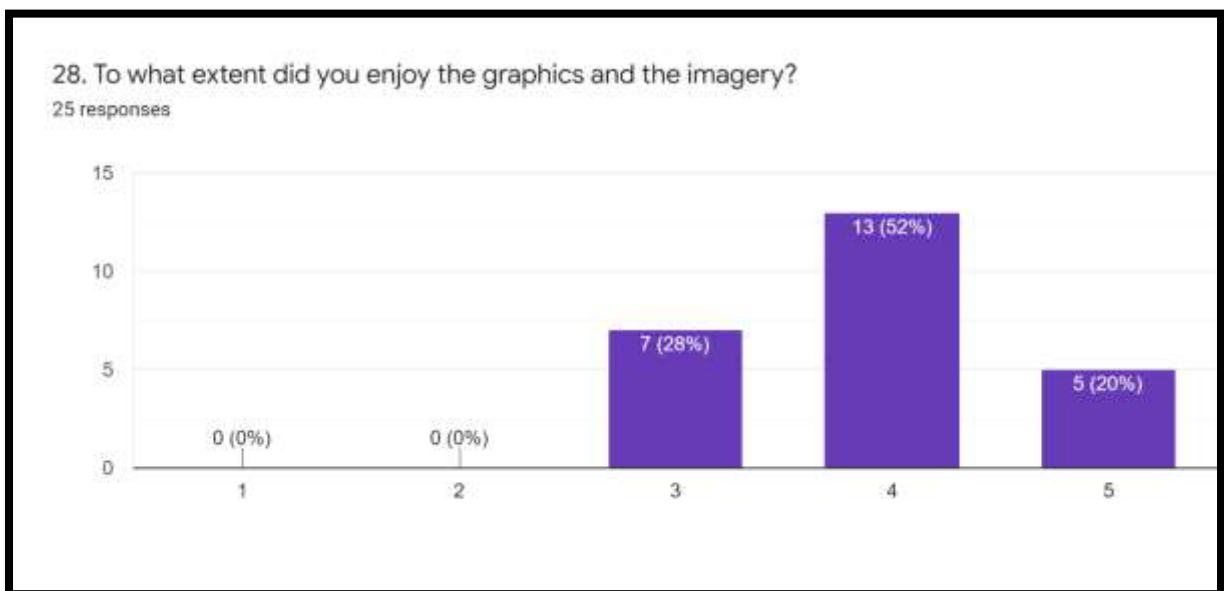


Figure 94 - Zombie First-Person Shooter Playtesting Questionnaire: Question 28

For question twenty-nine the participants were asked “How much would you say you enjoyed playing the game?” 52% of participants said that they most definitely enjoyed playing the game. 28% of participants said that they more or less enjoyed playing the game. 16% of participants said that they definitely enjoyed playing the game. Lastly, 4% of participants said that they somewhat didn’t enjoy playing the game.

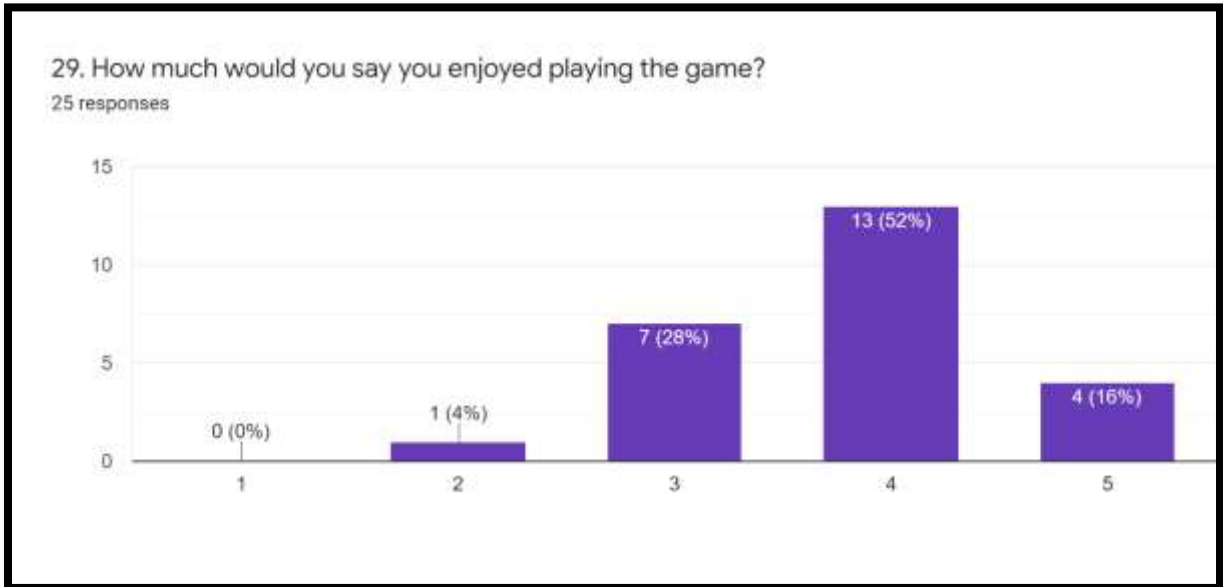


Figure 95 - Zombie First-Person Shooter Playtesting Questionnaire: Question 29

For question thirty the participants were asked “When interrupted, were you disappointed that the game was over?” 72% of participants said that they were more or less disappointed that the game was over when interrupted. 12% of participants said that they were mostly somewhat not disappointed when the game was over when they were interrupted. Lastly, 8% of participants said that they were somewhat disappointed when the game was over when they were interrupted and 8% of participants also said that they were definitely disappointed when the game was over when they were interrupted.

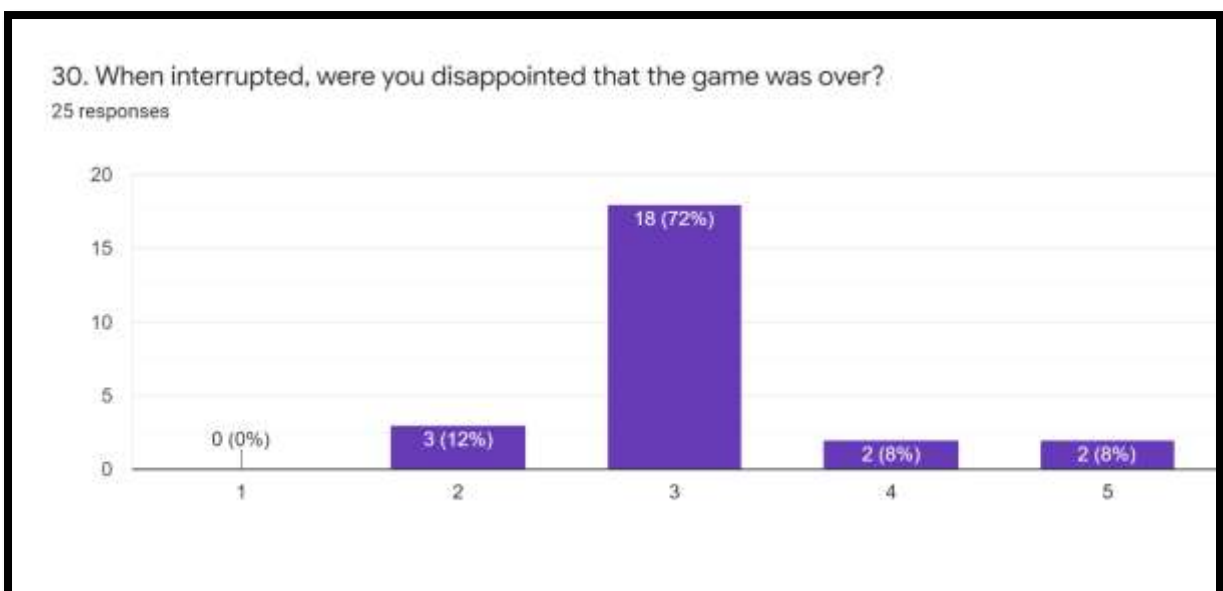


Figure 96 - Zombie First-Person Shooter Playtesting Questionnaire: Question 30

For question thirty-one the participants were asked “Would you like to play the game again?” 48% of participants said that they were more or less play the game again. 40% of participants said that they most definitely play the game again. Lastly, 12% of participants said that they would definitely play the game again.

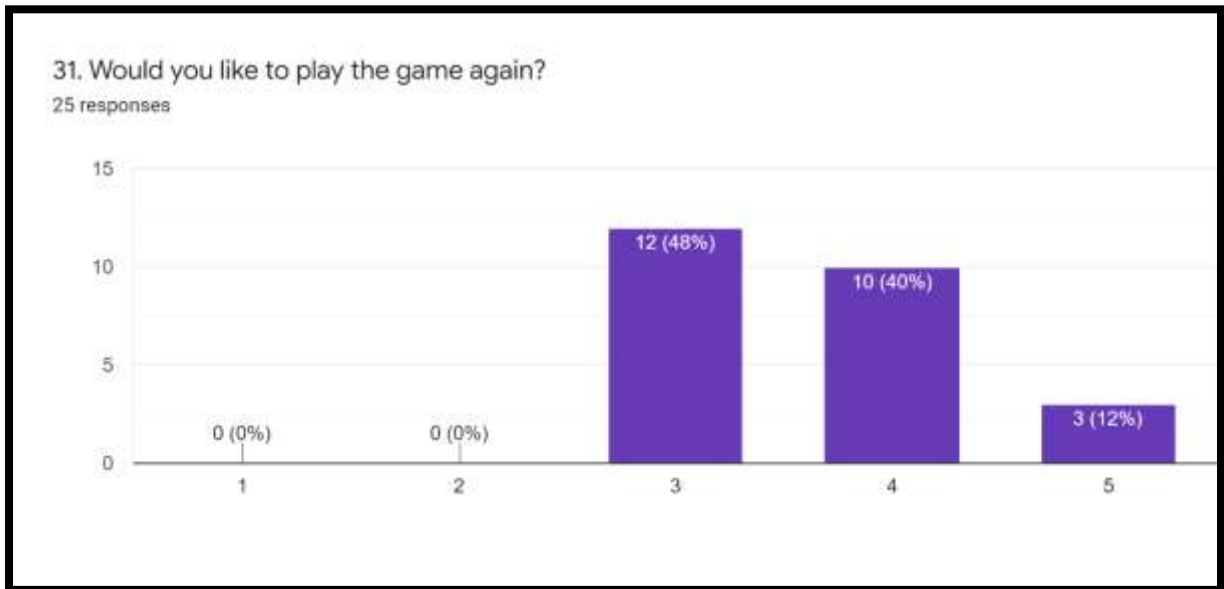
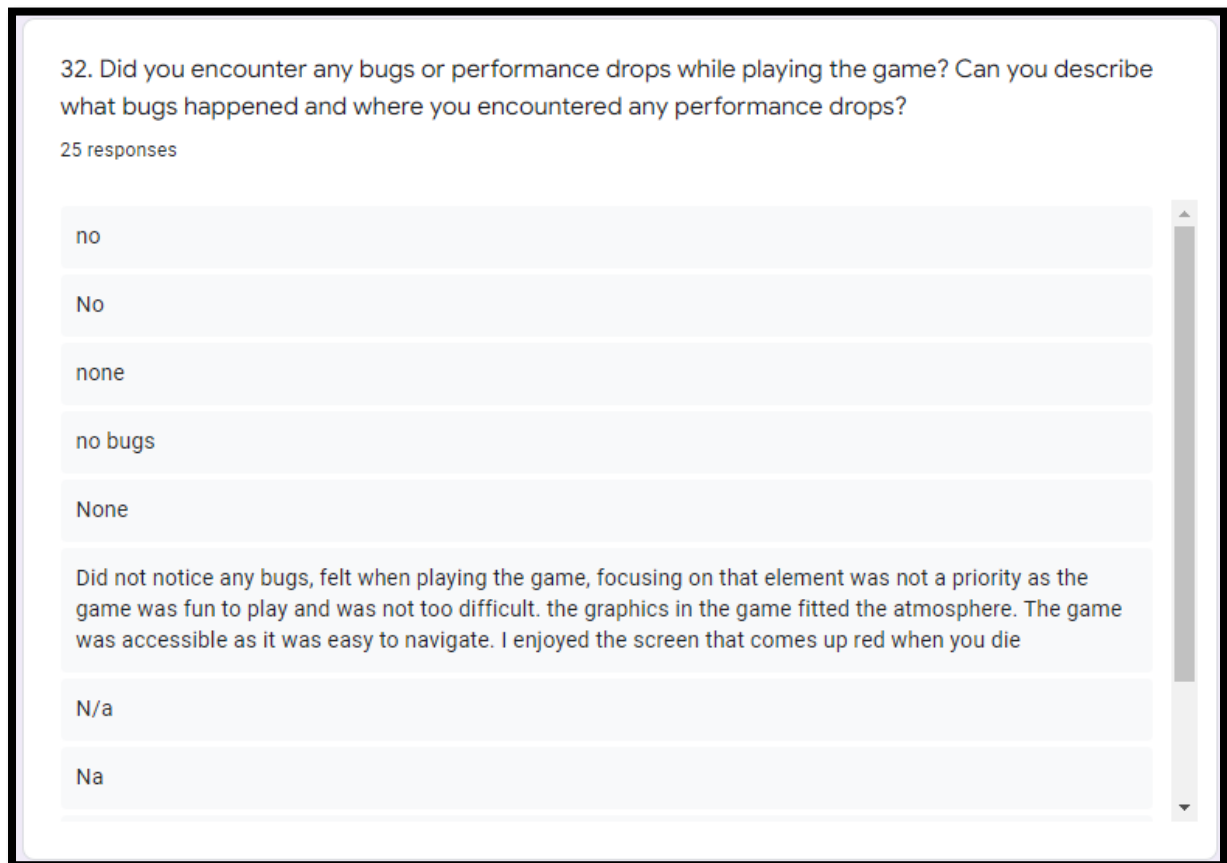


Figure 97 - Zombie First-Person Shooter Playtesting Questionnaire: Question 31

For question the last question of the questionnaire the participants were asked “Did you encounter any bugs or performance drops while playing the game? Can you describe what bugs happened and where you encountered any performance drops?” This is a free format text box where the participants can make any comments about any issues that they may have encountered when starting the game or during the gameplay. Below are some examples of comments made:



32. Did you encounter any bugs or performance drops while playing the game? Can you describe what bugs happened and where you encountered any performance drops?

25 responses

- no
- No
- none
- no bugs
- None
- Did not notice any bugs, felt when playing the game, focusing on that element was not a priority as the game was fun to play and was not too difficult. the graphics in the game fitted the atmosphere. The game was accessible as it was easy to navigate. I enjoyed the screen that comes up red when you die
- N/a
- Na

Figure 98 - Zombie First-Person Shooter Playtesting Questionnaire: Question 32

32. Did you encounter any bugs or performance drops while playing the game? Can you describe what bugs happened and where you encountered any performance drops?

25 responses

none

no bugs

None

Did not notice any bugs, felt when playing the game, focusing on that element was not a priority as the game was fun to play and was not too difficult. the graphics in the game fitted the atmosphere. The game was accessible as it was easy to navigate. I enjoyed the screen that comes up red when you die

N/a

Na

The pause menu navigation seemed to be broken, making it impossible to adjust any settings or even close the game.

No bugs

Figure 99 - Zombie First-Person Shooter Playtesting Questionnaire: Question 32 cont.

In order to establish the overall immersion score, I added all 31 data values for each participant and divided by the sum of the count. The graph above highlights participants overall immersion scores which ranged from 74 to 118.

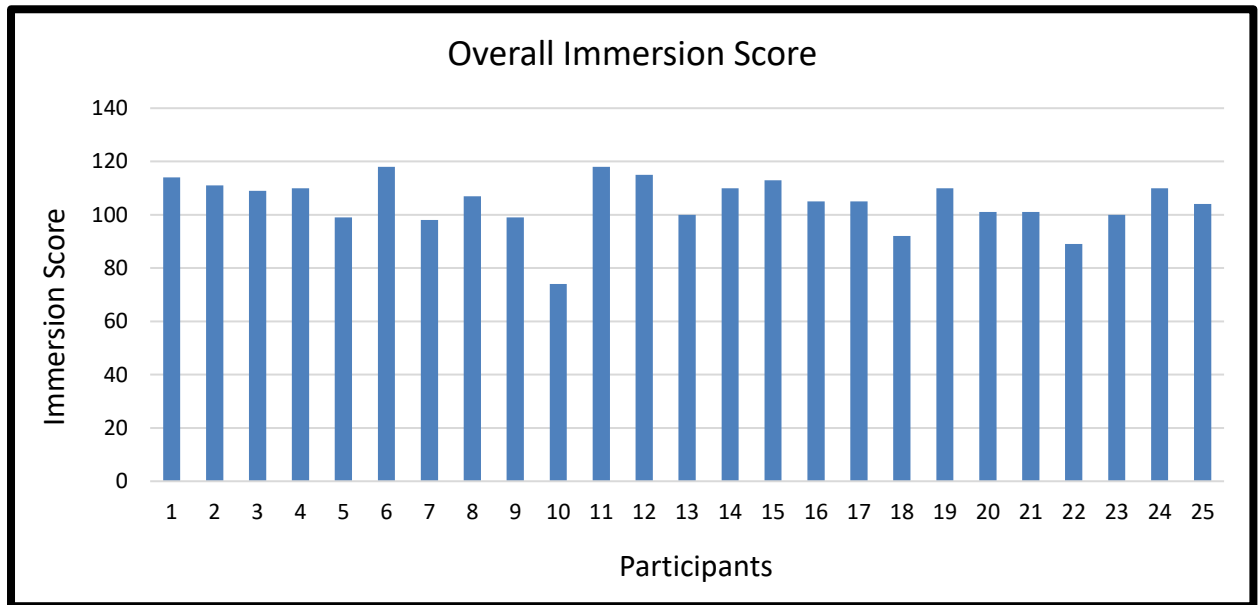


Figure 100 - Overall Immersion Score Bar Chart

In order to examine the relationship between immersion and time perception, I utilised a scatter graph to see if there is any relationship or connection between participants overall immersion score and the extent to which they lost track of time. The scatter graph shows somewhat of a positive linear relationship between higher immersion scores and higher time loss scores.

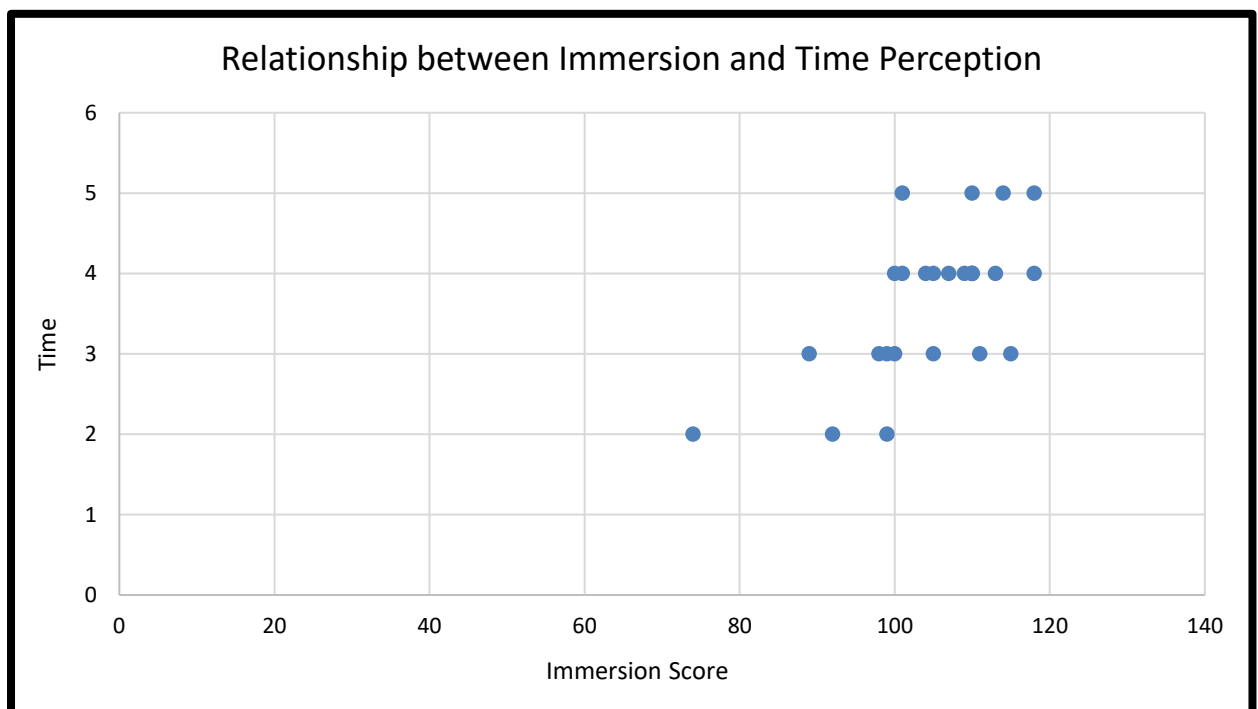


Figure 101 - Relationship between Immersion and Time Perception Scatter Graph

In order to examine if the relationship between immersion and time loss was significant I utilised the Spearman Rank Correlation using an online calculator. The results are shown below:

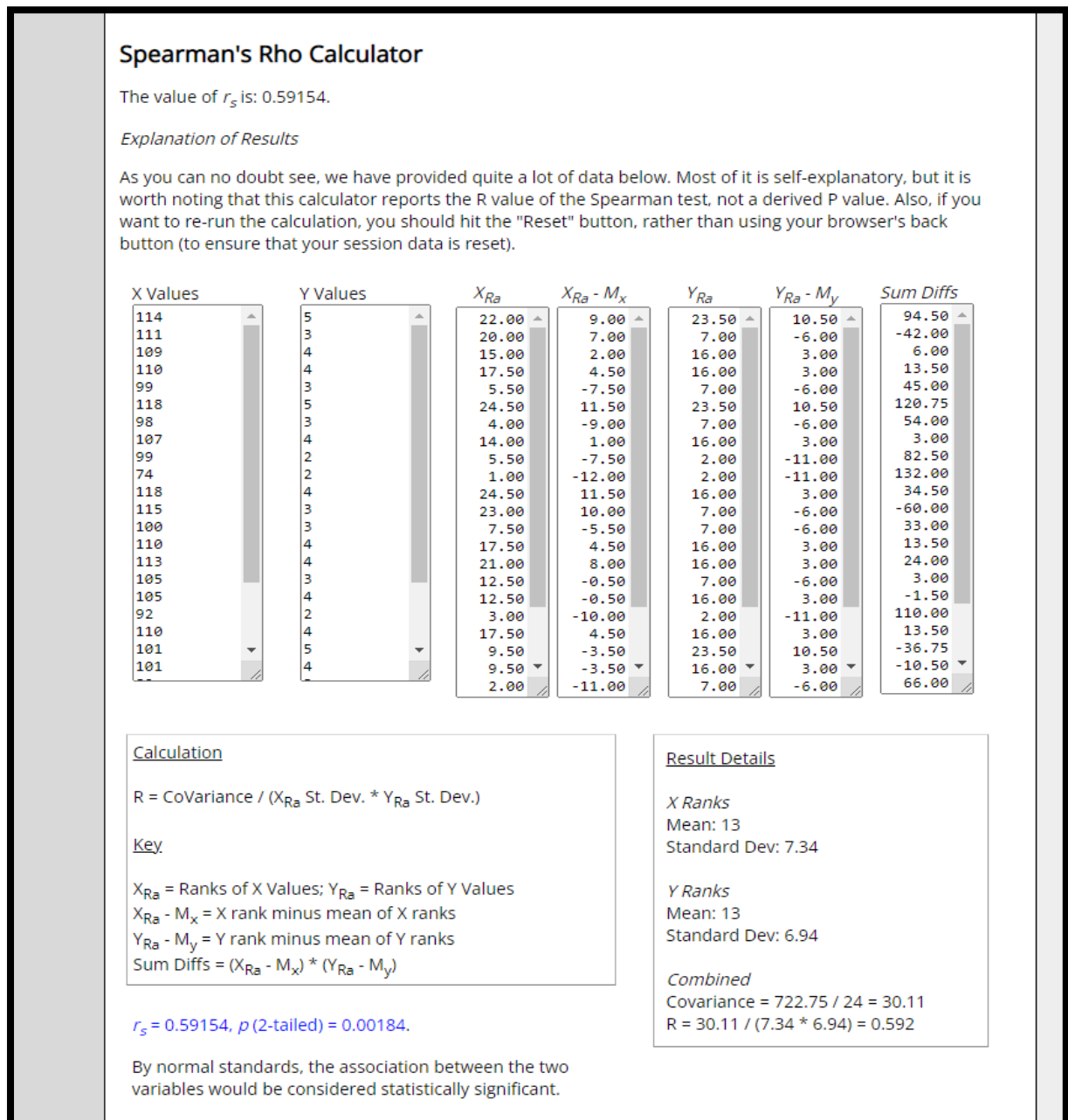


Figure 102 - (Spearman's Rank Correlation Calculator, 1904)

According to the test and normal standards, the association between immersion and time loss would be considered statistically significant ($r_s = 0.59154$, p (2-tailed) = 0.00184) meaning participants who had higher immersion scores were more likely to report higher degrees of time loss.

Evaluation

There are a few things to take away from the data that has been gathered and analysed. The first factor to consider is the total number of participants. It would've been helpful to have had at least 30-40 participants. Unfortunately, this was not possible because there were only 25 participants, the data might not be quite as accurate if there would have been more. If the game and the study was conducted in a lab environment this could also have allowed for time perception to be examined objectively by asking participants to retrospectively estimate the amount of time they played for this then could be compared to the actual time playing the game. This could have also meant the interview research method could have been considered which would have allowed for more in-depth data about participants experience of flow and immersion. Unfortunately, this was not possible due to the COVID 19 outbreak and guidelines that were in place at that time.

It is clear that the players enjoyed the game as a whole. It makes me extremely glad to know that others enjoyed the game I produced. From the bar chart above "How much would you say you enjoyed playing the game?" 52% of participants said that they most definitely enjoyed playing the game. 28% of participants said that they more or less enjoyed playing the game. 16% of participants said that they definitely enjoyed playing the game. Lastly, 4% of participants said that they somewhat didn't enjoy playing the game. The participants said that the overall gameplay was easy to follow and understand but I could have also made an easy-to-follow tutorial at the start of the game to help the participants understand the controls better. For the gameplay controls I was expecting a lot of problems from the participants, but I was pleasantly pleased to find that it was not the case. However, on reflection, I could have considered and implemented some adjustments to make things a bit smoother. In addition, I could have developed the game for Android or IOS operating systems this would make the game more accessible for participants, some participants mentioned that they didn't have a computer or a laptop to run the game. Therefore, I would have developed the game for these platforms. Additionally, from reviewing the participants questionnaire results a lot of the respondents mentioned that there were no bugs in the game, the game was fun to play and was not too difficult the graphics of the game fitted the atmosphere really well and the game was accessible as it was easy to navigate. The only real issue in the final production of the game came from the pause menu navigation where one of the respondents said that it was near enough impossible to adjust any of the settings or close the game.

Overall, I feel that there was a good number of questions in the playtesting questionnaire to determine and investigate the effect of flow and immersion on time perception in first-person shooters. This helped to establish the overall immersion score and by examining the relationship between immersion and time perception. The scatter graph shows somewhat of a positive linear relationship between higher immersion scores and higher time loss scores. However, considering the small sample size further research is required to validate the findings of this research and if they can be generalised.

Online Portfolio

Throughout this project, I posted information on LinkedIn and YouTube for others to view. This would benefit my portfolio in general because it would allow prospective employers to see just what I am actively working on. It was also a really helpful thing to do since it would have helped me raise people's interest in the game, which would ideally result in more people interested in testing this when the stage approached.

I promoted the project significantly on LinkedIn. I utilised this site since I have numerous contacts in the gaming industry on it, and it would ideally help me get my name out there as a developer. It would have been beneficial if anyone of them did some testing, as I am expecting some constructive feedback from them. I've shared videos and photos of the development at varying stages, which are seen below on the next page:

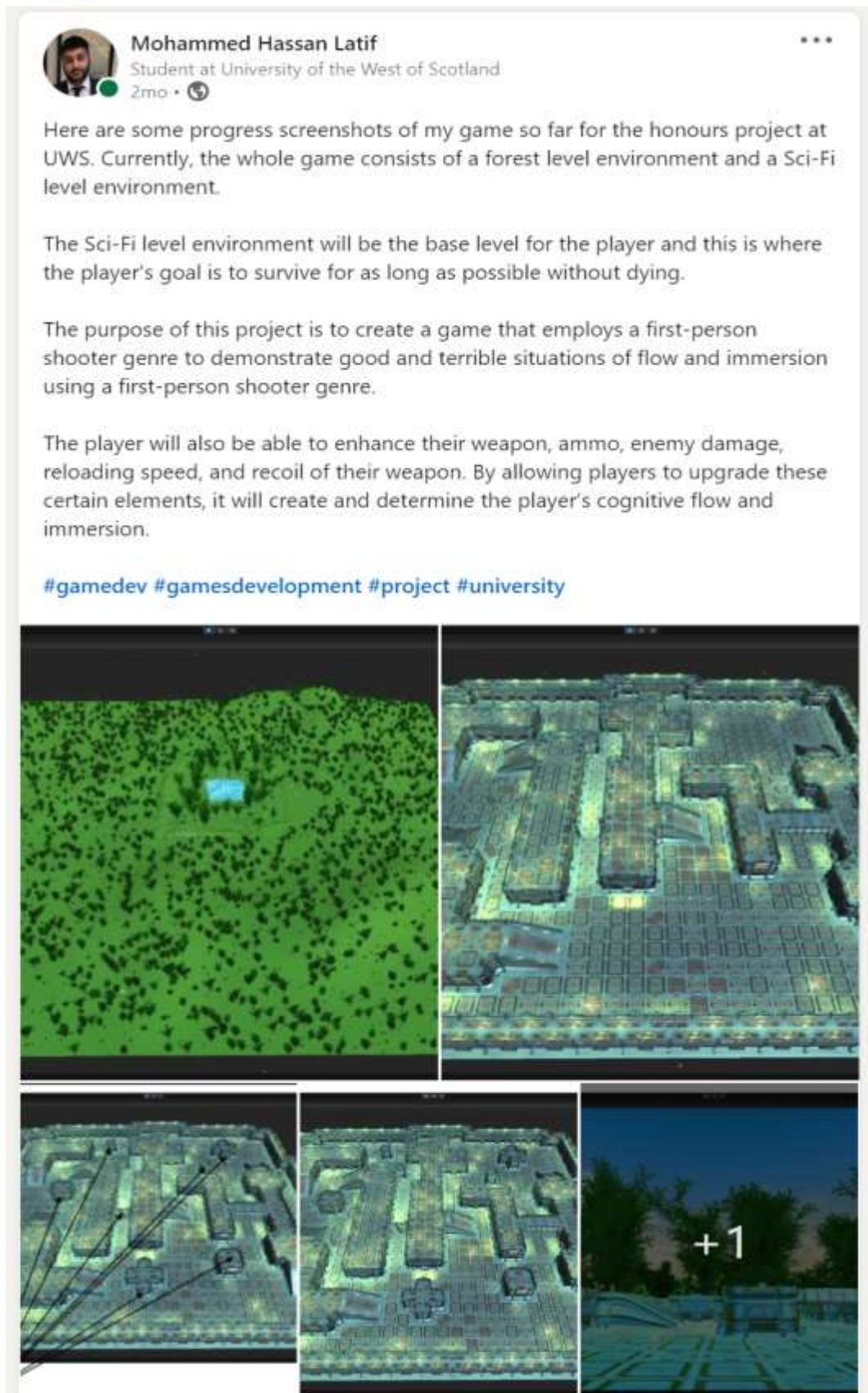


Figure 103 - LinkedIn Progress Update 1

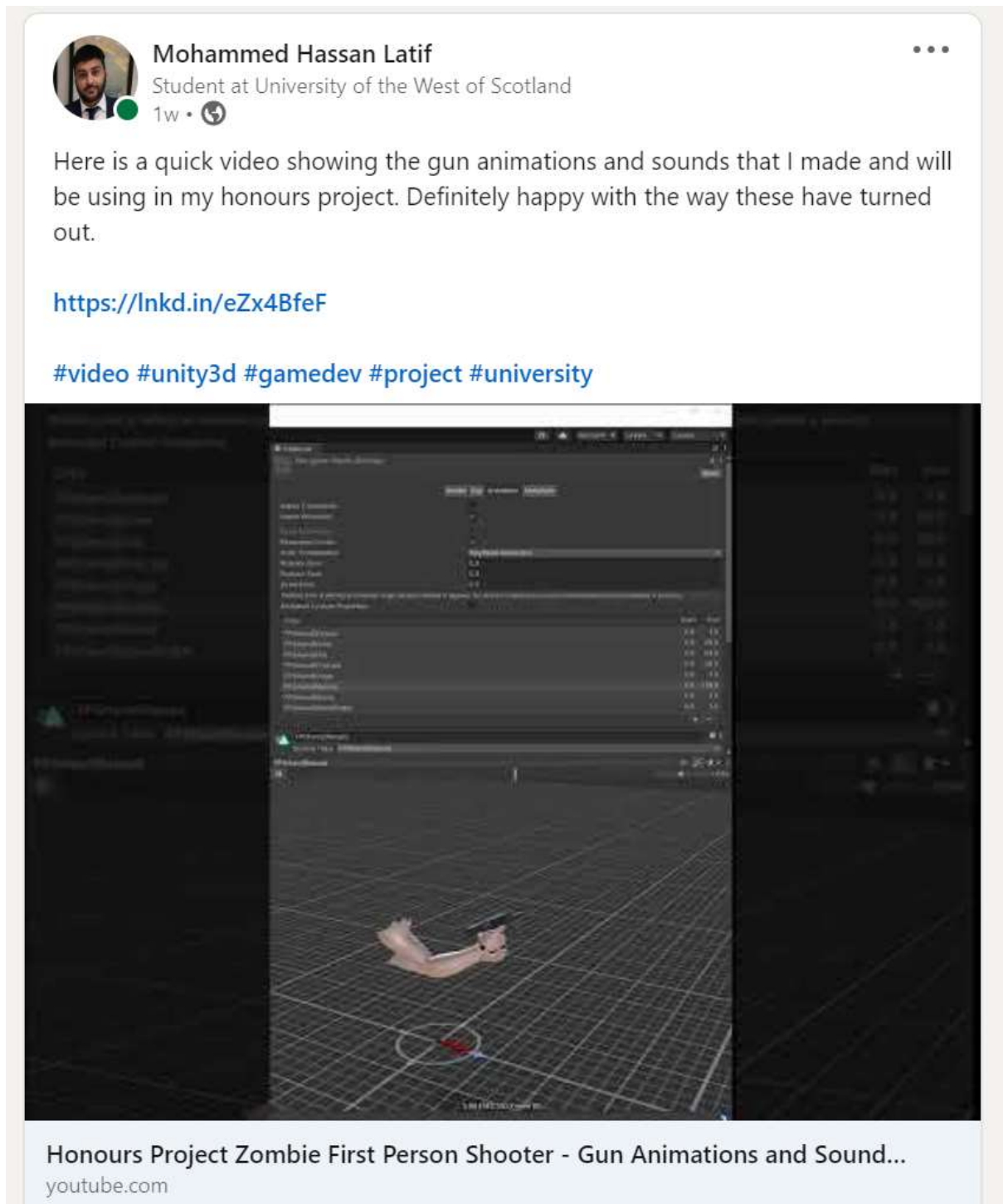


Figure 104 - LinkedIn Progress Update 2

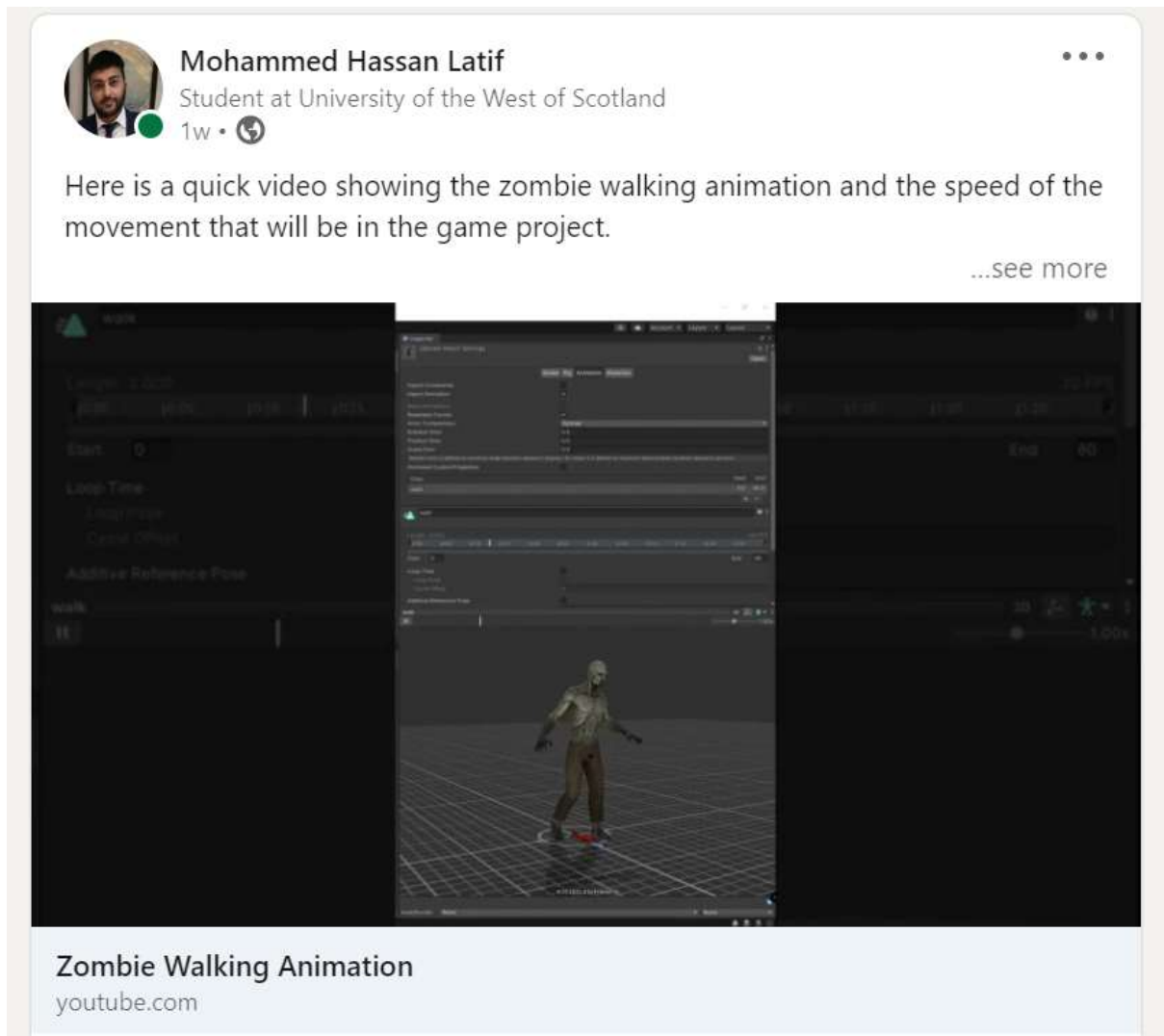


Figure 105 - LinkedIn Progress Update 3

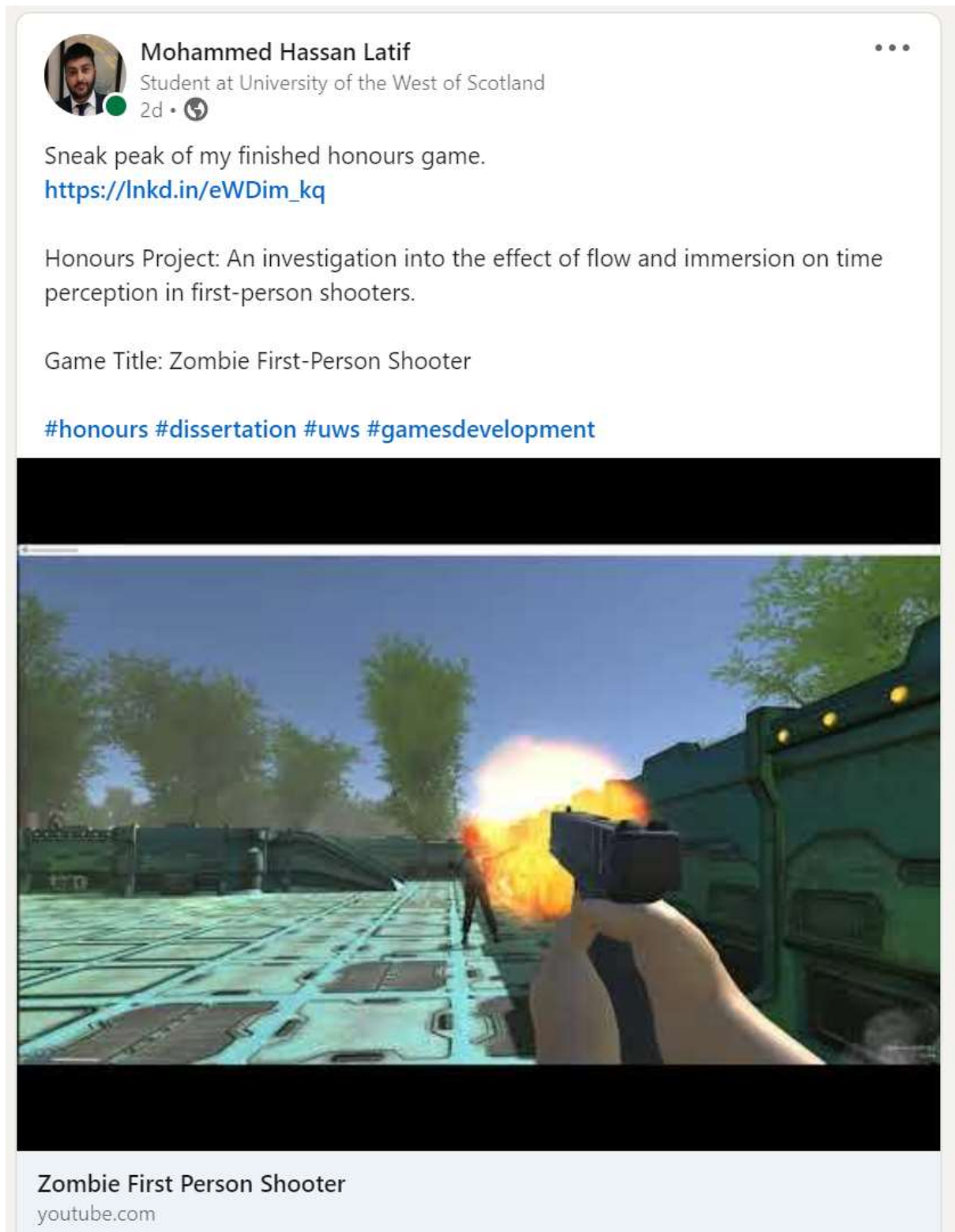


Figure 106 - LinkedIn Progress Update 4

Future Development

Overview

There have been highs and lows throughout the creation of this game. Nevertheless, I was managed to create a somewhat functional game that I am pleased with. There were a number of bugs I spotted just before the game went out for evaluation and testing where I would have wanted to have corrected, unfortunately due to the time constraints, I had to accept the game's current state. This has been the proudest thing I've worked on during my entire academic career studying computer game development. Because this is my proudest accomplishment, I would absolutely like to continue working on this in the future.

Issue 1

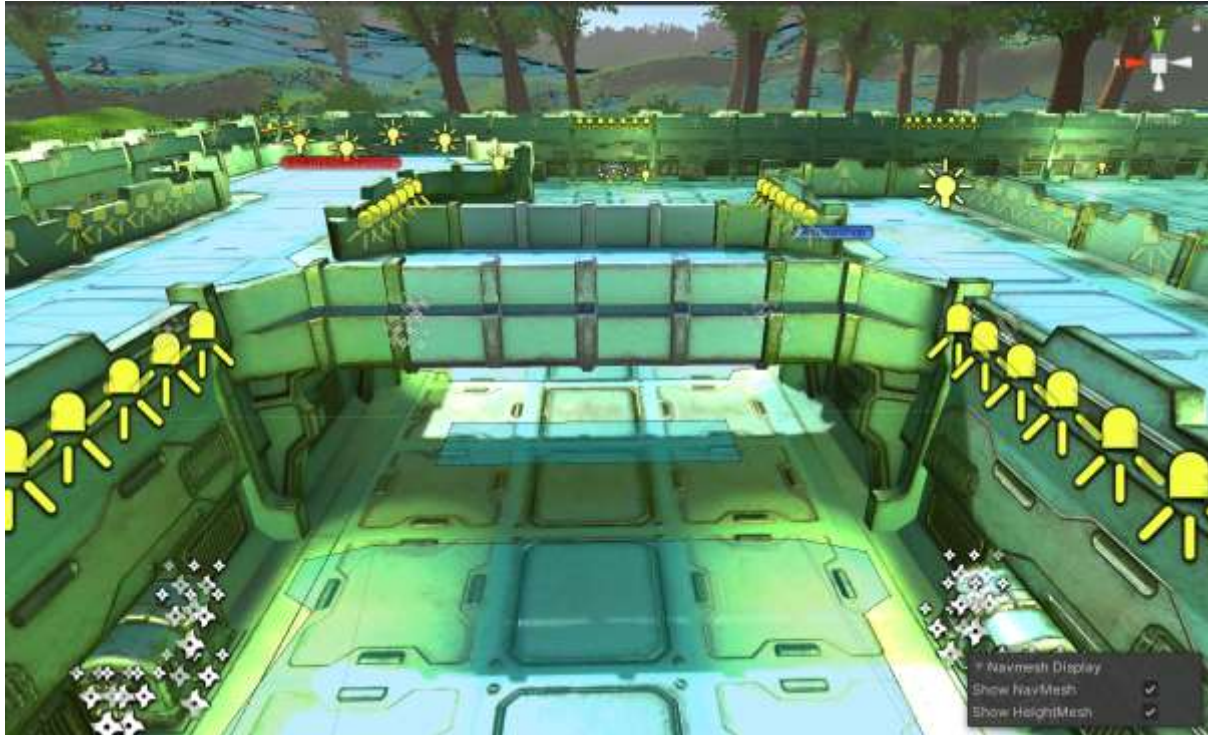
The first and most pressing issue I would like to fix is the pause menu issue. The pause menu in its current form has some problems due to not actually pausing the game properly when the player clicks on any of the options the actual character still fires the weapon, and the player's camera pans upwards making it near enough impossible to adjust any settings or even close the game. A workaround to this problem is to press the 'ESC' key and return back to the gameplay, then press 'ESC' key again and to use the keyboard arrows to navigate the menu and pressing enter to access any of the menu options. The player's mouse can still be used in options such as Video and Audio to adjust the game's video and audio settings.

The pause menu issue is described in more detail in the attached video below. Please note if the video does not play, please right on video and choose open in browser option. Alternatively, the video can be seen on my YouTube channel by following this link: <https://youtu.be/-UpqfgzICx4>



Issue 2

The second issue that I would like to look into is to do with the AI. The AI in the game was really difficult to implement and have them follow the walking path in the game. The AI can't walk under the bridge in Sci-Fi level environment. As you can see from the image below from looking at the light blue Navmesh area the AI navigation walking path is incomplete and does completely run underneath the bridge properly.



As you can see in the image above the AI gets stuck prior to reaching the bridge in the Sci-Fi level environment and cannot attack the player. A solution to fix this problem would either be to move the bridge up slightly or reduce the scale size of the bridge or remove the bridge completely to allow the AI to utilise the walking path under the bridge in the game.

Issue 3

The next issue that I noticed as well as a few others noticed was the AI respawning speed. The AI respawning speed around levels six and seven is perhaps too aggressive and the players start to feel overwhelmed perhaps too quickly in the game. A solution to fix this problem would be to slow down the rate of the AI respawning speed in the game's code. I created a script that allowed the AI to respawn and move faster after a certain amount of time in the game. A solution to fix this problem is that I feel that I could have made the AI difficulty a bit easier in the earlier levels in the game and more difficult in the later levels in the game. As you can see from the image below the player is on level seven in the game and the player is already swamped with the AI coming after them too quickly.



Minor Issues

Following these more major issues it all comes down to minor issues. These are issues such as the player not being able to open the doors in the Sci-Fi level environment. I took the early decision to remove the doors early in the development of the game since they were not working properly, which caused a lot of issues for the player and the AI because they would get stuck passing through the doors and the floor beneath the door.

In addition, another minor issue is performance in the game. Just after I released the game for testing some participants noticed that the game would take between five and ten seconds to load on a first time start. However, on some occasions when relaunching the game, it would take a minimum of two to five seconds to load the game. Even though these are small minor issues, it is crucial for me to solve since I want the game to be as polished as possible.

Additions

Afterwards when I have addressed all issues, I'd would like to consider introducing stuff like additional levels, side missions with secret locations, as well as the possibility to play specific levels. These additions would advance the game and offer additional content, which I believe would indeed be helpful. I would of course, go over and remove all or most of the changed parts from the game, then reconstruct the levels also with atmosphere I'd anticipate seeing in those particular levels.

Critical Appraisal

Overview

Throughout the process of completing this project, I successfully designed, documented, and created a first-person shooter game in Unity Engine. I've expanded my expertise of many software tools such as Unity Engine, Photoshop, Premiere Pro and Audacity. This experience will be helpful in future developments in other projects.

I feel I have spent sufficient amount of time on this project because it is adequately documented and structured. The finished Unity game did live up to my first expectations. In the beginning I thought there would be sections easier to do that turned out to be a lot harder than expected such as the pause menu options, inventory system, AI Navmesh and Occlusion Culling. Although the game tuned out well in my opinion there are still sections that I would really have liked to have fix such as the pause menu. The pause menu in its current form has some problems due to not actually pausing the game properly when the player clicks on any of the options the actual character still fires the weapon, and the player's camera pans upwards making it near enough impossible to adjust any settings or even close the game. In addition, some of the game optimisation and loading times issues as it has been one of the minor issues of the released game. I worked on the game a lot however the issues still remained, and it took a lot longer than expected to try and fix. If I had managed my time a little better, I believe that I could have fixed all of the issues aforementioned. I am happy that I managed to get two iterations of testing done but I wasn't able to fix some of the game issues aforementioned before the second iteration of testing. During this project, I found the dissertation to be endurable. This is due to the fact that I allocated time to fill in the dissertation as I progressed. Throughout the assignment, however, I felt as if I was falling behind, despite Gavin's assurances that I was doing well at each meeting.

During the early stages of development, I did experience a number of issues. The first issue was getting the AI Navmesh to work. The biggest issue I faced with this was getting the AI to work through the doors in the Sci-Fi level. To get around this I removed the doors completely and extended the floor underneath the doors, this way the AI knew they could navigate past where the doors and the door walls use to be, and the AI knew where they could and couldn't go through the whole Sci-Fi level. Another issue I faced was the lightning in the game. The lighting would be either too dark or the lighting wouldn't generate properly at all. To combat this issue, I created a real time lightmap and as a result the lighting turned out a lot better than I expected and it didn't hinder the performance of the game.

Improvements

I believe that I could have improved my time management considerably just because a few jobs took longer than anticipated, which meant I didn't have time before the end to fix performance issues or minor bugs. If I had enough time before the final play testing questionnaire, I could have fixed some of the elements and features to obtain more accurate findings from the users, that could have enhanced the game's ultimate conclusion. Other than these adjustments, I don't think I would change anything else whatsoever if I were to recreate the project because I believe almost everything went very smoothly.

Skills

During this project, I would definitely claim that I strengthened both my hard and soft skills. I've become more experienced with Unity and learned to use new features such as Occlusion Culling, in which the camera culls objects that may not be in range, and I've made a point of learning about how it can assist with efficiency and performance, such as scaling back shadowing and lighting, I have also learned about making an inventory system, AI Navmesh, and much more. I've also strengthened my soft skills, such as communication, as I've had to communicate with Gavin on a regular basis about how the project is progressing as well as what still has to be done. My project management abilities have increased because this is the first time, I have also had to plan everything from beginning to the end outside of working in a team.

Version Control

The use of version control has indeed been critical throughout this project. I wouldn't know what revision of the dissertation I was working on if I didn't have version control. It also was critical to always have upgraded versions of the game in case something went wrong with the original version of the game I was using. Without backup copies, there would've been a serious threat of losing everything if anything went horribly wrong.

Overall, Within Unity, I've learned lots of new skills such as Occlusion Culling, in which the camera culls objects that may not be in range, and I've made a point of learning about how it can assist with efficiency and performance, such as scaling back shadowing and lighting, I have also learned about making an inventory system, AI Navmesh, and much more. I will be able to utilise all of these skills in future projects. I'm extremely pleased as to how well the game turned out, as I put in a lot of time and work to get it to this stage. Gavin has also provided me with a wealth of knowledge and support all throughout project.

Conclusion

To conclude on the whole project, this part will summarise the project's two main goals.

Firstly, the purpose of this project was to create a game that employs the theory and research of flow and immersion using a first-person shooter genre. Unity Engine version 2020.3.26 was used to develop the game, in which the player's goal was to survive for as long as possible in the game. The player was able to enhance their weapon, ammo, enemy damage, reloading speed, and recoil of their weapon. By allowing players to upgrade these certain elements, we shaped the environment so players could experience cognitive flow and immersion based on the theoretical underpinnings of flow and immersion we examined. We explored the process used to build the proposed solutions and investigated the influence of flow and immersion on time perception in first-person shooter game that was developed.

Secondly, we investigated the effects of flow and immersion on time perception by inviting participants to complete the immersive experience questionnaire and provide feedback about their subjective levels of immersion and subjective experience of time loss after playing the game. The study found that there was a statistically significant relationship with participants experiencing higher levels of immersion reporting higher levels of time loss whilst playing the first-person shooter game. Therefore, this study suggests that flow and immersion does seem to have an impact on distorted time perception namely on the experience of time loss. However, further research is required with a larger sample size in order to obtain more accurate data and results.

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Appendices

The prequestionnaire is available to access online here:

<https://forms.gle/3BAqpLcWQaiRunjm8>

The playtesting questionnaire can be accessed here:

<https://forms.gle/3Dv7zp2L46WhpdGS6>

The final playthrough of the game can be found here: <https://youtu.be/IOT3geuQTq4>

The game can be installed from Itch.io online here: <https://hassan-latif.itch.io/zombie-first-person-shooter>

The game can also be installed from Google Drive here:

<https://drive.google.com/file/d/1uuAZej558QhDq6BGe0oMPdxxraoFFiBK/view?usp=sharing>

The source code of the game can be found here:

<https://drive.google.com/file/d/1fenuvKfW-VL5SKPUPj-iYvo6D5YFxoAd/view?usp=sharing>

Access to the full documentation for the dissertation can be found here:

https://studentmailuwsac-my.sharepoint.com/:f:/g/personal/b00333837_studentmail_uws_ac_uk/EtTtHCAr60lCqX5GzI5VKGsBgROCOviyBVRkOyEN8K8RFw?e=5DyccC



Figure 107 - Appendix A



Plain Language Statement Information Sheet

School: School of Computing, Engineering and Physical Sciences

Project Title: An investigation into the effect of flow and immersion on time perception in first person shooters.

Computing Hons Project Student: *Mohammed Hassan Latif*
Email address: B00333837@studentmail.uws.ac.uk

Computing Hons Project Supervisor: *Dr Gavin Baxter*
Email address: Gavin.Baxter@uws.ac.uk
Contact number: 0141 849 4182

Computing Hons Project Module Coordinator: *Dr Gavin Baxter*
Email address: Gavin.Baxter@uws.ac.uk
Contact number: 0141 849 4182

Programme Title: BSc (Hons) in: Computer Games Development

Dear participant,

You are being invited to take part in my research study for my honours project - An investigation into the effect of flow and immersion on time perception in first person shooters.

Before you decide it is important for you to understand why the research is being done and what will be involved. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Please take your time in deciding if you wish to take part and thank you for reading this.

What is the purpose of the study?

This study focuses on the effect of flow and immersion on time perception. By reviewing this literature and defining the most important problem in the area I will provide the basis for the rest of this thesis.

1. Current definition of the effect of flow and immersion on time perception.
2. How widely accepted is the effect of flow and immersion on time perception.
3. Types of effect, flow, and immersion on time perception.
4. Is the effect of flow, and immersion on time perception effective in different groups?

Figure 108 - Appendix B

Why have I been chosen?

You have been chosen to participate in this study to give your views and opinions of the video game that was created in relation to this study on the effect of flow and immersion on time perception in first person shooters. As a fellow game developer student or peer your feedback would be most valuable in relation to identifying any potential issues associated with the continued development and implementation of the game.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason. A decision not to participate will not affect your grades in any way.

What will happen to me if I take part?

As a participating subject you will be asked prior to commencing your involvement in the study participant information sheets will be disseminated by e-mail along with consent forms allowing potential participants to decide upon if they want to partake in the study. The information sheets will provide details about the study, what is expected from the participants, why they are being asked to take part, the duration of the study and also emphasising that they have the right to withdraw from the study at any time without giving any prior notice.

Will my taking part in this study be kept confidential?

All information, which is collected, about you during the course of the research will be kept strictly confidential. You will be identified by an ID number or letter and any information about you will have your name, address and all other identifiable details removed so that you cannot be recognised from it.

What will happen to the results of the research study?

A bound copy of the completed Hons Project report may be stored at the University of the West of Scotland library (subject to approval).

Who is organising the research?

The School of Engineering and Computing at the University of the West of Scotland is organising this Computing Hons Project.

Who has reviewed the study?

The project has been reviewed by the student's supervisor, moderator, year leader, module coordinator and chair of the School of Engineering and Computing Ethics Committee.

Contact for Further Information

For further information please contact:

Computing Hons Project Student: *Mohammed Hassan Latif*

Email address: B00333837@studentmail.uws.ac.uk

Alternatively, if participants have any concerns regarding the conduct of the research project please contact the School of Computing, Engineering and Physical Sciences Project Supervisor by contacting *Dr Gavin Baxter* – Gavin.Baxter@uws.ac.uk

Thank you for taking part in this study.

Figure 110 - Appendix D