

STRENGTH IN NUMBERS

A Social Media Fitness App

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Final Year Dissertation

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Declaration

I, Joshua Wan, declare that this work submitted for assessment is my own and is expressed in my own words. Any uses made within it of the works of other authors in any form (e.g., ideas, equations, figures, text, tables, programs) are properly acknowledged at any point of use.

A list of the references used within this document have been included.

Signed: Joshua Wan _____

Date: 21/11/21 _____

Abstract

Background: Physical activity, structured diets, and strong social connections are all extremely powerful tools that can be used to benefit a person's mental and physical health. During the Covid-19 pandemic, people have been confined within their own homes, leading to an increase in physical inactivity figures and a decrease in social interactions; over the course of this project, it shall present a possible solution in the form of an application. The purpose of the application will be to motivate people of every level of fitness reach their personal goals through the use of social incentives and novel extrinsic motivators such as: gamification, competitive leaderboards and interactions with other users. The application will also include tutorials and learning tools for exercising and dieting to teach beginners in a friendly, non-intimidating environment.

Methods: The participants will be males and females with ages ranging from 21-50 years old. The participants' frequency of exercise is to be recorded over the course of two weeks prior to being given the application whilst the statistics of each exercise shall be recorded at the beginning of the two weeks and at the end of the two weeks. The participants will then be split into three groups determined by their frequency of physical activity. Each group will be split in half, one half will be the control group; given a limited version of the application containing only progress tracking features, whilst the other half will be given the application containing all of the features. At the end of the two weeks data will be collected and studied.

Hypothesis: A two-way ANOVA will reveal that those in Group 1 with access to the application increase the frequency of exercise and their performance. It is expected that those with access to the application in Groups 2 & 3 increase their performance although the frequency of exercise may not vary. For those without access to the application, frequency and performance shall remain the same or decrease.

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1. Introduction

1.1 Motivation

Maintaining a regimen of exercise and a healthy diet are paramount whenever it comes to a person's overall health and wellbeing. Exercise plays an integral role in lowering the risk of coronary heart disease, stroke, breast cancer and even early death (NHS, 2021). In 2019 The Health Survey for England found that 28% of adults were obese and a further 36.2% were overweight (Baker, 2021).

Exercising and dieting can be a painstaking process that drives many people to quitting before seeing any real progress. A study was conducted to see if combining gamification with social incentives increased physical activity, it was found that people given incentives such as gamification, competition and support increased their physical activity when compared to those who had no incentives. (Jakicic and Rogers, 2020).

This project is of great importance to society as it seeks to tackle a lack of physical activity in the masses by providing a social media platform for its users to push themselves to attain their goal, track their progress, motivate, learn, and compete with their peers all at once. Relevant literature and applications will be reviewed to discover the successes and downfalls of current market dominators.

1.2 Aims

- This project aims to design and develop an easy-to-use social media fitness application with the purpose of creating a community that inspires each other to strive to reach their fitness goals.
- Provide a framework that users can utilise to track their progress, increase self-confidence, and learn the essentials of fitness.
- Provide the user with in-app social incentives and rewards that will increase the user's desire to continue exercising.
- Provide a platform for users to keep in-touch with and make new friends.

1.3 Objectives

- Continuously monitor and update the review of literature relevant to the project and highlight successes and downfalls of applications with similar characteristics.
- Develop an iOS and Android compatible framework (modular and flexible) for my application.
- Develop a method to calculate a user's estimated calories burned, dependant on the type of exercise, effort, and the user's statistics.
- Create a platform within the application that allows users to interact with other users by competing, messaging, and posting informative pieces of knowledge on dieting and exercise.
- Develop a feature that users can track and log meals and exercises into.
- Develop a section of the application that provides users with knowledge of physical activity and dieting.
- Integrate gamification into the application as a way to increase a user's motivation, e.g., competition, rewards, etc.
- Create an in-application economy with earnable points and rewards.
- Collect the data required to perform a detailed analysis of results.
- Conclude the effectiveness of the application according to the results analysed.

2. Literature Review

The purpose of this section is to provide an in-depth literature review of topics relevant to the project along with the strengths and weaknesses of current popular fitness applications on the iOS app store to establish the functional and non-functional requirements necessary in order to develop a successful application.

2.1 Wearable Technology

The development of smartphones in today's society has made them one of the most versatile handheld devices a person can own, 80.76% of the world's population have a smartphone (Turner, 2021) putting together a strong case for it to be classed as the most used electronic in the world. In 2017 a survey had found that 93% of runners preferred to have some sort of tracking device to collect their running data as seen in Figure 2.1 below.

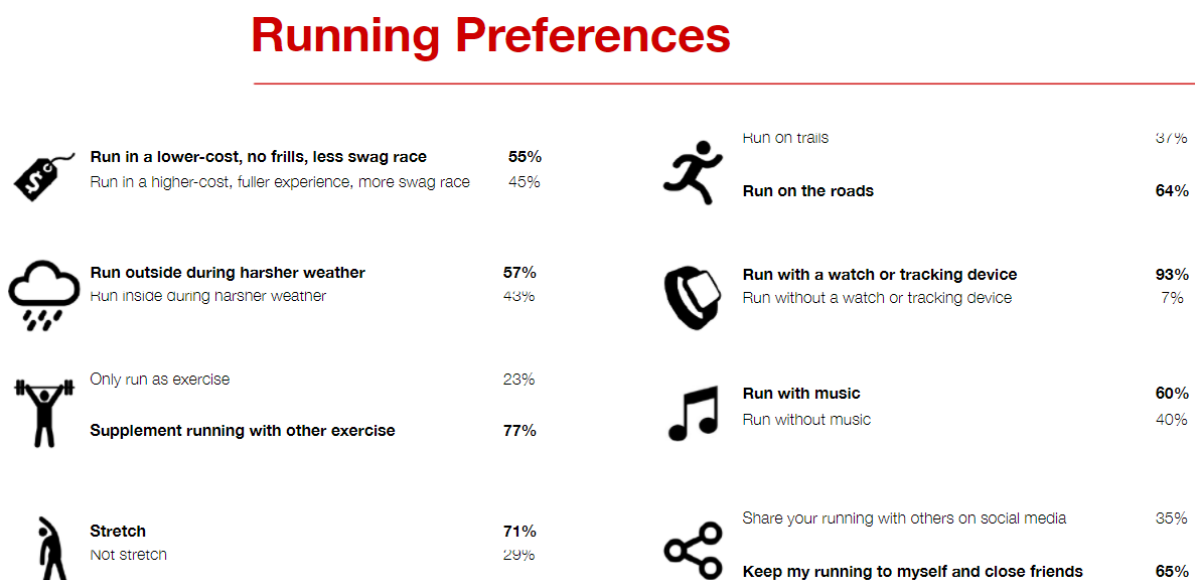


Figure 2.1: Running Preferences (Running USA, 2017).

A study was conducted on students using a blended learning model of fitness tracking applications and individualised teacher-coached running classes to find out if this affected the percentage of enrolled students that passed fitness assignments. It concluded that use of fitness tracking apps and coaching increased the passing rate by three times that of the control group without coaching or tracking applications (Chaloupský et al., 2019).

This study and the aforementioned surveys emphasize the availability of mobile phones as wearable technology, the preferences of runners to always have wearable technology when they run and also the effect tracking applications have on fitness performance.

2.2 Intrinsic and Extrinsic Motivation

When an individual is striving to reach a goal, having the knowledge of how to reach the goal will not achieve it single-handedly; the individual must also possess some form of motivation (Lindbloom, 2011). A study analysed the link between both intrinsic motivation and extrinsic motivation and levels of resistance training, concluding that intrinsically motivated participants performed significantly more resistance training than extrinsically motivated participants as shown in Figure 2.2 below.

Characteristics	Number of participants who meet recommended level of resistance training (n = 126)	Number of participants who do not meet recommended level of resistance training (n = 59)	χ^2	p
Gender				
Male	59	25	0.321	0.571
Female	67	34		
Marital status				
Married/living with other	71	26	3.145	0.370
Single	41	22		
Widowed	1	1		
Separated or divorced	13	10		
Education				
High school or less	16	11	2.600	0.627
Vocational/technical degree	6	3		
2-y college degree	11	4		
4-y college degree	56	29		
Graduate school degree	37	12		
Income				
<\$25,000	9	8	5.826	0.212
25,000–49,999	28	12		
50,000–74,999	24	7		
75,000–99,999	16	13		
100,000 and above	49	19		
Race/ethnicity				
Caucasian, non-Hispanic	104	46	0.548	0.459
Non-Caucasian and Hispanic	22	13		
Health self-determinism				
Extrinsic motivation	6	1148	9.280	0.002
Intrinsic motivation	120	48		

Figure 2.2: Bivariate analysis of participant's characteristics to meeting or not meeting recommended levels of resistance training. (Kathrins and Turbow, 2010). (This figure contains a typed error in the Health self-determinism rows where the number of participants who not meet recommended level of resistance training does not add up to n = 59. I believe the number 48 was duplicated onto the number 11, creating an entry of 1148.)

The aforementioned study highlights the efficacy of intrinsic motivation in resistance training, whilst the study performed by Cerasoli et al. analysed how intrinsic motivation and extrinsic incentives jointly predict performance. They discovered that intrinsic motivation is a medium to strong predictor of performance and that when tied with extrinsic incentives that indirectly tied to performance this remained the case, in agreeance to the study conducted by Kathrins and Turbow, however when

extrinsic incentives were directly tied to performance, intrinsic motivation became of less importance (Cerasoli, Nicklin and Ford, 2014). The literature reviewed in this section outlines the importance of intrinsic motivation whilst also mentioning how extrinsic incentives can be used to increase performance, this is discussed further in sections 2.3 and 2.4.

2.3 Gamification

Gamification refers to the application of typical elements of game playing in non-game contexts. A positive gaming experience is posited to be primarily determined by the balance of skill and challenge (Corcos, 2018).

A study was conducted giving the participants cognitive tasks, adding and removing game design elements to investigate their impact on performance and motivation. The results suggested that with more design elements, higher motivation and performance were observed, however, there was a potential threshold that had to be met for gamification to become effective. Once game design elements had removed from an ongoing task, performance did not decline (Groening and Binnewies, 2021).

Another instance of a typical game element – competition – increasing performance was documented in a study by J. Corbett et al, in which cyclists completed head-to-head competitions against their recorded best performances, assuming that it was another cyclist, resulting in faster performances for the cyclist (Corbett et al, 2012). In a study using a game to increase a user's physical activity, it was found that in-game rewards could positively affect the amount of physical activity a user was performing without decreasing perceived enjoyment of playing (Berkovsky et al., 2010).

Gamification has become a popular tool used by companies to promote customer engagement (Eisingerich, Marchand, Fritze and Dong, 2019) and from the studies reviewed can increase intrinsic motivation through the use of novel extrinsic motivators such as competition and in-application rewards. Gamification is discussed further along with social incentives in section 2.4.

2.4 Social Incentives

A person's fitness journey may sometimes fail before it even begins; this could be due to a number of factors, e.g. laziness, poor financial stability or even their own lack of belief in themselves. Overweight students were found to have lower intrinsic motivation during fitness testing than non-overweight students undergoing the same testing, leading to the conclusion that novel extrinsic motivators are necessary to improve perceived physical fitness in overweight students (Grao-Cruces et al., 2020).

A study including participants that were overweight or obese was carried out using gamification and social incentives as novel extrinsic motivators to determine their effectiveness at getting participants to increase physical activity for a 24-week intervention period with a 12-week follow up period. The participants were given wearable devices to monitor steps per day and were then split into three groups, not including the control group: A support group that encouraged family members or friends to support their engagement in physical activity, a collaboration group that introduced a participant with three other participants in the study, the group worked collectively to meet their goals in physical activity, a competition group that introduced a participant with three other participants in the study once more, this time the group of participants competed with each other on a weekly basis based on their step-based activity (Jakicic and Rogers, 2020). This study found that during the 24-week intervention period all three groups had significantly higher levels of physical activity when compared to the control group, however during the 12-week follow up period, the competition group was the only group to maintain this lead in physical activity.

Another study also documented that "A social incentive-based gamification intervention among families was effective at increasing physical activity." (Patel et al., 2017), supporting both, the previous and the following studies' findings, that when using a mobile game designed to let users exercise together, quality of physical activities increased by 15% compared to when users exercised alone (Chen and Pu, 2014).

The studies mentioned in this section and in section 2.3 show that gamification and social incentives can be used as powerful tools to increase an individual's motivation to complete a task via the use of extrinsic incentives and motivators such as competition, support, collaboration, and in-application rewards.

2.5 Social Media

Social media was created in 1997 by Andrew Weinreich with sixdegrees.com and has skyrocketed in popularity since then. 95% of teens in the United States are reported to have a smartphone or have access to one (Anderson and Jiang, 2018) and of the 5.27 billion mobile phone users in the world, 85% of them use social media (Dean, 2021).

Whilst social media can and is used by many people as entertainment, it can also be used as a pedagogic tool. A survey conducted with 1296 participants ranging from 13-18 questioned the participants to find out "How many young people actively access information on health-related material?" It was discovered that 53% of the young people questioned did in-fact use social media in this manner with 60% interested in physical activity, 53% interested in diet or nutrition and 8% interested in body image (Goodyear, Armour and Wood, 2018). This is supported by one of the conclusions drawn from a study on young women's negotiations of health and fitness on social media, "Our research evidences that health and fitness content on social media can be a hugely persuasive public pedagogy, influential in shaping how young women learn" (Camacho-Miñano and Gray, 2021).

Although social media can be used as an educational platform to assist people in gathering further knowledge of the health and fitness industry, there can be downsides to an individual's exposure to this category of content. A study on the influence of engaging with fitness inspiration using social media on a person's health and wellbeing investigated the positives and negatives of interacting with "fitspiration" detailed that "17.7% of participants were classified as high risk for an eating disorder, 17.4% reported very high levels of psychological distress, and 10.3% were at risk of addictive exercise behaviours" (Raggatt et al., 2018). However, it also found that exposure to this content increased

social support through being part of a community and increased access to reliable health information (Raggatt et al., 2018). Whilst the negative impact social media can have on an individual outlined by this study is extremely daunting, the social media used to obtain these results was influenced heavily by images posted by users of the fitness industry, potentially leading to a comparison of oneself to the athletes seen in aforementioned images. It may be possible that to decrease these percentages of eating disorders, psychological distress and addictive exercise behaviours, images may need to be brought out of the equation to prevent self-examination and self-criticism.

From this data it can be concluded that when developing a social media application, the majority of young people using the application would be interested in interacting with users willing to share their knowledge on health-related materials and creating a social media application that already provides this information with the feature of having user-inputted learning materials that are rated by other users would be beneficial for its popularity amongst the younger population. It is also of great importance to consider the psychological effects that a fitness oriented social media application may have on an individual and develop the system requirements with this in mind.

2.6 Fitness Applications

2.6.1 MyFitnessPal

MyFitnessPal (MyFitnessPal Inc, 2021) is currently ranked at number 2 in the UK on the iOS App Store when sorting for Health & Fitness apps (See *Figure 2.6.1.1 below*) making it the most popular health and fitness application on the market right behind Radox CertiFly, an AI driven application that certifies lateral flow tests for Covid-19. MyFitnessPal boasts a user base of 200 million members in addition to obtaining an overall rating of 4.4/5 stars with 2,449,181 reviews (MyFitnessPal Inc, 2021).

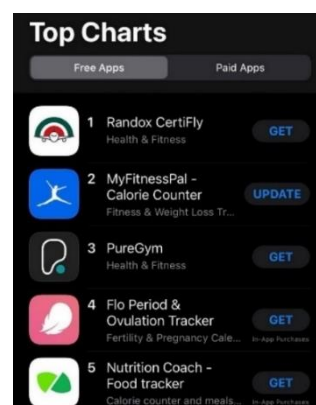


Figure 2.6.1.1: Top Charts sorted by Health & Fitness (iOS App Store, 2021)

MyFitnessPal carries features such as: Logging food and activity, setting goals, tracking your progress, learning from experts, a large database of exercises and recipes you can choose from and more (MyFitnessPal Inc, 2021).

From the reviews that can be found in Appendix 1, MyFitnessPal seems like an excellent application for tracking your macronutrient, micronutrient and caloric intake, a feature that is mentioned often in the reviews is the barcode scanner which easily allows users to input the ingredient they are consuming into each meal. The application has a user-friendly design for those who are focused on their dieting, however, the other features of the app seem to be crammed into one space without much thought and can be missed very easily if not searched for intentionally.

In February 2018, MyFitnessPal suffered a data breach in which the hackers obtained usernames, hashed passwords, and email addresses (Lukic, 2021).

The main takeaways from this application are:

- A large database of food and drinks users can access is a necessity.
- The barcode scanner is an extremely effective novel tool.
- Users enjoy ease of use when tracking their own data.
- A user-friendly interface is essential.
- Storing user data safely and responsibly is paramount.

2.6.2 PureGym

PureGym (PureGym, 2021) is currently ranked at number 3 in the UK on the iOS App Store when sorting for Health & Fitness apps (See *Figure 2.6.1.1 in Section 2.6.1*) proving it to be one of the most popular health and fitness applications available to the public. PureGym is the largest chain of commercial gyms in the UK promising customers perks such as 24/7 access to your PureGym, no rolling contract for memberships, a free PureGym app that holds an overall rating of 4.2/5 stars with 17,137 reviews and many more (PureGym, 2021).

PureGym's mobile app consists of features such as: contactless entry to the gym using a QR code, live attendance tracker, a database of workouts to choose from, tracking activity and more (PureGym, 2021).

From the reviews that can be found in Appendix 2 *Figures 8.2.1-8.2.4*, the PureGym application, whilst very popular and highly rated, has been displeasing consumers as of recent with its sluggish performance and unnecessary splash screen on loading the application. However, as shown in *Figures 8.2.5-8.2.8 in Appendix 2*, some users enjoy using the application for its ease of use, variety in workouts that it provides, and in person features such as: quickly scanning the QR code to enter the gym and checking how busy the gym is at any given time with the live attendance tracker.

Whilst the application is user friendly and contains some highly sought after features that a fitness application could benefit from, I believe the popularity of the application stems from the popularity of the brand; upon entering a PureGym a customer must enter their PIN number, for any customers that do not want to have to remember their pin number, they can simply download the application and use their QR to enter the gym contactless every time, leading it to be one of the most highly regarded features that the application contains.

The main takeaways from this application are:

- A large database of exercises is a necessity.
- Users will notice when an app does not perform quickly, therefore emphasizing the need for an optimised application.
- Do not add any splash screens or images that will hinder user experience.
- Novel features attract large audiences.

2.6.3 Fitbit: Health & Fitness

Fitbit (Fitbit, 2021) is a health and fitness application that works solely with the use of any model of wearable tracker produced by the company. Fitbit is an extremely popular application with a rating of 3.8/5 stars across 856,709 reviews (Fitbit, 2021) and 31 million active users (Vailshery, 2021).

The Fitbit application and wearables have evolved greatly over the past decade introducing revolutionary ideas to the health and fitness industry, with features such as: tracking your steps, calories burned, floors climbed, active minutes, your sleep, the quality of each sleep, tracking and analysing your heartrate and allowing you to join a community, connect and compete with other users (Fitbit, 2021).

Relative to the reviews pictured in *Figures 8.3.1-8.3.4 in Appendix 3*, Fitbit has successfully implemented many of it's features touching on many of the topics aforementioned in this literature review; the implementation of social incentives to build a community and make users accountable for their own physical activity, the use of gamification with challenges and rewards, and fundamental health and fitness features such as tracking progress, learning tools to educate the user about their body and setting goals. However, as seen in *Figures 8.3.5-8.3.7 in Appendix 3*, Fitbit has been having some issues as of recent allowing users to sync their wearable devices to their mobile phones, stopping all functionality of the application. This is a major flaw that renders the Fitbit app unusable for those it affects and leaves Fitbit at risk of redundancy if the flaw is not fixed completely.

The main takeaways from this application are:

- Building an app that must sync with any external hardware can lead to syncing problems and unhappy users.
- Community building and other social incentives are very effective in increasing user engagement.
- Gamification is essential to provide users with novel extrinsic motivators.

2.6.4 Pokémon Go

Pokémon GO (Niantic Inc, 2021) is a free-to-play mobile game that was released in 2016. Whilst Pokémon GO is not a health and fitness application, it is an extremely popular mobile game with a rating of 4.3/5 stars across 14,934,468 reviews (Niantic Inc, 2021) that promotes physical activity solely through gamification. It promotes physical activity by allowing users to traverse the real world

in search of “Pokémon” in your local area, ensuring that users are walking by introducing a speed limit that, if exceeded, will not allow users to earn distance-based rewards.

From the reviews found in *Figures 8.4.1-8.4.4*, it can be seen that Pokémon GO has found success in incorporating real-world activities into the game whilst maintaining an easy-to-understand idea and interface suitable for children and adults. Pokémon GO was not developed to be a health and fitness application, shown by its lack of features in this sector, however, it has introduced an element of gameplay that has successfully motivated its users to increase their physical activity by providing them with in-game rewards and tasks such as: finding more powerful Pokémon to battle non-player characters with other users, competing against other users in gym battles and trying to find every Pokémon to complete their Pokédex.

The main takeaways from this application are:

- Gamification through rewards, tasks and other incentives is extremely effective in motivating users to increase their physical activity.
- The social features of this application can motivate friends and family to socialise with each other through the application, increasing everyone’s physical activity.

2.6.5 Application Review

Following the review of three highly popular health and fitness applications and a popular mobile game, MyFitnessPal, PureGym, Fitbit, and Pokémon GO, it was made apparent that there certainly are some features that a successful health and fitness application cannot go without. It was also outlined that along with these key features, a health and fitness application must contain a key novel feature that differentiates it from others to avoid being generic. With each application reviewed, amidst their successes, there were also downfalls, these came in the form of complicated user interface that was hard to navigate, features not working, slow performance, unnecessary features that hinder use of the application and syncing issues with external hardware.

As discussed in sections 2.1 and 2.4, motivation is a crucial element to increase physical performance of individuals, whether it be intrinsic or extrinsic and as shown in *Appendix 5*, there is strong evidence to support that user experience increases whenever the user begins to see real world results whilst using an application.

The following is a list of features obtained from reviewing the existing popular applications in sections 2.6.1-2.6.4 that have proved to directly impact physical performance, quantity of physical activity and user experience:

- Tracking and logging meals and exercise (Sections 2.6.1, 2.6.2 & 2.6.3)
- Fast performing, easy-to-use user interface (Sections 2.6.1 & 2.6.2)
- Variety in the form of a large database of meals and exercises to choose from (Sections 2.6.1 & 2.6.2)
- Novel extrinsic motivators (Social incentives, gamification, etc) (Sections 2.6.1, 2.6.2, 2.6.3 & 2.6.4)

3. Requirements

The functional and non-functional requirements listed in this section have been sorted using the MoSCoW prioritisation technique. Requirements from this section have been inspired from the literature review and will be compartmentalised into different functionalities for the application.

3.1 Functional Requirements

ID	Description	Priority
FR-1	User Profile	
FR-1.1	Create account	Must have
FR-1.2	Edit Account Details	Must have
FR-1.3	Personalise Profile	Should have
FR-1.4	Allow links to other social media	Could have
FR-1.5	Allow users to post pictures to the platform	Won't have
FR-2	Log & Track Exercises	
FR-2.1	Choose an exercise to perform	Must have
FR-2.2	Log & store the number of sets and reps of the chosen exercise	Must have
FR-2.3	Compare performance of new and old exercises	Must have
FR-2.4	Calculate the number of calories burned per workout/exercise	Should have
FR-2.5	Track phone during cardio exercises to measure distance	Should have
FR-2.6	Create new exercises/workouts	Could have
FR-3	Log & Track Meals	
FR-3.1	Log & store each meal	Must have
FR-3.2	Calculate calories for each meal	Must have
FR-3.3	Compare calories from day to day/week to week	Should have
FR-3.4	Include a barcode scanner to load any foods into the application for tracking	Should have
FR-4	Learn Exercises	
FR-4.1	Choose an exercise to learn	Should have
FR-4.2	Choose from exercise topics posted by the system	Should have
FR-4.3	Choose from exercise topics posted by a user	Could have
FR-4.4	Rank by user inputted sort function e.g., popularity, newest, etc	Could have
FR-5	Learn Dieting	
FR-5.1	Choose a recipe posted by the system	Should have
FR-5.2	Choose a recipe posted by a user	Could have
FR-5.3	Choose from dieting topics posted by the system	Could have
FR-5.4	Choose from dieting topics posted by users	Could have
FR-5.5	Rank by user inputted sort function e.g., popularity, newest, etc	Could have
FR-6	Social	

<i>FR-6.1</i>	Allow users to add friends	Must have
<i>FR-6.2</i>	Allow users to search for other users	Must have
<i>FR-6.3</i>	Allow users to join and create groups	Must have
<i>FR-6.4</i>	Allow users to message friends or groups	Should have
<i>FR-6.5</i>	Allow users to share personal bests or workouts with friends or groups	Could have
<i>FR-6.6</i>	Allow users to comment or like shared personal bests or workouts of friends, if shared	Could have
FR-7	Competition	
<i>FR-7.1</i>	Allow users to view a leaderboard of friends and groups, ranked on personal performance	Must have
<i>FR-7.2</i>	Allow users to opt-in and opt-out of leaderboards	Must have
FR-8	Gamification	
<i>FR-8.1</i>	Reward users based on personal achievements	Must have
<i>FR-8.2</i>	Reward users based on leaderboard performance	Should have
<i>FR-8.3</i>	Have a progress bar that increases a user's rank	Could have
<i>FR-8.4</i>	Reward users based on social achievements	Could have
FR-9	Motivation	
<i>FR-9.1</i>	Send users notifications with motivational messages	Could have
FR-10	Moderation	
<i>FR-10.1</i>	Users will be able to report any inappropriate messages or user accounts	Must have
<i>FR-10.2</i>	Users will be able to block any accounts that they do not want to interact with	Should have

3.2 Non-Functional Requirements

ID	Description	Priority
NFR-1	Performance	
<i>NFR-1.1</i>	Application must perform operations quickly	Must have
<i>NFR-1.2</i>	Application must be robust	Must have
<i>NFR-1.3</i>	Portability	Must have
NFR-2	Aesthetics	
<i>NFR-2.1</i>	Visual appeal	Must have
<i>NFR-2.2</i>	Ease of use	Must have
<i>NFR-2.3</i>	Functionality	Must have
NFR-3	Data & Security	
<i>NFR-3.1</i>	Anonymise stored data	Must have
<i>NFR-3.2</i>	Store data safely	Must have

4. Testing Strategy

Software testing is an essential part of any software development lifecycle, it's purpose is to ensure that the application is fully functional and presents no errors or bugs at runtime and also to confirm that the application contained the functionality of the proposed requirements. During the development of the application, I shall deploy several stages of testing to ensure that the application runs as intended once in the user's hands.

Unit testing will be the initial stage of testing deployed. A unit refers to a requirement and the application will be divided into each unit and each unit shall be tested to ensure it functions as expected. This will outline any errors or bugs at runtime within the smaller units of code before continuing onto the next stage of testing.

Integration testing will follow after the unit testing stage. This will group several units together to test their interactions with each other when combined and help to discover any errors or bugs that occur during runtime.

The final stage of testing will be system testing. System testing will consist of tests run on the entire application once each requirement is fulfilled. The purpose of system testing is to find any errors or bugs at runtime when the application is compiled and will conclude the software tests.

5. Evaluation Strategy

Evaluation of a product is as necessary as software testing is when developing an application that will be used by the general public. In the late stages of development an evaluation will be carried out with the purpose of collecting feedback that will be examined and acted upon to develop a final product. All feedback and data collected will be stored and processed according to the UK's GDPR guidelines (UK Government, 2018).

Participants will be recruited via email and must fill out a short questionnaire containing demographic information and a consent form. The participants of the evaluation will be required to have an android device as a prototype application is easier to produce as a .apk file than an iOS application live on the app store. Participants will then be given a set of tasks to complete to ensure that they are evaluating the full functionality of the application. They will then be given an evaluation form to fill out to provide feedback for the application. This information will be written up and categorised in order of requirements mentioned, evaluated, and then discussed.

Considering that the application is a social one, accounts shall be created to give the users evaluating the app an accurate representation of the social features that the application has to provide.

6. Methodology

This section details the methodology that will be used to obtain the results that will then be analysed to produce a conclusion determining the effectiveness of the application.

6.1 Recruitment

Potential participants will be recruited using a variety of methods. Each potential participant will be informed that if they participate in the study for the full 2-week period, they will be entered into a raffle with other participants for a £20 Amazon Gift Voucher provided by myself. They will also be told that during any part of the study they can withdraw their participation and all data collected for that individual will be deleted promptly. I shall approach family, friends and local fitness entrepreneurs with a clientele and ask them if they would like to participate in the study and use the application. They will then be given a QR code which will allow them to fill in a questionnaire to collect data on each participant's demographics and lifestyle. Participants will not be excluded from the study due to any information given in this questionnaire.

6.2 The Study

The participants will be split up into 3 groups according to current quantity of physical activity. Group 1 shall consist of participants who perform some form of exercise between 0-2 times per week, group 2 shall consist of participants who perform some form of exercise between 3-4 times per week and group 3 shall consist of participants who perform some form of exercise between 5-7 times per week. After dividing participants into these 3 groups, each group will then be randomly split in half; half of the participants will use the application for the 2-week period and the other half of the participants will be given a version of the application with reduced features not designed to motivate the participants via novel extrinsic motivators. Once the application has been developed, it will be given out to the participants with the request that they use the application to record their workouts and diets for the length of the study. At the end of the study, the participants will be asked to complete a questionnaire to give feedback on user experience and usability. This data and the data collected by the application will be reviewed and concluded upon and deleted once final marks are released.

7. Project Management

7.1 Project Timeline

The Gantt chart below in *Figure 7.1.1* details the timeline of the Deliverable 1 document. The Gantt chart aided in meeting self-made deadlines in order to meet the set deadline of Deliverable 1. Each task has been allocated a certain time according to the importance of the task according to the “Dissertation Handbook” and the complexity of the task.

PLANNING STAGE				Semester 1											
Supervisor Meetings				Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Supervisor Meeting 1	30 minutes	21/09/2021	21/09/2021												
Supervisor Meeting 2	30 minutes	28/09/2021	28/09/2021												
Supervisor Meeting 3	30 minutes	05/10/2021	05/10/2021												
Supervisor Meeting 4	30 minutes	12/10/2021	12/10/2021												
Supervisor Meeting 5	30 minutes	19/10/2021	19/10/2021												
Supervisor Meeting 6	30 minutes	29/10/2021	29/10/2021												
Supervisor Meeting 7	30 minutes	02/11/2021	02/11/2021												
Supervisor Meeting 8	30 minutes	09/11/2021	09/11/2021												
Supervisor Meeting 9	30 minutes	16/11/2021	16/11/2021												
Supervisor Meeting 10	30 minutes	19/11/2021	19/11/2021												
Deliverable 1															
Choose Topic & Initial Research	1 Week	13/09/2021	20/09/2021												
Abstract, Aims & Objectives	1 Week	20/09/2021	27/09/2021												
Literature Review	5 Weeks	27/09/2021	01/11/2021												
Requirements	1 Week	01/11/2021	08/11/2021												
Strategy for Testing & Evaluation	1 Week	08/11/2021	15/11/2021												
Methodology & Project Planning	1 Week	08/11/2021	15/11/2021												
Deliverable 1 Proofing	1 Week	15/11/2021	22/11/2021												
Ongoing Review of Literature	3 Weeks	01/11/2021	22/11/2021												

Figure 7.1.1: Deliverable 1 Timeline

The Gantt chart below in *Figure 7.1.2* details the timeline of the development stage of the application and the dissertation document. The Gantt chart outlines the development of the application taking a linear, waterfall methodology, completing one task after the previous has been completed. This timeline accompanied by that of the ongoing review of the literature and writing of the dissertation document including analysis of data must be met in order to successfully develop the application and write the dissertation document before the submission deadline. As in *Figure 7.1.1* each task has been allocated a certain time according to the “Dissertation Handbook” and the complexity of the task.

DEVELOPMENT STAGE				Semester 2														
Supervisor Meetings				Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
Supervisor Meeting 1	30 minutes	11/01/2022	11/01/2022															
Supervisor Meeting 2	30 minutes	25/01/2022	25/01/2022															
Supervisor Meeting 3	30 minutes	08/02/2022	08/02/2022															
Supervisor Meeting 4	30 minutes	22/02/2022	22/02/2022															
Supervisor Meeting 5	30 minutes	08/03/2022	08/03/2022															
Supervisor Meeting 6	30 minutes	22/03/2022	22/03/2022															
Supervisor Meeting 7	30 minutes	05/04/2022	05/04/2022															
Supervisor Meeting 8	30 minutes	19/04/2022	19/04/2022															
Deliverable 2																		
Ongoing Review of Literature	1 week	10/01/2022	17/01/2022															
Setup database to hold information	1 week	10/01/2022	17/01/2022															
Create User Profile	1 weeks	10/01/2022	17/01/2022															
Create a database of exercises	1 week	17/01/2022	24/01/2022															
Implement logging and tracking exercises	1 week	24/01/2022	31/01/2022															
Create a database of recipes & implement barcode scanner	1 week	31/01/2022	07/02/2022															
Implement logging and tracking diet information	1 week	07/02/2022	14/02/2022															
Implement social features	1 week	14/02/2022	21/02/2022															
Recruit participants for evaluation & study	2 weeks	14/02/2022	28/02/2022															
Implement Competition, Gamification & Motivation	1 week	21/02/2022	28/02/2022															
Implement Moderation	2 days	28/02/2022	02/03/2022															
Test system for bugs and fix any issues	1 week	02/03/2022	09/03/2022															
Ask evaluation participants to evaluate application	5 days	09/03/2022	14/03/2022															
Amend application according to evaluation feedback	1 week	14/03/2022	21/03/2022															
Ask participants to participate in the study	2 weeks	21/03/2022	04/04/2022															
Analyse data from study and add to dissertation	3 weeks	04/04/2022	21/04/2022															
Write Dissertation	15 weeks	10/01/2022	21/04/2022															

Figure 7.1.2: Deliverable 2 Timeline

7.2 Risk Analysis

7.2.1 Risk Identification

This section details the identification of possible risks to the development of the application. The risks listed has been classed by levels of severity via the table shown in *Figure 7.2.1.1*. Risks are ranked according to their likelihood of occurring and the severity of the impact the risk brings. Risks are ranked as follows:

- **Low:** Risks that are unlikely to impact the project
- **Medium:** Risks that have the possibility to impact the project and require mitigation
- **High:** Risks that are likely to impact the project drastically that must be mitigated immediately

	Impact				
Likelihood	Very Low	Low	Moderate	High	Very High
Very Likely	L	M	H	H	H
Likely	L	M	M	H	H
Possible	L	L	M	M	H
Unlikely	L	L	M	M	M
Very Unlikely	L	L	L	M	M

Figure 7.2.1.1: Risk Analysis Key

The following table in *Figure 7.2.1.2* contains all possible risks related to this project:

ID	Risk	Description	Type	Severity
1	Project deadline is missed	Gantt chart dates are not followed, and the project is not finished	Project	H (Possible – Very High)
2	Requirements are changed	A requirement is more complex than previously thought leading to too much allocation of resources and so it is changed or removed	Project	M (Very Likely – Moderate)
3	Files become corrupted	During the development of the application, project files become corrupted	Project	H (Possible – Very High)
4	Scale of project miscalculated	Deliverable 2 Gantt chart fails to grasp the complexity of tasks	Project	M (Likely – Moderate)
5	Errors hosting	The application encounters issues with hosting service	Technology	M (Unlikely – Very High)

6	Incapable software	The language used to develop the application provides ceilings to the application's features	Technology	M (Unlikely – High)
7	Participants drop out	During the evaluation or collection of results, agreeing participants drop out of the study	People	M (Possible – High)
8	Confidential data obtained by outside source	An outside entity attacks the database maliciously and obtains confidential data	Project	H (Possible – Very High)
9	No users consent to participating or evaluating	No users agree to participate in the study or the evaluation process	People	H (Possible – Very High)
10	Supervisor falls ill	Supervisor can no longer provide feedback due to illness	Project	L (Unlikely – Low)

Figure 7.2.1.2: Identified Risks

7.2.2 Risk Mitigation

The table below in *Figure 7.2.1.3* provides mitigation methods for each risk identified in *Figure 7.2.1.2* and will be consulted during through each step of the development process to ensure that each mitigation method is being followed:

ID	Risk	Mitigation Methods
1	Project deadline is missed	Follow the workflow of the Gantt chart precisely
2	Requirements are changed	Discuss with supervisor and identify the maximum amount of time the Gantt chart suggests for new requirements
3	Files become corrupted	Save the project to multiple spaces on a hard drive and use online version control tools such as: GitHub (GitHub, 2021)
4	Scale of project miscalculated	Follow the workflow of the Gantt chart precisely and if any tasks become overbearing or too complex, amend the requirements and detail why
5	Errors hosting	Have multiple choices that can be relied upon if one hosting service does not meet the standard expected
6	Incapable software	Use widely trusted and proven languages and libraries
7	Participants drop out	Provide incentives to participants to complete the study
8	Confidential data obtained by outside source	Employ sufficient security measures according to the University's Information Security Incident Management Policy (Heriot Watt University, 2017) such as: anonymising and encrypting user information, storing sensitive data in separate databases, etc.
9	No users consent to participating or evaluating	Attempt recruiting participants at every given opportunity and make the entire process as painless as possible
10	Supervisor falls ill	Attempt to find a substitute manager for this time period

Figure 7.2.1.3: Risk Mitigation Methods

7.3 Professional, Legal, Ethical & Social Issues

7.3.1 Professional Issues

“A professional is someone who belongs to a professional body” (MACS, 2021). As an individual undertaking an honours project overseen by the School of Mathematical and Computer Sciences of Heriot Watt University, I must adhere to the professionalism standards of the British Computer Society in order to mitigate the potential professional issues that “Strength in Numbers” poses regarding licencing and data anonymity, e.g., not having the correct licenses to distribute the application, not anonymising participants’ data after agreeing to it, etc.

This project chose the British Computer Society’s standards as those worthy of adhering to as they are a registered charity founded in 1957 that has been incorporated by the Royal Charter in 1984 with over 60,000 members in 150 countries (British Computer Society, 2021) that “seeks to uphold the highest ethical standards and practices in a rapidly changing digital landscape” (BCS, 2021).

7.3.2 Legal Issues

This application has the potential to present legal issues in terms of data collection and so will closely follow the guidelines set by the UK’s implementation of the General Data Protection Regulation (GDPR) (UK Government, 2018) in order to safeguard a participant’s data. “Strength in Numbers” will only collect data that is relevant to the study and will only be kept for the length of the study and deleted promptly once final marks are released. Participants can withdraw from the study at any time and hence their data will not be processed or kept. At the end of the study participants will be given the option of continuing to use the application, with the consent of the participants, data from the study will be kept to allow participants to continue to use the application. Participants need not fill out physical documents and documents stored virtually will be regularly backed up to prevent data from being lost and protected with a secure password.

The application will use a variety of libraries and frameworks, potentially leading to licensing issues. This issue can be remedied through the use of open-source libraries and frameworks that do not contain allow for any licensing infringements upon publishing the application.

7.3.3 Ethical Issues

When working with human subjects and handling sensitive data, it is important to identify the possible ethical issues that may present themselves and proceed with the application with the correct ethical procedure. This project has been granted ethical permission to recruit participants to complete a 2-week analysis of their physical statistics and progress as well as how they interact with the application given that the participants give their consent to such things. No participants will be pressured into taking part in the study and will be given ample time to consider their participation. Participants will be reminded that during any part of the study they can stop their participation. No form of deception will be used on the participants at any given time and all data recorded will be anonymised. All precautions will be set in place to ensure risk of injury or harm to participants is minimal. The study will not prey on vulnerable participants.

According to the above guidelines, the project will face no ethical issues.

7.3.4 Social Issues

This project's purpose is to connect users to likeminded individuals who compete, support and collaborate with one another and to promote a beneficial, healthy lifestyle to its users through increased physical activity, well-structured diets. This has the possibility of raising a variety of social issues and concerns. During the development of the application, it will be ensured that it never demoralises or criticises its users current lifestyle choices. This can be guaranteed as the application is merely a tool that the user can choose to use that provides the user with information regarding their current physical and dieting information and will be developed as such. When forming the user requirements, the decision to not allow users to post pictures was made to try to limit any psychological stress users may endure due to comparing themselves to other users. The user will be allowed to report any users or messages they receive as well as block any users that they do not wish to interact with, preventing harassment or abuse that a user may receive by other users. Users will also be given the choice to post their information onto their account, either for anyone who looks up the account to see or to be kept private, only for permitted users to view.

8. Conclusion

The aim of this project is to produce a social media platform with the tools necessary to succeed as a health and fitness application and help its users obtain their goals.

Through the literature reviewed, it became clear that the way to accomplish this aim was by implementing novel extrinsic motivators into the application such as: gamification and social incentives. These features accompanied by the common features found in the applications reviewed create a formula that has the potential to produce an excellent health and fitness application. The features mentioned can be seen to have been integrated into the project plan in the requirements section (Section 3).

With the knowledge that has been granted by the literature review and the requirements drafted, the project management section (Section 7) outlines the actions necessary and within what timeline they need to be completed in order to produce the application described throughout this document. Section 7 also outlines the possible risks and how they shall be mitigated, along with any issues that may stem from a professional, legal, ethical, or social standpoint.

Although the application has not yet been developed, the ingredients and steps required to do so have been presented within this report.

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Appendices

Appendix 1 – MyFitnessPal Reviews

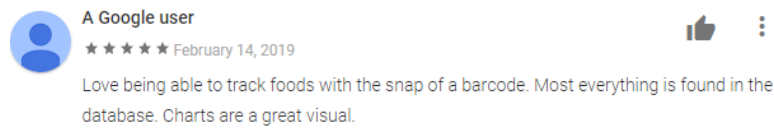


Figure 9.1.1 (MyFitnessPal, 2019)

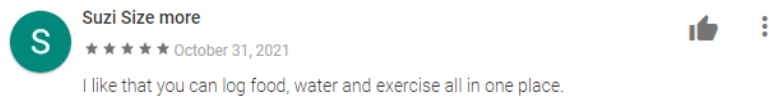


Figure 9.1.2 (MyFitnessPal, 2021)

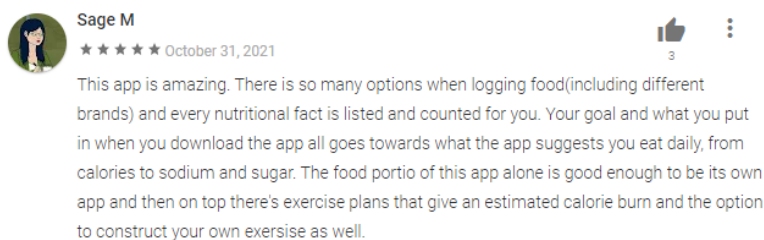


Figure 9.1.3 (MyFitnessPal, 2021)

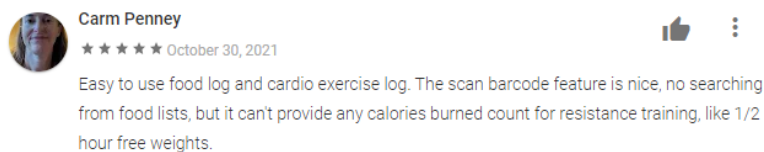


Figure 9.1.4 (MyFitnessPal, 2021)

Appendix 2 – PureGym Reviews

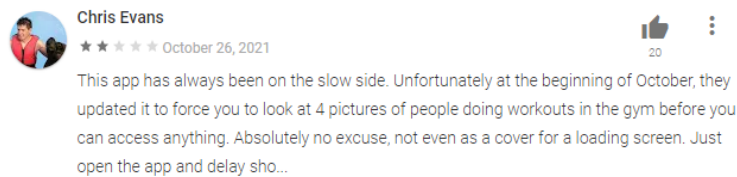


Figure 9.2.1 (PureGym, 2021)

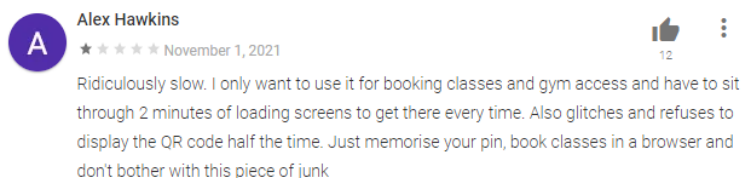


Figure 9.2.2 (PureGym, 2021)

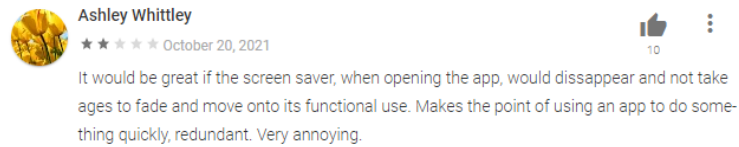


Figure 9.2.3 (PureGym, 2021)

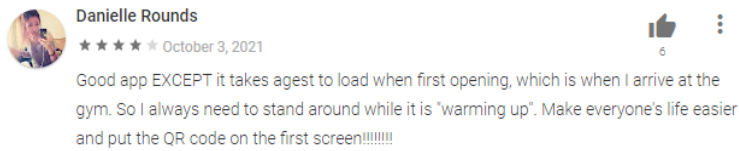


Figure 9.2.4 (PureGym, 2021)

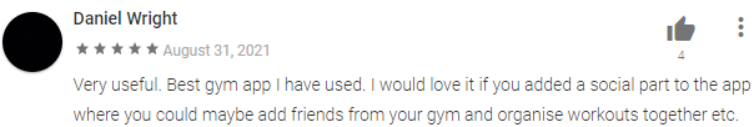


Figure 9.2.5 (PureGym, 2021)

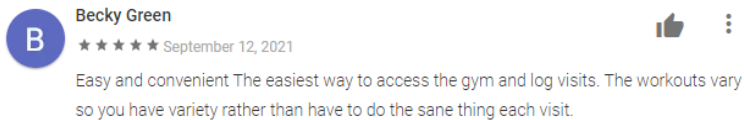


Figure 9.2.6 (PureGym, 2021)

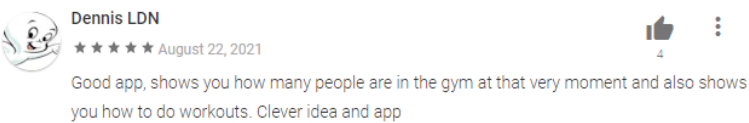


Figure 9.2.7 (PureGym, 2021)

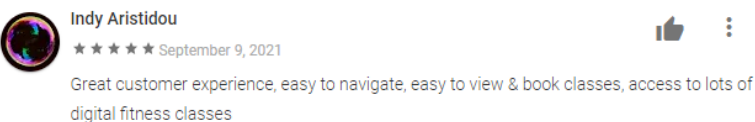


Figure 9.2.8 (PureGym, 2021)

Appendix 3 – Fitbit Reviews

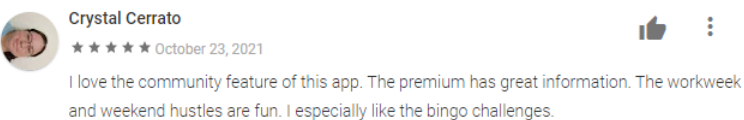


Figure 9.3.1 (Fitbit, 2021)

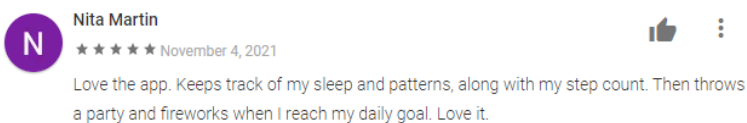


Figure 9.3.2 (Fitbit, 2021)

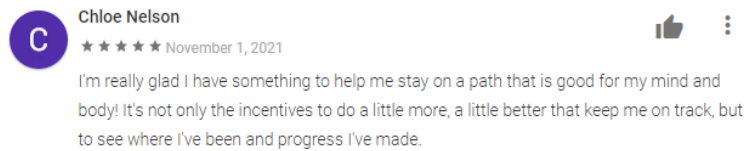


Figure 9.3.3 (Fitbit, 2021)

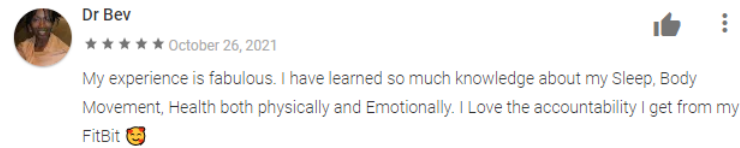


Figure 9.3.4 (Fitbit, 2021)

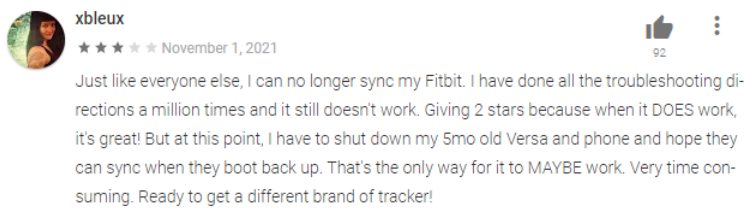


Figure 9.3.5 (Fitbit, 2021)

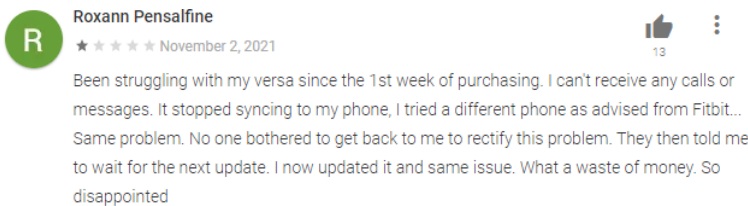


Figure 9.3.6 (Fitbit, 2021)

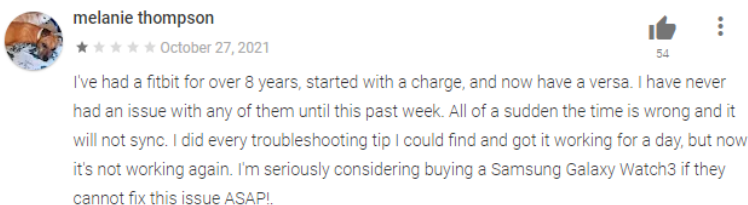


Figure 9.3.7 (Fitbit, 2021)

Appendix 4 – Pokémon GO Reviews

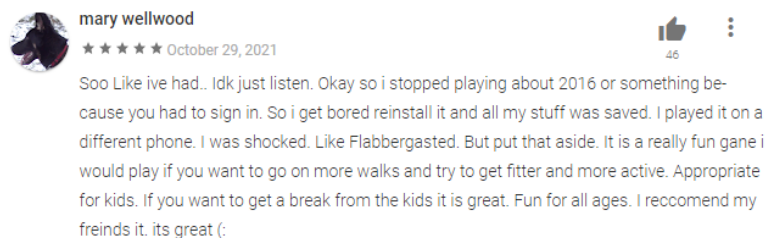


Figure 9.4.1 (Niantic Inc, 2021)

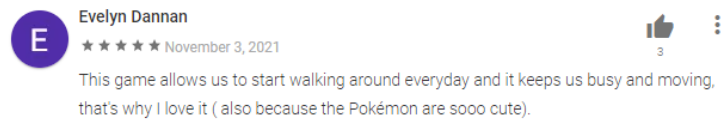


Figure 9.4.2 (Niantic Inc, 2021)

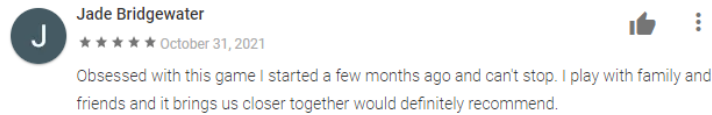


Figure 9.4.3 (Niantic Inc, 2021)

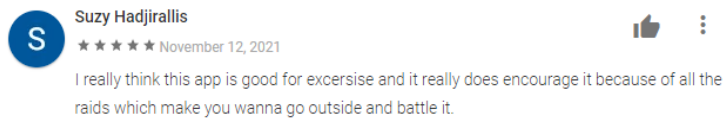


Figure 9.4.4 (Niantic Inc, 2021)

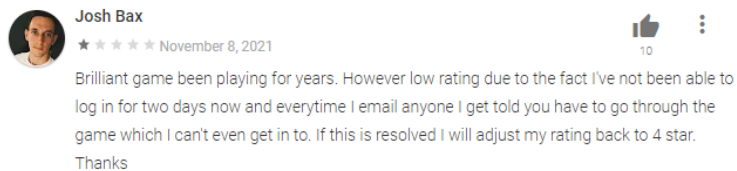


Figure 9.4.5 (Niantic Inc, 2021)

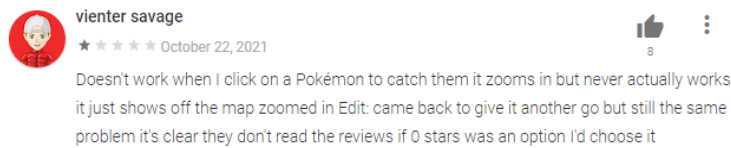


Figure 9.4.6 (Niantic Inc, 2021)

Appendix 5 – Mixed Reviews

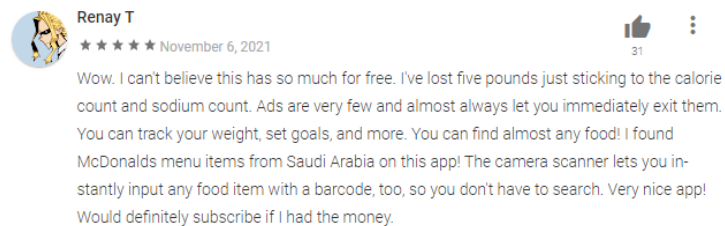


Figure 9.5.1 (MyFitnessPal, 2021)

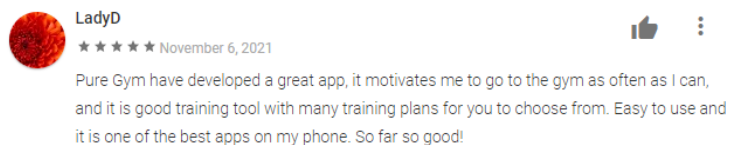


Figure 9.5.2 (PureGym, 2021)

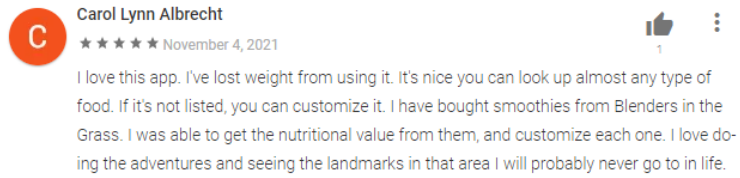


Figure 8.5.3 (Fitbit, 2021)

Appendix 6 – Consent Form

Consent Form

The objective of this study is to evaluate the effectiveness of novel extrinsic motivators and other fitness app features in helping you reach your fitness goals.

You will be asked to use the mobile app to track your workouts and meals for a period of 2-weeks and choose a category of what your fitness goals are. This will first require you to download "Strength in Numbers" to your personal phone. If you do not wish to do any of these tasks then you may opt out of the study. After the duration of the 2 weeks, you will be asked to fill out a short questionnaire about your experience that will take no more than a few minutes.

All information collected will be anonymised to protect your identity and ensure that no data can be traced back to you. All data stored shall be encrypted and stored securely in a password protected computer system. Any accounts that were created on the application for the study will be deleted after final results have been released. If for any reason you would like your account/data deleted before the end of the study or if you would like your account/data to be kept after the end of the study this will be granted.

You may opt out of the experiment at any point with no repercussions and any data already recorded will be deleted promptly.

For any enquiries please do not hesitate from emailing: jw147@hw.ac.uk

Project Student: Joshua Wan - jw147@hw.ac.uk

Project Supervisor: Benjamin Kenwright - b.kenwright@hw.ac.uk

TERMS & CONDITIONS:

- Neither the Heriot-Watt University nor the investigator accepts any responsibility for any loss/damage incurred by the use of the mobile app on the participant's computing device.
- Submitting this consent form enters you into a raffle draw to win a £20 Amazon Gift Voucher.
- Withdrawing from the study at any point after giving consent does not affect your entry into the raffle mentioned above.
- Raffle entries are limited to 1 per participant

*

☐ I have read and understand terms & conditions outlined above

☐ I give consent to taking part in this study

Please sign your name below: *

Your answer

Submit

Clear form

Figure 8.6.1: Consent Form