Nottingham Trent University

School of Science and Technology



COMP40321 – Major Project

Of

Title

By

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Project report in part fulfilment

of the requirements for the degree of

Master of Science with Honours

in

Computer Science

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# *Abstract*

# *Acknowledgements*

Throughout the development of this project I would like to thank:

* Matthew Harris for his continuous support and advice during the completion of this project.

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# ***Chapter 1 – Introduction***

# Research Context

The research title for this project is “Can VR applications help with fitness?”. Virtual Reality is a new console that requires physical movement to play games. Using this technology, an interactive and engaging fitness application can be developed to keep users healthy and fit from their homes while having a fun time doing so.

This project plan document will explain the aims and objectives of the application, such as functionality that can be added to make the application. The tasks section will present the deliverables of the project, what are used to create the Gantt chart. This section will also present the quantitative and qualitative research that can gather information for this project. The sources and resources that are required to complete this project will be stated and explained how they will be used. Potential risks that the developer can encounter will be stated with a key that determines the severity level of the risk, the likelihood of the risk-occur and the impact the risk will have. The time plan section will contain a Gantt chart. This chart will represent the timeline of the entire project. Each task will have a time frame of when it will be completed by. Finally, the literature review, this literature review has entailed numerous hours of researching reports and websites to a set of questions that are connected to the overall question of this project. These questions have been documented and backed up by reports, websites, and reviews that are giving statistics and information that support the question on hand.

## Aims and Objectives

### Aims

The main aim of this project is to see if VR (Virtual Reality) can help people lose weight through a fun and engaging application that provides workouts that can be done from home.

### Objectives

The object of this project is to develop an application in VR that can help users lose weight from their homes. “When you strap on your Oculus Quest 2 and start playing VR [fitness](https://www.themanual.com/topic/fitness/) games, you can stealthily get in shape, strengthen your muscles, burn calories, and improve your cardiovascular fitness” (Sayer, 2022). Developing an application that is fun and engaging that contains full body workouts that they can select based on their routine. Workouts will be thoroughly researched that are good for each muscle group to help build muscle, as well as cardiovascular workouts to help lose overall weight. This will all be put together and create workouts that the user can be based on the options the user selects.

Currently, the fitness application market within VR is based on games that have a high movement that increases the users' heart rate. However, this doesn’t target the whole fitness element. Making an application that the user can select what muscle group they would like to work on, for example, chest and triceps can be done by a series of different pushups. An animated avatar that shows the workouts will be in front of you just like a just dance game. The user can follow the animated avatar and perform the series of workouts. A level system can be introduced such as an easy, medium, and hard, these settings can make the difficulty of the workout routines harder by adding in more reputations of the workout or by making it hard by putting the user in a different position such as clap press-ups instead of normal press-ups.

Another idea that can be introduced into the application is cardiovascular option. This can be done in two ways one where the user can perform cardio workouts such as jump jacks or running on the spot. This can be done with a timer that is attached to an animated avatar once the avatar changes work out the user also changed workout making it a HIIT (High Intensity Interval Training) workout. “HIIT involves short bursts of intense exercise alternated with low intensity recovery periods” (Tinsley & Read, 2021). This kind of training is perfect for VR the reason for this is because the HIIT workout roughly lasts the duration of around 10 to 30 minutes. This is good because “As a general goal, [people] aim for at least 30 minutes of moderate physical activity every day” (Healthy Lifestyle Fitness, 2021). This is perfect due to the battery life of the VR headset last around 2 hours and “Despite how short the workout is, it can produce health benefits similar to twice as much moderate-intensity exercise” (Tinsley & Read, 2021).

The second option that can be added is a free room this room can contain a boxing bag and other mini games that aren’t work out based but games that still burn calories when playing.

Adding in audio that can push the user while performing the workouts will increase motivation and allows the user to keep on going like a personal trainer at a gym. Attaching music to the workouts can be a possible feature as the music gets faster the workouts get faster as it slows down the workouts get easier making it the HIIT workout routine.

## Report Overview

# ***Chapter 2 – Context***

## Introduction

## Orientation and Background

Gaming and fitness have always been in the market in the forms of the Nintendo Wii, PlayStation Move, and the new current consoles the Switch fit, and VR headsets. These consoles had features that targeted fitness through gaming, the Nintendo Wii which was released in 2006 was the first to incorporate movement into its games. “The primary controller for the Wii is the [Wii Remote](https://en.wikipedia.org/wiki/Wii_Remote), a wireless controller with both [motion sensing](https://en.wikipedia.org/wiki/Motion_detection) and traditional controls which can be used as a [pointing device](https://en.wikipedia.org/wiki/Pointing_device) towards the television screen or for [gesture recognition](https://en.wikipedia.org/wiki/Gesture_recognition)” (Nintendo, 2022). A sensor was provided with the console that was placed at the top or near the tv. This sensor picked up all gestures from the remote. Games like Just Dance picked up motions from the controller and matched them to the game, this was one of the fitness games the Wii provided however this game did not track calories burnt or how long the user played the game.

Nintendo brought out a device called the Wii Fit, “the Nintendo Wii Fit™ is a new product that is purported to improve balance, strength, flexibility, fitness and general well-being” (J. C. Nitz, 2009). The Wii Fit was a censored board that the user can place on the floor and stand on, which would calculate their weight and height, this then provides workouts featuring a variety of [yoga](https://en.wikipedia.org/wiki/Yoga), [strength training](https://en.wikipedia.org/wiki/Strength_training), [aerobics](https://en.wikipedia.org/wiki/Aerobics), and [balance](https://en.wikipedia.org/wiki/Balance_(ability)) mini-games. The latest generation of consoles, such as the Switch, has the adventure ring and VR. Both consoles use sensors that track the user’s gestures/movements.

VR has two types of models the hive has sensors that are placed in the corners of the room this allows the whole body to be tracked. Meanwhile, the Oculus (made by Facebook) has sensors built into the headset that allow it to be played anywhere at any time. Nintendo has created a new console called the switch they have created an attachment like the Wii fit called the ring fit adventure. This handheld product “Encourages you to exercise, stretch and the occasional yoga pose to defeat enemies while levelling up and increasing your attack & defence power” (Super Busy Mum, n.d.). As you can see, video games and fitness applications have always been on the market, but with the new technological advances of VR, we can take this to another level not by just tracking the controller’s movement but by real-life actions the user performs.

## Problem Statement

As COVID-19 entered our lives, gyms were closed for most 2020 and 2021 and many people exactly “62% of UK adults played some form of video game in 2020” (The Guardian, 2021). However, gaming isn’t the only reason because of the fear of covid, “Gyms have been identified as "high risk" locations for catching coronavirus due to sweat and dampness heightening the spread of germs” (Binding, 2020). Because of this, many people are still afraid to use gyms for working out. Virtual Reality can change this as workouts can be directly done from your home in a fun and interactive manner through games or fitness applications.

“Activity-based video games generate a higher level of engagement than with traditional exercise. This seems to reduce the level of exertion in players considerably. Usually resulting in a higher level of motivation to stay with the workout activity, rather than stick with regular exercise” (AIPT, 2019). Virtual Reality is the latest technology in tracking the user's full body using sensors either in the corners of the room or built into the headset. Using these developers can create fitness applications that can track your whole body and provide workouts that can target different parts of the body. The oculus quests have an option where the user does not need to hold the controllers to play a game. You can use your hands that are picked up from the sensors. This means that developers can include workouts routines into games, giving the users a full-body workout with no restrictions. The quote above mentions “activity-based video games” this means creating a game where users will enjoy the content of the game. This will keep users engaged with the applications which will want them to continue playing. “VR fitness training is all about simulating specific game mechanics to help people achieve real-world fitness results. And virtual reality focuses on immersing the senses by transporting players out of the ordinary into fictional environments” (Viro Move, 2019).

## Research Questions

Main question – Can VR applications help with fitness?

1. What are the statistics on the number of gamers, UK citizens having desk jobs, and the average of people that are obese?
2. What types of VR applications are currently in the market?
3. What are the pros of VR fitness applications?
4. What workouts can be done in VR?
5. Unity vs unreal?

## What are the statistics on the number of gamers, UK citizens having desk jobs, and the average of people that are obese?

Currently “The majority (81 percent) of UK office workers spend between four and nine hours each day sitting at their desk, equating to an average of 67 sedentary days per person each year.” (Bean, Majority of UK workers sit at their desk between four and nine hours a day, 2018) This represents that a high percentage of UK citizens do not require to move around at work however “Gamers 26-35 years old play for eight hours 12 minutes per week. This increased more than 25 percent in the last year”. (Limelight, 2019) Limelight has also discovered that 44 percent play more than seven hours a week and 25 percent play more than 12 hours a week. From these statistics, we can see that a high percentage of people who have desk jobs do play games in their free time. “In contrast, those working in administration are those most at danger, with obesity rates of 77 percent; a substantial 15 percent higher than the national average.” (Bean, Office workers have substantially higher rates of obesity than national average 0, 2017) “In Louisiana, one in every three children (35.3 percent) aged 10-17 is overweight or has obesity, and one in five (21.1 percent) has obesity.” (Louisiana State University, 2018) This shows children do not get enough exercise and some may agree that gaming isn’t the best way for losing weight however VR changes this statement.

## What types of VR applications are currently in the market?

VR is a whole new industry where games require some sort of movement to play, played Creed: Rise to Glory is a virtual boxing game where the user can fight AI fighters or other real fighters through the online mode. As boxing isn’t about just punching using your arms it requires your whole body from the twist of your knee to the movement of your hip to your arm acting like a whip. Shane hoalst said that they “played Creed: Rise to Glory for 36 minutes and tracked my workout with an Apple Watch. I started the game in the gym so I could warm-up. I did the punching bag and boxing dummies for about 5 minutes, then I jumped into the fights.” (Hoalst, 2018) overall, this allowed him to burn 385 calories with an average heart rate of 144BPM, this equals to half-hour run on the treadmill.

An example of this is amateur boxers training using the heavy bag in VR. Trained boxers are targeted for this type of training as they have already mastered the basic techniques, they can use their techniques against a heavy or speed bag in VR this can help prevent injuries such as to the wrist. Having the option to use a virtual bag can allow boxers to run virtual workouts based on cardio as well as games that target different parts of the bag representing a part of the opponent’s body.

Canelo a professional boxer said that “He instantly applied his famous defensive head movement and slipped the opposing character’s punches. Canelo then returned fire with a combination and scored an early knockdown.” (benson, 2021) As you can see that this game can help users train by fighting online and virtual opponents through sparing directly from their homes without any additional equipment besides the headset and the controllers for a full-fledge workout from home. These types of games have drills, workouts, and trackers built into the applications that can help users keep a record of when they last played and how many calories were burnt as well as the increase of difficulty of workouts over time in a fun and engaging manner with built-in music and fun/realistic animations.

Another example of a game where fitness isn’t the main feature but burns calories anyway. This game is called Beat Saber and is a simple game where blocks with arrows come towards you, the user must slice these blocks with their swords matching to the beat of the song. However, this game does get more difficult involving the player squatting down to avoid obstacles moving from side to side in a fast manner while slicing the blocks that come towards you. Tyler Treese said that “We were able to burn over 10 calories per minute while testing it” (Treese, 2019). This quote shows that even though this game doesn’t target fitness in any way still contains elements that require users to move which results in losing weight.

## What are the pros of VR fitness applications?

“There is evidence from laboratory studies that immersive VR exergaming is more engaging than standard exercise and may distract participants from exertion” (Nuša Farič, 2019). As the VR Fitness application takes the user to a new world this allows users to escape from the boring workout routines that most gyms provide. VR gaming has taken an approach to reward the play in ways of new customization features through battle passes, these battle passes unlock rewards through the number of achievements the player gets such as completing 100 pushups. Some games on the market reward players with an adventure giving the user new sceneries and new workouts through the trail depending on the workout they choose this is what makes gaming addictive. This allows people to be motivated to get up and work out as most people stop going to the gym as they aren’t seeing results so rewarding the player is an alternative to keep them engaged and addicted to the game.

Viro fit also mentions that**“**Some addictions are good, healthy and needed to help us live a long, happy and healthy life” (Viro Fit, 2019). VR Fitness applications are already helping gamers, teenagers, and adults who struggle to find energy or time for regular physical activities such as going for walks or doing home workouts.

“Physical inactivity is a serious global problem and can lead to serious diseases and disorders” (Viro Fit, 2019). Another positive of VR is that it can reach out to specific groups of people and offer them many health benefits such as people who are obese are gamers or people who are shy to go to the gym or go for runs.

“We found that people who have tested our fitness solutions naturally adapt and sync to new physical movements much faster when they are fully immersed” (Viro Move, 2019). The reason for this is that players spend more time in the activity/game and do not worry about their physical appearance. Adding in advanced movement that the user performs can help players enhance their skills passively, faster than in real-life fitness activities. “VR’s potential to improve mood, visual-spatial skills, coordination, motivation, and energy expenditure and as such, careful consideration for the design features of the future exergames is paramount” (Nuša Farič, 2019).

## Workouts that can be done in VR.

There are many workouts that can be done such as floor workouts that can target specific muscle groups such as push ups help increase muscle mass on the chest. “Push up is the perfect exercise if you want to strengthen your upper body. Doing this exercise regularly every day will strengthen your chest muscles and make you more fit” (Ahmad, Suherman, Safari, & Saptani, 2020).

Cardio based workouts can also be done from with the use of HIIT or high intensive interval training. “HIT is normally achieved through the use of intervals. HIT can be broadly defined as repeated bouts of short to moderate duration exercise (i.e. 10 seconds to 5 minutes) completed at an intensity that is greater than the anaerobic threshold” (Paul B. Laursen, 2002). As the VR headset has a battery span or 2 hours this type of workouts can be sufficient for a home routine.

“The virtual exercise trainer provides audio and video feedback to enable the participant to follow the exercise movements more accurately” (Hyeyoung Cho, 2014). Having an avatar that performs the movements in front of the user will allow the user to understand the positioning and technique of each exercise. This will prevent the user from harming them self’s while performing the workouts. “Playing a virtual reality computer bicycle game, or an interactive virtual reality bicycle experience on a computer while exercising on a stationary bike at moderate intensity (60–70% maximum heart rate)” (Thomas G Plante, 2003).

## Unreal vs Unity

“The Unity game engine is a multi-functionality game engine that can support 2D and 3D graphics along with drag and drop and the benefit of C# scripting” (Ramiz Salama, 2021). Unity can compress assets, mipmaps and many other graphical settings that can allow the application to support all types of platforms that the developer would like the application to run on. “Unity also provides developer services: Unity ads, Unity analytics, Unity certification, Unity cloud build, Unity every play, Unity IAP, Unity multiplayer, Unity performance and reporting and Unity collaborate” (Ramiz Salama, 2021). These services can be used to implement new features into their application without any additional charges to the developer. Unity can support 27 different platforms that these applications can be built for example PlayStation, windows, and VR. Unity has a huge prebuilt asset store that developers can use for their application directly through the UI (user interface) of Unity. Unity also has won the best engine award at the UK’s develop industry awards.

Unreal was made and developed by Epic games. “Its main use was for FPS games only, but it proved useful in other game genres like MMORPG, Stealth, Adventure etc” (Ramiz Salama, 2021). The source code used to develop these applications is C++ the reason for this is because most games now adays use C++ as their primary language for game development. “The official stable version is Unreal Engine 4. It can support Windows, Mac OS, Oculus Rift, Xbox, PS, Nintendo and other platforms that are crucial in the gaming industry nowadays” (Ramiz Salama, 2021). Unreal uses a code block system that allows rapid development of game logic without the use of scripting that Unity has and has a live debugging system. Having the code block system reduces the complexity of the coding element of game development making it less overwhelming to new developers exploring game development. Unreal also does not have a complex UI that is very easy to navigate and easily picked up by new developers.

UE4 or unreal engine 4 is the version that will be used to create this project, due to UE5 still being developed by epic games and not compatible for full development due to many bugs errors and compatibility errors. “UE4 has a major feature which is real-time global illumination using voxel cone tracing, pre-computed lighting was eliminated” (Ramiz Salama, 2021). This means that games can simulate indirect light reflected by objects placed within your scene.

Overall Unreal is amazing for graphically intense performance games, that uses high quality assets with large amounts of polys and large asset packages with a simple code block style to develop on. Unity supports many more platforms almost every new product that is released to the market that other games engines don’t support. Unity also doesn’t seek any royalty on the earnings of the game once released.

# Conclusion

VR gaming can change the way people can train and work out while having fun and this can be done through fitness applications.

More fitness applications are being developed and have entered the market through VR and only a few have been mentioned above, each game has some sort of fitness element incorporated into its gameplay. Some games do this passively such as Beat Saber and don’t sell as a fitness game meanwhile games like creed target that fitness element of the game.

There are many positives for VR only some have been mentioned such as that VR workouts are more addictive due to the engagement the games provide. Allowing users addicted to a fitness game allows users to become physically healthy and prevents diseases/disorders and passively enhances motor skills without focusing on each skill independently.

Unreal will be the chosen engine due to the fact of how well Unreal handles with large asset packs. Unreal is also known for how well they it deals with graphically intense games with rendering speeds, and with the simple code block style of coding development will speed up overall.

Many workouts can be done within VR however finding the most suitable workouts without the user hurting them self’s, is the key on making a successful fitness application.

VR fitness is a new generation of workout routines that can be done directly from your home in an engaging and fun manner. With the research provided VR fitness applications can help users lose weight via various games provided with the headset

# ***Chapter 3 – New Ideas***

## Introduction

*Chapter 3* will detail the methodologies that will be used within the lifecycle of the project, the task and deliverables which establishing what the key points of development and how it will be done, the time plan which displays the lifecycle of the development in a Gantt chart design, understanding the key risks that could occur and how to mitigate them, the key aims and objectives and when they need to be completed by, and finally the project planning document which will display some ideas that could be used within the actual VR project shown through multiple figures.

## Tasks and Deliverables

These deliverables are tasks that the developer will need to carry out to complete the project. These tasks will be used to create the Gantt chart and provide the developer a time frame on when each task will be completed by this will stop nay unseen events that can occur during the project.

### Deliverables

|  |
| --- |
| * Project planning document submission |
| * literature review submission |
| * Researching existing products currently in the market |
| * Researching fitness workouts that can be done in VR |
| * Researching assets that can be used in the application |
| * Summarizing research notes |
| * Ui design of the application |
| * Architecture design |
| * Creating models such as use case, class diagrams and activity diagrams |
| * Summarizing and checking models |
| * Using questionnaires to discover what people want from a fitness application   (Making questionnaire) |
| * Uploading questionnaire online |
| * Summarizing results |
| * Making assets using 3ds max such as props and animations for props or avatars |
| * Establishing a VR environment such as connection with the Oculus headset |
| * Downloading assets from marketplace or personal files and adding them into the   project folder |
| * Adding in animations to avatar/mannequin |
| * Setting up settings, workout, and free roam menu |
| * Setting up individual rooms for the 3 workout options |
| * Adding in users’ area to work out in |
| * Adding in mini games inside the free roam area with a score system |
| * Finishing prototype 1 |
| * Testing the applications using unit tests, functional tests, and testers |
| * Fixing bugs and errors that have been shown through testing |
| * Prototype 2 finalization |
| * Complete the final year project document |
| * Submission |

## Time Plan

### Gantt Chart

**CHANGE:** Gantt chart allocates appropriate amount of time for each development task, though no time has been assigned for writing up the report at the end.

Total duration (weeks): 25

## Sources of Information and Resources Required

### Sources of Information

#### Stack overflow

Stack overflow can help developers with errors, bugs, or ideas to make their code work or finding an easier way to code a specific area. This will be used if an error occurs through out this project as developers can post their issues the answer isn’t there.

#### Supervisor

The supervisor can help keep the project on track by setting weekly meetings as well as helping with any issues or new features that can be added into the application.

#### VR lectures

Using lecture material from third year VR module can help throughout this project, with additional features, setting up an VR environment correctly and 3ds max tutorials.

#### Unreal forums

Unreal forums can be used for new ideas and functionality within this project. This can also be used to fix any bugs or glitches within the actual software this can be found by the community posts. Unreal forums can also be used for tutorials or learning new tools and techniques that other users have found while using the software, this then can be introduced into your own projects. This also can be used to create focus groups to discuss a specific topic so for this case a fitness application.

#### Social media platforms

Social media platforms will be used to share w-questionnaires or creating a community to share and discuss new ideas or giving the community updates on the games progress. These communities can help the developer in the long run as these people can test the game when the alpha version of the game is ready to play.

### Resources Required

#### Desktop pc

A high-end desktop is required for game development especially for VR development. The reason for this is that high end desktops allow faster compile times. PCs (personal computer) can render the application with fewer lag spikes and bugs and can handle larger assets that laptops may struggle dealing with. “If you have not worked on games before, you should consider upgrading to a gaming-specific desktop, which will have the highest CPU, storage, and graphics speed” (Spezzy, 2022).

#### Oculus quest 2

The oculus quest 2 is the latest addition to the VR family that is affordable compared to other headsets in the market. The reason this was chosen is that it does not require any external sensors that need to be placed around the room. Another reason for this decision is that most VR headsets require a high-end PC to run. The oculus is a standalone device that doesn’t require a PC to run.

#### Unreal engine

Unreal engine 4 is the software that will be used to create this application.

#### Epic games market store

Epic games store is an asset marketplace where developers can buy or download assets to use in their application. Assets like avatars, music, props and many more packages are available. Some are free to download, meanwhile some are paid.

#### 3ds max

3ds max can be used to create assets and animations for props and avatars for the application from scratch using polygons and meshes.

#### Microsoft Word and Excel

Microsoft word will be used to document and plan this project, and the use of Excel will be to create the Gantt chart for this project.

## Project Risks

Key

Severity–High–Medium–Low–Acceptable

Likelihood–Likely–Possible–Unlikely

Risk impact–High–Medium–Low

### Data Loss

The likelihood of this happening is possible. Data loss can occur in numerous ways, from technological error or by human error. The severity level of data loss is unacceptable. The reason for this is the fact of restarting a whole application or not frequently backing up, causing to return to an undeveloped document or application. This makes the risk impact of data loss high. Making sure data is saved correctly within the hard drive of the computer or external sources such as the cloud or an external hard drive will prevent data loss or corruption. Backing up work after iteration will help get back on track if an occurrence of corruption occurs.

### Time Management

Time management is a risk that requires attention throughout this project. Planning each task precisely will allow this project to be completed within the time frame that has been set. Issues such as not hitting each task within the duration given can cause numerous issues, such as not having enough time to complete other tasks within the project. This causes the severity level and the risk impact high. The likely hood of this happening is possible. The reason for this is that unexpected delays can occur, such as illness or the task was harder than expected to complete. A way to prevent this from happening is by giving each task a realistic time frame, a Gantt chart or external software, such as Trello, can allocate a realistic time frame for the completion of each task. Trello is a program that allows users to plan out tasks and displays which tasks require priority and more time to complete.

### Technology Error

Technological error such as not having the right equipment to support the software or not having the software accessible can cause a high-risk impact and severity issue. The reason for the high evaluation is because the project will stop and cannot continue developing the application. The likelihood of this happening is possible since certain software such as unreal can only support certain CPUs and graphic cards within the computer due to the rendering issue when developing the application and handling large asset packs or polys.

### Large Project Scope

### Clients not available for testing

Testing is an important part of any application not having testers available can cause many hidden bugs or issues from being revealed. This is a medium risk impact and severity level the reason for this is because unit tests and functional tests will be done by the developer so most bugs and glitches can be found. Likelihood of testers not available is unlikely the reason for this is because testing the application can be quick, however anyone can test an application to provide feedback and many people on reddit or other forums are willing to test and give feedback on any issues within the application. Preparing these links by making pages on forums in advance can prevent the issue of testers being unavailable and starting a community that are willing to do the tests when the application is ready.

### Cost

## Planning Document

### Game Overview

The purpose of this application is to allow users to lose weight in a fun and interactive manner.

### Game Structure

The game contains 4 levels or floors this can be accessed through the main menu. When the user enters a workout room, mannequins will be present with a button and a timer. The user will interact with the button what will start the animation showing the user how the work out is done. Once the user is ready, they start the timer, the user performs the workout until the timer is done then moving onto the next workout. Once they finish their workouts, they can input their weight and how many times they completed the circuit. A difficulty setting will be implemented based on the fitness level of each users both workouts will increase difficulty gradually when the next level is selected.

The free roam section will implement games that don’t target a specific muscle group or a set cardio plan. This is perfect for users who do not have the time to complete a full workout that’s been set out for them.

### Reward Mechanism

At the end of each workout the user will be able to enter their weight the application will be able to keep track and present a graph to the user showing them their progress. This refers to the cardio section of the application. In the free roam each game will have their own score system that will be awarded based on the user’s performance.

### Safety Mechanism

As the oculus has a system where the user can draw a grid or an outline around the area, they are playing in the game will automatically stop the game when the user goes out of bounds. This will stop any injuries from taking place. Also adding in a prompt within the tutorial area saying make sure there is enough space to perform the work out will also prevent any injuries from taking place. Preventing any injuries through the workout is also a area that needs attention having an animation that shows the user how to perform the workout properly without the user injuring them self.

### Main Menu / interface Functionality

The main menu will be interacted with a pointer system located on the users controller. The user will be teleported to the level the user selects. The level choices that the user will be able to select from are the tutorial, muscle groups, cardio, and free roam.

The user will be able to open the settings by looking at the left wrist. This will open the menu up where the user can interact with, the menu will disappear when the user looks away from when wrist. This menu will include buttons that will quit the application, changing level, and turning the game volume up and down.

## Functional and Non-Functional Requirements

## Functional Requirements (FR)

### Map

* The map should allow the presence of assets
* The map should allow collisions on the objects
* The map should allow materials to be added onto the assets
* The map should contain lighting and shading
* The map should contain a floor that the layer can move around on

### Player

* The player should be able to move around the level
* The player should be able to turn around in game via movement in real life and through thumb sticks
* The game should allow the user to exit the game
* The game should only display the player no one else

### Doors

* The player should be able to push a door to open it. The door should return to its original state after a few seconds
* The door should have collisions so they can’t go straight through

### Main game

* The player should be able to click on the button. the cube should go down and up after a few seconds
* The animation should play when the button is played
* The animation should only be played once and returned to the idle state
* The timer should start when the button is clicked
* The timer should stop at zero
* The timer should restart when the start button is clicked

### Minigames

* The player should have access to the mini game section
* The player should be able to start each game
* The player should be able to play each game
* The player should be able to gain points through out the game
* The game should stop when the game is over
* The mini games should load in without any bugs or glitches

### Menu system

* The player should be able to turn on a pointer to click on a button
* The button should change colour when hovered over
* The pointer should disappear when the button is released
* The pointed should appear when the button is pressed
* The menu should appear when the player looks at their wrist
* The menu should disappear when the player should look away from their wrist
* The user should be able to click on the buttons using their index finger in game
* The button should take the user to the corresponding level
* The game should not be running in the background before the user clicks play
* The game should load the player to the home menu

## Non-Functional Requirements (NFR)

#### **Frame’s rate & response time**

“VR setup that generates frame rates below 90 frames per second (FPS) is likely to induce disorientation, nausea, and other negative user effects. The lower the frame rate, the worse the effects.” (IRIS VR part of the wild, N/A). Because of this the minimum FPS rates should not go below 90 frames this can be tested through the game engine when laying the game. The response time for the controllers’ buttons should not exceed more than 3 clicks to perform the action that its intended to do. The rection time for these clicks to perform the action must be less than 0.7 seconds as well as the maximum time cannot exceed 3 seconds.

#### Usability

All buttons within the application should not exceed more than 3 clicks to perform their intended action as this can ruin the user’s experience. This can be achieved through usability testing and functional testing. All interactable items and games must perform as intended as any small issues can ruin the users experience.

#### Required resources

As this game is made for the oculus quest 2 the user will not need any additional PC with specific specifications. This game is compatible with other VR headsets such as the hive as this headset uses a PC to run their games. so, this game can be run on any headset that can uses a PC and the quest 2 as its primary host.

#### Platform

As the oculus quest 2 uses and android platform the game cannot be run on any other VR device as other headsets uses windows will have a separate build that can be deployed onto Side quest or steam to run using a PC. This can be tested by building the application as windows and running it on the quest as a plugged-in device instead of a stand-alone application supporting the quest 2.

#### Maintainability

The code that has been written for this application must be organised correctly this refers through proper file names, labelling each section of code, labelling blueprints correctly and correctly organising the assets used. by completing these tasks, the application can be easily assessed and maintained through a third-party service or another group. As this will avoid any confusion and issues with the application.

This application uses the unreal code block system that uses the framework from C++ this will shorten the development time of the application. This also makes it easier to understand what’s happening with each section due to the visual aspects of the system.

#### Observation

This non function requirement is based on keep track of the application that’s being made such as any bugs, errors or issues that have showed up through development. A log or table must be created to keep track on what the issue was and how it was solved. This will prevent any issues in the future if the same error or bug happens again. As well as having backups will prevent any data loss from occurring and will prevent developers from starting from scratch.

#### Security

This application will have permissions the reason for this is that we will need permission to hold and use this data to present graphs and other features that the user will use in this applicaiton. Making sure all data is confidential and requires authentication when accessed will prevent any unauthorised people from viewing the user’s data. There are many ways to prevent leaks or unauthorised access such as having the data encrypted.

#### Testability

The application will carry out functional, unit and user testing. With these tests this will bring out any errors or bugs that are missed during the development stage. Functional tests will test the functionality of the application. unit testing will test if there are any issues with a selection of code and user testing will take place during the end of the development stage where users can try and play the application a report on any changes that is required when playing the game. the unit and functional tests will be carried throughout the application making sure everything is working as intended.

# ***Chapter 4 – Implementation***

# Methodology

The methodology that has been chosen from this project is Agile. “The Agile methodology is a way to manage a project by breaking it up into several phases” (wrike, 2021). The reason Agile is the chosen methodology is because if anything goes wrong the developer can easily go back to the previous stages of the project. This allows additional features to be added or changed. This will give the flexibility to go back and still complete the work by the deadline and not worrying about having to restart.

# jkjkjjjjj

# ***Chapter 5 – Results and Discussion***

## Introduction

## Challenges Encountered

## Legal, Social, Ethical and Professional Issues

### Legal Issues

This fitness application must not breach any copyright laws, assets used within this application either are made by the developer himself or bought from the creators them self. These assets must not breach “The Data Protection Act” (GOV.UK, 2018) and follow the principles that they use. The user will not need to enter any private or personal data they don’t want to add however an option will be there for the user to add their weight to the application. Product reviews will be stored safely with a participation from that is signed and dated by the review these reviews will be anonymous and stored by a password locked folder. Data that participants provided will be deleted when the participants request to, and copies of the data will not be made or stored elsewhere. The rating system determines the age group that is suitable to play the game. “The PEGI rating on a game confirms that it contains content suitable for a certain age group and above” (Ask about games, 2021). This is determined by the content the developer shows of the game. “The Computer Misuse Act (CMA) was drafted in 1990 as the law governing the way that individuals can lawfully access data on a machine” (McCallion, 2022). By following this act not letting anyone who doesn’t need the reviews of the public will not gain the access to this information. This also includes the developer’s actions accessing the user’s information that they enter on the application will not be read or used by the developer unless access has been given from the user. Making sure the users data is secure from malware attacks with the use of anti-virus/ malware software.

### Social Issues

This application must have content suitable for the rating that it receives. Making sure all routines can be done safely from home without the user getting hurt or presenting a tutorial to show how the workout is done properly. The game should not present any inappropriate content that is not related to the topic on hand. This application main goal is help people lose weight from their homes so this will benefit anyone who are willing to lose weight in a fun and engaging manner that tracks the user’s progress. This game will require having space since most routines either require the user to lie down on the floor or performing erratic actions that can accidently hurt themselves from their surroundings. Making sure the user has enough space can prevent this from happening. This application will also work on skills such as patience, resilience and habit forming. However, this also helps the user with many health benefits such as improving circulation and strengthens your heart preventing many diseases like heart disease.

### Ethical Issues

This application should not breach the BCS code of conduct. “Conduct your professional activities without discrimination on the grounds of sex, sexual orientation, marital status, nationality, colour, race, ethnic origin, religion, age or disability, or of any other condition or requirement” (BCS, 2022). Discrimination is a massive issue that if breached can cause many ethical issues and will stop user from playing the application so keeping the application suitable for everyone will please all target groups and communities. The controls used for the application must be basic that all age groups can easily understand and use the game for their benefits. The Virtual Reality should not be used by people who suffer from motion sickness or Cybersickness. ““Cybersickness,” a form of motion sickness associated with VR headsets, is also known to occur when there is a mismatch of visual information and known body position” (Canadian Association of optometrists, 2022).

Researching the existing games on the market will show key features that can be implemented in this application. Researching elements of games that allowed them to become successful should allow the application to keep the users attention and engagement while playing. The rest of the research will be designing and finding assets that do not discriminated against any communities or groups that may use this application.

### Professional Issues

As this application is a fitness application many workouts will be avoided as they are not practical to do in VR such as jumping jacks. This will be dangerous as the user can lose their Barings and hurt them self and the environment, they are in. what will question the developer’s choices.

Making sure that the research done within the workouts must be precise the reason for this is that the level systems must include everyone, for example people who can’t perform a push up and someone who can perform 50. This covers the BCS act of discrimination because this application will allow all user with different abilities to use the application what will overall increase the target market for the application. Having beginner setting will change this issue and won’t bring the developers professional issues to question as this is a serious matter.

**CHANGE:** One area perhaps missed in **ethical** issues is communicating to the participant the nature of the study.

# ***Chapter 6 – Conclusions and Future Work***

## Project Conclusions and Summary

## Future Work

## Project Limitations

# *References*