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SCHOOL OF SCIENCE AND TECHNOLOGY

Healthify

by

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in

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of the requirements for the degree of
Bachelor of Science with Honours
in
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ABSTRACT

Health related diseases have been increasing over the years due to a lack of exercise and people living unhealthy lifestyles. Although research has been conducted to tackle this issue, statistics show that the problem is still prevalent in today's society.

This work introduces a solution in the form of a smartphone application which aims to improve the overall well-being of individuals through tackling a key cause of unhealthy lifestyles.

The solution implemented is successful in that it provides users all relevant information they will need to improve their well-being and live a healthier lifestyle. The application further assists with dietary planning and ways of weight-watching whether it's losing or gaining

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The focus of this project is to promote a healthier lifestyle through a smartphone application by encouraging individuals to exercise more and help to implement healthy habits in their lives.

Over the years, technology has greatly improved and made lives easier. Technology is being used in nearly every sector, from construction to medicine, and by every kid, teenager, and adult in their daily lives. However, technology has a lot of negative impacts associated with it; excessive use of technology is making people lazy, making them less active and affecting their well-being. For this reason, technology is known to be pervasive, however in the past few years, innovative ways of using technology to benefit people's well-being have been sought. The lack of exercise in our society has led to an increase in a lot of health-related diseases/illnesses such as heart disease and obesity, as well as playing a big role in other medical conditions. As a result of this, there are now countless smartphone applications and many fitness equipment (i.e., smartwatches) made available to people in the hopes of helping them stay healthy and improve their overall well-being.

Unfortunately, even with this growing innovation of resources and research being conducted to find more efficient ways to improve our health, statistics (refer to Figure 2) show that obesity is still increasing over the past couple of years instead of decreasing. This suggests that, although there are now advanced technical resources in place to benefit people, these are mostly used

by those who already engage in physical activity. Through my research, I have found that the general populace does not interact with or use these resources. I speculate that the main reason for this is how the average person would not know how or where to start getting into exercising, as they lack the relevant information regarding a healthier lifestyle. Another reason could be lack of motivation, which can also be linked with the first reason; as they do not have all the information available to them, they will therefore struggle to find motivation. This results in many people giving up on trying to achieve a healthier lifestyle after only minimal browsing.

1.2 Aims and Objectives

This project aims to develop a smartphone application which will encourage and help motivate individuals to live a healthier lifestyle. It will contain all the necessary information they will need to improve their well-being, such as: various types of indoor and outdoor exercise; how to monitor one's weight; managing calorie intake, and other beneficial healthy habits. It will focus on different ways to keep the users motivated and engaged over time, helping them to reach their goal of living a healthier lifestyle. The project will take inspiration from popular fitness applications, and will look to improve on the features already available by developing a solution which will aim to focus on the areas they are lacking in.

The roadmap to the rest of this document, Chapter 2: Context will analyse existing research and solutions promoting a healthier lifestyle. It will also identify the limitations of the current solutions and how to overcome them. The following chapter, Chapter 3: New Ideas will propose a new solution, taking research conducted in the previous chapter into consideration, by building upon and improving strong features identified in Chapter 2. Chapter 4: Implementation documents the process of designing and the implementation of

the proposed solution. Once the proposed solution has been implemented, Chapter 5: Results/Discussion will analyse and discuss the results of testing and evaluation carried out on the implemented solution. The final chapter, Chapter 6: Conclusions/Future Work reflects on what has been learnt and summarises the success of the project, in addition to briefly discussing any potential improvements and/or future work.

CHAPTER 2

CONTEXT

2.1 Introduction

This chapter will present and discuss the research conducted on the topic, and any existing solutions that promote healthier lifestyles. The literature is then analysed and examined to further identify any limitations with the current solutions.

2.2 Literature Review

The project will tackle physical health issues in the UK due to a lack of exercise. According to research by the NHS (July 2012), a lot of health issues in the UK are due to a lack of exercise which is "as deadly as smoking". It has been estimated that "one in 10 cases of heart disease" (10.5%) and "just under one in five cases of colon cancer in the UK" (18.7%) often can be due to lack of exercise. In 2008, inactivity caused more than 5.3 million of the 57 million deaths estimated worldwide (NHS 2012). Lack of exercise can also cause the bones to become weak, increase risk of diabetes or induce hypertension (Kristin Davis, n.d). However, over the years, health issues relating to a lack of exercise did not decrease; obesity being one of the main concerns. Obesity is a medical condition where a person is overweight and carries an unhealthy amount of body fat which severely impacts their health. In a very recent article by the NHS (May 2019), during 2017/18 there were 10,660 patient admissions who had illnesses directly relating to obesity, and 711,000 where obesity was a "primary or a secondary diagnosis" - which is very similar to statistics recorded in 2016/17 (10,705). Obesity was more common in female adults than it was in male

adults. For every 4 patients, 3 were female (74%) for illnesses directly relating to obesity, and around 2 in every 3 (66%) for illnesses that had some relation to obesity. The statistics show that obesity was commonly found in adults aged between 35-64.

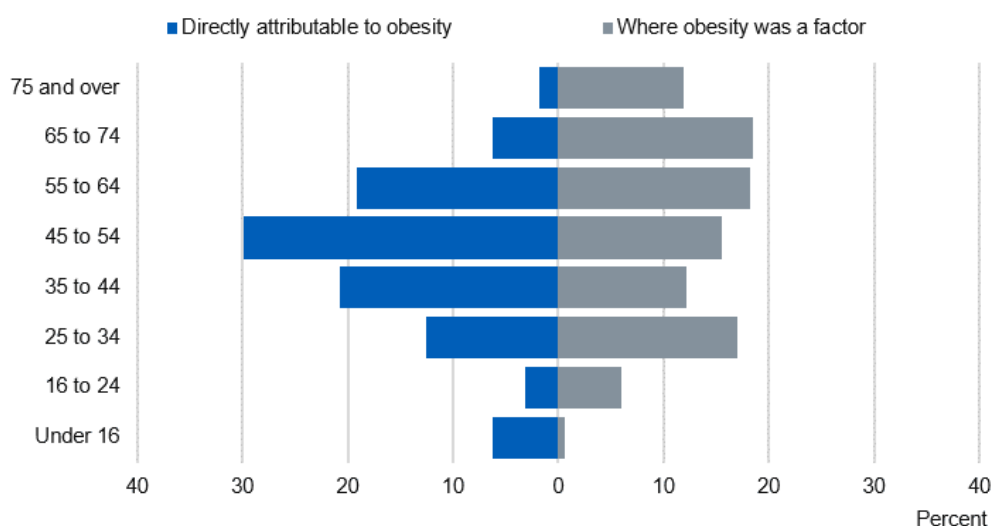


Figure 1: Adults Affected by Obesity

"The majority of adults in England in 2017 were overweight or obese (64%)" and the percentage of obese adults was "29% higher than in recent years" (NHS 2019). The percentage of obesity increased "steeply between 1993 and around 2000" in England, however, the rate of increase became slower after that.

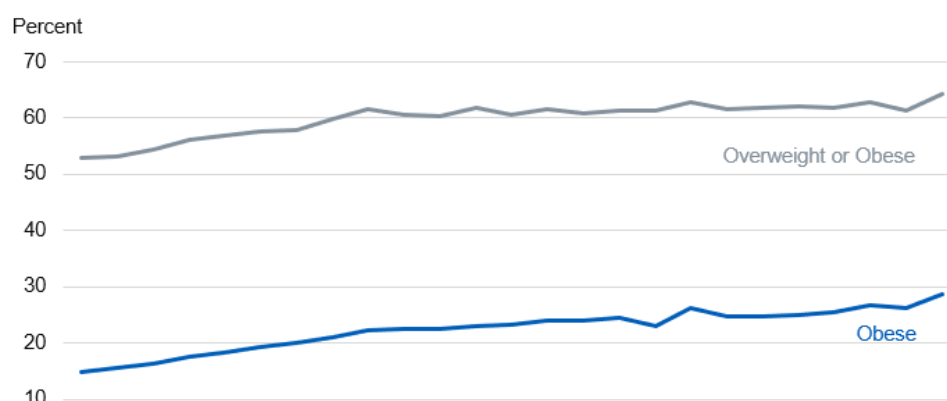


Figure 2: Rate of Obesity Over the Years

This suggests that despite the NHS knowing about this increase in obesity throughout the UK for a very long time, and researchers coming up with solutions to try and tackle this issue, they could not decrease the number of patients being admitted into hospitals due to obesity; instead, the numbers were gradually increasing with time. Nonetheless, they did manage to slow it down in recent years. The research showed that not only adults are at risk of being diagnosed with physical health illnesses such as obesity, but young children too. The same article stated that in 2017/18, prevalence of obesity in year 6 children has increased by 1% compared to 20.0% in 2016/17 (Fig.4). For children in reception the percentage did not change much and was “similar at 9.5% in 2017/18” (Fig.3). However, compared to 2006/07, the percentage is lower for children in reception but is higher for kids in year 6 (NHS 2019).

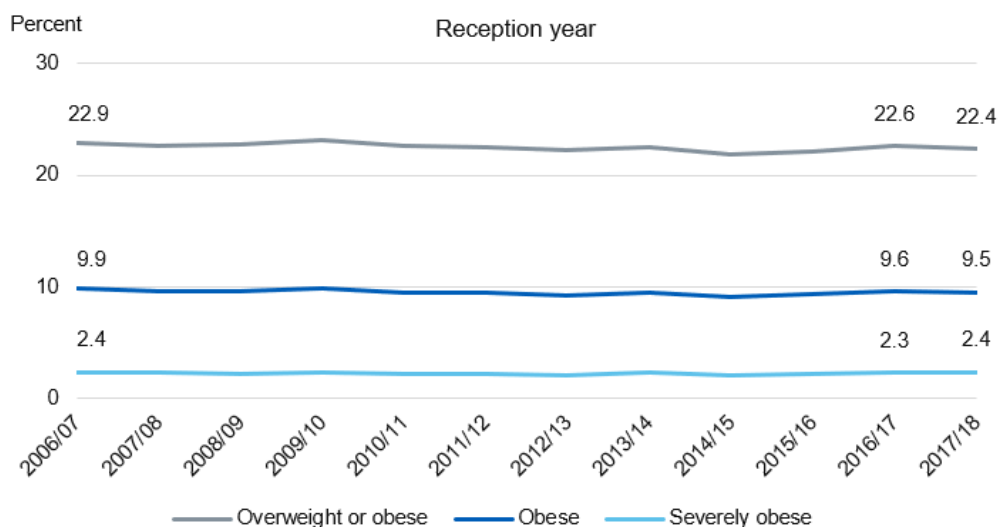


Figure 3: Kids in Reception Affected by Obesity

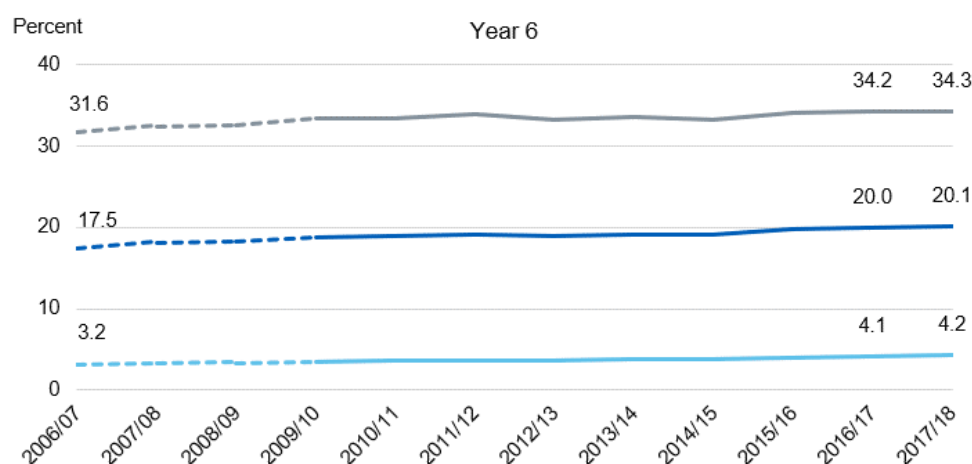


Figure 4: Kids in Year 6 Affected by Obesity

2.2.1 Health Risks Associated with Obesity

If someone is even 40% overweight, they are “twice as likely to die prematurely” when compared to a person of average weight (Robert 2017). This is because obesity is a serious health hazard which has huge potential to lead to other health complications. Some of the more serious health conditions include heart disease and stroke, high blood pressure, diabetes, cancer, gallbladder, gallstones, and breathing problems such as asthma and apnoea to name a few. Heart disease and stroke are known to be the leading causes of death/disability according to research done in the U.S (Robert 2017). Being overweight can increase the risks of high levels of cholesterol in the blood, which often leads to heart disease. It can also lead to angina (pain in the chest induced by a decrease of oxygen to the heart) and sudden death. Type 2 diabetes is one of the two major types of diabetes; as well as being a leading cause of early death, it also causes heart disease, stroke, and blindness, which reduces the body’s ability to control blood sugar. Being overweight can increase the risk of developing Type 2 diabetes by twofold. Gallstones are small stones in the gallbladder. In most cases, they do not need to be treated; however, if one becomes lodged in an opening in the gallbladder, it can cause excruciating stomach pains. Gallstones are very common in the UK, as it is estimated that

"more than 1 in every 10 adults in the UK has gallstones" (NHS 2018). Research shows that individuals who are most likely to develop gallstones are both overweight/obese, and female of years 40 (and over). According to cancer research UK (2018) "more than 1 in 20 cancer cases are caused by excess weight" in the UK and being overweight/obesity is the second most prevalent cause of cancer. There are many types of cancer which are caused by excess weight, such as: breast cancer (in women), bowel, womb, kidney, liver, meningioma (a type of brain tumour) etc. Men are more likely to develop colorectal cancer and prostate cancer. This includes breast and bowel cancers which are the most common types of cancer, and pancreatic, oesophageal and gallbladder cancers, which are the most difficult to treat (Cancer Research UK, 2018). Increasing one's daily intake of physical activity can help reduce their weight, which will in turn decrease their chances of developing any diseases forementioned.

2.2.2 Solution to Obesity Epidemic and Benefits of Exercise

There is no simple solution or fool proof strategy in preventing diseases such as obesity; as it is a very complicated problem, a multifaceted approach must therefore be taken. Contrary to what some people may think, the key to "maintaining a healthy weight isn't short-term dietary changes; it's about a lifestyle that includes healthy eating and regular physical activity" (Centers for Disease Control & Prevention, 2019). Patients of such diseases are also advised to "lose weight safely by eating a healthy, balanced diet and regular physical activity" by their GPs (NHS, 2019). To lose weight at a safe and healthy rate, people are advised to reduce their daily calorie intake by 600 calories. The exact amount will vary between men and women - for men, they are recommended to consume a maximum of 1,900 calories per day; for women, 1,400 calories per day. A healthy diet should include lots of fruit and vegetables, plenty of starchy

foods (such as bread, rice, pasta etc), milk/dairy foods, non-dairy sources of protein (such as fish, meat, eggs etc), and small amounts of food or drinks which contain high fat and sugar content. It is important not to consume foods which contain high levels of salt as they can raise blood pressure, which can be dangerous if you are already obese. However, it is advised to avoid fad diets and trends as they are unsafe and could make you ill. Managing your calories intake will help you to lose weight, however maintaining that healthy weight will require you to do some physical activity to burn energy. According to NHS (June 2018), exercise "can reduce your risk of major illnesses, such as heart disease, stroke, type 2 diabetes and cancer by up to 50% and lower your risk of early death by up to 30%". Physical activity isn't only beneficial for those who wish to maintain a healthy weight, but "it can help prevent and manage more than 20 conditions, such as reducing the risk of type 2 diabetes by 40%" (NHS, 2019). It is recommended by the Chief Medical Officers for an adult to do a minimum of 150 minutes of activity a week (moderate intensity). Brisk walking, cycling, and dancing are all examples of moderate-intensity activity, where the activity increases your heart rate. Alternatively, to push yourself further, you could do 75 minutes of vigorous-intensity activity every week, where your heart rate increases significantly accompanied with heavy breathing. Examples of vigorous activity include: running, jumping rope, most competitive sports, hiking uphill, etc. To prevent obesity, it is recommended to exercise longer each day so one does not regain weight. 45-60 minutes of moderate-intensity activity a day is recommended to prevent obesity, and 60-90 minutes of activity each day is recommended to avoid regaining weight. Parents are advised by the GP that "children over the age of 5 should ideally get at least 60 minutes of vigorous-intensity exercise a day" and idle activities such as playing games or watching TV should be restricted (NHS, 2019). According to research, it is medically proven that people who do regular exercise have an up to 35% lower risk of coronary heart disease and stroke; 50% lower risk of type 2 diabetes; 50%

lower risk of colon cancer; 20% lower risk of breast cancer; 30% lower risk of early death; 83% lower risk of osteoarthritis; 68% lower risk of hip fracture; 30% lower risk of falls (among older adults); 30% lower risk of depression, and 30% lower risk of dementia (NHS, 2018).

2.2.3 Health and Technology

People have become less active in the modern age, partly due to technology as it has made our lives so much easier. On the other hand, technology has also been beneficial to us as it has played a huge role in improving healthcare and revolutionising the way we exercise. Some of the benefits that technology has brought to healthcare include better treatments and equipment, which enabled doctors to provide better care and help treat long-term illnesses thus improving the quality of life for many people. Better equipment has also allowed doctors to research medicine more efficiently, which has helped to discover treatments for some life-threatening illnesses. Technology has allowed physicians around the world to share their findings and research, and patient records are stored into cloud databases which makes viewing in-depth medical information on patients widely accessible to doctors. Furthermore, the use of new and advanced software has led to identifying diseases more rapidly and disease control possible. This has allowed the World Health Organization [WHO] to classify illnesses, alongside their causes and symptoms, into a massive database which has "more than 14,000 individual codes" (Awais dar, 2018). This data can then be accessed by medical professionals and researchers, allowing them to control diseases and improve overall healthcare.

2.3 Current Solutions

Technology is also playing an active role in promoting exercise. These can be found in the form of: exergames, wearable technology, and mobile applications.

Exergames were mostly targeted at children and teenagers, who are known to spend most of their free time playing games instead of going out; but now, it also attracts adults as there is an improved variety of games that target this older age group. However, exergaming is not the cure for an inactive lifestyle - it is but a means to motivate those who do not undertake any form of physical activity to do exercise. The engaging nature of the game makes it enjoyable for everyone, which is perfect for people who struggle to get any exercise done because they have a mindset of only thinking about how tiring and exhausting it will be. But with exergames, their mind will be occupied in the game, focusing on how much fun they are having rather than how taxing it is - thus making exercising both mentally and somewhat physically easier. Exergames also helps to burn as many (if not more) calories as brisk walking and can be beneficial to those who have been diagnosed with type 2 diabetes or obesity. Moreover, these games allow interaction between players, such as family or friends, which further helps to motivate the individual.

2.3.1 Exergames

Dance Dance Revolution (DDR) is very popular, and one of the best examples of exergames. It is a perfect alternative to outdoor physical activities such as running, cycling, and swimming. DDR is available on the console, and can be played using a dance pad/mat. It also has a workout mode where the user can choose from either workout time or calorie burn mode. Workout time allows one to have a session which can last up to two and a half hours. There are different difficulty modes the user can choose, ranging from beginner to intermediate and advanced. The calorie burn mode allows the user to pick the number of calories they would like to burn during that session. It's recommended to select somewhere in-between 300-750 calories. During each stage in the game, it will display how many calories the user has burned (or the session time remaining) and will also display the equivalent distance of how much you would have run.

Wii Sports is another great example of an exergame, which was produced by Nintendo for their console, Nintendo Wii. It included five different games: tennis, golf, bowling, boxing, and baseball, which can be played using a wireless, handheld controller that detects the player's movement and mimics them. For example, in the baseball game, the user will need to swing their controller to manoeuvre the baseball bat, as well as timing it correctly in order to produce a direct contact with the ball on screen. Although Wii Sports will not help players burn as many calories as playing an actual sport, it can certainly help them to remain fit.

2.3.2 Wearable Technology

Wearable technology has also started to become a trend which helps to promote exercise, i.e. smart watches. These have many features, including pedometers and accelerometers. Pedometers count and monitor the number of steps you have taken throughout the day, during activities such as walking or running. Accelerometers record the body's acceleration per minute, providing a detailed report on the frequency of one's heart rate. This monitoring of an exercise's intensity is very useful for athletes or people in cardiac rehabilitation programs. Wearable technology, such as smart watches, provide different features depending on their manufacturer, which gives the consumer a wide scope of exercise options to most suit their routine. Examples of smart watches which promote exercise include Honor Band 4, Xiaomi Mi Band 3, Germin Viviosmart 4, Fitbit Charged 3 and Polar Vantage M and V. Honor Band 4 and Xiaomi Mi Band 3 both provide basic fitness features such as monitoring your step count, distance travelled, floors climbed and calories burnt. Some versions of the watches also include built-in heart-rate monitors, which helps monitor whether you're within the fat burning zone or not. They also have built-in GPS or, like most watches, have the ability to get GPS data from your phone. Motivational reminder features serve helpful, as the smart watch will vibrate to remind you to

start moving, and additionally provides the ability to set goals (e.g., step count). For people who have unhealthy sleeping habits, there is a sleep tracker which will help you monitor whether you are getting enough sleep. Polar Vantage M and Polar Vantage V are more advanced options, and therefore include extra features compared to other smart watches. These watches include a barometer and recovery measurements to ensure you are not overtraining (or if the training is not intense enough) by monitoring the intensity, volume, and frequency of the exercise. These features provide one with more in-depth running data to help one develop a balanced and steady running style, through giving information on: ground contact time, balance, stride length, cadence, and vertical ratio. Moreover, jump and orthostatic modes are included where the device tests the strength of your leg muscles, and displays your heart rate in correspondence to your movement. Lastly, these watches provide analysis on training load, and how challenging a session is compared to other workouts previously completed.

2.3.3 Active Notts (Website)

There are a lot of solutions available both online and on mobile which promote exercise and a healthier lifestyle. For example, 'active notts' is a website which contains information on every sport/physical activity to aid people with their health issues. It allows the user to search for the sport by typing the name of the sport in the search bar; alternatively, they can search for sports which might help them with their certain health conditions. For example, they can type 'Mental health' in the search bar, and the website will display every sport which can be beneficial for people struggling with mental health. When the user clicks on the sport, the website displays an overview of the chosen sport - this is very useful for anyone who is not familiar with the sport. It also displays the benefits of this chosen sport; any costs the user may need to take into consideration (e.g., equipment, kit etc); how to get involved/started; equipment the user will

need, and interesting facts about the sport. At the bottom of the page, users can search for opportunities available in their local area (or within their chosen radius), where the website will display all the clubs/facilities available for the sport. The user can filter the search result by date, gender, skill level, age range, family friendly, disability etc. When the user clicks on the club/facility, the website will then display a brief description of the club, their contact details, and its location. The website does not just contain information about all types of sports, but physical activities as well. It displays a variety of activities, from: chair-based exercises, walking, gardening, yoga to crossfit, dance, Qigong etc. When the user clicks on activities, the process, and options they are given are the same as when they click on a sport, letting them search for opportunities and interact with filters etc. This website is great for anyone wishing to get started with playing a sport, having no prior knowledge on it.

2.3.4 Smartphone Applications

Mobile applications play the biggest role in revolutionising exercise, because mobile phones are the most commonly used and easily accessible piece of technology available today. This vast usage gives exposure to an incredibly large and diverse audience, which can be influenced through applications and adverts. According to Lauren Pufpaf (2019), since the launch of the iPhone in 2007, fitness apps have grown exponentially, with “nearly 320,000 health and fitness apps in the app stores in 2018”. There are all types of fitness applications available for free which offer similar features (and more) to smart watches and other fitness technology available. There are apps which allow you to track and monitor your sleep, plan your workout sessions, provide analysis on progress, track your calorie intake, audio-based workouts, and more. The majority of these apps are free of charge, allowing anyone interested to take part. For example, there are apps which create daily/weekly workout plans for you, and act as if it’s your personal fitness instructor. These applications are very

beneficial to those who cannot go to the gym because of their financial situation, or those who do not have such facilities locally.

2.3.4.1 Find a Player

'Find a Player' is a mobile application designed to help encourage people who are not part of any sport clubs to get involved, by helping them find new clubs they can join for those interested in playing weekly at a competitive level. However, for players interested in playing in their spare time as a hobby, 'Find a Player' allows the user to find local players for their team (i.e., 5-a-side football match or any sport) if they are short on numbers, and vice versa (they can join a team for a quick game of their chosen sport). The user can approve or decline applicants by viewing their application. This is possible as users can create their own profile where they include brief information about themselves, which also allows others to add the user as their friends. 'Find a Player' also lets the players rate one another, which allows for other users to determine someone's skill level. This makes things easier for users to review applicants. This application process is not solely targeted towards individual players, but to organisers and clubs too, as it allows them to register their clubs, advertise sport events, and recruit players or teams. 'Find a Player' also has a message feature where the user can talk to a player individually or create a group chat. This application is available on Android as well as IOS devices. This is great for people who do not have a lot of free time but wish to play their favourite sport as a hobby and not regularly. This application provides the opportunities to join someone else's team or make one whenever they wish to play, becoming another great way to get friends and families involved.

2.3.4.2 Playwaze

Playwaze is a great app for encouraging people to get involved in a sport. It allows organisations to provide opportunities, such as setting up and managing local, regional and/or national tournaments. Sport team owners can also create an account and register their team, so they can manage and have a means to communicate with all the players at once, making it helpful in collecting payments online, and creating sessions and competitions. There is also a feature which provides you with analysis and a report on participation data. Users can see the progress their players are making through their coaching, as well as organising fixtures between other teams or arranging quick matches. The users can also share video clips, photos, or any other information on the news section. This application is versatile in that users can choose to manage their teams and competitions via Playwaze's website in addition to the mobile version, so they do not necessarily need to do everything on the application. Playwaze is great for universities and schools in helping to promote sports for youth.

2.3.4.3 MyFitnessPal

MyFitnessPal is one of the best motivational mobile applications which monitors diet and exercise. The app is mainly used for people who wish to gain or lose weight, as it logs everything you eat and drink every day (from their food database). To make sure the feedback and advice it gives to the user is as accurate as possible, it will ask for the user's information such as height, weight, their age and additional info which it will use to calculate if the user is overweight, underweight, and what type of recommendations are needed for the user to get to their desired weight. The application has a unique feature whereby after you have finished logging your food on the app, it will tell you what your weight will likely be by a certain date (e.g., in 1 month or 6 months' time) if the users food intake everyday (until that specific date) was the same. This helps motivate the user as they can visualise and see the end result before reaching it, giving them that extra push to stay motivated and focused on reaching their goal. However, if you were to skip or not focus on your calorie intake (having consumed way less or way more than indicated), it will display a warning message showing it would be dangerous if the user's food intake everyday was like that of today. MyFitnessPal also lets you add in your custom recipes which will give the app the most accurate representation of your calories intake; users can set their recipes as private or add to the public database. MyFitnessPal offers more premium features for users, but it will require built-in purchases to gain access to these. One of the premium features is that the users will start getting videos with short workout summaries containing inspirational interviews. There is also a community for the users where they can talk to fellow users, share success stories and experiences, talk about different recipes, and more.

2.3.4.4 Endomondo

Endomondo is a motivational mobile application which aims to “motivate people to get and stay active”. It is designed to track workouts, provide users with audio feedback, and offers guidance on how to reach their goal(s). It is a personal training app which also syncs with their website where the users can view their training log and analyse their fitness activity. Endomondo helps to make fitness plans for the user and sets targets for them to chase no matter what type of exercise one chooses whether it’s running, cycling, football or golfing. Once the user has set targets for their exercise, the app will give real-time audio feedback on how well the user is doing, which provides them with motivational encouragement. The application allows users to compete against themselves and, most importantly, against their friends and relatives as Endomondo allows users to share their activity with other users. Users can view their friend’s activity, send messages to help motivate or give them challenges to do. Endomondo keeps a record of the user’s activity and provides them with information in the form of graphs and statistics, which allows them to see how many calories they have burned, how many miles they have logged, and how quickly they are improving. Endomondo is free to use; however, it also has a premium version which gives the user access to more features, such as personal training plans tailored to the user’s goal and fitness level. Endomondo assesses the user’s fitness level by making them do a small induction, which helps the app to see how fit the user is currently and makes it easier to recommend fitness plans and set goals.

2.3.4.5 FitPlan

Fitplan is one of the best personal training mobile applications available, with more than 1.4 million users worldwide. Fitplan offers fitness plans made by professional, well-known personal trainers for their users, whether they wish to train at home or at the gym. Users are given step-by-step instructions as they follow daily workouts with videos. There are tools for the users to track their weight, reps, and time. There is a section called "Feed" where there is exclusive motivational content, such as other users' motivational success stories, as well as fitness and nutrition tips. There are different types of fitness plans available for all types of users, from "Power Shred" - which helps users to shred fat and gain muscles - to "Step up Strength", which helps users to tone and tighten their physique (this is targeted more towards women, featuring "booty gains" and fat loss schemes). Fitplan is also available on Apple Watch, so it can sync with the app and help users track their heart rate, reps and weight more easily. However, the downside about Fitplan is that it is a subscription-based application, meaning reduced accessibility for all as users will need to subscribe monthly or yearly to gain access to the app's content.

2.3.4.6 Pokémon Go

With time, exergames have also adapted to the current era and taken a step towards wider inclusivity of all ages in the form of Pokémon GO. This is a smartphone game that has combined gaming and adventuring with the real world. Pokémon is a famous, world-renowned Nintendo-owned franchise where humans, known as Pokémon trainers, catch, train and battle fictional characters known as Pokémon (short for pocket monsters). Pokémon Go has a unique way to encourage users to go outside more by using location tracking and mapping technology to create an 'augmented reality', which allows users to walk around the real world and interact with Pokémon characters that randomly appear on the game map. When the users are within close enough range, the Pokémon can then be seen on phone screens and the users can throw 'Pokéballs' at them to try and catch these characters. The aim for players is to try and catch as many Pokémon as they can, which vary in rarity and species depending on one's location. The in-game map is very similar to google maps, but designed in an anime-style minimalistic way, with building and street names replaced by Pokémon related landmarks. Players can fight 'Gym leaders' to get control of the gyms, but they must first travel physically to the gym's close proximity in order to interact with it. If the gym is the same colour as the team they are affiliated with, then they are able to insert their chosen Pokémon into the claimed gym. However, if it is a different colour, users can battle for the control of that gym. There is also a co-op feature which allows the players to travel with a friend, allowing users to travel around fighting other trainers or catching Pokémon together, as well as being able to have a friendly battle with each other. This level of enhanced integration mixing VR with reality generated lots of appeal for all audiences, and generally succeeded in encouraging more people to venture outside in search of exploration, getting more exercise as a result.

2.3.4.7 Glo

Glo is a very popular yoga application which offers over 4,000 classes, from yoga and meditation to Pilates, led by 50 different teachers. The users will be asked 3 simple questions when they use the Glo app for the first time, which will allow the application to personalise the type of content it provides. The teachers offer a variety of classes which benefits each user differently. There are courses for different types of users depending on their understanding, such as 'Yoga for beginners', meaning users can learn and practice yoga at their own pace, allowing anyone to do yoga regardless of whether they are new to yoga or not. Glo offers a huge variety of courses, such as 'Self-Care Through Yoga and Ayurveda' which focuses on teaching which environmental stressors cause people to be out of balance with themselves and learning ancient Self-Caring techniques to find one's physical and mental health. Or the 'Radiant Body Cleanse' course which 'focuses on cleansing, detoxification and re-mineralization through diet and yoga'. The best thing about this app is how unrestrictive it is in letting users practice at home whenever they wish, and there is no need to physically go to the gym which makes it very convenient for the majority as most people deal with busy schedules.

2.3.5 Comparison

Table 1: Comparison of Existing Solutions

Name	Pros	Cons
Exergames	They are a great way to motivate people (especially kids) to get some exercise	It is good for making children perform some sort of exercise but should not replace physical activities which require you to go outside as getting fresh air

	<p>whilst having fun at the same time.</p> <p>Encourages individuals to push themselves further by making it competitive and having scores for how well they do. Also allows for competitive interaction with family or friends.</p>	<p>is extremely important for living a healthier lifestyle.</p> <p>Can affect eyesight as it requires users to stare at the screen for a prolonged period of time.</p>
Smart Watches	<p>They do not just tell you the time, but also provide many other features to help with your workout sessions.</p> <p>Has a fitness tracker as one of its core features which will help users keep track of their fitness goals and push themselves to reach these.</p> <p>Allows users to view notifications whilst running, cycling, or performing any other activity where it is not safe to take out your phone to have a look.</p>	<p>Although they provide a lot of useful features, they are quite expensive, and the more affordable ones are not as helpful as they don't come with the full functionality required.</p> <p>The screen size can also be an issue as you cannot do everything on it and will need to use the smartphone to make up for it.</p> <p>The features such as fitness tracker etc which the smart watches provide are also available on smartphones as there are countless</p>

		applications available free of charge which provide the same features
Active Notts	<p>Gives brief description about the chosen sport which is useful for beginners</p> <p>Helps identify any costs the player may need to cover which can be difficult to know for someone new to the sport</p> <p>Shows location of the club on the map + contact details so if the person has any enquiries, they can contact them or visit them in person</p> <p>There is a filter option for people with disability so they can search for clubs which will suit their needs</p> <p>Search for the sports associated with wellbeing keywords. i.e. if they search of "mental health" the website will display all sports that can be helpful</p>	<p>It is very confusing and difficult to navigate through the website as it is overpopulated with too many options and not clear where to look for certain pieces of information.</p> <p>Majority of people have access to phones and prefer to look for information using them, and this website is not very responsive and makes the navigation even more confusing than it already is.</p> <p>Also, many users will find it inconvenient to search for the website on google every time they would like to visit it.</p> <p>There is no way to keep track of the user's fitness goals and only provides information on clubs and sports.</p>

	for people with mental health issues	
Find a Player	<p>A great app for those who wish to play sport as a hobby on the weekends but do not have a team or group of friends with the same interests.</p> <p>It also allows people to connect with others locally with the same interests and make new friends.</p> <p>Allows users to look for members to help fill in someone's absence in their team or create a new team.</p> <p>Good to communicate with your team and manage members</p>	<p>Only good for people who already know how to play and not very useful for beginners as no one would want someone who cannot play in their team.</p> <p>Only good for users who wish to play competitive sports and not for those who wish to play for fitness.</p>
Playwaze	It is a great platform for organisations to encourage the youth by arranging competitions and promote sports. They are also handing out prizes which will	It heavily relies on organisations to set up competitions or the user to be part of some team to participate.

	<p>motivate a lot of individuals to take part.</p> <p>Playwaze also allows managers or organisations to manage their team(s) by allowing in-app communication</p>	<p>It is quite difficult to use the application as it is very confusing and looks complicated to use. You will need to look online or have someone who has used the application to help you understand it better</p>
MyFitnessPal	<p>Great motivational tool for people who wish to maintain a healthy weight.</p> <p>Having graphs and statistics helps users see their progress and motivates them to push themselves to reach their goal.</p> <p>Has a lot of features and functionality to track your eating lifestyle as it records your recipes (calories intake) and allows you to share with others or try someone else's</p>	<p>According to the user reviews on play store, it is constantly down for maintenance. Very complicated to create a recipe.</p> <p>It doesn't let you record less than 1000 calories per day.</p> <p>If you miss to log in calories for one day, it makes it very hard and difficult to log in calories the following day as it gives wrong recommendations which ruins the statistics of the user's progress.</p>
endomondo	<p>The audio feature is really good and unique as people find it helpful to have</p>	<p>Premium versions, which are a lot better, are very pricy for monthly subscriptions.</p>

	<p>someone motivate them which helps them push themselves.</p> <p>Endomondo also sets targets for users to achieve which will help motivate them.</p> <p>Makes the users compete against themselves (previous workout stats) in order to help them see their progress and push them further. Also allows users to compete against family and friends</p>	<p>Has poor GPS location tracking and drains the phone battery very quickly according to user reviews. As well as very difficult to connect to friends.</p> <p>Also known to give wrong statistics about the workouts</p>
Pokémon Go	<p>Modern day exergame which has successfully made a lot of people, especially gamers, go outside more often.</p> <p>Allows users to travel their neighbourhood with friends which is more fun compared to having to walk around alone.</p> <p>Allows users to compete with others which will</p>	<p>It's good for encouraging people to go out more, however, they aren't burning enough calories to make a difference to their weight.</p> <p>Only appealing to those that enjoy playing games or are familiar with the franchise.</p> <p>Can be boring if you don't have any friends to play with and lose interest very quickly.</p>

	<p>motivate them to catch more Pokémon in order to be the strongest, thus having to walk around more often.</p> <p>Very good for users who may be obese and find it difficult to do some sort of physical activity</p>	
Glo	<p>Glo has a big range of classes which provide different benefits so it will most likely cover and align with the users' goals.</p> <p>It is very beneficial especially for users such as female users who may be pregnant, as Glo provides users with courses led by professionals on how to safely exercise which will benefit the baby and the mother.</p> <p>Provides users with clear instructions as well as video to help them understand the exercise better.</p>	<p>The app is known to direct users to classes or videos to users which they don't have any interest in.</p> <p>This is also a subscription-based application so most people will not want to try it out, even though they provide a trial.</p>

	Can sync the app with smart watches.	
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CHAPTER 3

NEW IDEAS

3.1 Introduction

The new ideas being proposed will take the research done in the previous section into consideration and will try to integrate the strong points as well as improve on the areas where the current solutions lacked. The proposed solution is a smartphone application which encourages individuals to live a healthier lifestyle. The reason for this is because in today's modern age, every kid, teenager, and adult have a smartphone, and thus the proposed solution would be able to reach the widest audience compared to creating a smartwatch or a website.

The solution proposed in this document is different from the initial proposed solution in the planning document (available in Appendix A). After some further research, it was decided the features and functionality proposed previously would not be appropriate or beneficial to the target audience.

3.2 Proposed Solution

The main target audience the proposed application will focus on will be individuals below 40 years old, however this does not mean users aged 40+ years will not be able to use the application or gain its benefits.

3.2.1 Application Features

3.2.1.1 Registration and BMI Test

When the users first use the application, they will be required to sign up/register before they can start using the application. After successfully registering, they will be asked a few very simple questions to help determine if they are healthy, overweight, or underweight (BMI test). In addition to this, they will be asked what their end goal is; whether it is to lose weight, gain weight, or maintain their weight. The application will then recommend to the user how many calories they should burn each day and what their calorie intake should be, so as to successfully maintain, reduce, or gain weight at a healthy pace. It will also recommend a physical activity/exercise or sport which can help the user burn the right amount of calories and the types of beneficial food to aid with this (i.e. carbs if trying to gain weight).

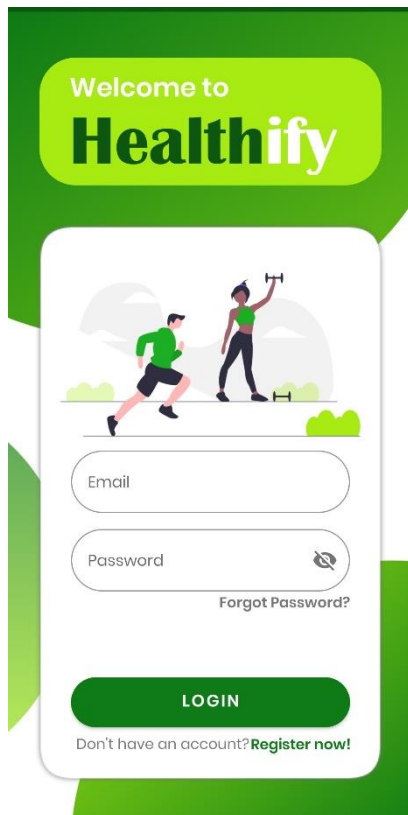


Figure 5: Login Screen

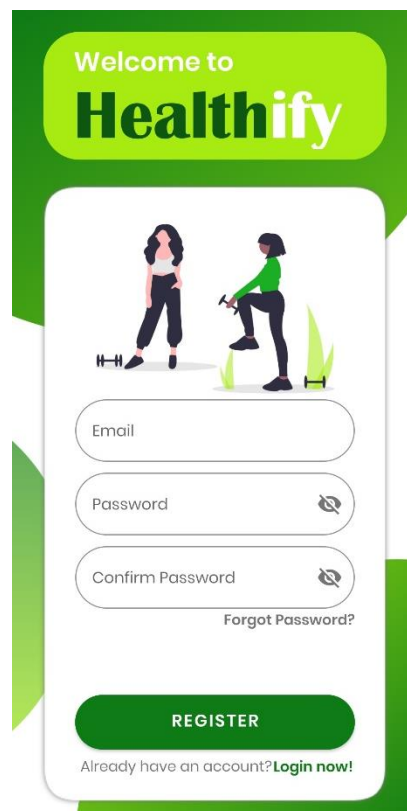


Figure 6: Register Screen

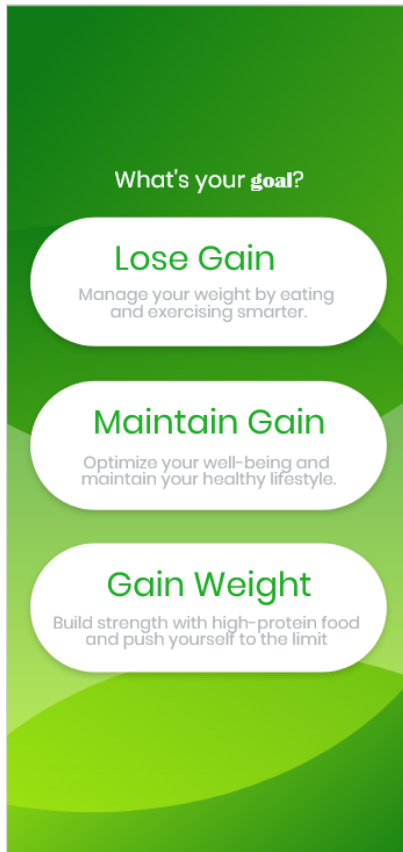


Figure 7: 'User Targets'
Screen

← **User Details** ⓘ

Let's get started!

ⓘ Username
 ⓘ Date of Birth 04-12-1997
 Gender Male Age 23

ⓘ Weight Unit kg
 ⓘ Height Unit kg

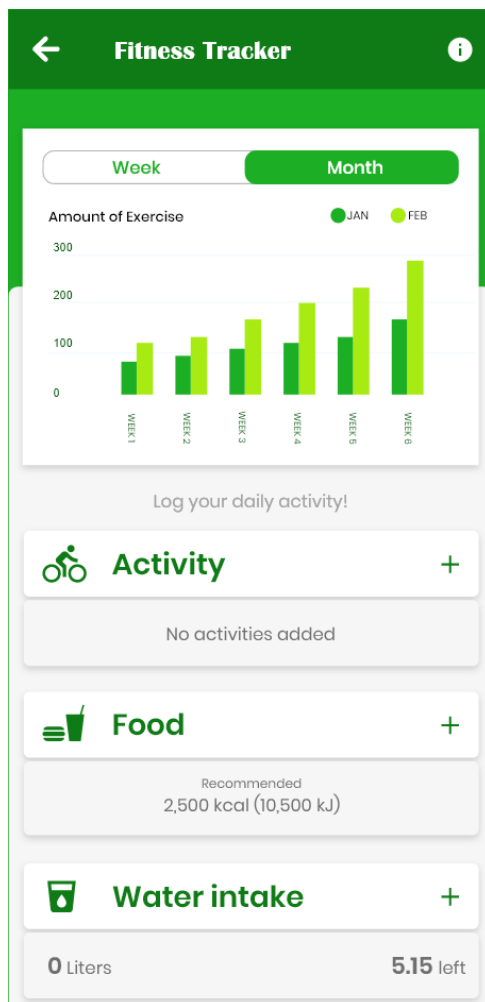
It's ok to estimate. You can change it later in settings.

✓

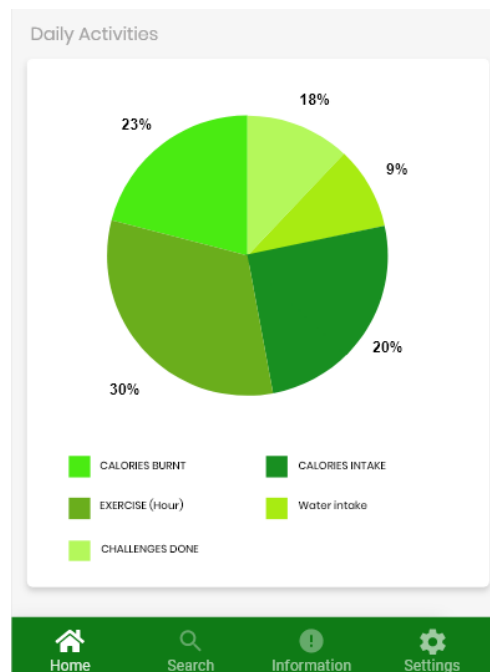
Figure 8: BMI Test

3.2.1.2 Fitness Tracker

The users will also be able to log their daily physical activity through the proposed application. This will allow the application to track users' progress/statistics and present them in the form of graphs or charts. Using this data, the app will give the user a visual representation of their progress, how much they have improved, and how far away they are from reaching their goals. It will also allow the user to display their progress weekly or monthly and, in addition, show a comparison graph of their progress from the previous week/month.



**Figure 10: Fitness Tracker
Screen (1)**



**Figure 9: Fitness Tracker
Screen (2)**

3.2.1.3 Sports and Exercise Encyclopaedia

The proposed application will have information regarding all sports to promote exercise by giving helpful tips and advice. It will have a brief description of the sport and explain the benefits each sport will have on the body. Additional information includes how many calories players could burn on average, any equipment you will require in order to begin, and the general costs you may need to think about (i.e., club membership etc). The application will also allow players to search for any clubs or sport centres/facilities in their local arena (or within a certain radius) hosting that particular sport. It will then display all local facilities within the chosen radius, as well as their address, contact information, and location pinned on the map. This will be possible after the user provides the application with their post code, which the application will use to filter data and display the correct facilities. Aside from sport activities, the app will furthermore contain other forms of physical activities for those not interested in sports; for example, hiking, yoga, and running etc. In addition to all this, the user will be recommended other applications dedicated to a certain sport or physical activity. This is for those who do not wish to join a club or cannot go to the facility due to busy schedules etc. For example, if a user wanted to do yoga at home and did not wish to join a yoga club, then the proposed application would recommend the user a few external options, such as 'Glo', which is a mobile application dedicated to yoga that allows the user to practice it at home. There will also be diagrams and illustrations provided for each exercise that can be performed at home. This is put in place in order to prevent any users from injuring themselves due to performing activities incorrectly.

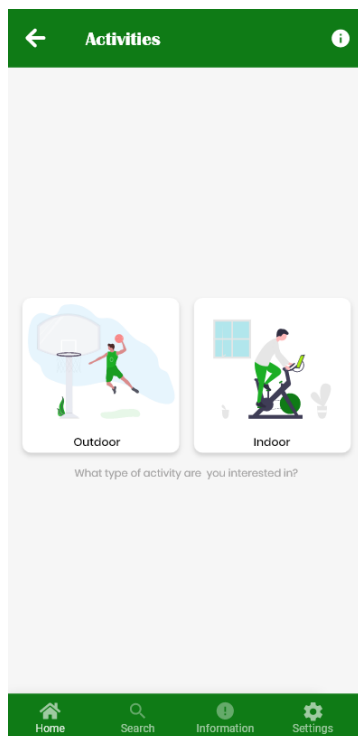


Figure 12: Activity Info

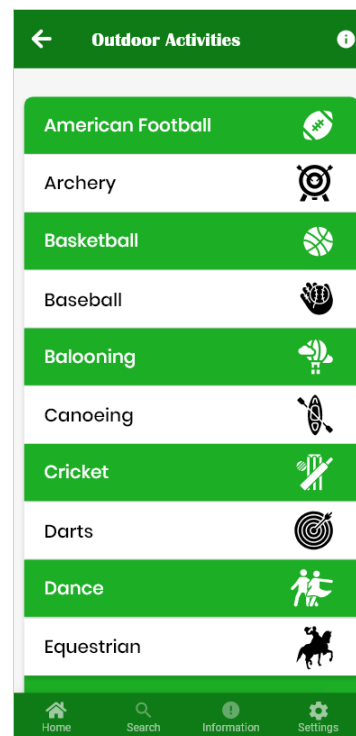


Figure 11: Outdoor Activities

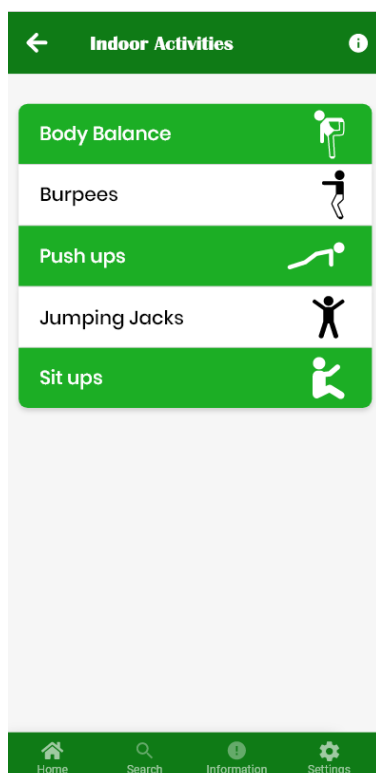


Figure 14: Indoor Activities

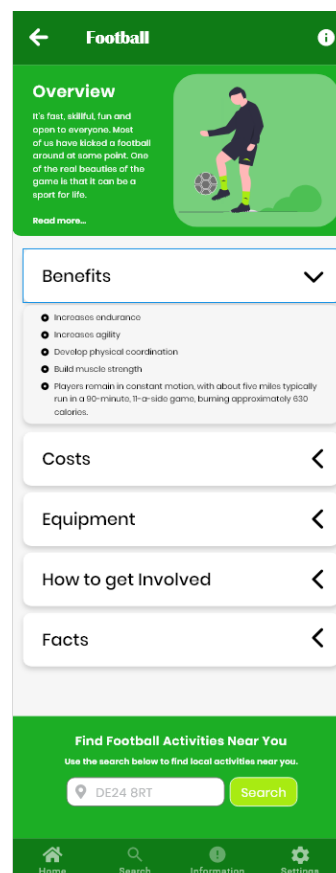


Figure 13: Select Type of Activity

3.2.1.4 Daily Challenges

The proposed application will provide users with daily challenges to help keep them motivated, which will earn them points once the challenge has been completed. At the end of each week, using accumulated points, the users will be ranked depending on how many challenges they completed. This will provide a competitive aspect to the proposed app, and furthermore motivate users to compete for higher ranks, encouraging them to strive to gain as many points as they can and thus resulting in increased exercising and staying healthy.

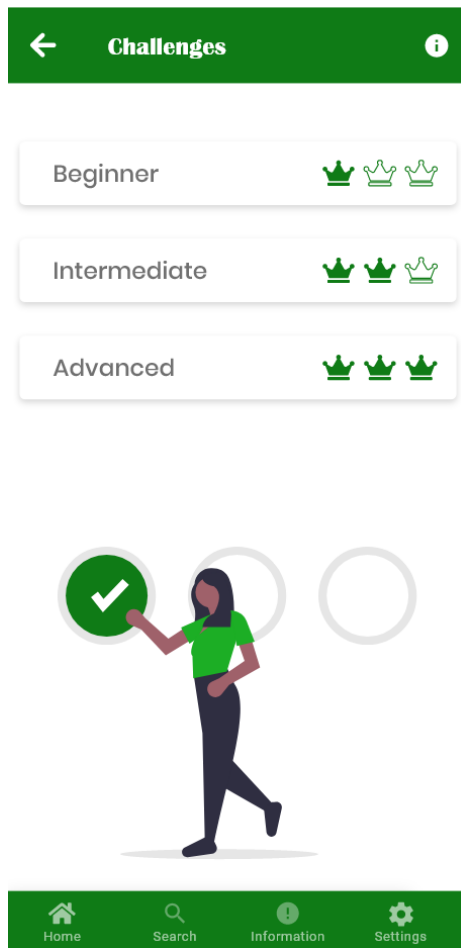


Figure 16: Beginner Challenges Screen

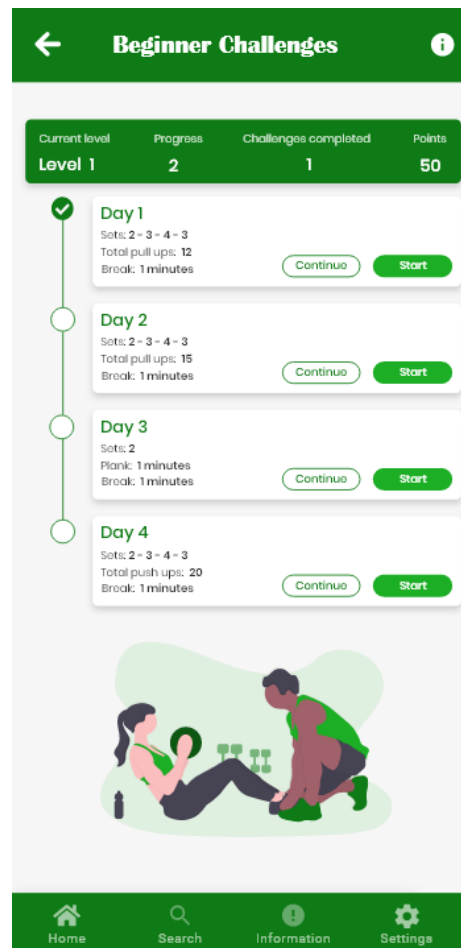


Figure 15: Daily Challenges Screen

3.2.1.5 Chat Room and My Story

The application will also include a chat feature to keep users engaged. Through this, they will be able to talk to fellow users about their experience or help others, sharing and exchanging advice. Interaction with other people on the app will help users to stay motivated in continuing to push themselves to reach their goals, as they will know they are not alone. In addition to this, there will be a blog-type feature called “My Story”, where users can share their successes, their progress thus far, or any helpful advice they would like to give to new users.

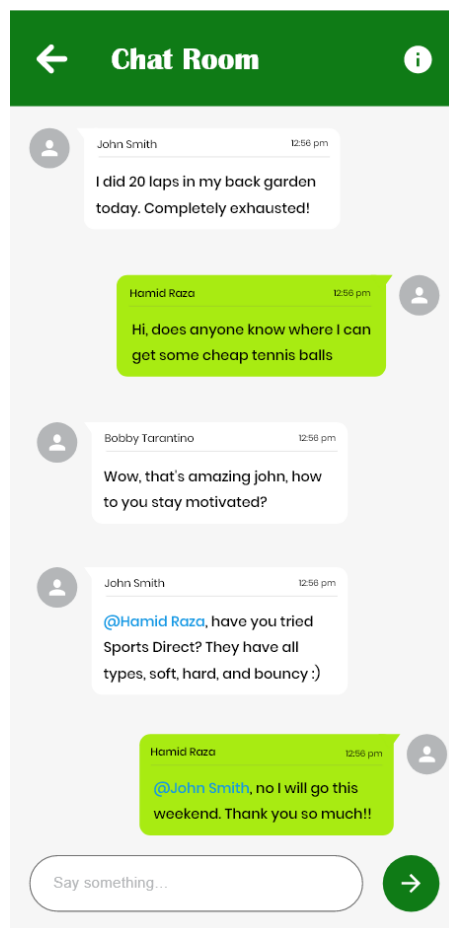


Figure 17: Chat Room Screen

3.2.1.6 Sleep Tracker

There will also be a "Sleep Tracker" feature which will help users manage their sleeping schedule; not having enough sleep can affect their motivation because if they are tired, then they will most likely not want to exercise. According to the NHS, "people who sleep less than 7 hours a day tend to gain more weight and have a higher risk of becoming obese" (NHS, 2018). Therefore, having the right amount of sleep is very important to an individual's well-being and physical health.

3.2.1.7 Water Intake Tracker

Besides the sleep tracking function, there will also be a feature within the application that helps to keep track of how much water the user is consuming, as being hydrated is very important for exercising and living a healthier lifestyle. The user will be sent a notification at every set interval to remind them to take a water break, so they can consume the minimum amount of water the body needs. In a recent study (Henry Ford 2020), one of the negative impacts of drinking less water (amongst countless other consequences) is weight gain.

3.2.2 Project Requirements

This section will detail the overall project requirements and resources needed for developing the proposed solution. It will also list the requirements that should be met in order for the proposed project to be considered a success.

3.2.2.1 Resources

The table below (Table 2) shows a list of general resources required for the project, as well as any additional requirements.

Table 2: Resources Required for the Project

Software	Hardware	Other
Android Studio IDE, Adobe Xd	Smartphone with Android 5.0+ operating system	Android Developers Documentation, Material Design Documentation, YouTube, Java and XML Docs
Firebase Realtime Database		Firebase Documentation, Google Account
GitHub Desktop		GitHub VCS Repository, GitHub Account

3.2.2.1.1 Justification of Resources

A software development environment is required for the app to be developed in, and Android Studio is currently one of the best Integrated Development Environments (IDE) for developing android applications (Alex mullis, 2020).

Adobe Xd will be used to design the proposed application, as it is a leading user experience and interface software. A smartphone with the android operating system as well as the minimum version of Lollipop (5.0) will be required to run the proposed application; older versions will not be able to support some of the application's features. To aid the development process, the android developers and material design documentation (alongside others) will be used to assist in utilising and implementing some of the proposed features successfully.

Firebase Realtime Database will be used to store all of the user and application data. Firebase Realtime Database updates information, providing the latest data in real time which makes the application reliable as it keeps up with any technological developments. Firebase documentations will be used to make sure that the Firebase database is implemented successfully and works as intended. However, in order to use the Firebase database, a Google account will be required.

A version control system repository will be required to store different versions of the project's source code. This will allow for rollbacks to an older version of the source code, if or when the application breaks due to bugs or errors in the code which cannot be identified. Using the software 'GitHub Desktop' will make it easier to keep track of changes made to the code, as it provides any changes and differences in the code visually, in addition to adding small comments or notes before you commit to the repository.

3.2.3 Software Requirements

All the functional and non-functional requirements for the proposed application are listed below:

3.2.3.1 Functional Requirements

The application must:

- FR1** – allow multiple user accounts.
- FR2** – allow the user to register.
- FR3** – allow users to sign in their accounts
- FR4** – allow users to sign out
- FR5** – store the user data in the cloud database
- FR6** – allow users to update their personal information (password, username etc.)
- FR7** – work out the users' BMI test results using the data provided
- FR8** – show what their (healthy) weight should be
- FR9** – show what their daily calory intake should be
- FR10** – recommend the best exercise/sport to help them with their end goal
- FR11** – recommend the types of food which will help with their end goal
- FR12** – allow users to log their daily physical activity
- FR13** – keep track of users' progress
- FR14** – display a graph to show their progress (weekly/monthly)
- FR15** – display information on any local clubs/facilities in the users' area
- FR16** – display detailed information on all sports
- FR17** – display indoor and outdoor physical activities
- FR18** – display diagrams on how to perform certain exercises correctly
- FR19** – recommend external applications which specialises on areas the proposed application lacks on
- FR20** – provide new daily challenges
- FR21** – display users on a table, ranked depending on how many challenges they complete
- FR22** – allow users to join the "chat room"

- FR23** – allow users to send messages to each other in the chat room
- FR24** – allow users to post their motivational stories
- FR25** – allow users to see other users' motivational stories
- FR26** – allow users to log their sleeping schedule
- FR28** – display if user is getting enough sleep
- FR29** – track amount of users' water intake
- FR30** – send notification every set interval to remind user to drink water
- FR31** – work out how many calories they burned during the week
- FR32** – display a graph to show if they are on target/of target from their initial goal
- FR33** – The application features will not be available if the user is not signed in
- FR34** – Store information about all activities in the database
- FR35** – Update app when new sport/activity added
- FR36** – Update app when any sport/activity deleted
- FR37** – Update app when information on any sport/activity updated

3.2.3.2 Non-functional

NFR1 – the design and layout of the proposed app should be user-friendly and professional

NFR2 – the application should be easy to navigate through

NFR3 – the colour theme should be appropriate for the target audience and should correspond, in addition to convey the message of the 'health' aspect of the proposed application

NFR4 – use appropriate font that is easy and clear to read

NFR5 - the colour scheme and the typography should be consistent throughout the whole app

NFR6 – all types of android phones with the 5.0 operating system (or above) should be able to use the proposed application

3.2.3.3 Justification of Requirements

The software requirements listed above were decided based on the information gathered as part of the primary research, as well as during research on existing solutions available.

Having users create their own accounts is necessary for distinguishing individual users and storing their data separately. Personalised accounts will help users to identify each other more easily and allow the application to keep track of everything such as retrieving the correct data for each user.

Storing the data in a cloud database will make sure that the data is safe and can be accessed remotely; therefore, users can use the application on multiple devices without losing or affecting their progress. This will also ensure each individual's privacy and data protection, so that other users cannot access another's personal details.

Obtaining users' BMI results is important in allowing the application to help users more effectively, by providing any necessary information they will need in order to reach their long-term goals.

Having a visual representation of their progress will keep users motivated, as they will be able to perceive the progress and improvements they are making over the course of the month. By providing a competitive aspect whereby a table of users who have completed the most daily challenges appears at the top, it will allow all users to push themselves farther and help them to stay motivated in reaching their goal(s).

Providing user interaction via "chat rooms" and the "My Story" feature will allow people to connect with one another and keep each other motivated through sharing their success stories, or by guiding those in need of advice or new to the application.

3.2.4 Project Schedule

The following section contains the planned project schedule outlining the estimation of workload for various phases and the tasks to be completed for the respective phase.

3.2.4.1 Project objectives and milestones

This project's main objectives and milestones are as follows:

- Research and review existing solutions
- Identity the limitations of the current solutions
- Create a prototype of the proposed solution
- Implement the proposed solution
- Test and evaluate the implemented solution

Table 3 represents the project milestones with the deliverables required for each milestone

Table 3: Project Milestones

Milestone	Deliverables
Project Registration	Project Proposal Project approval
Review Point 1	Project Monitoring Form RP1 Project Planning Document Ethical Issues Declaration Form
Review Point 2	Project Monitoring Form RP2 First Draft of Context Chapter Discussion on Next Draft – New Ideas Chapter
Review Point 3	Project Monitoring Form RP3 First Draft of New Ideas Chapter Discussion on Project Implementation Discussion on Next Draft - Project Implementation Chapter

Project Submission	Project Report Implementation Report
Demonstration (FYP Degree Showcase)	Implemented Solution

3.2.4.2 Project Gantt Chart

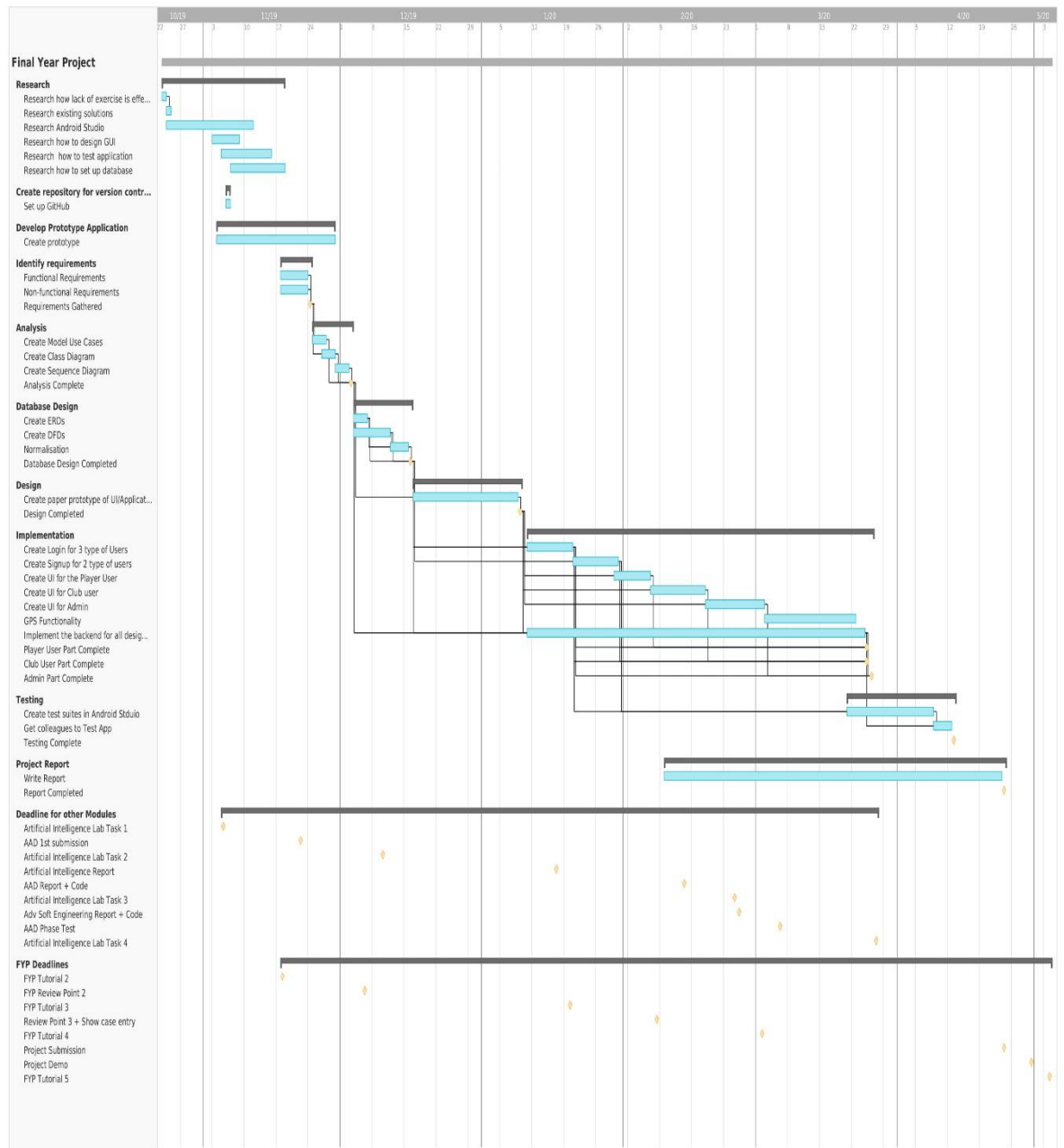


Figure 18: Gantt Chart

CHAPTER 4

IMPLEMENTATION OR INVESTIGATION

4.1 Introduction

After documenting the proposed solution and the analysis of requirements in the previous chapter, this chapter will document the implementation phase of the software development lifecycle. This will include the methodology followed, and design and development of the proposed solution.

4.2 Methodology

It is important to choose and follow a methodology prior to beginning development/implementation of the project. Choosing the right methodology can be critical in successfully delivering projects on time.

For this project, the agile methodology was decided to be the most suitable. The agile methodology works by breaking the project down into several phases and allows one to build on previously developed functionalities. Due to time restrictions, there is a possibility that not all features forementioned will be implemented. This makes agile methodology the ideal pathway for this project, as it allows for the requirements to be adjusted at any point in time throughout the entire developmental process of the project.

4.2.1 Agile Scrums

Out of the few agile frameworks, the framework chosen for this project is Scrum. It is a framework which helps people deliver products of the highest possible value while addressing complex adaptive problems.

Scrum projects consist of timebox events called sprint. Sprints are fixed time-period events which usually last between one and four weeks. A new sprint begins immediately after the previous sprint ends, which creates consistency throughout the project.

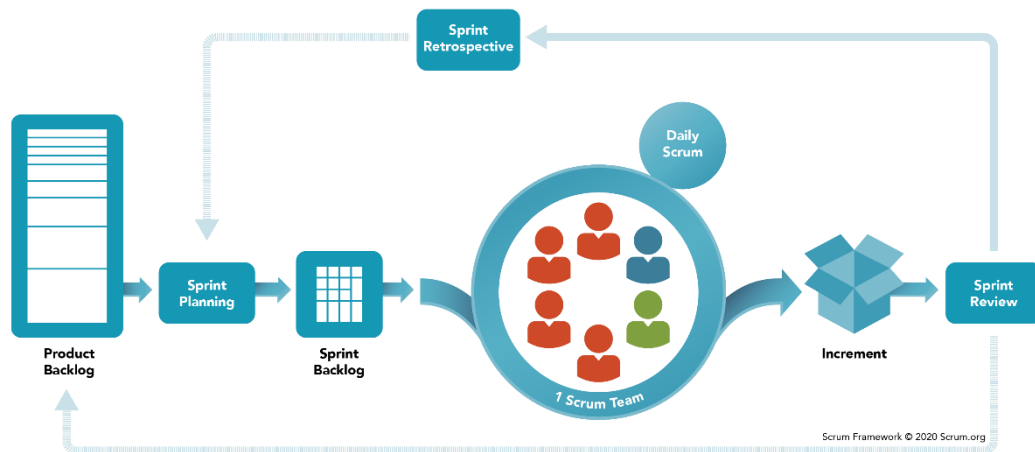


Figure 19: Scrum Framework

Due to time restrictions and other coursework deadlines, only one week was spent on the implementation stage, which resulted in the project containing only one Sprint. To ensure there was at least one standout feature implemented in the application during the short period, planning took place to decide which tasks needed to be completed during the Sprint and how much time or effort they would require to be completed. Under normal circumstances, there would have been three/four Sprints, and when planned tasks are not completed during the Sprint, they are dragged into the next Sprint as the highest priority tasks.

4.3 Design

4.3.1 Use case diagrams

The figure 20 below shows the UML notation Use Case Diagram which represents the relationship between use cases to show how they would interact with each

other. UML use case diagrams show the system and software requirements for an underdeveloped program, they provide a visual representation of how the system is expected to behave.

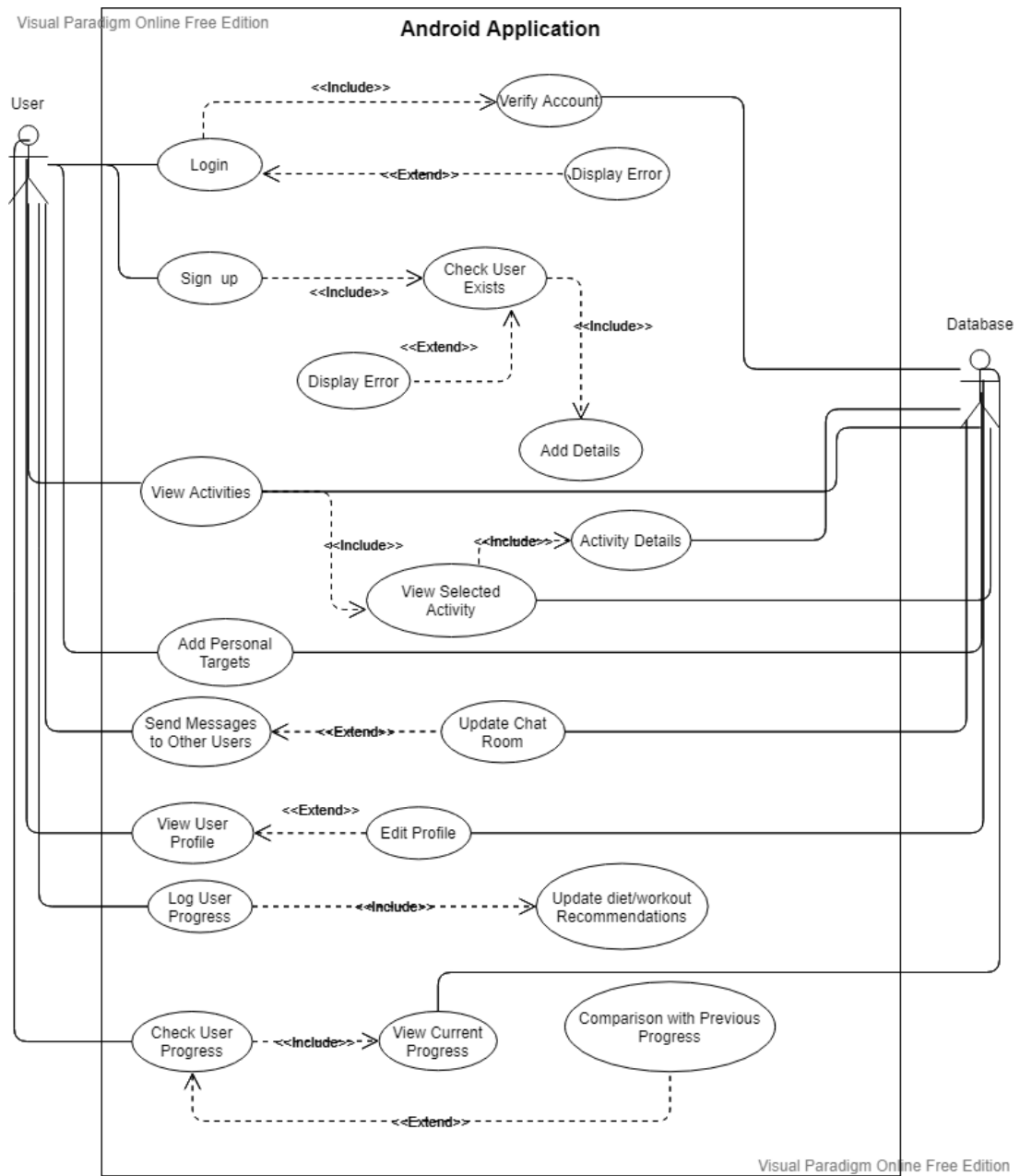


Figure 20: UML Use Case Diagram

4.3.2 Database Structure (Firebase)

Google's Firebase was chosen for storing and managing the back-end data of the proposed application. As discussed before, Firebase is a free cloud service which stores its data in a JSON tree. It provides a variety of key features such as User Authentication using email/password, social media accounts (Facebook, Twitter etc) and even phone numbers. Realtime database is where the data is synced in real-time and provides the users with the latest information across all the applications.

The advantages of using Firebase database are that the data will be stored online, making it easier to access anywhere at any time. It furthermore provides secure data so that users' data will not be leaked or compromised. The device will not require additional storage to manage the data - this is unlike SQLite, another backend database for smartphone applications.

The figure 20 shows a screenshot of the most recent state of the Firebase (JSON) database. The higher-level nodes have been expanded to give an overview of the database's structure. Currently, there are 2 main nodes that contain information on the different types of physical activities, indoor activities, and outdoor activities. The data is nested under their respective nodes to make it easier for the application to differentiate the types of data being stored, allowing it to easily read and write into the database.



Figure 21: JSON Database Structure (Firebase)

4.3.3 User Interface Design

4.3.3.1 Logo and Name

In order for the application to look and feel professional, it was necessary that an appropriate name and logo was chosen. Since the proposed application is aimed at helping to improve the overall health and well-being of its users, the name "Healthify" was chosen. This name gives off the feeling that through using it, one can enhance their lifestyles and become healthier.

After deciding on the name, the next step was to create a logo. It was important that the logo also looked professional with the right colours and gave the visual representation of a healthy lifestyle through an appropriate colour theme. The colour 'Dark Green' was chosen as the primary colour, 'Lime Green' as the secondary, and white as adjacent. The word 'health' was in a different colour to make it stand out and relay the message of what kind of application this is. To make the logo feel more user friendly and inviting, it was decided to add "Welcome to" on top of the logo.



Figure 22: Logo for the Application

4.3.3.2 User Interface

User Interface designs were created in Adobe Xd to get an idea of how the proposed application will look like.

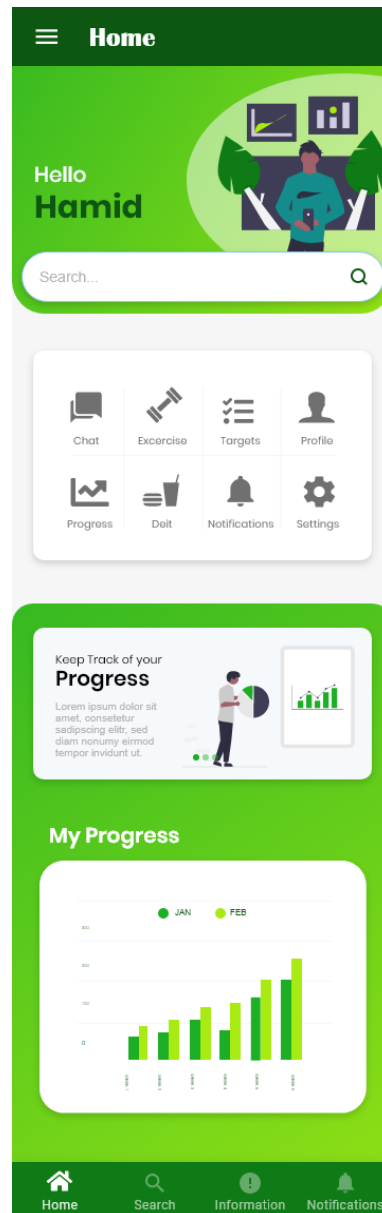
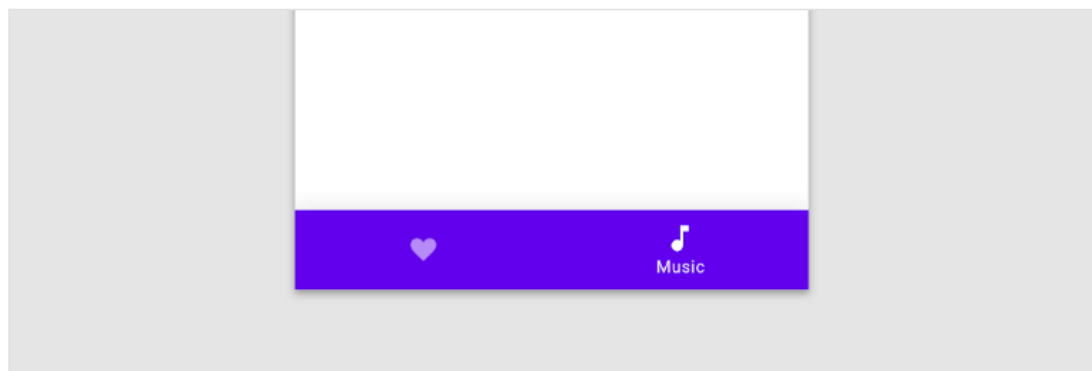


Figure 23: User Interface (Home Screen)

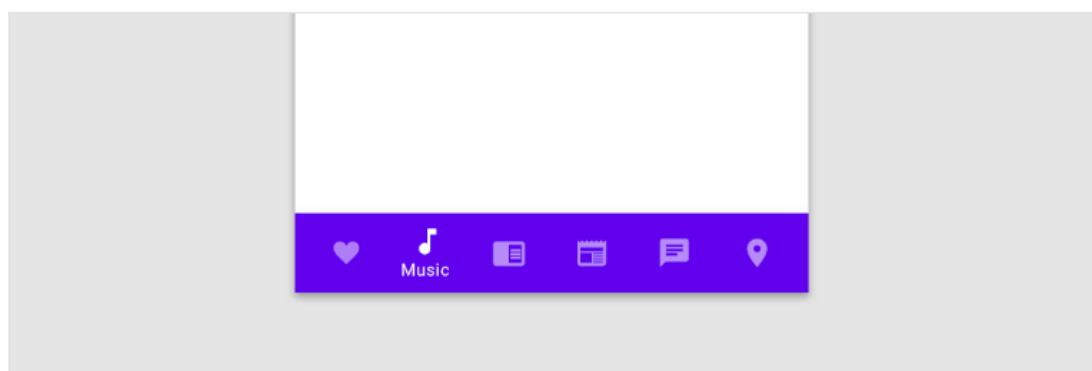
Figure 23 shows the design for the home screen of the application. The design contains a welcome screen with bold, colourful visual illustrations and a bottom navigation. The bottom navigation was chosen over the side navigation (Drawer

navigation) due to it being easier for the user to click the menu icons as everyone uses and press on their phone with their thumbs. However, because there were so many features present in the application, instead of adding them all at the same navigation menu, they were split into two different navigations. The bottom navigation is the main navigation which will be accessible throughout the application, and it contains all important features the user may always want access to. Meanwhile the second navigation contains all extra features and will be available only on the home page.



Don't

Don't use a bottom navigation bar for fewer than three destinations (use tabs instead).



Don't

Don't use more than five destinations. For those cases, try tabs or a navigation drawer.

Figure 24: Google Material Guidelines - Bottom Navigation

While designing the user interface, Google Material Guidelines for design was taken into consideration to ensure the application looks professional so as to maximise user experience. For example, when designing the bottom navigation, it was recommended that the navigation should not contain less than three navigation destinations, and no more than four for a professional look. After reviewing this research, it was decided that only four navigation destinations were included in the bottom navigation.

Apart from Google's Material Design Guidelines, Neilson's 10 Usability Heuristics for User Interface Design (Neilsen, 1994) were also taken into consideration. The first heuristic, regarding the visibility of the system status, was achieved via displaying the title of the page the user can navigate to. The second heuristic was making sure the language used matched between the system and the real world, which was accomplished by implementing common terminology found in sport-related applications, such as "Fitness Tracker", into the language so it is simple for the user to understand. The third heuristic, user control and freedom, were fulfilled by giving users the option to cancel any input boxes or press the backspace key on their phones to remove a text if they do not wish to send it. The consistency and standards heuristic was achieved by having a bottom navigation available on all screens, as well as having a consistent colour theme throughout the application. Error prevention heuristic was attained by having validation on user input through displaying a small message which corresponds to the button/navigation item they press. The sixth heuristic, which is recognition rather than recall, was integrated by having a variety of illustrations throughout different screens so that each screen was unique and stood out from one another. The eighth heuristic, aesthetic and minimalist design, was achieved by providing straightforward dialogs and labels, avoiding any irrelevant information. Helping users to recognise, diagnose, and recover from errors,

which is the ninth heuristic, was achieved through displaying error messages when validating user input.

4.3.4 System Architecture

A standard system architecture for an android application is a three-tier architecture, which is made up of a presentation layer (or user interface layer), logic layer (or application layer), and data layer. The advantage of a three-tier architecture is that each layer can be developed or updated simultaneously without impacting the other layers.

The presentation tier provides the user interface, where the end user will interact with the application. Logic tier provides the core functionality and is known as the heart of the application. It is where all the information is processed, and where any communication between both data tier and presentation tier is made possible. The final tier, the data tier, is where the processed information is stored by the application. Figure 25 shows a representation of the android application architecture.

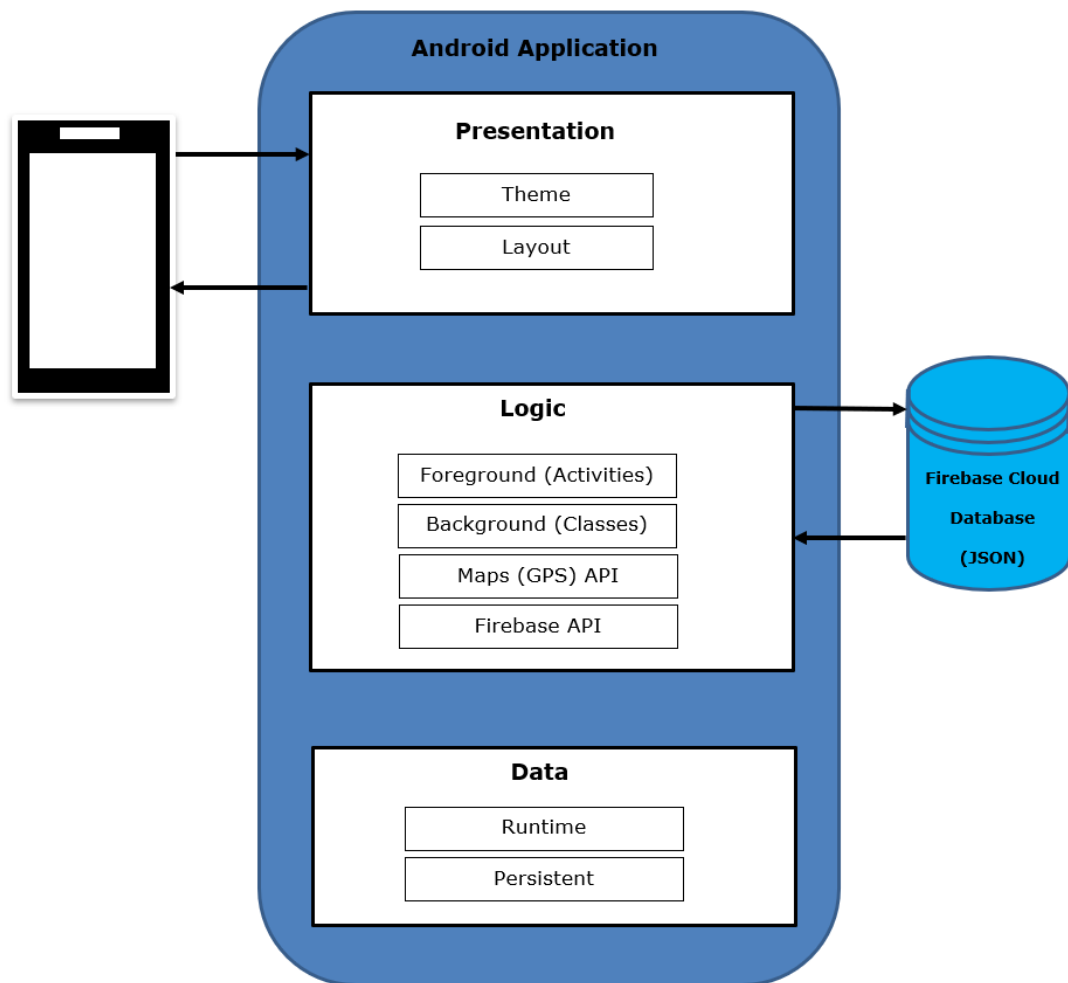


Figure 25: System Architecture Diagram

4.4 Development

The following section documents the developmental phase of the proposed application. It will also detail any issues and challenges faced throughout the process.

4.4.1 Version Control

Before the actual development of the application began, it was important to set up a control version for documenting and monitoring the process, in addition to

having a back-up of the application's source code in case of an accidental malfunction or the code being lost.

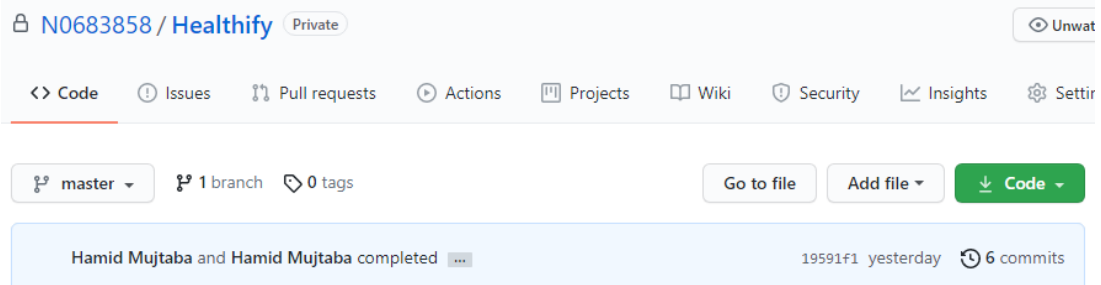


Figure 26: GitHub Repository for Project

At the end of each day, a commit was made to ensure that the latest version of the source code is always backed up. If there were any mistakes made in any aspect of the coding process, then you can roll-back to a previous saved version.

4.4.2 Scrum Board

To manage and keep track of all tasks which need to be done within each Sprint, an online tool called "Kanban Tool" was used for creating the Scrum Board. It allows users to create tasks or drag-and-drop them under different columns that represent the current state of the task. The board used for this project included 3 columns: "To Do", "In Progress", and "Done", to help manage tasks efficiently. Each task will be moved under the "In Progress" column when it is being implemented, and then transferred under the "Done" column once finished.

To do	In Progress	Done
+	+	+
Create registration page		
Create login page		
Set up the database		
Setup user authentication		
Add user validation		
Store user data in database		
Set-up application home screen		
Create activities page		
Add outdoor activities to the database		
Add indoor activities to the database		
Display the data of activities/sports from the database		
Create user targets page		

Figure 27: Scrum Board (Sprint 1)

4.4.3 Sprint 1

4.4.3.1 Project Setup

The first step was to correctly setup the Android Studio IDE by adding the colour codes which will be used throughout the project, on top of adding external libraries to the project to help with the implementation of certain features. It was also important to specify the SDK version, so that the application runs smoothly on the intended mobile devices. Figure 28 shows the Gradle file of the project where the external libraries are added alongside other important information.

```
1  plugins {
2      id 'com.android.application'
3      id 'com.google.gms.google-services'
4  }
5
6  android {
7      compileSdkVersion 29
8
9      defaultConfig {
10         applicationId "com.hamidraza.healthify"
11         minSdkVersion 21
12         targetSdkVersion 29
13         versionCode 1
14         versionName "1.0"
15
16         testInstrumentationRunner "androidx.test.runner.AndroidJUnitRunner"
17     }
18
19     buildTypes {
20         release {
21             minifyEnabled false
22             proguardFiles getDefaultProguardFile('proguard-android-optimize.txt'), 'proguard-rules.pro'
23         }
24     }
25
26     compileOptions {
27         sourceCompatibility JavaVersion.VERSION_1_8
28         targetCompatibility JavaVersion.VERSION_1_8
29     }
30 }
31
32 dependencies {
33     implementation 'androidx.appcompat:appcompat:1.3.0'
34     implementation 'androidx.recyclerview:recyclerview:1.1.0'
35     implementation 'androidx.cardview:cardview:1.0.0'
36     implementation 'com.google.android.material:material:1.3.0'
37     implementation 'androidx.constraintlayout:constraintlayout:2.0.4'
38     implementation 'com.google.firebase:firebase-database:19.7.0'
39     implementation 'com.google.firebase:firebase-auth:20.0.4'
40     implementation 'com.firebaseui:firebase-ui-database:7.1.1'
41     implementation 'androidx.navigation:navigation-fragment:2.3.5'
42     implementation 'androidx.navigation:navigation-ui:2.3.5'
43     implementation 'androidx.legacy:legacy-support-v4:1.0.0'
44     testImplementation 'junit:junit:4.12.0'
```

Figure 28: Project Gradle File

4.4.3.2 Database Connection

The next step was to set up the database connection with Firebase Realtime Database. Realtime database is one of the databases Firebase provides, which is synchronised in real-time and provides the latest data saved in the database. To achieve this, the built in Android Studio Assistant tool was used to help manage this.

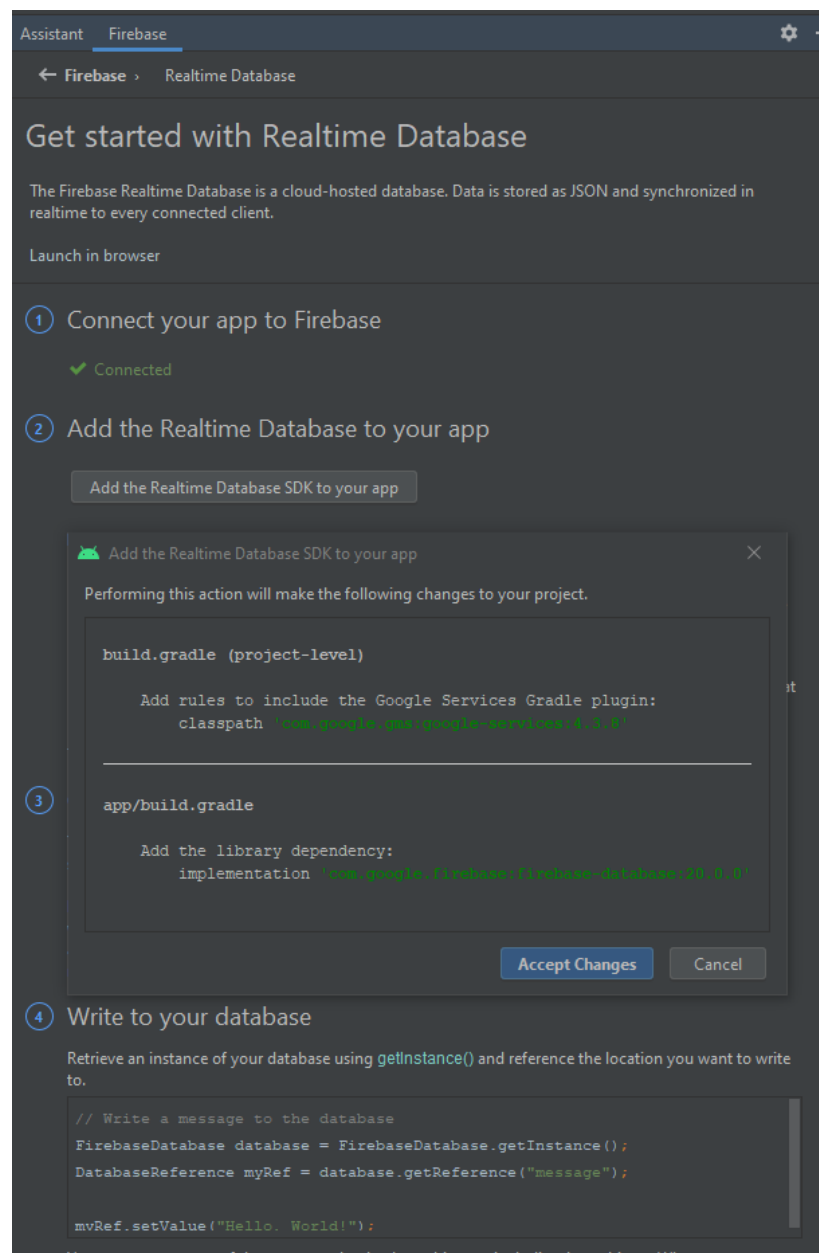


Figure 29: Firebase Database Setup

4.4.3.3 Account Creation

The next task was the implementation of both registration and login screens. To execute this, 2 android activities were created, which generated one XML file and one Java file for each activity screen (Login and Register). The XML file managed the 'User Interface' elements, whilst the Java file handled the data/input provided by the user. After creating the input fields and buttons, 'Firebase User Authentication' was integrated using 'Android Assistant' to oversee users. Using the Firebase User Authentication, the application was able to determine whether the account details of the user already exists; if not, it will display an error, and they will not be able to login to the application.

```
private void validateLogin()
{
    final String email = emailTextView.getEditText().getText().toString();
    final String password = passwordTextView.getEditText().getText().toString();

    emailTextView.setError(null);

    // ===== CHECK IF TEXT BOX ARE EMPTY ===== //
    if(TextUtils.isEmpty(email) || TextUtils.isEmpty(password))
    {
        emailTextView.setError("Cannot leave any fields empty!");
    }

    // ===== GIVE USER FEEDBACK ===== //
    Toast.makeText( context: this, text: "Logging in...", Toast.LENGTH_SHORT).show();

    // ===== COMMUNICATION WITH FIREBASE ===== //
    mAuth.signInWithEmailAndPassword(email,password).addOnCompleteListener( activity: this, new OnCompleteListener<AuthResult>()
    @Override
    public void onComplete(@NonNull Task<AuthResult> task) {
        //==== CHECK IF LOGIN SUCCESSFUL =====//
        Log.d( tag: "Login", msg: "Login Successful: (signInWithEmailAndPassword() onComplete() is: " + task.isSuccessful());

        //==== WHAT HAPPENS IF LOGIN SUCCESSFUL/NOT SUCCESSFUL =====//
        if (!task.isSuccessful())
        {
            emailTextView.setError("Username or Password incorrect!");

            //== GET EXCEPTION ==//
            // Will tell why is was not successful
            Log.d( tag: "Login", msg: "Login not Successful: " + task.getException());
        }
        else
        {
            Intent intent = new Intent(getApplicationContext(), MainActivity.class);
            finish();
            startActivity(intent);
        }
    }
});
```

Figure 30: Login Details Validation

Similar Validation, which can be seen in Figure 30, was added to the registration screen as well. It made sure that user details are appropriate (i.e., valid email address) before adding any details to the database.

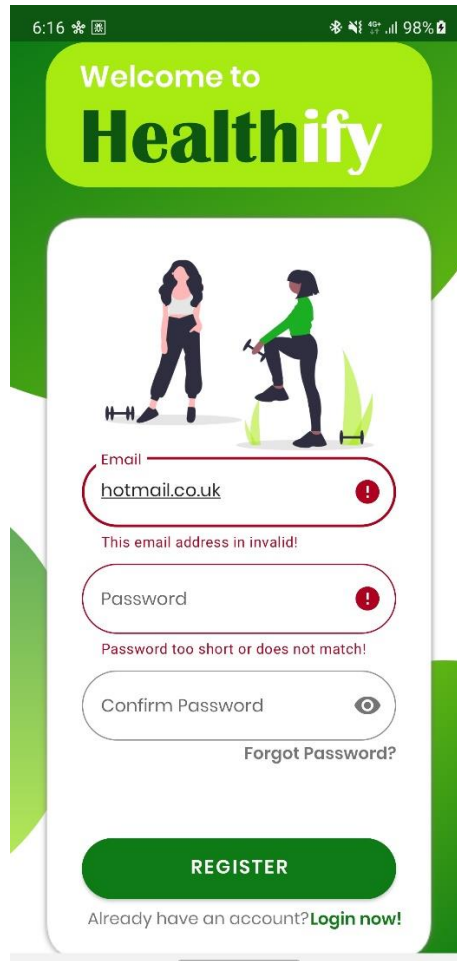


Figure 31: Validation on Registration Screen

After finishing the registration and login screens, the home screen was implemented, which looks similar to Figure 23 shown in the 'User Interface' section.

4.4.3.4 Adding Sport/Physical Activities

The next main feature implemented into the application was one of the standout functionalities which makes this application different from the rest. Firstly, the information on all the different activities/sports was added to the Firebase Realtime Database. Next, the data was fetched from the database and populated into a recycler view with the sport/activity names. When the users clicked on the activity name, it would display the activity in more detail.

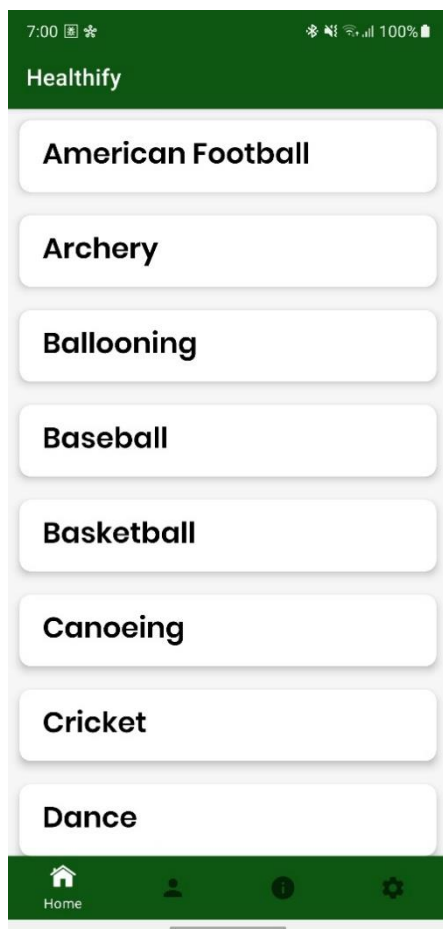


Figure 33: Outdoor Activities Screen

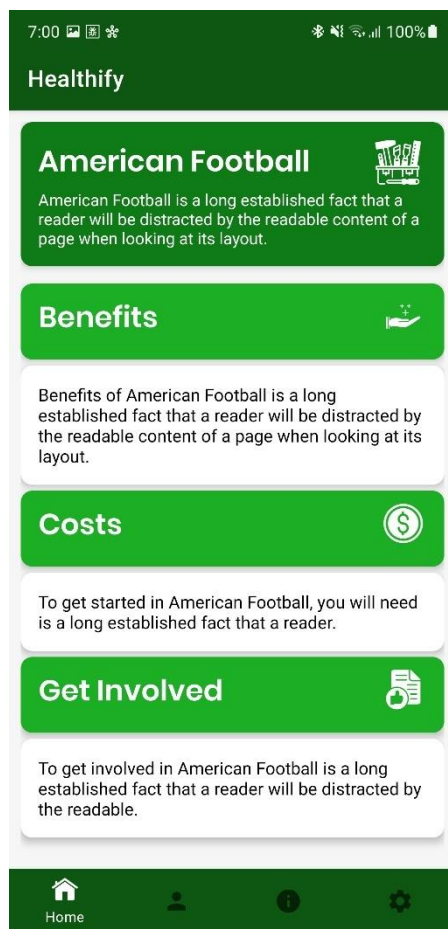


Figure 32: Detailed Activity Screen

4.4.3.5 Requirements Completed

4.4.3.5.1 Functional Requirements

Functional requirements that were completed during the Sprint are as follows:

FR1 – allow multiple user accounts.

FR2 – allow the user to register.

FR3 – allow users to sign in their accounts

FR4 – allow users to sign out

FR5 – store the user data in the cloud database

FR6 – allow users to update their personal information (password, username etc.)

FR16 – display information on all sports

FR17 – display indoor and outdoor physical activities

FR33 – The application features will not be available if the user is not signed in

FR34 – Store information about all activities in the database

FR35 – Update app when new sport/activity added

FR36 - Update app when any sport/activity deleted

FR37 – Update app when information on any sport/activity updated

4.4.3.5.2 Non-functional Requirements

Non-functional requirements that were completed:

NFR1 – the design and layout of the proposed app should be user-friendly and professional

NFR2 – the application should be easy to navigate through

NFR3 – the colour theme should be appropriate for the target audience and should correspond, in addition to convey the message of the 'health' aspect of the proposed application

NFR4 – use appropriate font that is easy and clear to read

NFR5 - the colour scheme and the typography should be consistent throughout the whole app

NFR6 – all types of android phones with the 5.0 operating system (or above) should be able to use the proposed application

4.4.3.6 Issues and Challenges

One of the issues faced when implementing the login page was that even though the user information was correct and user details were saved into the database, the application would display an error. To figure out the reason for this, debugging was carried out using the `Log.d()` method to figure out what error the `getException()` was displaying. This helped to determine the problem, which was that the data users typed into the input fields were not being converted into strings before accessing the database trying to match user details. Another issue faced was that the recycler view on the sport/physical activities screen had too much space in-between each item/activity name. After doing some debugging and conducting some research online, it was discovered that there was an error in the code which kept pushing each item in the recycler view farther down than intended.

Creating the detailed view (figure 33) for each sport/activity was one of the biggest challenges faced. Initially, it was decided to have the boxes expand whenever the user presses on them; however, after attempting various methods to try to implement this, it did not function as desired. Therefore, it was decided to remove this "expandable" feature of the boxes and display them in an open view instead. In addition to this, there was supposed to be a small option available for users to find opportunities near them, which would then display search results on the map. However, this required a lot of time and effort to realise, so unfortunately it was not possible to integrate this option into the application. Similarly, there were a few more functionalities implemented - such as a 'User Targets' Screen - that could not be fully completed due to time restrictions.

CHAPTER 5

RESULTS / DISCUSSION

5.1 Introduction

This chapter will analyse and perform tests to weigh up the success of the application. It will then further analyse it and discuss its limitations and any results gained.

5.2 Functional Requirements Testing

Manual testing was conducted to verify that the application's features and functional requirements identified in Chapter 3 perform as expected. Before running the following tests, any existing application data was removed to ensure that the tests are valid. However, due to this project only containing one Sprint, not all of the functional requirements/features were implemented, meaning that only the limited functionality implemented can be tested.

Table 4: Functional Requirements Testing

ID	Test	Expected Result	Actual Results	FR/NFR Met
1	Try to sign in before creating an account	Should display an error as the account does not exist	Results were as expected	FR33

2	Create a new account and login	Should add the user details to the database and user should be able to login	Results were as expected	FR2, FR3, FR5
3	Login using an existing account	User should be able to login	Results were as expected	FR3
4	Sign out	User should be logged out	Results were as expected	FR4
5	User Detail Validation	Should display an error if user details not correct when creating a new account or logging into an existing one	Results were as expected	FR33
6	Display all indoor activities	Should display all the indoor activities when user presses the "indoor activities options" on the "Activity Types" screen	Results were as expected	FR17, FR34

7	Display all outdoor activities	Should display all the outdoor activities when user presses the "outdoor activities options" on the "Activity Types" screen	Results were as expected	FR17, FR34
8	Display additional (detailed) information on the activity clicked	When the user presses on the activity name, they should be taken to another screen which displays the activity in more detail	Results were as expected	F16, FR34
9	Update app when any sport/activity deleted	When an activity/sport was removed from the database, it should not be displayed in the application	Results were as expected	FR35

10	Update app when any new sport/activity added	When a new activity/sport is added in the database, it should be displayed in the application	Results were as expected	FR36
11	Update app when information on any sport/activity updated	When information on any of the existing activities changed, the updated information should be displayed	Results were as expected	FR37

5.3 Compatibility Testing

Compatibility testing was conducted after first carrying out functional requirement testing, so as to ensure the application can be used on all mobile devices with different screen sizes and operating versions (API versions). For an accurate compatibility test, it would be ideal to have used different devices; however, apart from the device which was used throughout the project (Samsung Galaxy Note 10 Plus), it was difficult to get a hold of other devices. Thus, a compromise was made using the built-in emulator in Android Studio, which lets users simulate different devices.

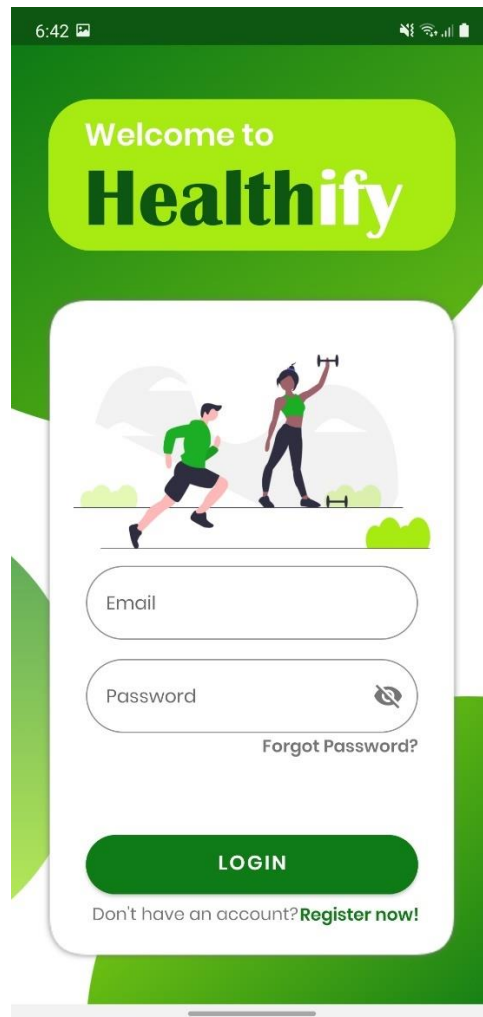


Figure 34: Application on Samsung Galaxy Note 10 Plus

The figure 34 shows how the application looks on a Samsung Galaxy Note 10 Plus, which has a screen size of 6.80 inches, and runs on SDK version 30.

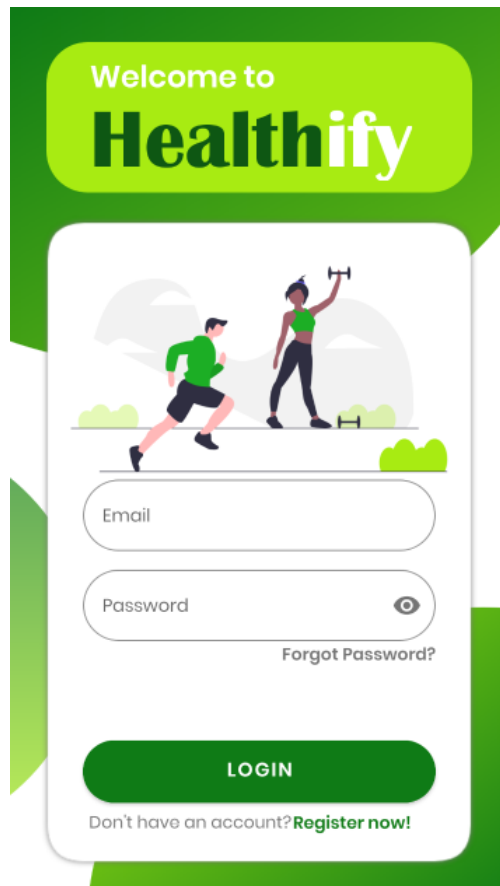


Figure 35: Application on Google Pixel

The above figure shows the application being simulated on a Google Pixel device, which has a screen size of 5 inches and runs on SDK version 21.

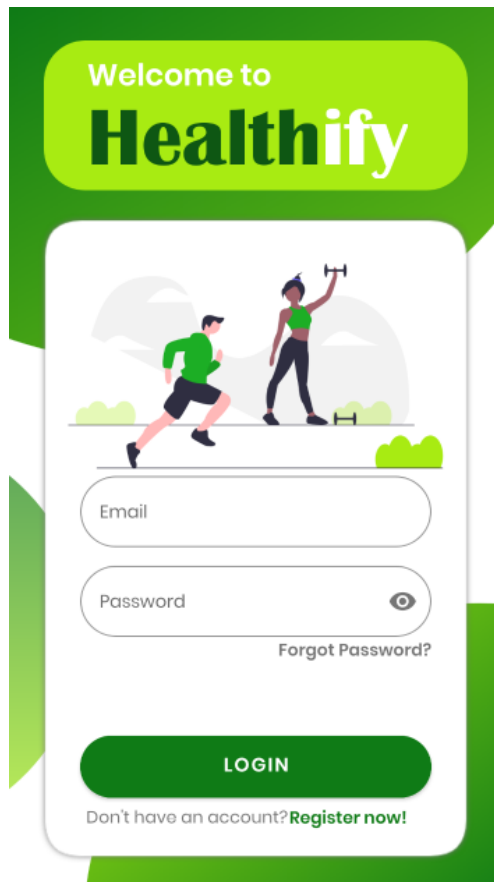


Figure 36: Application on Google Nexus 5x

Figure 36 shows how the application would look if it were run on a Google Nexus 5x, which has the screen size of 5.2 inches and runs on SDK version 23.

5.4 User Testing

User testing is vital for every project to ensure it fulfils and meets the needs of the users as intended. It will help determine anything which could have been overlooked accidentally or identify any issues or new ideas with the application. However, it was not possible to have actual users participate in the testing of this application; therefore, this section will present a test plan which would have been carried out had there been any users to test the application.

5.4.1 Usability Evaluation

After the users have used the application and are familiar with its functionality and features, they would have been asked to fill in a questionnaire, to help to determine the successes and any limitations.

Table 5: Usability Questionnaire (1)

	Very Easy	Quite Easy	Neutral	Difficult	Very Difficult
How was the application to use overall					
How easy was it to look for the information you were looking for					

Table 6: Usability Questionnaire (2)

	Over a month	Three weeks	Two weeks	One week	Less than a week
How long did you use the application					

Table 7: Usability Questionnaire (3)

	Definitely	Likely	Maybe	Unlikely	Very unlikely
Will you use the application again					
Will you recommend the application to others					
Did the application help you					

improve your lifestyle					
Did the application help motivate you					

What feature did you like the best and why?

Which feature did you not like and why?

Which feature could be further improved?

--

What can be done to improve the application?

5.5 Limitation of the Solution

Without actual feedback from users, it was hard to determine limitations with the application and therefore difficult to analyse any areas it is lacking in. However, the few limitations identified in this section are from the experience of the author throughout this document.

The first limitation would be firstly getting active users involved, as there are countless health applications already available that have higher popularity and better ratings. Normally, people tend to download or use applications which have the highest ratings or the best reviews. Without enough users, competitive features will not work as intended, i.e.: 'Leader board', 'Chat Room' and 'My Story'.

There could be a limitation with the "Sports and Exercise Encyclopaedia" feature, where users can access the GPS option to view any clubs or facilities within their local area for the chosen activity/sport. It would be difficult and time-consuming to add in all the sport facilities and clubs across the country manually; therefore,

additional research can be done to look for external API, or, a separate functionality can be implemented that lets clubs and facility owners add/advertise their clubs via the app.

CHAPTER 6

CONCLUSIONS / FUTURE WORK

6.1 Conclusions

The focus of this project was to promote a healthier lifestyle through a smartphone application that encourages individuals to exercise more and aims to implement healthy habits in their lives.

This was achieved by providing users with all the information they may need to live a healthier lifestyle at their fingertips and motivating them by keeping them engaged through features such as 'Leader Board', 'My Story' and 'Chat Room', so they know they are not alone on this journey. This will help users to stay motivated, especially those who find themselves giving up too early or wanting to quit because they find it difficult to change their unhealthy habits.

Users can use the application to look up a variety of sports or physical activities that interest them, and learn everything they may need to know, from how to get involved, to what equipment they may need to get started. In addition to this, it has features to help them find opportunities locally; or, the users can choose 'indoor activities' if they do not wish to go out and want to start by doing physical activities in the comfort of their own home. This tackles the issue of a lack of motivation highlighted in earlier chapters due to a lack of information readily available.

The application includes features for those who prefer to log everything and track their progress over time. It keeps a log of not only their physical progress, but dietary habits as well, in addition to recommending users how to safely gain, maintain, or lose weight.

Putting the project into context, the proposed solution greatly improves on the features and functionalities highlighted in Chapter 2, as well as implementing new features they were lacking in. In conclusion, after weighing up the improvements and limitations this project tackles, the application can be largely considered a success, as it would have met the initial aims and objectives had it been completely implemented as intended.

6.2 Future work

In this section, a few areas are highlighted for future work. Although the project can be considered a success, there are certain aspects of the application which could be improved.

The first potential improvement could be to implement an offline mode for the application, whereby users can access certain features that do not rely on an internet connection. This would allow for a wider range of users to be interested in using the application, especially young adolescents who do not have as much data to spare, as most health-related smartphone applications require an internet connection.

Another improvement could be including motivational reminders to boost users' enthusiasm and continue working towards their goals. At times, simply hearing a few motivational phrases can greatly encourage someone to keep pushing forwards and aim for the finish line. This can be presented in the form of notifications which, besides increasing motivation, can also remind the user to keep up with their daily workouts. This leads to another crucial factor because usually when somebody is trying to implement a new activity into their daily routine, it can prove to be extremely difficult as they are not used to making extra time for the activity. Therefore, a small motivational reminder via notifications can be very helpful.

There is also room for improvement in the 'chat room' feature, because some users will be shy or overwhelmed when meeting a lot of new people they are unfamiliar with. Thus, it can be useful to have a feature that allows users to add one another as friends so they can exchange messages privately. Furthermore, this can be beneficial for users who wish to ask a question but are not comfortable with asking it publicly.

The application could also showcase videos of different activities/sports to give users a clearer idea on how these sports are played. Additionally, it could include videos on ways to perform certain indoor activities so as to avoid incorrect execution of these activities and causing injury to the user(s).

Currently, the proposed application solution can only be used on Android OS smartphones. In order to reach a wider audience, future research could be done on ways to transfer the application and all its features onto the Apple iOS to appeal to a wider potential audience.

6.3 Legal, Social, Ethical and Professional Issues

6.3.1 Legal

As the proposed solution stores the users' personal information, it is therefore important to be aware of any legal issues that would apply to the project. For instance, the Data Protection Act 2018 controls how organisations or businesses handle personal data. The solution was developed whilst keeping the Data Protection Act in mind, handling user data within the application as specified and storing all data safely into the Firebase cloud database so that unauthorised personnel do not have access to it. Even within the application itself, users cannot see any personal information regarding other users except for their usernames, which they can make up or use their actual names if they choose to.

6.3.2 Social

The project will have social issues which will need to be taken into consideration as well; for example, it will have a positive impact on families and individuals, as the project aims to implement healthy habits in their lives together. Potentially, the proposed solution can also be used by health specialists, who may recommend the application to patients who are struggling with an unhealthy lifestyle. Schools may also encourage young students to use the application, so that they can get used to having healthy habits from a young age.

A social issue that could impact the project negatively is cyberbullying, since there is a chat function where users can exchange messages between each other. This leaves the possible risk of someone being bullied or made fun of because of a silly question or boastful remark etc.

6.3.3 Ethical

An ethical issue which could have an impact on the project is the misuse of information such as identity theft and offensive material. There are many cases of people committing crimes such as scamming others through identity theft. As previously described in the legal issues section, the application ensures that user data is stored safely and prevents unauthorised personnel from accessing it. If the information were to be leaked to the wrong people, then it could be shared or sold on the 'dark web' to commit crimes by impersonating someone else.

6.3.4 Professional

Throughout the project, the BCS Code of Conduct was followed to create an inclusive smartphone application with professional integrity. Google Material Guidelines and Nielsen's 10 Usability Heuristics for User Interface Design were

adhered to ensure the application's user interface looked professional and ergonomic to use.

6.4 Synoptic Reflections

Many skills were learnt over the course of this project which will serve to be very beneficial in future projects. The project was mainly developed in Java using Android Studio, which greatly enhanced the Java skills and developmental ability in creating Android applications professionally. The project also enabled skills to be learnt that will be useful for future employment, such as Agile project management using Scrums framework. To conclude, the project was considered successful overall in meeting its expectations and its aim of filling a gap in the current market of having an app that displays all relative information regarding living a healthier lifestyle readily available at one's fingertips.

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APPENDIX A: PROJECT PLANNING DOCUMENT

A1 Introduction

The chosen topic for the project is a mobile application aimed at individuals who have interest in Sports. The application will try help individuals who are not familiar with clubs by providing all necessary information and help they may need to get started. The reason behind the chosen topic is related to physical health issues in the UK due to lack of exercise which will be discussed in more detail later. Thus, the application will aim to encourage more people to get involved and help them find opportunities in their area. Health issue is the main problem this project aims to tackle and provide a potential solution for. According to the NHS (July 2012) a lot of health issues in the UK are due to the lack of exercise which is "as deadly as smoking". It has been estimated that "one in 10 cases of heart disease (10.5%) and just under one in five cases (18.7%) of colon cancer in the UK" often can be due to lack of exercise. In 2008, inactivity caused more than 5.3 million of the 57 million deaths estimated worldwide (NHS 2012). Lack of exercise can also cause your bones to become weak, risk of diabetes or hypertension (Kristin Davis, n.d).

The focus of the project is to try creating an application which will encourage individuals to be active by joining their local clubs or sport facilities as a means to stay fit. The purpose of the application is to store data on variety of sport clubs/facilities, opportunities (includes GPS feature) and all there is to know about getting for the user all in one place. Often people want to join a local club etc but do not have enough information about the clubs or their location which this project will help resolve. Currently, there are no solutions in the app market or online that offer same functionality or features to the proposed project.

However, there are a few resources which help achieve similar results. For example, using Google maps to locate suitable local clubs or facilities and then receive directions. Facebook is another platform which helps achieve similar results. Facebook has a functionality which allows its users to create Facebook pages where they can post updates and events. After doing some research, there were few pages that can be found on Facebook who advertise sport clubs/tournaments providing opportunities to people, such as "Sunday League Football (West Midlands Only)" page. 'Sunday League Football' also advertises kits players can buy at a very reasonable price. Another online resource which provides information are sport associations such as the FA (Football Association) website; where you can find all there is to know about Sunday league football clubs. The user can find their city's Sunday league (Men/Women and different ages), and all the teams currently registered; among other things, they also keep track of match results and player/club statistics. There is an app called "Match Report Pro" on Google Play/App Store which provides similar features and functionality compared to the proposed project; It is free to install. The application allows its user to create an account (usually the club manager) and register their team on the platform. The user will have the ability to manage their team from the app as they can add the player information, register match dates (when the match date approaches it will send them a notification); 'Live Scoring' system, Team statistics & individual player stats. The app has a built-in function which will automatically write match report for the user. The user can also communicate with the team sending them messages and chat using the app. There are also sport facilities who post leaflets to advertise around the local area and often provide indoor sports opportunities, such as 'DW Fitness First', 'David Lloyd' and 'Moorways' etc who offer indoor boxing and swimming lessons.

A2 Amins and Objectives

This project aims to create a sports application intended to encourage individuals to partake in sports of their choice. The projects aim to achieve this by the following:

1. Research/Learn to develop in Android Studio

Do research and learn how to implement the features needed for the application. Without doing research, it will prove to be difficult later and will likely be a big setback for the project. The research should take no more than 2-3 days maximum.

2. Provide people with all the information about local clubs

Try implementing features and functionality which will make people look into local clubs and all the information they may need to get into their chosen sport. This may take some trial and error to meet the user requirement. Majority of the time will be used achieve this.

3. Develop a user-friendly UI

Implement a very simple user interface which is easy to use. Will attract more people to use the application compared to an application which is very complicated to use, so after some time, users will get frustrated and not use it. This may take around a week.

4. Find a way to safely store user data

It will be important to have a secure way to store user data by implementing a database, so no one else has access to it. Also, this will make sure the user data is saved so they will not have to keep making an account each time they use the app.

5. Provide map feature

Implement a GPS feature which shows the location of the clubs which will make it easier for the user to locate

6. Intergrade functionality for variety of sports

Have a variety of sport options for the user because everyone has different likes and dislikes, so instead of forcing a specific sport, it will be good to have a variety to choose from.

7. Add functionality for individuals to leave reviews

A3 Tasks and Deliverables

There are a few tasks and deliverables which need to be completed in order to meet the aims and objectives set. The tasks and deliverables include:

1. Research

- Research how lack of exercise is affecting individuals and the main reason behind it
- Research existing solutions currently available to see what their strengths and weaknesses are and try to add the improved functionality in the app
- Research Android Studio using their documentation and online tutorials to help develop skills
- Research how to design GUI
- Research way to test the application to ensure the code has no errors and it runs fine
- Research how to set up database for mobile application using Android Studio

2. Create a repository for version control which will enable to backup all the data and keep it safe, so it is not lost

3. Develop prototype of the application by putting together all the knowledge gained from the research

4. Identify requirements

- Identify functional requirements for the application
- Identify Non-functional requirements
- Milestone: Requirements gathered

Dependant: Functional and Non-functional requirements

5. Analysis

- Create model use cases
Dependent: Requirements gathered
- Create class diagram which will show the structure of the system and classes it will need
Dependent: Requirements gathered
- Create sequence diagram which will show the interaction between objects and classes
- Milestone: Analysis complete

Dependent: All Analysis tasks

6. Database Design

- Create ERDs (Entity relationship diagram) which will show the relationship between entities within the application
Dependent: Analysis
- Create DFDs (Data flow diagram) which will show the data flow within the application
Dependent: Analysis
- Normalisation of the data which will allow to reduce dependencies
Dependent: DFDs & ERDs
- Milestone: Database Design completed

Dependant: Database Design tasks

7. Design

- Create a paper prototype of the application

Dependent: Analysis and Database Design

- Milestone: Design completed

Dependent: All design tasks completed

8. Implementation

- Create user login for Player user, Club user and Admin

Dependant: Design and Database Design

- Create Signup for 2 types of users

Dependent: Design & Database Design

- Create UI for the Player user – Dependant: Design

- Home interface
- Profile interface
- Local sport facilities interface
- Competitive clubs' interface
- Non-competitive clubs' interface
- Quick Match

- Create UI for Club user – Dependant: Design

- Home interface
- Profile interface
- Add Club static interface
- Add club league interface
- Upload Club photo interface

- Create UI for Admin – Dependant: Design

- Home interface
- Manage player user interface
- Manage club user interface

- Implement the backend for all 3 UIs - Dependent: Database,

Analysis & Design

- Backend for Player user
- Backend for Club user
- Backend for Admin

- GPS functionality which shows the location of the club- Dependent:
Design
- Milestone/Deliverable: Player user part complete
Dependent: Creating UI and Backend completed
- Milestone/Deliverable: Club user part complete
Dependent: Creating UI and Backend completed
- Milestone/Deliverable: Admin part complete
Dependent: Creating UI and Backend completed

9. Testing

- Create test suites using Android Studio to make sure the application works fine and meets the project requirements
Dependent: Login/Sign up being completed
- Get colleagues to test it to make sure it meets the user requirements
Dependent: Implementation being completed
- Milestone: Testing complete

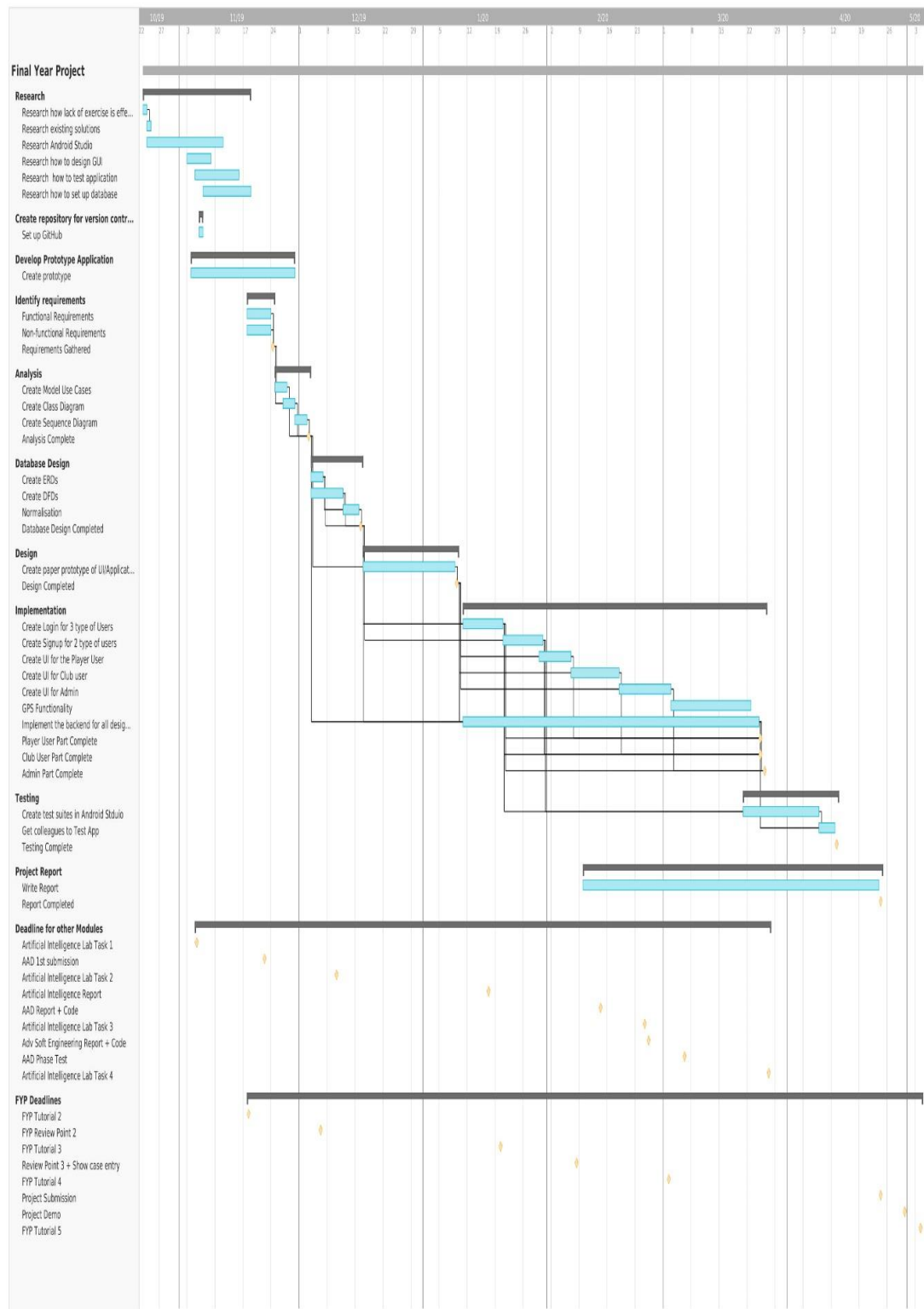
10. Project Report

11. Deadline from other modules

Once the application is completed and tested, it would be uploaded to Google Play which is Android App store so users can freely access it. Also, have local clubs and individuals use the application and receive their feedback. However, this is out of scope for this project due to having deadlines for other modules.

Milestone	Date	Deliverables completed
Review Point 2	6/11/19	1,3
Tutorial 3	20/01/20	2,4,5,6,7 half of 8
Tutorial 4	01/03/20	8,9

A4 Gantt Chart



A5 Resources

The main resource which will be used throughout for the project will be Android Studio which is an IDE for android development. It is Java integrated development environment which provides the user which drag-and-drop tools. This makes it easier for the developer to work on the interface for the application they are trying to create; it also gives the user a visual representation of how the application will look on a mobile phone. Android Studio is of the best android development IDE (Adam Sinicki, 2018), one of the reasons for this is because it provides the user with a virtual device so they can execute and run the code to see how the application would look along with how it works. The application will be implemented using 'Android Java' programming language which is very similar to Java because it is Java based and there are large Java libraries supported in Android (Java).

The project will aim to target Android platform instead of iPhone (IOS). The main reason for this is because according to the statistics, Android share 74.45% of the market while IOS shares only 22.85% (Martyn 2019). This shows that the project will be able to influence a large number of audiences, compared to IOS. For the storing data, the application will use a database called Firebase which is a cloud-based database. The application will also use 'Flutter' which is a Google Framework. The project will use Flutter to assist with implementation of the user interface as Flutter has its own UI system. The project will use version control to ensure the work is safe and has been backed up in case of any unforeseen incidents. To achieve this, the version control which will be used is called 'GitHub'. GitHub is the most used version control system amongst developers as it is very versatile and has many useful functionalities. Once the project has been finished, it will be then uploaded on 'Google Play' for users to access which is the platform where android users download apps from.

There are various online resources which will be used to assist with the completion of the project. Udemy and YouTube will be used to watch tutorials on how to implement features/functionality for the application and to increase the knowledge on mobile development. Udemy is an online platform for online courses, which teaches its users from the basics to the advanced techniques of the topic. YouTube is a media platform where the user can find any type of video they wish to see. There are also Mobile Application labs which provide information on many useful functionalities which could be used in the project. The lab tutor for the mobile application module along with my personal tutor are also available to assist with the project and give helpful advice when needed. Friends and colleagues who are familiar with android development can also be source of information if there are issues while working on the project. For designing the user interface paper prototype, 'Fluid UI' is a very helpful online platform which allows the person to drag and drop UI features such as buttons, text boxes etc, making it very easy to design a prototype. 'Material Design' is a website which will assist when designing GUI for the application as it contains different layout and design ideas for mobile applications, websites and desktop consoles etc. The only hardware required for the project would be a mobile phone with Android OS installed.

A6 Project Risks

Potential Risk	Probability (Out of 5)	Cause of the Risk	Potential Solution
Not meeting requirement	1	The functionality and features aren't meeting the project requirement	Get in touch with local clubs/friends and colleagues and

			see if they are willing to give feedback
Project too complicated	2	Making the project way too complicated and unrealistic to complete in the given timeframe by adding too many/complicated features	Discuss with PT if the features are realistic or unrealistic to create. Start by working on the easier features and leave the complicated ones to last
Users do not use the application	0	There might be some features the application is lacking	Get some feedback from friends (who play sports), PT, colleagues and maybe even local clubs.
Interface is very confusing and complicated to use	3	Due to lack of experience making application, it could prove to be difficult to add all those features in a user-friendly way	Try to get advice from 'Mobile Application' module lecturer and PT. Don't add too many features on a single interface, instead try to have a variety of interfaces for different features to

			make it simple to use for the user
The project doesn't get finished on time	2	Due to having lots of work to do for other modules, there isn't much time to work on the project	Manage time well by using free sessions/time efficiently and make a weekly timetable to divide the time appropriately between the modules.
Work gets deleted	1	Accidentally delete the code file, or laptop/computer stops working	Make sure the work is backed up and use source control (version control) such as 'GitHub' to keep work safe and backed up

Database is not set up properly	3	The database isn't implemented properly so the app cannot store user information, such as login info when they register. This will result in the app not functioning properly plus them having to make a new account over and over.	Do some testing while implementing the app features. Do some research on how to set up the database properly in 'Android Studio'.
Home computer breaks down	2	The computer at home stops working due to unforeseen circumstances	Come to university early so you can use their facilities i.e. computers
Error in the Code	5	Not implementing test suites to test the code for errors etc which could result in the application being full of bugs and ruin user experience	Research how to write test suites in android studio and what resources are available online to help achieve this

A7 Legal, Social, Ethical and Professional Issues

There are many legal, social, ethical, and professional issues which need to be taken into consideration while working on the project. One of the legal issues which may affect the project is General Data Protection Act (GDPR) 2018. Data

Protection Act 2018 is the updated version of Data Protection Act 1998 where the personal information used by organisations or businesses need to be, "handled in a way that ensures appropriate security, including protection against unlawful or unauthorised processing, access, loss, destruction or damage" [1]. This act will affect the project as the application will store the users' personal information such as, name and address etc, thus, while implementing the application, it is important to make sure the user's data is safely protected. One way to achieve this is by making sure no one has access to user data except the user or the admin. Also, only the user can see their own personal information. Computer Misuse Act is another legal issue which will affect the project. This act ensures the personal data of individuals is safe and protected from "unauthorised access and modification" [2]. The solution to this is like the previous one, by making sure unauthorised users do not have access to other people's details. In addition to this, the data can be stored in an online database instead of the phone. This will keep the personal information protected and away from unauthorised personal, so they will not have any means to access it. One other legal issue which may need to be taken into consideration is Freedom of Information Act. However, this will not have an impact on the project because the Freedom of Information Act only covers public authorities [3].

There are a few social issues to be taken into consideration such as the impact on the society i.e., families, education, workplace etc while working on the project. The project may have a positive impact on families as they may download it to get into sports/exercising and aim to improve their wellbeing together. It can also affect educational sector as schools may encourage student to download the application, so they make take interest in sports and look after their health from a young age, as the lack of exercise because a habit as you get older and become lazier which increases the chance of health problems. It may have an influence the youth and encourage them to get out of their houses

instead of using their phones or computers at home all day. This will help decrease the risks of social isolation as they are going to meet new people and socialise by making new friends. Cyberbullying can be another issue which may affect the project as one of the potential features to improve the project could be to add social media side where people talk about their experiences with different clubs and give them a rating out of. However, this could result in cyberbullying, for example if someone give a poor rating or leaves a negative comment about a club, the staff or the members of the club could be offended which could result in cyberbullying.

One of the ethical issues which may affect the project is misuse of information such as identify theft and offensive material. There have been many cases of identity theft where people have had unauthorised access to someone's detail or using social media. The application will store user's personal information, thus if someone else other than the user had the access to it, their identity can be stolen; someone can stalk them as they will have their address details.

Therefore, it is important to keep the user data safe as mentioned previously in the legal issues. Someone can make a club account as a prank and add offensive material or inappropriate location details instead of a sports club or facility.

Thus, it is important the admin monitors the clubs being added, the potential solution to this can be that before the club/facility details are added to the club, the admin will have to approve it, if it is declined, then the data will not be added to the app. Ethical issues such as Safe Guarding (DBS) doesn't impact the project as it doesn't involve anything which may put anyone's health in risk, neither does it involve working with kids.

There are professional issues which may also influence the project; thus it is important to ensure the British Computer Society (BCS) Code of Conduct is taken into consideration which lists how to keep your work at the professional standards. Under the 'Public Interest' section, it is mentioned to ensure

professionalism, your activities should not discriminate “on grounds of, sex, sexual orientation, marital status, nationality, colour, race, ethnic origin, religion, age or disability” [4]. This could have an impact on the project as there could be clubs listed in the application who discriminate against a certain type of people, or if the application for example, had the options where it specifically asked for their race and filter the sports, they can do depending on what race they chose. Thus, it is important when creating the application, not to include any features which may discriminate, and include an option for users to report any clubs they may feel are discriminating. In the code of conduct, it is also stated to keep professional competence and integrity in mind, meaning respect other people’s alternative news and accept criticism with an open mind. This can be applied to the project, so when a colleague/friend or PT gives some criticism, do not take it to heart and be upset about. Instead use that criticism to improve the project further. When working on projects generally, sometimes unexpected issues can arise which could have a big impact on the project and effect its progress, therefore, it is important to react to any unexpected situation appropriately to show professionalism.

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