



*A study into the effect yoga and mindfulness has on the wellbeing and performance of high performing cricketers with the development of a yoga-based iOS mobile application.*

Harris Aslam

Submitted in partial fulfilment of the requirements of Edinburgh Napier University for the Degree of BENG Software Engineering

School of Computing

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## **Abstract**

In this literature review, a research task has been undertaken to gain a deeper understanding into the effect yoga and mindfulness has on the performance and wellbeing of high performing cricketers. The study will look at how yoga, mindfulness and meditation can help an athlete on and off the field. The aim of this project is to research, design and implement an iOS application based on the researched information. The development of the application will include an investigation into current software concepts and how these concepts could be used to develop an application that can allow for significant benefits in an athlete's life. To gain this perspective an in-depth analysis of current literature regarding sport and mindfulness will be looked at. As well as this, key software concepts will be researched which includes context awareness, ubiquitous computing and the Internet of Things (IoT). At the moment, the lack of real context aware applications around this subject area raises the importance of developing such an application.

## **Key Words:**

Cricket, sport, athlete, performance, mindfulness, yoga, meditation, mental health, fatigue, body, confidence, anxiety, context awareness, ubiquitous, internet of things, situational environments, software concepts, activity orientated context, pervasive computing.

# Table of Contents

<b>CHAPTER 1 – INTRODUCTION .....</b>	<b>9</b>
1.1 BACKGROUND .....	9
1.2 MOTIVATION BEHIND PROJECT .....	11
1.3 AIMS / OBJECTIVES.....	12
1.4 SCOPE OF THE PROJECT AND CONSTRAINTS .....	14
1.5 SOURCES OF INFORMATION .....	16
1.6 STRUCTURE OF THE DISSERTATION .....	17
<b>CHAPTER 2 – LITERATURE REVIEW.....</b>	<b>19</b>
2.1 INTRODUCTION .....	19
2.2 THE IMPORTANCE OF YOGA AND MINDFULNESS HAS ON ATHLETES .....	21
2.3 CONTEXT AWARENESS.....	25
2.3.1 <i>Ubiquitous computing and the Internet of Things (IoT)</i> .....	27
2.3.2 <i>Context Awareness Applications in Healthcare and challenges</i> .....	28
2.4 CONCLUSION .....	30
<b>CHAPTER 3 – APPROACH (METHODOLOGIES) .....</b>	<b>31</b>
3.1 INTRODUCTION .....	31
3.1.1 <i>Programming Language and Version Control</i> .....	32
3.1.2 <i>Sensors</i> .....	32
3.2 APPROACH / METHODOLOGY .....	33
3.2.1 <i>Scrum</i> .....	33
3.2.2 – <i>Three-Tiered Architecture</i> .....	36
3.3 CONTEXT AWARENESS AND CHALLENGES .....	38
3.4 QUALITY ASSESSMENT AND CONCERNNS.....	41
3.5 SUMMARY .....	42
<b>CHAPTER 4 – DESIGN .....</b>	<b>43</b>
4.1 REQUIREMENTS ANALYSIS AND PRODUCT BACKLOG .....	43
4.1.1 <i>Project Requirements</i> .....	43
4.2 FUNCTIONAL REQUIREMENTS AND NON-FUNCTIONAL REQUIREMENTS .....	46
4.3 WIREFRAMES .....	48
4.4 USE CASE .....	49
4.5 CLASS DIAGRAM .....	50
4.6 TEST STRATEGY.....	51
4.7 DESIGN SUMMARY .....	53
<b>CHAPTER 5 – IMPLEMENTATION AND TESTING.....</b>	<b>54</b>
5.1 SPRINT 1 (19.02.20 – 05.03.20).....	54
5.1.1 <i>Project Set Up</i> .....	54
5.1.2 <i>Add Firebase and other libraries to application</i> .....	55
5.1.3 <i>Begin Development</i> .....	56
5.1.4 <i>Classes created</i> .....	57
5.1.5 <i>Testing</i> .....	57
5.1.6 <i>Sprint Review</i> .....	58
5.2 – SPRINT 2 (09.03.20 – 26.03.20) .....	59
5.2.1 – <i>Development</i> .....	59
5.2.2 – <i>Classes created</i> .....	60
5.1.3 – <i>Testing</i> .....	60
5.1.4 – <i>Sprint Review</i> .....	60
5.3 – SPRINT 3 (03.05.20 – 30.05.20) .....	61
5.3.1 – <i>Development</i> .....	61
5.3.2 – <i>Classes created</i> .....	62
5.3.3 – <i>Testing</i> .....	62

<i>5.3.4 – Sprint Review</i> .....	62
5.4 – SPRINT 4 (21.06.20 – 09.07.20) .....	63
<i>5.4.1 – Development</i> .....	63
<i>5.4.2 – Classes created</i> .....	64
<i>5.4.3 – Testing</i> .....	64
<i>5.4.4 – Sprint Review</i> .....	64
<b>CHAPTER 6 – EVALUATION .....</b>	<b>67</b>
<b>6.1 EVALUATION .....</b>	<b>67</b>
<i>6.1.1 Overall Project Review</i> .....	67
<i>6.1.2 Project Aims, Achievements and Difficulties</i> .....	68
<i>6.1.3 Learning Outcomes</i> .....	70
<b>6.2 ATHLETE EVALUATION OF PROTOTYPE .....</b>	<b>73</b>
<b>CHAPTER 7 – CONCLUSION .....</b>	<b>74</b>
<b>7.1 CONCLUSIONS .....</b>	<b>74</b>
<b>7.2 FUTURE WORK .....</b>	<b>76</b>
<b>REFERENCES .....</b>	<b>77</b>
<b>APPENDIX 1 – INITIAL PROJECT OVERVIEW (IPO)</b> .....	<b>80</b>
<b>APPENDIX 2 – INTERIM REPORT MEETING REVIEW</b> .....	<b>82</b>
<b>APPENDIX 3 – DIARY SHEETS .....</b>	<b>84</b>
<b>APPENDIX 4 – CODE.....</b>	<b>113</b>

## List of Figures

<b>FIGURE 1 – IMAGE OF AGILE SCRUM APPROACH TO BE USED AND FOLLOWED IN THIS PROJECT.....</b>	<b>31</b>
<b>FIGURE 2 – IMAGE OF SCRUM APPROACH MAIN FEATURES.....</b>	<b>33</b>
<b>FIGURE 3 – IMAGE OF AGILE SCRUM APPROACH TO BE USED AND FOLLOWED IN THIS PROJECT.....</b>	<b>34</b>
<b>FIGURE 4 – IMAGE OF THREE-TIRED ARCHITECTURE TO BE USED AND FOLLOWED IN THIS PROJECT.....</b>	<b>36</b>
<b>FIGURE 5 – IMAGE DISPLAYING BREAKDOWN OF HOW THE CONTEXT AWARENESS MODEL WILL TRANSFER SENSED DATA INTO MEANINGFUL CONTEXT FOR THE APPLICATIONS USE.....</b>	<b>40</b>
<b>FIGURE 6 – WIREFRAMES FOR THE PROTOTYPE APPLICATION.....</b>	<b>48</b>
<b>FIGURE 7 – USE CASE DIAGRAM OF A POSSIBLE USER INTERACTION METHOD .....</b>	<b>49</b>
<b>FIGURE 8 – CLASS DIAGRAM FOR THE SYSTEM .....</b>	<b>50</b>
<b>FIGURE 9 – NEW iOS APPLICATION ‘Diss2020’ HAS BEEN STARTED.....</b>	<b>54</b>
<b>FIGURE 10 – EXAMPLE OF ‘POD FILE’ CONTAINING THE LIBRARIES USED WITHIN THE PROJECT.....</b>	<b>55</b>
<b>FIGURE 11 – CONVERSION OF XCODE PROJECT TO XCODE WORKSPACE .....</b>	<b>55</b>
<b>FIGURE 12 – DEVELOPMENT PROGRESS IN SPRINT 1 .....</b>	<b>56</b>
<b>FIGURE 13 – DEVELOPMENT PROGRESS IN SPRINT 2 .....</b>	<b>59</b>
<b>FIGURE 14, FIGURE 15 – DEVELOPMENT PROGRESS IN SPRINT 3 .....</b>	<b>61</b>
<b>FIGURE 16, FIGURE 17 – DEVELOPMENT PROGRESS IN SPRINT 4 .....</b>	<b>63</b>

## List of Tables

<b>TABLE 1 – SHOWING THE MUST HAVE FEATURES OF THE APPLICATION .....</b>	<b>14</b>
<b>TABLE 2 – SHOWING THE SHOULD HAVE FEATURES OF THE APPLICATION .....</b>	<b>14</b>
<b>TABLE 3 – SHOWING THE COULD HAVE FEATURES OF THE APPLICATION .....</b>	<b>15</b>
<b>TABLE 4 – SHOWING THE WON’T HAVE FEATURES OF THE APPLICATION .....</b>	<b>15</b>
<b>TABLE 5 – SHOWING THE BENEFITS LINKED TO MINDFULNESS.....</b>	<b>23</b>
<b>TABLE 6 – SHOWING WHAT KIND OF WORK EACH SPRINT WILL UNDERTAKE .....</b>	<b>35</b>
<b>TABLE 7 – SHOWING THE DIFFERENT TYPES OF TESTING TO BE USED IN THE PROJECT.....</b>	<b>51</b>
<b>TABLE 8 – SHOWING THE TESTING BEING CARRIED OUT ON THE APPLICATION .....</b>	<b>58</b>

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## Chapter 1 – Introduction

### **1.1 Background**

In this project we will look at the use of context awareness to develop an application for yoga and mindfulness whilst evaluating the affect these practices have on the performance and wellbeing of high performing cricketers.

Context awareness is the act of when a device recognises the current environment due to the programmed context that the device has been given to understand and interpret. In order to develop a context aware system, it should make use of 3 basic functionalities: Sensing, Thinking and Acting (Beggas, 2015). This works as the sensors are used to acquire data about the physical world or certain important aspects. The thinking functionality provides reasoning to this acquired data so there is a deeper layer of understanding. Once the information has been gathered and understood, the relevant actions are undertaken so that it is of benefit to the user (Beggas, 2015).

There has been a sharp increase into the development of ubiquitous computing and the Internet of Things (IoT) into daily life (Li, Eckert, Martinez and Rubio, 2015). The rapid increase in this field and the fact that context awareness applications are able to adapt their behaviours to the changing environment with minimum human intervention (Li, Eckert, Martinez and Rubio, 2015) has led to an increased amount of customisation of features. This is with regards to how the information and services are presented to a user as well as the automatic execution of tasks in behalf of the user. In doing so, the user feels a much more personal experience as if the application is catering for their exact needs. From this we can understand that the goal of context-aware applications is to respond to context changes to enhance the computing environment for the user through these means (Beggas, 2015).

An example of a current context awareness application that is embedded within Apple devices is Apple's personal assistant "Siri". This is an in-built voice-controlled system that has been around for several years now but has grown from strength to strength in its capability of being able to help a user in their day-to-day tasks and using context awareness to do so. The idea is that a user will be able to get the assistants attention

by saying the words “Hey, Siri” or through the home button and the assistant will be ready to take any commands. Siri allows for the user to complete meaningful tasks such as sending a text message or by informing the user of their schedule without the user having to lift a finger. It can also find places by gathering the user’s location along with many other shortcuts (Apple, 2020).

This project investigates the term “context awareness” to gain a better understanding of what this means and how it works. In order to do so, relating terms such as ‘ubiquitous computing’ and the ‘Internet of Things (IoT)’ will also need to be looked into as they further increase the understanding of how to build context aware applications.

A prototype application will then be developed to demonstrate how context awareness can aid in the area of athlete’s health and wellbeing. The prototype will not be a fully functioning application in terms of showcasing all the sensors embedded within a device (in this project an iPhone), however it will make use of a few important ones that will be useful when creating this sort of application.

## **1.2 Motivation behind project**

The importance around context awareness is that it has become a very attractive piece of technology now that smartphones have become such an indispensable piece of equipment in our daily lives. With these devices now containing more powerful sensors than ever before, it has allowed for the opportunity to create and develop software that is smarter and more user focussed. Through producing software that reduces the need for a user to physically interact with it, allowing for the application to “think for itself”, there will be a greater context awareness ability which brings ease not only to the user but in the development of applications.

The importance of mental health in sport as an athlete is a personal one for me as it is an issue I personally went through. Sport is very demanding and whilst the general perception is that these demands are mainly physical, the mental aspects of it is often disregarded or not given as much importance. However, the drain and mental fatigue that comes with any type of sport is very much a cause for concern and studies are increasing around this area. The concern is that this pressure or mental fatigue can have negative effects on an athlete’s training and performance and an athlete may not be willing to talk about it to other people - in particular their coaches and friends. To overcome this, an application that tracks their daily training routines and their daily thoughts and feelings is definitely something which needs to be developed. By tracking these, if any causes for concern do arise then they can be identified and addressed as soon as possible, this would be for the player’s own benefit.

From here we can see the reasons as to why delving into context awareness is important, not only to better understand the importance of context awareness, but to also improve fields of study away from computing. Not only are we able to investigate context awareness in the modern world, we can also look at how context awareness can progress the health and wellbeing of athletes. In doing so it will be an interesting study on how the potential use of understanding a computational method can help better an athlete’s performance on and off the pitch. This prototype will allow for an understanding in how software can aid an athlete’s mental preparation. This area is currently understudied and developing such a prototype is definitely worthwhile which will be brought to light further in the literature review.

### **1.3 Aims / Objectives**

The aim of this dissertation is to study context awareness and mental health in sport and develop an iOS prototype application that can aid athletes in their sport through a context aware application.

The application will make use of the following sensors:

- Accelerometer (measures physical acceleration and gravity).
- GPS (measures device location).
- Gyroscope (measures device rotation).
- Proximity sensor (measures closest surfaces).
- Compass
- Barometer

When collecting data, it is important to only use information that is going to be useful otherwise time will be spent collecting data that cannot be used or serves no real purpose to the actual device.

In this project the information that is needed is:

- Users schedule so that the application can see what kind of day they are having and can promote yoga / mindfulness techniques based on their day.
- Users location so that it can show the relevant yoga / mindfulness studios.
- Users day-to-day health and wellbeing. Gaining this information will be carried out through a wellbeing tracker page on the application. Here, athletes will log how they feel and answer specific questions which have been thoroughly researched from existing techniques as having high importance when dealing with the health and wellbeing of athletes.

This project will also look at context awareness and discuss how it works and its importance in today's technology. This will be done by examining current applications bearing context awareness within the mindfulness area such as Headspace and Calm which focus on meditation and sleep through short guided mediation practices and analysing how the technologies that they use can be best used in an application catered for athletes.

Another objective will be to use the unified modelling language (UML) to visualise the design of the application to be developed, including use case and class diagrams which will provide a deeper understanding into the working of the project.

This project will be completed using the Agile development method and there will be some research conducted into why this methodology will be beneficial to this project and how the use of sprints (development in 2 week iterations) will prove to help the project come to a successful completion. One benefit of using the Agile method is the constant phased testing after each sprint so there will be a well running app by the end of the project that has been comprehensively tested.

Once the product has been developed, the next stage would be the testing of the application through human trials and receiving an honest evaluation of the product from the front-line users (athletes).

After the evaluation from the athletes, the self-evaluation will commence, and any appraisals and criticisms will be made. This will be conducted by going through the aims and objectives of the project and evaluating how well they were met - if met at all. The overall management of the product will be looked into in order to analyse whether carrying out this project proved its worth and whether or not the way it was conducted was a success or not. To round off the evaluation there will also be some reflection on what could have been done better as well as some insight into future development.

## **1.4 Scope of the project and constraints**

In this project it is extremely important to define the scope. In modern technology the amount of sensors within devices makes it possible to obtain and record endless amounts of data. While this is possible, it is important to understand what information is actually required for this project to be successful. In order to do so it is crucial to define the scope of the project right at the beginning so that there is a clear-cut understanding of what is required. This is because if the understanding is not clear and too much or the wrong data is collected, it will only cause problems in the development of the program. The scope will be defined using the MoSCoW prioritisation method:

<b>Must Have:</b>
The fundamental ability to gather context through sensors.
Ability to access the sensors which have been mentioned in the Aims & Objectives section of this chapter. Permissions may need to be given.
A dedicated ‘User Input’ page where they daily answer a few questions about their personal thoughts and feelings, this information is tracked and produces context for the application.

***Table 1 – Showing the must have features of the application***

<b>Should Have:</b>
Demonstrable version for iOS devices, with the required sensors as per the Aims and Objectives section.
Sufficient testing documentation and metrics data, both for measuring the reliability and performance of the platform.

***Table 2 – Showing the should have features of the application***

### **Could Have:**

Access to user calendar so that this context can be gathered via this method. However, this is reliant upon the user actually being someone who is active in using their phone calendar and maps out their day in accordance to what they are doing. Would be a good idea to ask athletes whether they use their calendar in such a way to make a decision on this concept.

Implementation for Apple devices such as smartwatches (Apple Watch).

***Table 3 – Showing the could have features of the application***

### **Won't Have:**

Full functionality - this development will only be a prototype showcasing how a mobile application could take advantage of contextual information within a yoga and mindfulness prototype application for athletes with the aim of gathering information that will help them on and off the field.

The application will only be suited for iOS devices, meaning it will not run on Android or other smartphone platforms.

***Table 4 – Showing the won't have features of the application***

As we can see by using the MoSCoW method, this project has a clear and concise scope. From the breakdown, this project is restricted to development to iOS devices so only Apple devices will be able to access this application for implementation and testing. This project will be developed using Xcode in the Swift language. To test the application this will be completed using the Xcode Simulators and also on an iPhone XS Max.

## **1.5 Sources of Information**

In order to conduct a full and in-depth analysis of the project, the information gathered will be obtained from several reliable academic and non-academic sources. To ensure that the information is of relevance and is legitimate, any gathered data will be properly analysed to ensure its validity. This will ensure that the study is not undermined by false data, therefore making the study accurate and useful for the current project, and also in the hope that future Researchers and Analysers can find this study beneficial for any further studies they chose to carry out in the future.

Sources include:

- Journal Articles
- Napier Library Search
- Athletes, Sports Coaches, Yoga Teachers and Mindfulness Professionals.
- Supervisors / Lecturers
- Previous Dissertations
- Other academic sources

Any information gathered by academic sources will be referenced using the Harvard Referencing style. While non-academic sources will be used within this study, there will be a conscious effort to ensure this information is unbiased and has been acquired from reliable personnel, who have a professional knowledge and understanding around the area in which they are being asked to provide details about.

## **1.6 Structure of the Dissertation**

### **Chapter 1 – Introduction**

The introduction will discuss what the area of study is and why the area is required to be researched in the current world. In this opening chapter a short understanding of context awareness will be provided with some background information. Also discussed in this chapter will be the motivation behind the project, as well as defining the aims and objectives of the project along with the scope. This will allow a clear declaration of what will be expected from this project.

### **Chapter 2 – Literature Review**

The literature review will delve further into context awareness to provide an in-depth analysis of why it is becoming so popular alongside ubiquitous and the Internet of Things (IoT). The research will then move and look at the health and wellbeing of sports athletes whilst also discussing context awareness in healthcare to try and bridge the gap between context awareness and sports psychology. This is to gain an understanding of how a context awareness prototype application could be developed and used in helping players grow their health and wellbeing to help them on and off the field.

### **Chapter 3 – Approach (Methodologies)**

This chapter will discuss the key approaches and methodologies taken to ensure that the proposed prototype solution can be developed. Here, the Agile Scrum Methodology will be explained so that an understanding can be made around why the project was carried out using this method. Also, within this chapter it will touch upon context awareness and define what context is going to be important for this project as well discussing how the application will adapt its behaviour in line with the context generated from the sensors.

## **Chapter 4 – Design**

Within the design chapter there will be an insight into how the system will look and be built. This will provide a visual understanding of the thought processes into why elements have been put together to form the prototype. This includes UML diagrams, wireframes, software architecture.

## **Chapter 5 – Implementation and Testing**

This chapter will provide evidence of the implementation of both context awareness platform and prototype application. This will be proven by providing an insight into what actions occurred during the phased “sprints”. The information provided from these sprints will be; what was meant to be carried out, what was actually carried out, screenshots of code as well as screenshots of relevant unit testing and finally discuss any issues within that sprint as well as screenshots of the actual prototype application. In doing this, a full overview of the project progress can be viewed and maintained.

## **Chapter 6 – Evaluation**

The evaluation chapter will allow for the completed work to be both internally and externally evaluated. This will be carried out via user testing if possible as well as questionnaires and interviews if possible.

## **Chapter 7 – Conclusion**

The concluding chapter will allow for thoughts about the success of the project to be honestly discussed with a focus on self-appraisal / criticism around how the project was carried out and whether it was successful or not. It will also discuss what could be implemented in any future work.

## Chapter 2 – Literature Review

### **2.1 Introduction**

This lit review will extensively research the area surrounding mindfulness and cricket as well as the computational concepts that are available but have not been currently implemented into an application for this specific area. To do so, an understanding regarding what yoga and mindfulness is and how they contribute positively to high performance athletes. The study will then look to provide an understanding of how technology and context awareness can be used to create a brand-new application in this field to add increased functionality and make it really useful for athletes. The report will also dive into what is good and bad contextual information so that there is a solid understanding of what contextual data will be important for a project like this.

Sport in general is often perceived as mainly being very physically demanding. However, the mental side of sport is often disregarded as a minor factor in the life of an athlete, despite the fact that from a young age these athletes have been competing and fighting, often rigorously, for their positions within teams. This process goes on for a number of years and the mental strength that is required to be able to compete at optimum level on every single occasion can be quite detrimental to the health and wellbeing of the individual. In turn, this has an effect on not only the pitch events but also events that take place off the pitch for example social media backlash and critical evaluation of performance. These things can affect the human mind in a negative way so ensuring that athletes are well supported is fundamental to safeguard athletes to ensure they can continue to perform at their best ability. Cricket is a prime example of a sport affecting the human mind in a challenging way it brings so much competition and mental strain that then further harms the human body. This has a long-lasting effect on the athletes which may only come to affect them after they have retired from their sport. The review will take a look at how practising yoga and mindfulness can aid in this process of freeing the mind of an athlete to try and keep them in the best headspace and look at what technologies are available to help achieve this.

Context awareness appears in a lot of applications in our smartphones today; it is when computers can sense and react to their physical and contextual environment. Contextual based information is often used in mobile applications such as current

location for finding directions, the use of wearables such as smartwatches for counting the number of steps or tracking a person's heartbeat to working out how many calories they are burning whilst exercising.

Over the past decade smartphones have been instrumental in the life of humans. From being able to communicate with others over long distances on the go with the touch of a button, to being able to set schedules and arrange our whole lives on these handheld smart devices. With the rise and strength of smartphones and smart devices this calls for there to be significant innovation and more contextually aware applications developed for our mobile devices.

One reason for this is that there are now more data sensors available than ever before in smart devices which are used in our daily lives. Due to this there has been greater motivation to expand the use of contextual awareness in computing and develop applications which are smarter and aid people in their everyday lives. Sensors including GPS, accelerometer, and heart rate sensors are now embedded within the majority, if not all of smartphones available today. Contextual information can be based on many different factors such as behavioural, situational and spatial.

To go hand-in-hand with context awareness there are two other important computing concepts called "Ubiquitous Computing" and the "Internet of Things (IoT)". The first term derives from the Latin word "ubiquitas" which means being everywhere. "When equipped with sensors these computers can record the environment of the object in which they are embedded and provide it with information processing and communication capabilities" (Friedewald and Raabe, 2011). The second term Internet of Things (IoT) is defined as also being called the "Internet of Everything which is a new technology paradigm envisioned as a global network of machines and devices capable of interacting with each other" (Lee and Lee, 2015). So, it is notable that these descriptions both align together well when talking about context awareness computing as they integrate parts of computer systems which bring together and process information.

## **2.2 The importance of yoga and mindfulness has on athletes**

“Mindfulness as a present-orientated form of mental training affects cognitive processes, and is increasingly considered meaningful for sport psychological training approaches” (Bühlmayer et al., 2017). The ability to perform successfully in sports is based on not only the physical capacity but is also reliant on the phycological awareness and readiness. There have been many studies on the physical aspect of sport. However, there is still very little quality research on the effect’s mindfulness has on a sports athlete’s performance on the pitch and also off the pitch.

“One form is psychological skills training (PST) this refers to the cognitive behavioural techniques – goal setting, imagery, mental rehearsal, arousal control, self-talk and precompetitive routines.” (Hasker, 2010). However, as there seems to be a lot of research on these specific techniques in sport and sport performance this literature review will not look at this method. Instead, this review will focus on the practice of mindfulness and yoga as mental training methods. “Defined by Kabat-Zinn, mindfulness is a structured mindset to be aware of the present moment experience in an accepting, non-judging, and non-avoiding way” (Kabat-Zinn, 1994). There are many approaches and practices that can help to attain mindfulness – whether that be through the practice of meditation or through the discipline of yoga. Mindfulness was first introduced into sport in the 1980’s. However, following this, the use of mindfulness was very limited before the turn of the century. It is unknown whether this was due to people being slightly sceptical of the practice or if they just had little to no knowledge about how these forms of training the mind and body could benefit and increase performance.

After years of growth and popularity in mindfulness due to clinical psychology, we can also begin to see greater deployment of mindfulness bask practice in sport (Bühlmayer et al., 2017). Nowadays, we are increasingly seeing more athletes turn to yoga and mindfulness practices with some individual athletes and coaches even becoming teachers of yoga practice not just to teach other people but to further their own understanding and enlighten them about the benefits and potential within these techniques. “Mindfulness is said to influence physiological and psychological states through various processes, such as bare attention, experiential acceptance, non-

attachment or clarity about one's internal life" (Moore, 2009). Cleary, from this statement there are meanings here which can be taken and adapted to sport life. Having a balance between physical and mental strength will in turn prolong an athletes career and even help them after retirement as a large number of athletes end up depressed once they have left the sport as "the transition is often found to be difficult because of the sudden cessation of intense demands of elite athletic performance, compounded by the sudden loss of the athlete's intense devotion to professional athletic competition and its attendant rewards" (Schwenk, Gorenflo, Dopp and Hipple, 2007).

Recent studies into so called "precision sports" such as golf, have looked into the effects that different forms of mindfulness and yoga practices have on athletes. In doing so, an understanding is formulated around what benefits these specific types of practice can provide for athletes both on and off the field. From the completed studies it has been discovered that athletes have displayed improved performance through adding mindfulness and yoga into their training regimes. Many of these studies conclude that mindfulness practice is an effective training component in sport psychological training. This is due to the reasoning that "mindfulness intervention changes behaviour by helping individuals to mindfully experience emotional and cognitive processes." Meaning, athletes are able to be more open towards negative thoughts and processes which in turn leads to them dealing with these negative circumstances in performance environments and daily life in a positive manner (Goodman, Kashdan, Mallard and Schumann, 2014).

There are many other benefits which are said to be linked to mindfulness, such as:

- Decreased recovery time
- Coping with stress and managing tension
- Present moment awareness
- Acceptance / non judgmental
- Aid in injury recovery process and injury prevention
- Reduced anxiety levels
- Decreased muscle tightness, greater relaxation and peacefulness

***Table 5 – Showing the benefits linked to mindfulness***

However, more research is needed to carry out proper analysis as there are arguments that certain factors such as “anxiety and narrow focus are not key factors in performing better as well-trained athletes can manage higher levels of emotion during performance” (Gardner and Moore, 2012). Currently there is not enough detailed research on the variety of sports as many would require individual performance requirements to be met. A way to counter this is to develop and adapt mindfulness practice so that the best mindfulness practices for that relevant sport is implemented.

In conclusion, here it can be said that mindfulness practices have the potential to notably improve the athlete development process. Not only can mindfulness-based practices provide psychological benefits, but they can also provide physical benefits. Through these practices “athletes can unlock their achievement potential in an efficient way” (Bühlmayer et al., 2017) and take their sporting ability to new levels both on and off the park. Based on the research above “it seems reasonable to consider the mindfulness strategies as a regular training skill for athletes” as it is shown that mindfulness has the potential to aid athletes to deal with issues such as anxiety and stress with the negative stigma surround these areas and deal with them in a positive manner. Nonetheless, as stated previously, due to the diverse performance requirements more conclusive research is required to be carried out in order to gain a

full understanding of the real impact it has based on certain sports. Another area to ponder is that these processes cannot implement change overnight as many studies suggest a minimum 6-week period in order to see real progression in athletes from mindfulness practices. The use of technology to make sure athletes take advantage of these mindfulness strategies is key to continuing their development. Therefore, the use of context-awareness technology should be considered to develop an application that will be useful for athletes which must also be easy and enjoyable.

## 2.3 Context Awareness

“In 1994, Schilit and Theimer were among the first to introduce the term ‘context-aware’ in relationship to computing. An overview of context-aware systems by Hong, Suh and Kim show that context awareness involves acquiring, sensing or being aware of context, as well as adapting to it or using it. Correspondingly, according to Dey and Abowd context awareness falls into two categories, namely using context and adapting to context” (van Engelenburg, Janssen and Klievink, 2019). In Layman Terms, context awareness is the ability of a system or device to gather information about the user’s environment at any given time without human interaction and adapt its behaviour according to the environment (Baldauf, Dustdar and Rosenberg, 2007). Context can be provided through direct user input or context can be dynamically collated and analysed through software and hardware systems for the best interest of the user. However, to create a pure context-based system, the more the application can learn and adapt itself the better. This means less user input and more use of sensors and technology.

Context can be defined by specifying 3 categories; computing, user and physical context (Beggas, 2015). Computing context is data which is relevant to the device for it to perform to its best ability such as network connectivity, bandwidth, nearby resources. User context is information about the user which aid’s the system to perform – this can include background information about the user’s, location, emotional state, daily activity. Lastly, there is the physical context such as lighting, noise level, traffic conditions, temperature (Beggas, 2015). In this application there will be a focus on the user context.

The goal of these applications, which make use of context, is to ensure that there is a response to any adjustment in the environment. This can be followed out through a change in the use or presentation of data that is available to the user. This could also mean that tasks are carried out dynamically for the user.

In order for context to be generated it is important to understand what type of context is required for the specific program and what sensors are available to collate this information. In the prototype being developed it will be using user context which

enables the application to gain information about the user in order to then manipulate the applications behaviour for the users benefit. This is completed through the use of sensors. There are a vast number of sensors available on the current market today which assist in the process of gathering contextual information. The more use of sensors, the more context that can be created and implemented into the application which in turn makes it more reliable for the user to use. “Sensors are designed to provide devices with context information from their surroundings, they have proven to be very useful in our modern world in countless areas from industrial to medical applications. However, sensors themselves are of no use independently, as their data must be collected and processes in order to be used” (Tortorella, Kinshuk and Chen, 2017). In saying this, there is a huge importance in selecting the correct sensors to gather information to be used as context. There is also importance in making algorithms and functions which are able to handle the data that is being pulled in from the sensors. These will then be able to execute the context in a sensible manner or handle the context in the background to the users benefit.

“A context aware system can be viewed as having 3 basic functionalities; sensing, thinking and acting” (Beggs, 2015). This the concept that will need to be used for the prototype application in development. In sensing, it is here that the relevant information of the user’s surroundings is collated and found. In thinking, it is here that the examination of the information and understanding of it is carried out to ensure it is in fact what is required and it makes sense. Finally, in acting, it is here that the relevant actions are carried out on the context information that has been brought together.

When the history of context awareness is looked into, it is clear to see that due to the lack of advancement in the early stages around context technology, there were issues such as minimal computational power and memory. In modern day technology, these previous issues have now been overcome because of an increased portability of solutions / devices and a more ubiquitous presence.

### **2.3.1 Ubiquitous computing and the Internet of Things (IoT)**

Talking about an ubiquitous presence allows for there to be discussion around ubiquitous computing and the Internet of Things (IoT). As aforementioned, ubiquitous computing is where devices (which are unseen) communicate wirelessly with each other and perform tasks in a meaningful way in order to reduce the users need to manually interact with the devices to achieve a goal. This technological concept is key when discussing context awareness technologies as the fundamental outcome of both these concepts is to make processes easier for the user, so the user is minimising his/her interaction but is still able to receive information and complete tasks.

Furthermore, the Internet of Things (IoT) expands this notion of devices communicating in a way by “building a dynamic network infrastructure, connecting a variety of physical and virtual “things” with the use of mobile devices and sensors” (Gubert, da Costa and Righi, 2019). This allows for communication not just on a local level but it calls for a much wider connected world, for example, nowadays many car manufacturers have increased their software capacity so much so that their customers are provided with a mobile application that allows the user to control their car via their smartphone. Mercedes-Benz, owned by Daimler AG, has a product called “Mercedes Me” in which no matter how far away the user is from the car, if the user forgets to lock the car doors, then after 5 minutes the user will receive a notification on their phone and they are then able to lock the doors. Moreover, it is possible for the user to find out further information about the car such as tyre pressure, collision detection, when a service is due and so much more – all of which can all be carried out via the application.

This kind of interaction of being in control of something when a person is not actually physically in the location is being expanded due to the use of the Internet of Things (IoT). By combining devices to create this network it allows for information to be gathered, analysed and then have actions carried out. This fits in well with the basic functionalities of a context aware system as being able to sense, think and act.

### **2.3.2 Context Awareness Applications in Healthcare and challenges**

Healthcare is one field which will continue to thrive and evolve as technological advancements are made. The technologies like context awareness system keeps the healthcare professionals away from the manual work and shifts part to digitalized methods (Rakshitha, Immanuel, 2017). The principal reason for conducting this project is due to there being little research when considering at mental health and sport together. In order to try and gain an understanding of this, context awareness applications in the healthcare sector will be researched to possibly try and determine why this could be and discuss difficulties faced when creating a context aware application for health. “Enabling advanced IoT technology in custom systems is still a significant challenge in this field, suffering from problems such as lack of accurate and economical medical sensors, non-standardized IoT system architectures …” (Baloch, Shaikh and Unar, 2018). Here, we can see that some issues arise due to the technology that is available today and issues also may arise due to the infrastructures put into place to carry out these kinds of technological builds.

These are not areas which should provide difficulties in this project, but these challenges need to be stated and thought of. In order to do so before the implementation of this project, there will be a deep analysis into the sensors required to make this application when it comes to gathering context. As well as ensuring that the correct approaches are applied to the project through proper research. Previous drawbacks in technology such as lack of computational power and memory are quickly being overcome – meaning an increased portability of solutions / devices and a more ubiquitous presence. However, there are other challenges which can bring about concerns such as power management (Alirezaie et al., 2017). The sensors in a mobile device will need to be running constantly in order to be able to gather and sense contextual information. So, ensuring that the frequent use of these sensors do not take up too much of a user’s battery life is required to ensure that the user’s personal device does not run out of battery life. This is important because if the application does take up too much battery power the user will most likely discard of the application as was found in 2017 when between 20-47% of battery usage was taken up by Facebook running in the background making it quite the memory and battery hog due to it running constantly in the background (KOETSIER, 2017). Most new iPhone’s boast about their

battery life being able to last 24hrs however this is dependent on low to moderate usage (John, 2019). Keeping the power consumption of an application is key as all users may not have new iPhones therefore, ensuring it is even across all models is an important factor. The issue around power consumption has been found in many articles in this research, citing its important when planning this project.

Another major challenge with the vast technological advancements such as context awareness, IoT and ubiquitous computing is the area around security of these systems. Due to these systems being a source of very important data there is no room for leaks to such data to happen. Security of personal data is immensely important in the computing sector. In recent times the guidelines around data protection are being constantly updated to meet standards. This area around security becomes an even bigger deal with regards to personal health information. Ensuring that the data is only accessible by the people with the privileges to process the information is vital (Al-Neyadi and Abawajy, 2009). Preventing security threats is a top priority as any weakness in software systems can be exploited by hackers especially in this day and age. This can be proven by the following citation “The major goal is to prevent unauthorized end users or insecure computing devices from being able to access the sensitive data” (Rakshitha, Immanuel, 2017). Hackers have lots of training in software development methods, thus being able to reduce, if not eradicate, weak software is vital to creating useable and trustable programs.

## **2.4 Conclusion**

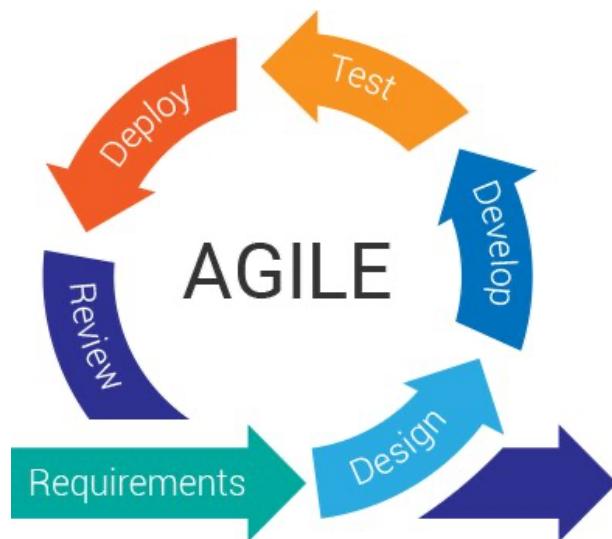
In conclusion to this literature review, it is clear to see that context awareness within embedded, desktop and mobile devices, will contribute to developing applications that provide the user with a better and more personalised experience. Due to the high demand for more technology and due to the rapid increases in technology, visions from the past – such as the autonomous self-drive cars, an idea that has been in the works since the 1920's are now already being sold on the market. However, the current driving safety laws haven't permitted their full use yet. Smart Homes is another example of a once 'futuristic' development however, these kinds of developments are now becoming real. Thus, there is no doubt that the context aware application can and will become pivotal in the advancement of healthcare.

The public wants to have less to think and worry about and be more in control – this can all be achieved from their smartphone. Devices which allow for data to be transferred without any human interaction or physically seen networks called the 'Internet of Things' along with the terms such as ubiquitous and pervasive computing, all help to further understand what contextually aware technology is. In order to do so understanding what areas of these technological concepts are useful and required by the public at the right time is very important. However, as with the rise in personalised and connected technology, critical issues such as privacy and data integrity rise, and as technology builds up more of a picture in our lives, this information must be kept private and secure. In this literature review we looked at why yoga and mindfulness are important for cricketers and how it benefits them on and off the pitch. We also look at the rise of context awareness and why it should be implemented into an application catering for yoga and cricket due to the advantages of the context awareness applications. Context awareness allows for new and innovative development of applications through assembling data from sensors and processing them in a specific and useful way. As the world's technology improves it is no doubt that context awareness will be a mainstream development type across all fields.

## Chapter 3 – Approach (Methodologies)

### 3.1 Introduction

This chapter will discuss the key approaches and methodologies that were put into action in order for the proposed prototype to be developed. There will be research on the Agile Scrum Methodology and why it was chosen for planning this project. There will also be discussion on the Three-Tiered Architecture system and why it was chosen to work hand-in-hand with the Agile Scrum development process to further ensure the project was properly planned and maintained. Furthermore, there will be a study into current industry standards for obtaining context and what these methods are. This will follow a discussion around what data will be relevant to be gathered for a mindfulness prototype application for athletes and understanding how data should be evaluated as being useful and then how it can be transformed into contextual data.



***Figure 1 – Image of Agile Scrum approach to be used and followed in this project.***

In order to properly and accurately plan the requirements of this project this section will start with an explanation on how the project will be planned using the Agile Scrum development approach. This includes understanding the exact requirements of the project to ensure it has the correct features, a brief insight into what each sprint entails in terms of development progress as well as explaining how the prototype will be tested after each sprint and why doing it this way is a huge benefit to the end result of the prototype. As is key with any Scrum development, a product backlog will have to

be created which is a prioritised list of the features which allows the development process to get underway without the need for a lengthy planning process. This will be carried out through User Stories which will be provided first-hand by athletes. One key factor of Scrum is that it allows for fluidity due to not being a rigid methodology and so an overload of information around each sprint is not required. This is because the approach allows for updated requirements through the project due to the constant reviews of the project progress, prototype and its developmental needs.

### **3.1.1 Programming Language and Version Control**

The development of the application will be carried out using Apple's Xcode Software Development Suite. The program itself will be coded using the Swift Programming Language. These will both run on an Apple MacBook Pro which is sufficient and up to date to run the current version of Xcode when this project was started (v11.3.1). For storing data and information as well as any images and videos used during the development the Google Firebase real-time database will be deployed to act as the back end for this project.

For version control GitHub will be used as Xcode 11 provides a set of rules that can be optimised to control the GitHub flow. GitHub is a fantastic version control system that allows for changes in implementation to be maintained during the development process. The project will have one master branch, from here on, after each completion of a sprint has been complete, the MVP of that sprint will be pushed onto the Git repository. This will mean that in total there will be 4 versions of the prototype uploaded to GitHub.

### **3.1.2 Sensors**

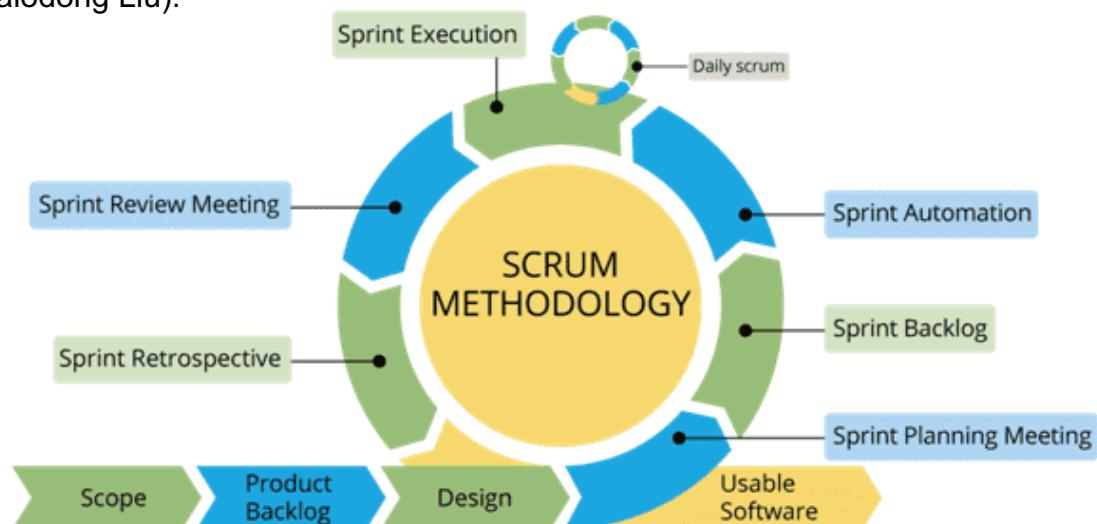
To be able to access the sensors embedded within iOS devices the recommended Apple Frameworks will be used in order to enable the sensors use. For the use of the accelerometer, gyroscope, pedometer and environmental-related events the Core Motion framework will be used. To obtain the athletes location the Core Location framework will be used. For use of map services, the MapKit Framework will be implemented so that the user location can bring up nearby yoga / mindfulness studios.

### 3.2 Approach / Methodology

Now there will be a more focussed analysis of the Scrum methodology approach as well looking at the Three-Tiered Architecture and putting together a testing operation for the prototype context aware athletes' application.

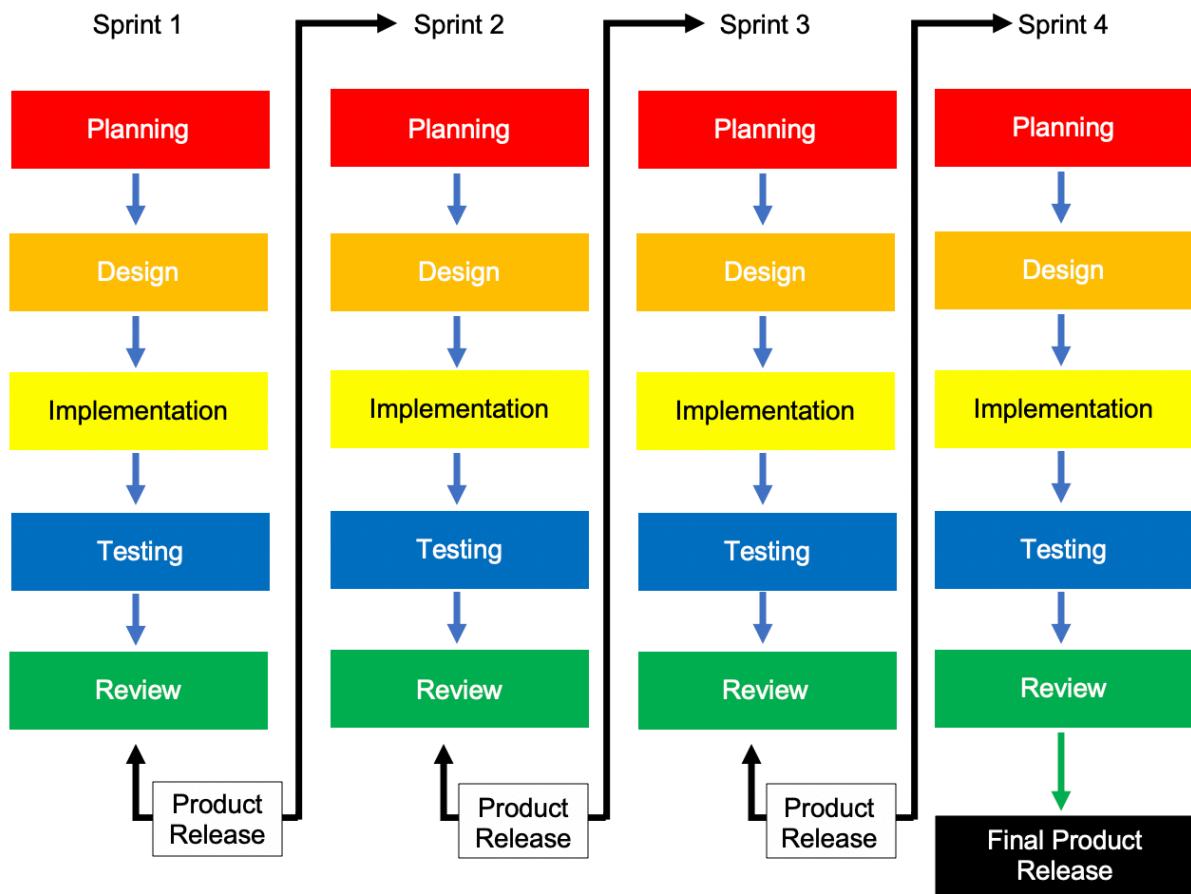
#### 3.2.1 Scrum

The approach that will be used for the development of this context aware athletes' application is the Agile Scrum methodology. Choosing an agile methodology is beneficial for this project as it compensates for changes in requirements which other approaches such as the Waterfall methodology doesn't allow for, therefore choosing Agile benefits this project. "Scrum is an incredibly simple, effective, and popular software development framework" (Reddy, 2015). The Scrum approach is built of several key stages which are continuously developed in cycles (sprints) until the project is completed (Bibik, 2018). The stages are; Planning, Design, Build and Testing. The test stage is followed by a review in which all the main shareholders will come together to analyse the product and discuss whether it is a viable product and if it can progress to the next sprint. As this project is being completed by a single developer for a university dissertation, and not by a team, this means that all the features of a Scrum approach will not be utilised. This includes all the meetings as seen in the image below because it is not feasible for this development. Instead, these will be replaced with a single regular meeting with the dissertation supervisor (Xiaodong Liu).



**Figure 2 – Image of scrum approach main features**

The areas of the Agile Scrum approach that can be followed will be displayed in the diagram below:



**Figure 3 – Image of Agile Scrum approach to be used and followed in this project**

Using this image as a visual representation of how this prototype application will be developed, it can be understood that the project will be completed within 4 sprints. Each sprint will deliver a product release or a Minimal Viable Product (MVP). However, as mentioned previously, due to this being a single developer application with no client, shareholders or team, the MVP will be up to the discretion of the developer. The last sprint (sprint 4) will see the delivery of the end prototype delivered.

To gain an understanding of what each sprint will entail, the table on the next page helps to understand this.

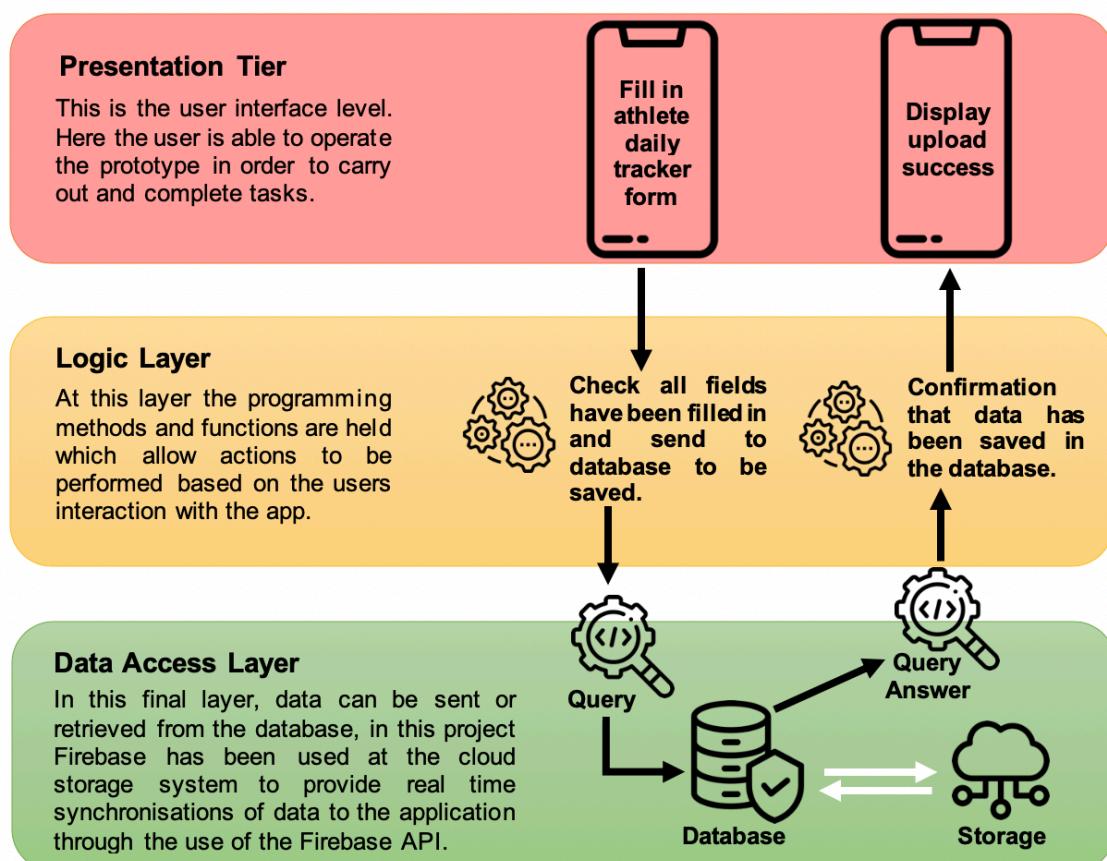
Sprint	Description
1	In the first sprint there will be a focus on gaining a brief understanding of the project so that development can begin. This will be carried out through the use of the product backlog and trying to carry out the most important tasks of the development. This allows for a strong foundation to be built by focussing on putting the approach and architecture in place in order for the future sprints as they will be more development heavy.
2	In the second sprint the focus will be around implementing the athlete's context profile which is an area that allows players to feedback their daily thoughts and feelings around their own health and wellbeing as well as any training updates. This daily tracker is the main feature of the application as it allows for a diary to be built up of the athlete's individual reflections which is fundamental as that is what this application is trying to achieve.
3	In the third sprint there will be a focus on taking advantage of the sensors within the iOS devices to gather context in this way. This includes using the athlete's location to find yoga / mindfulness studios near them. Using the scores from their user's daily tracker to prompt self-yoga / mindfulness techniques.
4	The fourth sprint is an area where other interesting and useful features can be implementation into the prototype to make it more useful and engaging for the athlete. These implementations have been added on the follow up of research initially carried out in order to see what users tend to want from an application. This includes a messaging / chat page which allows for communication across the team and also a points system which builds a sense of competition between players. The reason for the points is because it has been seen as a positive way to keep people engaged with applications and makes them more likely to use it.

**Table 6 – Showing what kind of work each sprint will undertake**

### 3.2.2 – Three-Tiered Architecture

The architecture of this project will be the three-tiered architecture system. This is a client server type of system which has been broken up into 3 layers: the presentation layer, the application layer and the data access layer.

- The first layer is the Presentation Tier – this is the front end of the program where the user / athlete will be able to interact with the program through the user interfaces functionalities – buttons, text input, visual media etc.
- The second layer is the Application Tier – this is where the implementation of the coding and the communication between the user's interaction and any information required from the database is carried out (functioning business logic).
- The third layer – this is the Data Tier and it is here where the data will be accessed and sent to be stored (data storage system).



*Figure 4 – Image of Three-Tiered architecture to be used and followed in this project*

The benefit of using the three-tier system is that it allows for clear and precise understanding of what is to be achieved and how each stage is meant to work. The system increases the performance of applications by being able to handle multiple user's executions in the middle tier. It also allows for an increase in flexibility and maintainability as projects which need to be expanded or updated (which is highly important in today's fast evolving technology era) can be done. This is excellent when working hand-in-hand with the Scrum methodology as it is also an approach that allows for change with ease. Therefore, running the development of a program with both these approaches in place should see a successful prototype launched.

### **3.3 Context Awareness and Challenges**

As discussed in the literature review (chapter 2), context awareness is the “ability of a system or device to gather information about the user’s environment at any given time without human interaction and adapt behaviour according to the gathered information” (Baldauf, Dustdar and Rosenberg, 2007). To gain a deeper understanding as to why this is important, a look is taken at this quote “Humans are able to use implicit situational information to increase conversation. This ability did not transfer when humans interacted with computers” (Abowd et al., 1999). Now, when this quote is analysed it is possible to misunderstand and believe that if we are able to do a such a task without thinking about it, it must be easy to transfer this same task to a computational device. However, in early stage computing it was extremely difficult to provide situational information to computers, as devices did not have the array and magnitude of sensors nor the processing power that are currently available within our own pockets today. Abowd goes further on to say “By improving the computer’s access to context, there will be an increase in richness of communication in human-computer interaction”. This is extremely important in understanding the responsibility of developing context-based applications that help to ease humans day-to-day interaction with technology.

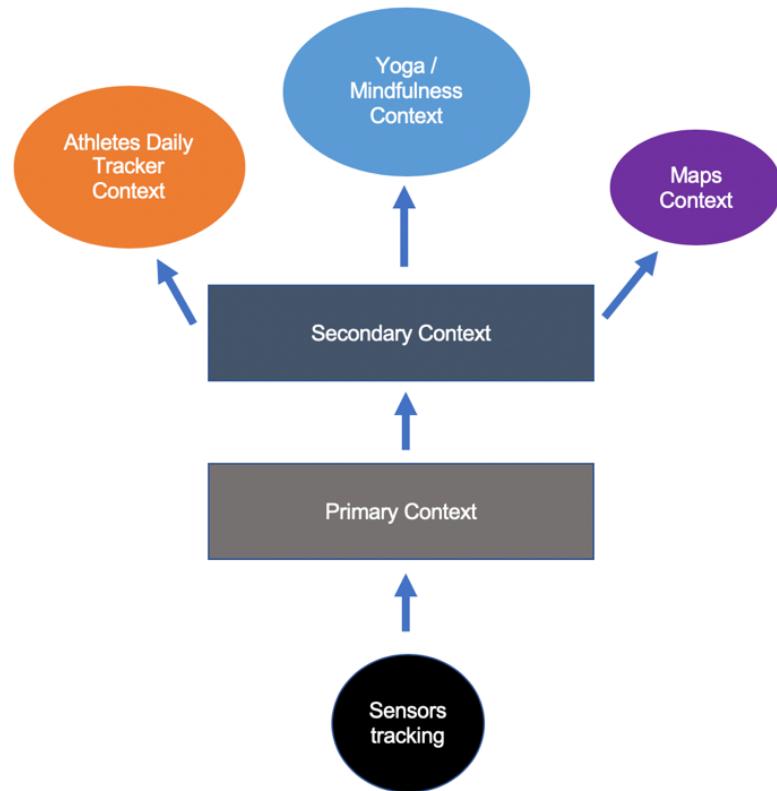
When discussing context awareness and its benefits to society it is vitally important to understand the challenges that do arise when considering developing an application. One challenge may come down to the lack of infrastructure in place to promote the design and implementation of context aware applications (Abowd et al., 1999). However, we know due to the current advancements in technology and the wide array of sensors that most devices now come with, that we are currently living in the era of how gathering data and using these inbuilt sensors to gather this data is very easy. Especially when looking at the sensors that will be needed for the construction of the yoga / mindfulness application, the device to be used (Apple iPhone XS Max) has all the required sensors to be able to build this application.

Another potential challenge is discovering compelling context-aware applications that assist people's everyday interactions (Abowd et al., 1999). Ensuring that the idea of the context aware application is something that society requires and will benefit from is very important. With the idea of a yoga / mindfulness context aware application that will help athletes to not only benefit on the pitch but be able to elevate their mental state to a higher and more powerful level which is required due to the amount of pressure that these athletes have to cope and deal with. Ensuring that athletes are able to manage any tensions or stress that they have in their mind is equally, if not more important than any issues they would have physically. In a study carried out it was concluded that athletes that are more open towards negative thoughts and processes leads to them dealing with these negative circumstances in performance environments and daily life in a positive manner (Goodman et al., 2014). Taking from this, developing a context aware application to help athletes will be a benefit for them and assist in their day-to-day lives.

Context awareness can be said to be broken up into 4 categories; location, identity, time and activity (Abowd et al., 1999). Looking at these categories they will be really useful in the development of the yoga / mindfulness application as each of the categories can be broken into a separate area of the application from which context will be generated.

- The location will involve not only gathering the user's location but also using this information to find nearby yoga / mindfulness studios and prompt these to the user.
- The identity will be used to gather an athlete's information as they create a profile account which will hold and store all their information collected in a secure database.
- The time will be used to store current time and date of when data has been collected as a backlog of this would be useful – especially for the athlete's daily review feature on the application as this will be proposed to be completed every day. Therefore, knowing the date of when it was completed is important.
- Lastly the activity might be used to take into consideration the athlete's actual physical activity including using the heart rate monitor if possible, pedometer to track movement and other sensors in order to track intensity levels.

From these initial headers (location, identity, time, activity) the data gathered here can be understood as a primary context source of information that leads to the algorithms converting this information into a secondary context source of information. These two sources are important for good context aware development to be created as it embodies the similar attribute as to how humans process and make use of information on a daily basis.



**Figure 5 – Image displaying breakdown of how the context awareness model will transfer sensed data into meaningful context for the applications use.**

All of the features will try to be implemented into the application so that it is well rounded and provides a more complete feel of use. However, as some of these features will be difficult to implement depending on various conditions which may hinder the development process. Despite this, every effort will be given to ensure that the prototype works in order to show how a context aware yoga / mindfulness application can help athletes to perform better on and off the pitch.

### **3.4 Quality Assessment and Concerns**

Measuring the quality of this project is going to be a critical way of determining whether or not this project has been successful. One way to assess the quality is to conduct a study of athletes before they use this application. This can be done by asking athletes to monitor how they feel on a daily basis depending on the kind of day they are having. This would be completed by providing the users with the prototype after the first two sprints have been completed, as to carry out this study all the user needs access to is the daily wellness tracker and for the system to keep a track of the users scores. These scores would be saved and once the prototype has been completed the athletes will then be given the full prototype for their scores to be monitored and tracked again. Once both sets of scores have been collected a review will take place into them to determine whether or not there was any change in scores. This experiment will help to determine the quality and success of the project.

One concern here is that due to this application being tested on cricketers it may be that this study is not possible as the cricket season in Scotland does not start until the end of March. Another concern is making sure that the data received is accurate and that the athletes are not just answering the questions without properly giving this experiment the significance it requires. However, this is just a small concern and it should not be an issue as the test users will be trusted individuals who have been made fully aware of why this experiment has been conducted.

### **3.5 Summary**

It has been important to discuss the reasoning behind choosing the approaches taken for the development of this prototype. In doing so, a brief understanding has been provided using the Scrum approach to break the overall process of how the project will be completed. This is by breaking the project down into small manageable sprints of which this development will have 4 sprints, made evident in Table 2.

Now that the Agile Scrum methodology and the three-tiered architecture have been identified as the foundations on which this prototype development will be built upon. The design of the project can now be focussed on which is what the next section will carry forward. This would be through the use of UML techniques including class and sequence diagrams to provide a visual concept representation of how the application should work and run as well as a more in-depth coverage of the proposed features for the athlete's application.

For this project there isn't a need to delve deeply into some aspects of Scrum as there is not an actual team working on the project so many meetings and Scrum roles will not be needed for this project. Also, as there is no client that this project is being carried out for there is less of an emphasis on wireframes and storyboards because there isn't a requirement to give the client a clear visual representation of how the program will look. However, for the sake of planning properly and maintaining quality throughout the project wireframes will still be used when the design stage is discussed in the next section.

## Chapter 4 – Design

### **4.1 Requirements Analysis and Product Backlog**

In this area the focus will be on the initial requirements of the prototype on a fundamental level. Here, the complexity of the development will be discussed through the use of design techniques such as the unified modelling language (UML) which allows the use of diagrams to be presented in order to provide a clear visualisation of the software system. Other techniques include discussing the functional and non-functional requirements as well as using wireframes to represent a model design of how the athlete prototype application user interface will look.

#### **4.1.1 Project Requirements**

The scenario for this project is that a prototype context aware yoga / mindfulness application is to be created for athletes in order for them to be able to deal with any mental / physical issues they may be having both on or off the field. In this section a system report will be conducted to provide an explanation of what the product will do, including a list of features which have been gathered through research.

Below are the pages and what each page will entail:

#### **Login Page**

The login screen is the initial first screen that the user will interact with. It is here they will be either requested to create an account if it is their first time using the application or they will be asked to sign into the application with their username and password, if they have made an account. There will be relevant security measures in place to ensure that any personal information is not easily hacked into by taking advantage of Firebase Security Rules.

#### **Home Page**

The home page will allow the user to navigate between the different features of the application. It will be of very simple design containing just images that users will be able to select in order to open the page associated with that button.

## **Daily Wellness Tracker Page**

The daily wellness tracker is one of the most important, if not the most, in terms of this application. It is here the athlete will provide an insight into how they are feeling by answering several questions that have been found to be most effective when it comes to looking after the health and wellbeing of an athlete. The questions include:

- Finding out how many hours they slept and the quality of their sleep
- Finding out how sore their muscles are
- Finding out how fatigued they are
- Finding out how stressed they are
- Finding out how much they are willing to train
- Finding out if the athlete is injured and also if they are feeling ill

It has been found that these questions really aid in the process of taking care of athletes but ensuring that the user is able to answer them in an engaging and quick manner is also very important. As it was found from research that just developing a form in which answers are typed into may prove to demotivate the user. Using this information as a guideline a 7-point system will be used for most questions that do not require a lot of background. Instead of typing in their answers a slider which is a user interface object will be used in which the user can make 1 of 7 choices (Terrible, Restless, Worse than Normal, Normal, Better than Normal, Fresh, Very Fresh). Based on the scores selected, a calculation can be executed on the score and this information will allow for context to be generated for the yoga / mindfulness centre, when particular types of classes are promoted to the user. This context allows for the best yoga / mindfulness types to be provided to the user in order to help them be in a better state of mind.

## **Yoga / Mindfulness Centre Page**

The yoga and mindfulness centre will contain videos and techniques which allow a user to carry out different types of yoga workouts in their own time. Tackling one of the biggest challenges these days is finding the time to be able to carry out such tasks. Therefore, enabling the athlete to have access to these techniques from the comfort of their own home will be beneficial for them.

There are several different types of yoga techniques and the one this application will display in its videos is Vinyasa flow yoga. However, Yin / Restorative, which are slower paced yoga techniques, may be incorporated into the application along with Power, which is a cardio based technique, to provide an overall balance and variety for the athletes. As mentioned before, based on the users scores in the daily tracker the user will be promoted videos that are more suited to help them in the specific moment they are in. For example, if they are having issues sleeping then a more relaxed Yin / Restorative yoga sequence will be beneficial for them to aid their sleeping, so that type would be advised to the user.

### **FindYourZen Map Page**

The FindYourZen Map allows for the user's location to be taken so that this context can locate nearby yoga studios or mindfulness centre. This feature will be good to encourage athletes to go out and join others in a state of seeking a growth in physical and mental health.

### **ChatBox Page**

The ChatBox is an area in which sports athletes can talk to each other as you would on any chat / messenger application. It is just an added feature that would be found useful from the questionnaire that was given to the athletes. The ChatBox may also allow for the sharing of yoga videos depending on the implementation / development time as it is not a necessary feature – just an added benefit.

### **Leaderboard Page**

The leaderboard page is another added benefit which has been implemented into the application in order to keep users engaged with the application. Through the use of this feature a sense of competitiveness can be generated which is perfect when taking athletes into account as they love to compete. So, developing a feature that rewards them for interaction with the application will not only keep them coming back to the application but maybe even get them signing on more than just once a day.

### **My Profile**

The profile page allows for the user to update their personal details. This includes their name, sports teams etc. This information is relevant for the application to run and also may include the option to remove their personal details if they would like to do so in order to comply with current GDPR regulation.

## 4.2 Functional Requirements and Non-functional Requirements

The functional requirements of the prototype are the features of the implementation that must be carried out. They are essentially the fundamental parts of the system that ensure the project requirements are met. The non-functional requirements are principles that should be met in order to produce an application that is worthy of being released to the public. They ensure quality of a product by judging the operation of a system.

The functional requirements are as stated below:

- The prototype is built using the Apple frameworks so that it can run on iOS devices – Xcode and Swift
- The prototype is able to sense surrounding environments and transform the sensed data into meaningful context
- The prototype uses the Core Location framework to uses sensors to gather the user's location for the applications context
- The prototype uses the MapKit Framework to find local yoga / mindfulness studios
- The prototype uses the Core Motion framework in order to access the devices sensors
- The prototype has a wellness tracker where athletes log their daily feelings

The non-functional requirements are as stated below:

**Efficiency / Performance** – The development should be fully responsive. This means that the response to a user's action should be performed immediately. For example, when an athlete is entering data into the wellness tracker and they use the UISlider the object should move the slider up and down as the user presses and slides their finger on the screen without any delay. Also, in terms of performance, when the user then tries to save their well ness report this should be completed in a very short time burst. The program should be well written so that the middle tier can handle multiple users trying to submit their wellness report at the same time without crashes or lags. This in turn creates a much more pleasurable interaction of the application for the user.

**Robustness** – The robustness of the prototype is extremely important as there should be no errors within the development of the product. The application should be thoroughly tested so that any faults during the development process can be found and solved before the release of the application. As the development will be using the Agile Scrum methodology testing is a major part of that process but ensuring that it is maintained to a high standard is very important.

**Legal** – Making the user aware of any legal requirements which need to be met has to be very clear from the start. This is to prevent any unfortunate events to be brought forward later on, as this is a context awareness application so the user's surroundings will be being monitored. Ensuring the athlete or user that this process is safe to carry out and ensuring that this data will not be unlawfully shared with Third Parties is key in building trust with the user. The prototype must ask the athlete for permission to access the sensors data before just gathering information without the user knowing as this could breach many laws including GDPR.

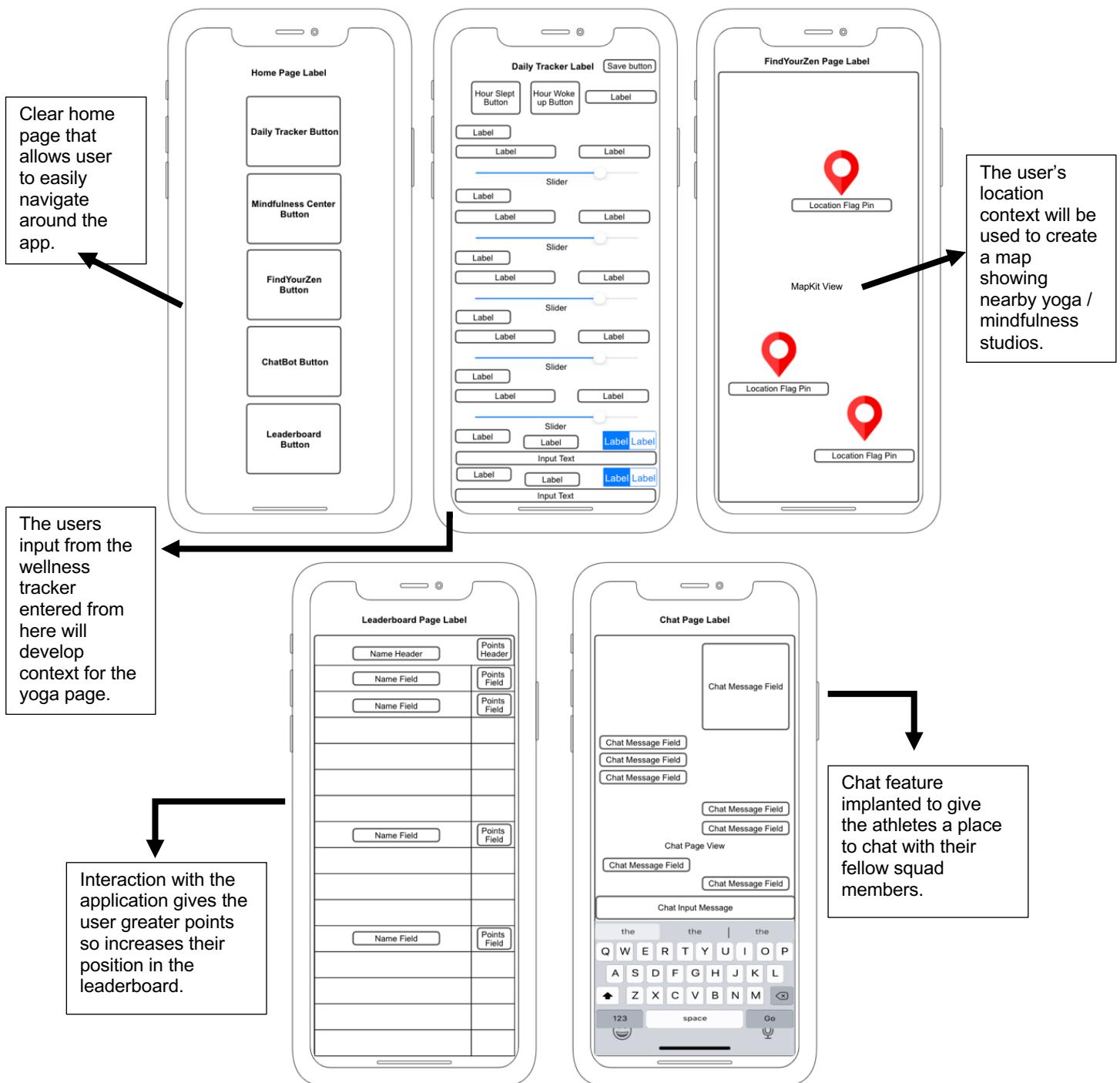
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**Security** – As the prototype will be collecting user data and also storing the athlete's personal information, making sure this data is secure is essential. Preventing hackers from gaining access to this information should be a fundamental part of the implantation process so ensuring that any weaknesses are found early in the development will be crucial to developing a successful application.

**User-friendly** – The prototype is going to be used by lots of athletes. The User Interface (UI) is where the user will be able to interact with the functionality of the application. Ensuring that the UI is of a modern clean layout that can be easily operated will allow for the athlete to have a very enjoyable user experience.

### 4.3 Wireframes

In this section the wireframes will be discussed as they are a very important part of the initial design process. The use of wireframes allows for design specifics to be worked out – such as the space between objects and also how to prioritize content on a particular page of the prototype. Below, wireframes for some pages of the application have been created in order to provide this visual concept of how the program is expected to run and look.



**Figure 6 – Wireframes for the prototype application**

#### 4.4 Use Case

A typical Use Case is a visual representation of how the user would be expected to take control of the application. Potentially the biggest feature of this application is the wellness review page. A user would navigate to the Wellness page and complete the questions that would be asked. They would do this by using the UI slider controller and text input boxes. Once the user has answered the questions and submitted them, the system would check to ensure all the answers have been completed. Upon the success of this, in the background, the system will gather the date and time and send all this information (wellness answers, data, time) to the database. The system will then use the answers from the user to generate a score which will be used to a) promote a type of yoga / mindfulness technique based on their current needs and b) update leader board points. Once this has been done, the wellness review page will close, and a confirmation pop-up will be shown to the user that the data has been saved. In the use case diagram below the following manipulation of the program has been visually shown.

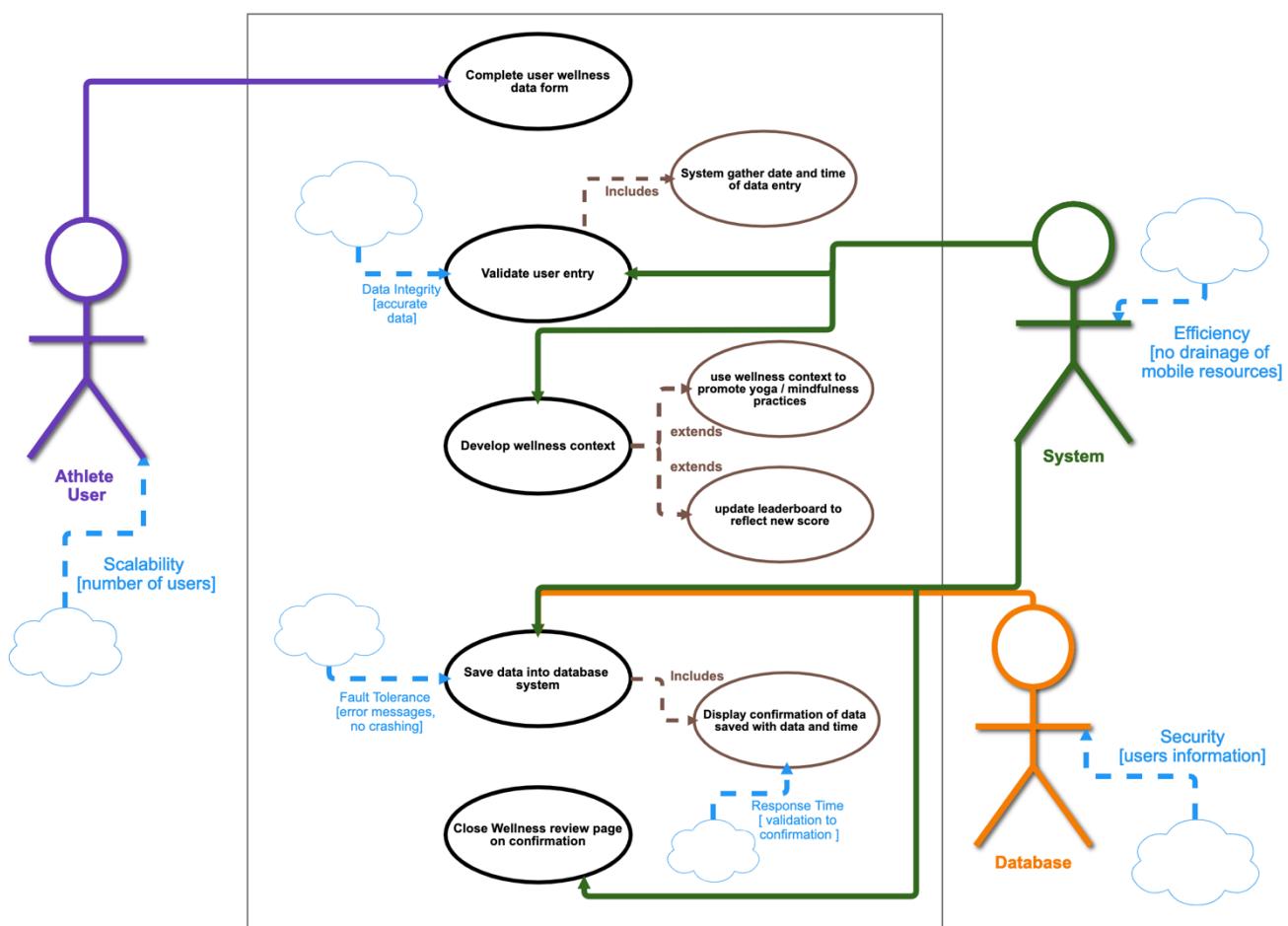
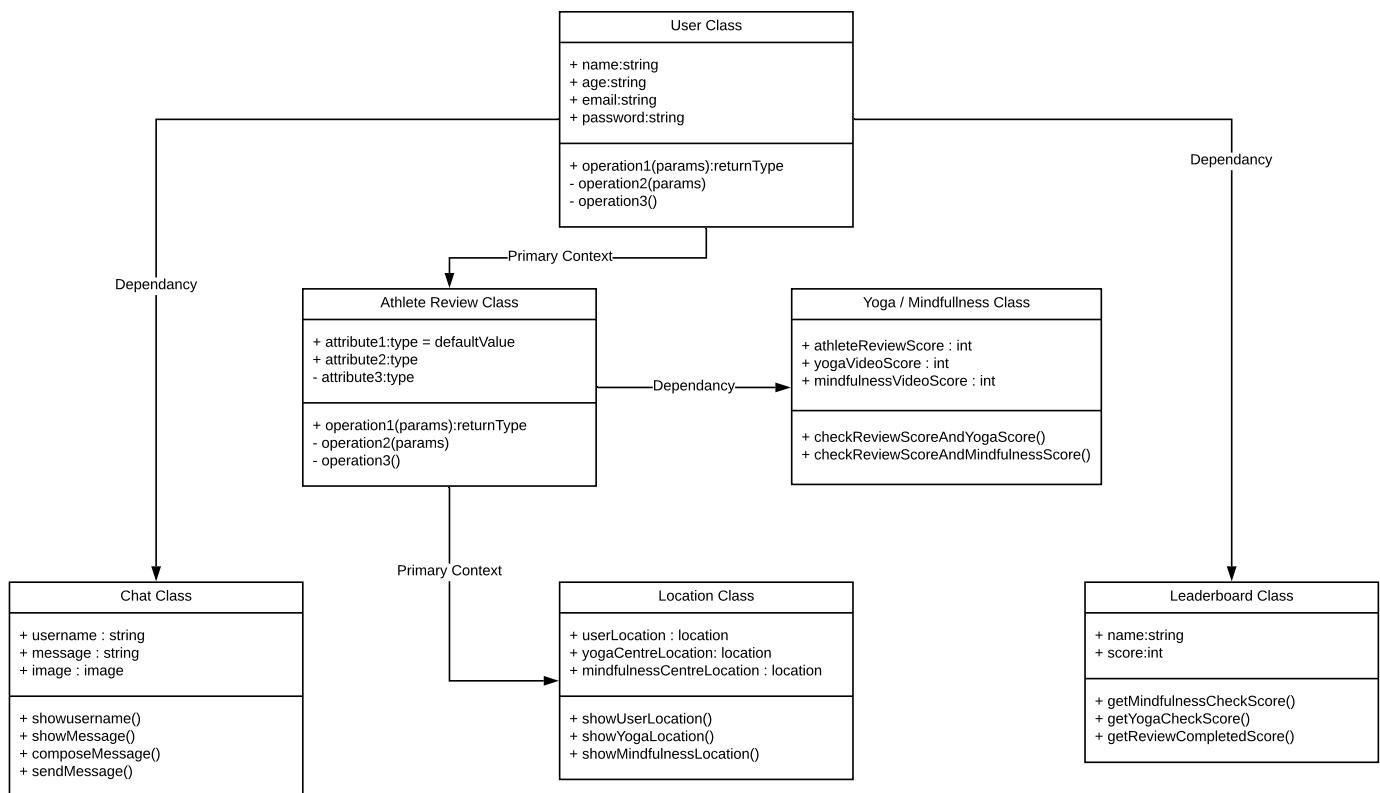


Figure 7 – Use Case Diagram of a possible user interaction method

## 4.5 Class Diagram

The class diagram is a visual representation of the relationship between the classes used in the program. From the image below, we can see that the user ID class is the main class other classes are dependent on that username class. The diagram shows that the Athlete Review Class and the Location class are primary sources of context as they represent the main holdings for the application. The Athlete Review Class is responsible for holding the information gathered from asking the users questions about how they are feeling physically and mentally. The yoga/mindfulness class is responsible for ensuring that the yoga and mindfulness videos can be given a score so that when it comes to judging what will best for the user this can be done so. The leaderboard class works out how to add points to a specific users account. The chat class represents all things to do with the in app messaging service.



**Figure 8 – Class Diagram for the system**

## 4.6 Test Strategy

In this section testing will be discussed as it is one of the most important parts of the development process. The reason being is that ensuring a proper testing strategy for the prototype is in place, it will provide confidence that the application works without errors and faults. Due to human error errors, defects and bugs can be unintentionally created within software, so making sure that a thorough test strategy is in place to reduce the chance of there being any issues with the prototype. By using the Scrum approach testing is done during every sprint, so before the next phase of development starts a comprehensive test of the program will be carried out to check the performance and security of the prototype.

There are many forms of testing that can be executed on an application but the ones that will be focussed on here are:

Test Type	Why it should be carried out
Acceptance	Acceptance testing is where the prototype is just a check to confirm if the program meets the requirements. This can be done by the developer and also by the athletes by letting them run the application and determine whether it is ready to be released.
Integration	Integration testing is where functions of the prototype which use 2 or more software modules are combined to make sure they work together and deliver results as expected.
System	System testing is where the full program will be tested as a whole to evaluate whether the prototype meets the requirements.
User Interface Test	This is where the user interface (UI) is tested to ensure that all the elements that the user can see and touch work as they should – this includes each button, each text input, video display etc.
Unit	Unit testing is where each individual module, which runs a particular function, works on its own. It is here that the most common errors or bugs in programs are found. So eliminating these will be a big help to ensuring the program works as it should.

**Table 7 – Showing the different types of testing to be used in the project**

The test scope is important when deciding the crucial parts of the program that need to be tested. There are various key functionalities of the program that need to be working in order for the application to be successful so prioritising them for testing is important.

- An athlete should be able to create and register an account
- An athlete should be able to login
- An athlete should be able to fill in a daily wellness tracker form
- An athlete should be able to see local yoga / mindfulness near them
- The application should be able to get the users location
- The application should be able to develop context from the daily wellness tracker input from the athlete
- The applications user interface (buttons, text boxes, media) should be clear and readable for the user to allow easy use
- The application should be user friendly by being straight forward to use and by displaying the relevant information on the correct pages
- The application should make use of sensors in order to generate context

The test environment is important to the testing stage as the correct use of equipment (hardware and software) will be required to endure efficient testing can take place. The testing will take place on a MacBook Pro using the Xcode simulator and also on an iPhone XS Max. The reason for choosing the MacBook Pro is that it has been used to create the application so it will be able to handle testing the prototype fully. The reason for choosing the iPhone is that it is a newer model so being able to run the application on the app will prove it can work when distributed.

The test tools for this project will run manual testing strategies. As good as automated testing is, it does not cover everything and can often miss up to 50% of software flaws (architectural errors) which are different to bugs (coding errors). Taking this into consideration, it makes much more sense to carry out a full manual test plan to ensure that not only software bugs are found but also software flaws are found and eliminated.

## **4.7 Design Summary**

The design stage is not considered to be a crucial part of the planning process when it comes to using Agile Scrum development, this is because each sprint incorporates a design phase. However, for the basis of this project, it should be carried out to show that proper planning around design has been carried out but, there is not a fundamental need to delve too deep into this area for now as it would be compared to the waterfall or other development approaches.

In this section, wireframes have been used as well as UML techniques including use case, class and sequence diagrams to provide a visual concept representation of how the application should work and run as well as a more in-depth coverage of the proposed features for the athlete's application.

In this stage, it was more about coming up with the basic necessities for the program including the functional requirements in order to begin the development stage which will be discussed next.

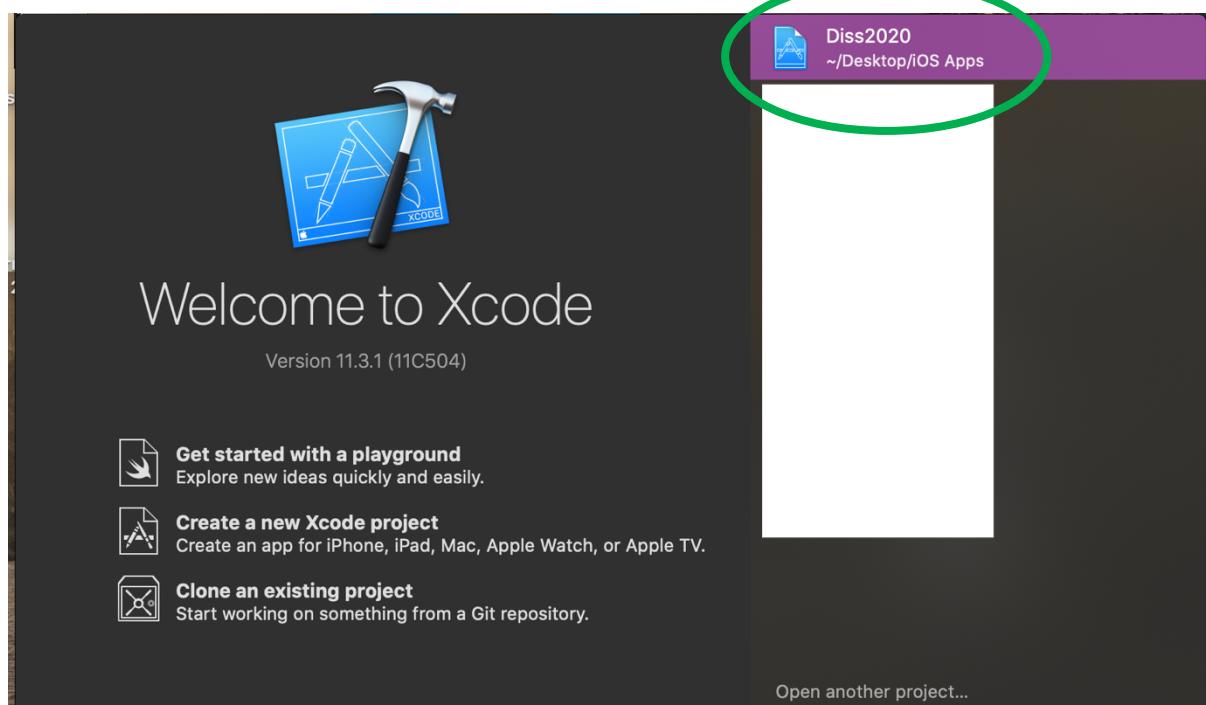
## Chapter 5 – Implementation and Testing

This chapter will provide evidence of the implementation of both context awareness platform and prototype application. This will be proven by providing an insight into what actions occurred during the phased “sprints”. The information provided from these sprints will be what was meant to be carried out, what was actually carried out, screenshots of code as well as screenshots of relevant unit testing and finally discuss any issues in that sprint as well as screenshots of the actual prototype application. In doing this a full overview of the project progress can be viewed and maintained.

### **5.1 Sprint 1 (19.02.20 – 05.03.20)**

The first sprint involved, setting up the Xcode development project, the database and start up pages of the prototype including the login pages and the implementation of the Daily Wellness Tracker.

#### **5.1.1 Project Set Up**

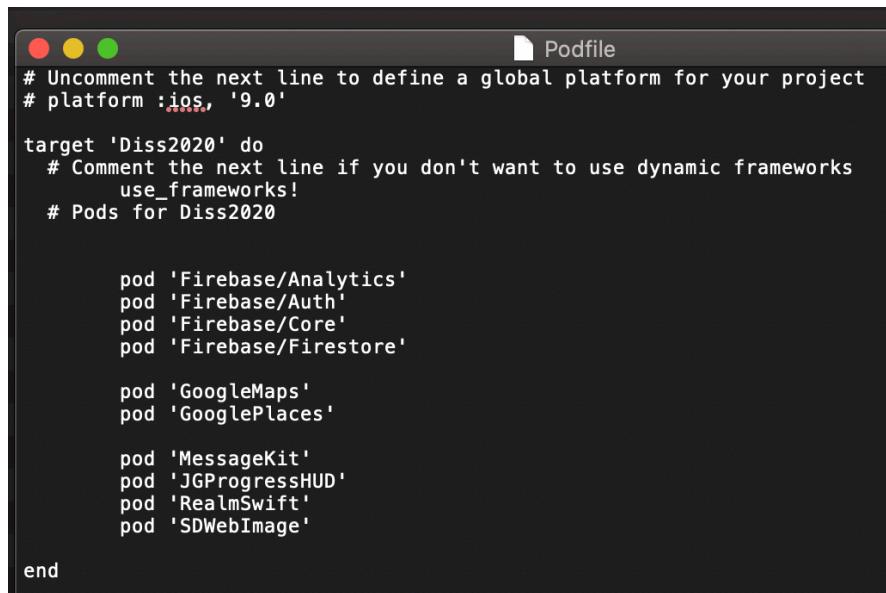


**Figure 9 – New iOS application ‘Diss2020’ has been started.**

Here the project has been created using Xcode 11.3.1. It is a single view app written in the Swift programming language using the Storyboard user interface.

### 5.1.2 Add Firebase and other libraries to application

In order to take advantage of several beneficial libraries CocoaPods is an great dependency manager that was used to install Firebase and other libraries into the project.



```
# Uncomment the next line to define a global platform for your project
# platform :ios, '9.0'

target 'Diss2020' do
  # Comment the next line if you don't want to use dynamic frameworks
  # use_frameworks!
  # Pods for Diss2020

  pod 'Firebase/Analytics'
  pod 'Firebase/Auth'
  pod 'Firebase/Core'
  pod 'Firebase/Firestore'

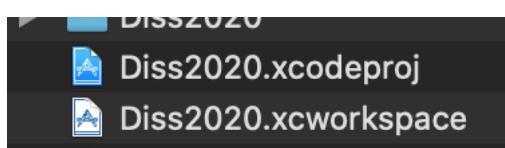
  pod 'GoogleMaps'
  pod 'GooglePlaces'

  pod 'MessageKit'
  pod 'JGProgressHUD'
  pod 'RealmSwift'
  pod 'SDWebImage'

end
```

**Figure 10 – Example of ‘pod file’ containing the libraries used within the project.**

In order to so, the original Xcode project will be converted into an Xcode workspace project. This is the project where all the coding will be carried out with the added implementation of the now accessible libraries.

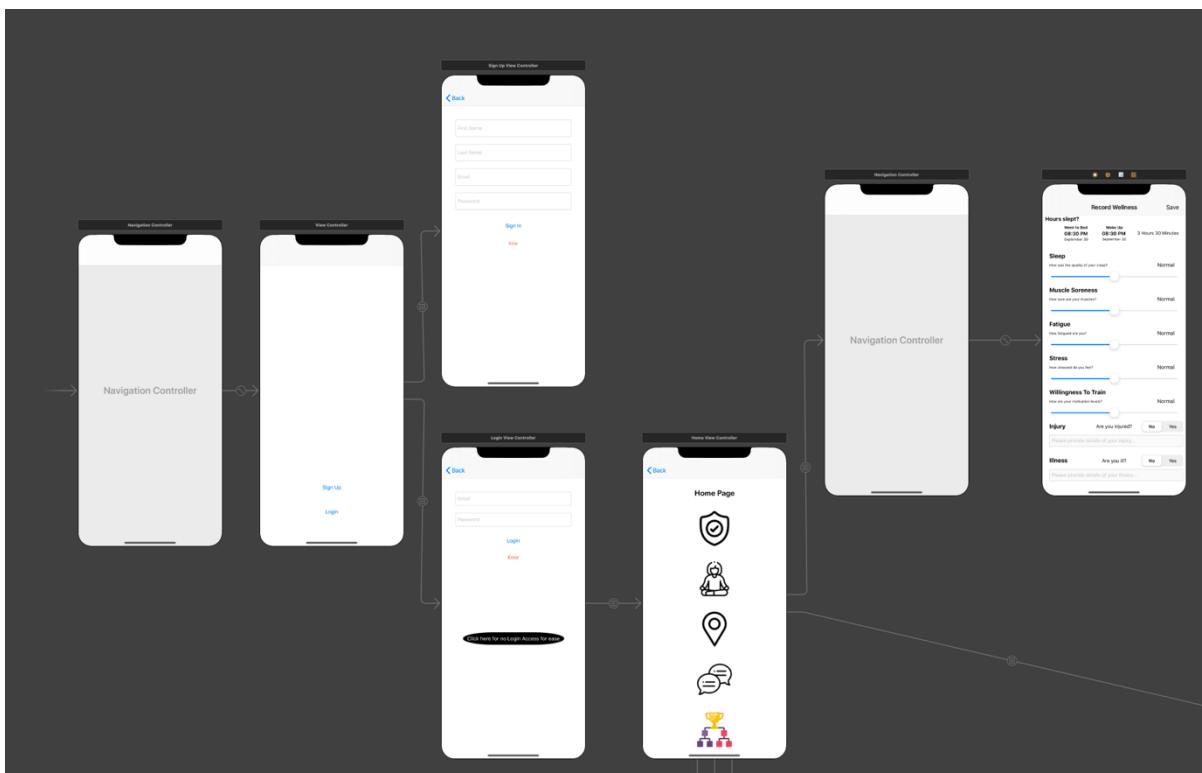


**Figure 11 – Conversion of Xcode project to Xcode Workspace**

### 5.1.3 Begin Development

Here we are going to look at the completed elements of the first stage. In this application it was important to capture the user's identity. This would enable user context to be generated. To do so register screen and login screens were developed that would capture basic information about the user, to create a user profile. The use of a personal profile was also necessary for the implementation of the user wellness screen, as the data would need to be saved in to their own profiles.

Following on from this was the implementation of the home page which utilized icons as buttons to navigate through the pages of the application. The biggest development was the start of the daily wellness system. As this functionality was the main front of the application it was really important for this to be carried out well. The simplicity of the user interface needed to be there for the user to be able to complete the questions quickly but also accurately and honestly.



**Figure 12 – Development progress in sprint 1**

### 5.1.4 Classes created

#### storageClass

Created the storageClass which would gather the information entered by the user and validate it and send the information to the database.

#### scoreClass

Once the user entry data had been saved and validated, the scoreClass would take in the users answers and generate a score. This wellbeing score would be saved alongside all the answers and would allow for a track in wellness to be kept. The scoreClass was also to be used to manipulate the videos in the yoga/mindfulness section as mentioned before.

### 5.1.5 Testing

Test ID	Area Tested	Purpose	Input	Expected Result	Actual Result
1	Register / Login Page	Check if system allows first name	blank	Error message	Error message shown <span style="background-color: green; color: white;">PASS</span>
2	Register / Login Page	Check if system allows last name	Johnny	Accepts Johnny	Johnny accepted <span style="background-color: green; color: white;">PASS</span>
3	Register / Login Page	Check if system allows email	J123.com	Error message “email address badly formatted”	Error message shown <span style="background-color: green; color: white;">PASS</span>
4	Register / Login Page	Check if system allows email	J@123.com	Accepts email	Email accepted <span style="background-color: green; color: white;">PASS</span>
5	Register / Login Page	Check if system allows password	Password	Rejects password	Password rejected <span style="background-color: green; color: white;">PASS</span>
6	Register / Login Page	Check if system allows password	Password123	Rejects password	Password rejected <span style="background-color: green; color: white;">PASS</span>
7	Register / Login Page	Check if system allows password	Password123!	Accepts password	Password accepted <span style="background-color: green; color: white;">PASS</span>
8	Wellness Diary Page	Check if went to bed scroller works	Click scroller	Scroller opens at bottoms of page	Scroller works <span style="background-color: green; color: white;">PASS</span>
9	Wellness Diary Page	Check if woke up scroller works	Click scroller	Scroller opens at bottoms of page	Scroller works <span style="background-color: green; color: white;">PASS</span>

10	Wellness Diary Page	Check if both scrollers give accurate time slept	Went to bed scroller: 10:30 PM night before Woke up scroller: 8:30 PM	10 hrs 0 mins of sleep	Scroller works Output: 10 Hrs 0 Mins <b>PASS</b>
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**Table 8 – Showing the testing being carried out on the application**

### 5.1.6 Sprint Review

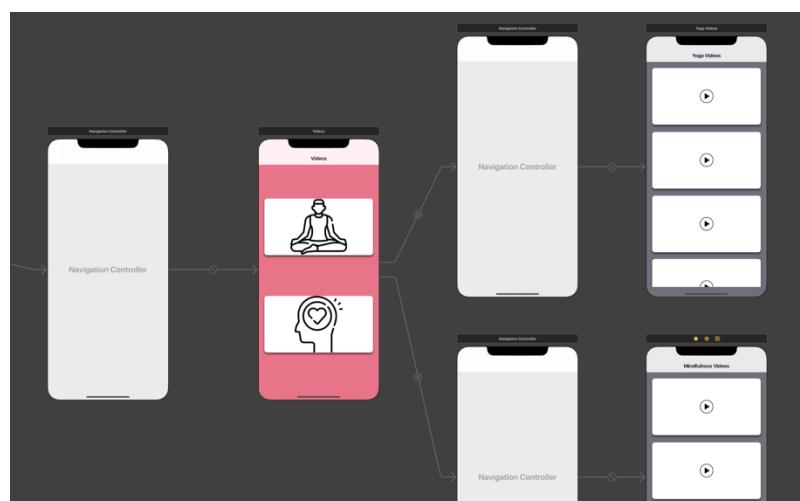
The first sprint was well carried out and the progress made during this sprint was really positive as the initial start to the prototype development. The sprint had been started later than expected due to some extenuating circumstances, however, the standard of work carried out has ensured that this first sprint has been successfully completed. No changes to the project plan were required, the product backlog had been fulfilled. The implementation of the agile and three-tiered approach was carried out as well as testing the program.

## 5.2 – Sprint 2 (09.03.20 – 26.03.20)

### 5.2.1 – Development

Here we are going to look at the completed elements of the second sprint. In this application the implementation of the yoga/mindfulness page was important as these techniques would be used by the athlete day to day. Following on from this the context generated by the daily wellness tracker would be used to manipulate what type of videos would be beneficial for the user based on the score they accumulated from the daily review information.

The issue here was that the yoga / mindfulness pages could not be implemented no matter how much effort was put into trying to get it working. The first issue arose around the placement of the view on the view controller as can be seen in the image below (figure 5)... the view here shows that the video file should sit inside that white frame with the black play button. However, when the prototype was run the play image would not be there and the video file would appear distorted. This made no sense as the constraints placed throughout the application have worked perfectly fine so for there to be an issue here proved to be very challenging to fix. The other issue was with the video files themselves as the original pre-coronavirus plan had been to get live recorded videos from real teachers, unfortunately however this was not possible due to the pandemic. In saying that though, with the issue of the actual card holder not allowing the program to display the video properly, there would have been an issue in displaying these videos anyway.



**Figure 13 – Development progress in sprint 2**

### **5.1.2 – Classes created**

Due to not being able to get this feature to work there was no classes implemented.

### **5.1.3 – Testing**

There was no testing carried out on the actual modules as there weren't any, due to not being able to get the yoga / mindfulness video pages to work.

### **5.1.4 – Sprint Review**

This was an extremely disappointing sprint as there was little achieved in terms of the functional requirements. The difficulty of trying to get the yoga/mindfulness video pages to work proved to be too much and that was extremely disheartening as it was going to make a really cool addition to the program. There was a lot of research that went into it but unfortunately the methods did not work. There is the feeling that due to Swift and Xcode being updated there must have been some changes made to the program that affected it from working.

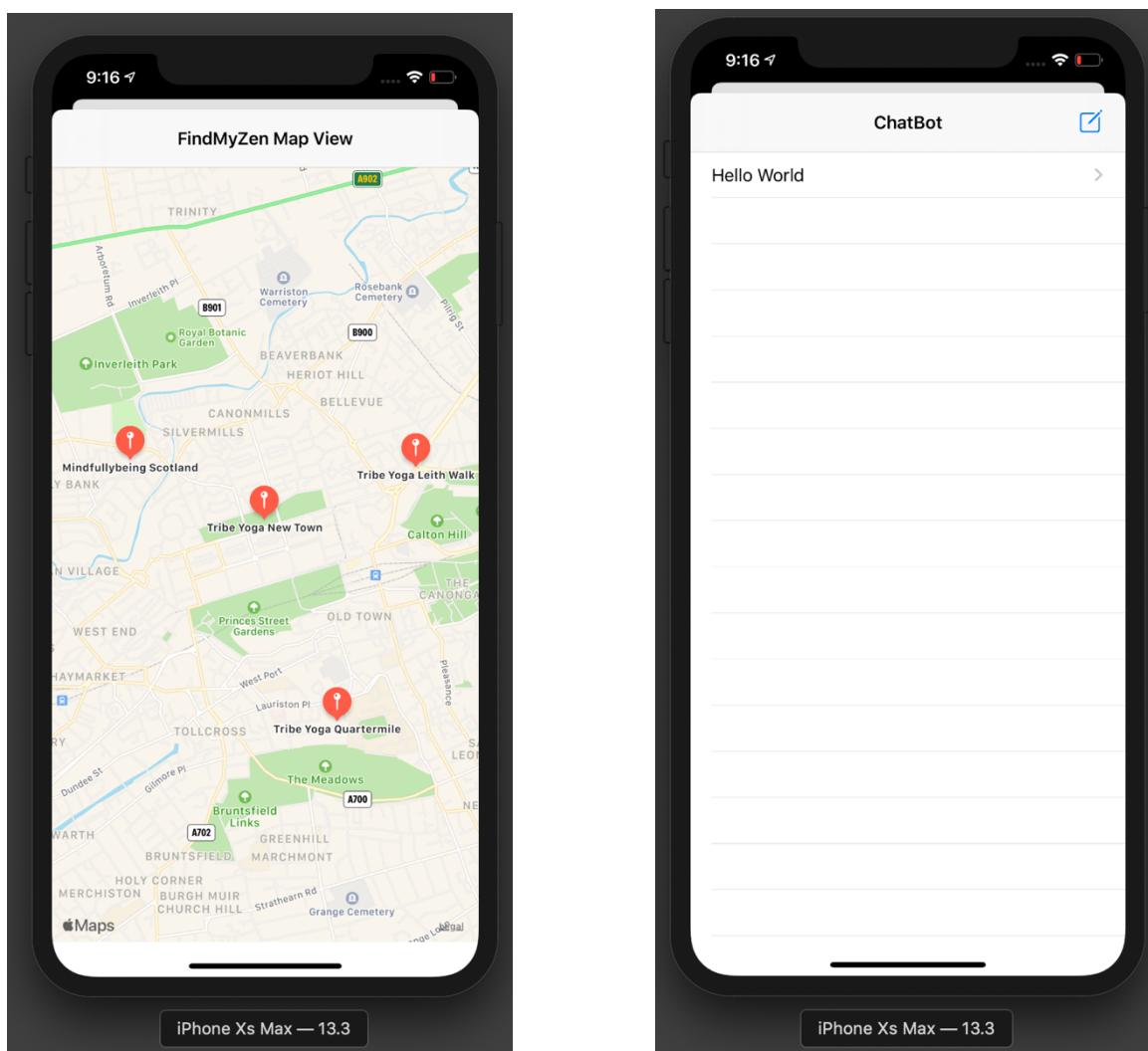
It was very strange as the view controller just wouldn't hold the image file or video file instead just not approving of it at all. This didn't make sense as the placement of objects on screen have been fine in other parts of the program so for there to be an issue here was extremely frustrating and resulted in there not being any videos.

## 5.3 – Sprint 3 (03.05.20 – 30.05.20)

### 5.3.1 – Development

Here we are going to look at the completed elements of the third sprint. One really cool feature of the application was the implementation of the map which would take user of the user's location context and find not only their location but also the location of local yoga and mindfulness studios located near the user. This would enable location context to be generated.

Following on from this a little bit of implementation was carried out in setting up the implementation of the chatBot feature which would allow the athlete to communicate with other users of the application.



**Figure 14, Figure 15 – Development progress in sprint 3**

### **5.3.2 – Classes created**

#### **getUserLocation Class**

This class finds the users location and will pinpoint it on the map.

#### **getYogaCentreLocation Class**

This class would find the nearby yoga studios and show them on the map.

#### **getMindfulnessCentreLocation Class**

This class would find the nearby mindfulness studios and show them on the map.

### **5.3.3 – Testing**

No unit testing carried out here.

**UI testing** – In this section, there was the use of different UI functions such as labels, mapView layout, text, navigation/view controllers opening, location pin size, buttons. So, to make sure that the functionality of these operations was all in check and that they ran without any issues was really important. Through this testing it was found that the label text size on the map was small so this was enlarged. Also adding red pins to the map made it easier for the location to stand out.

### **5.3.4 – Sprint Review**

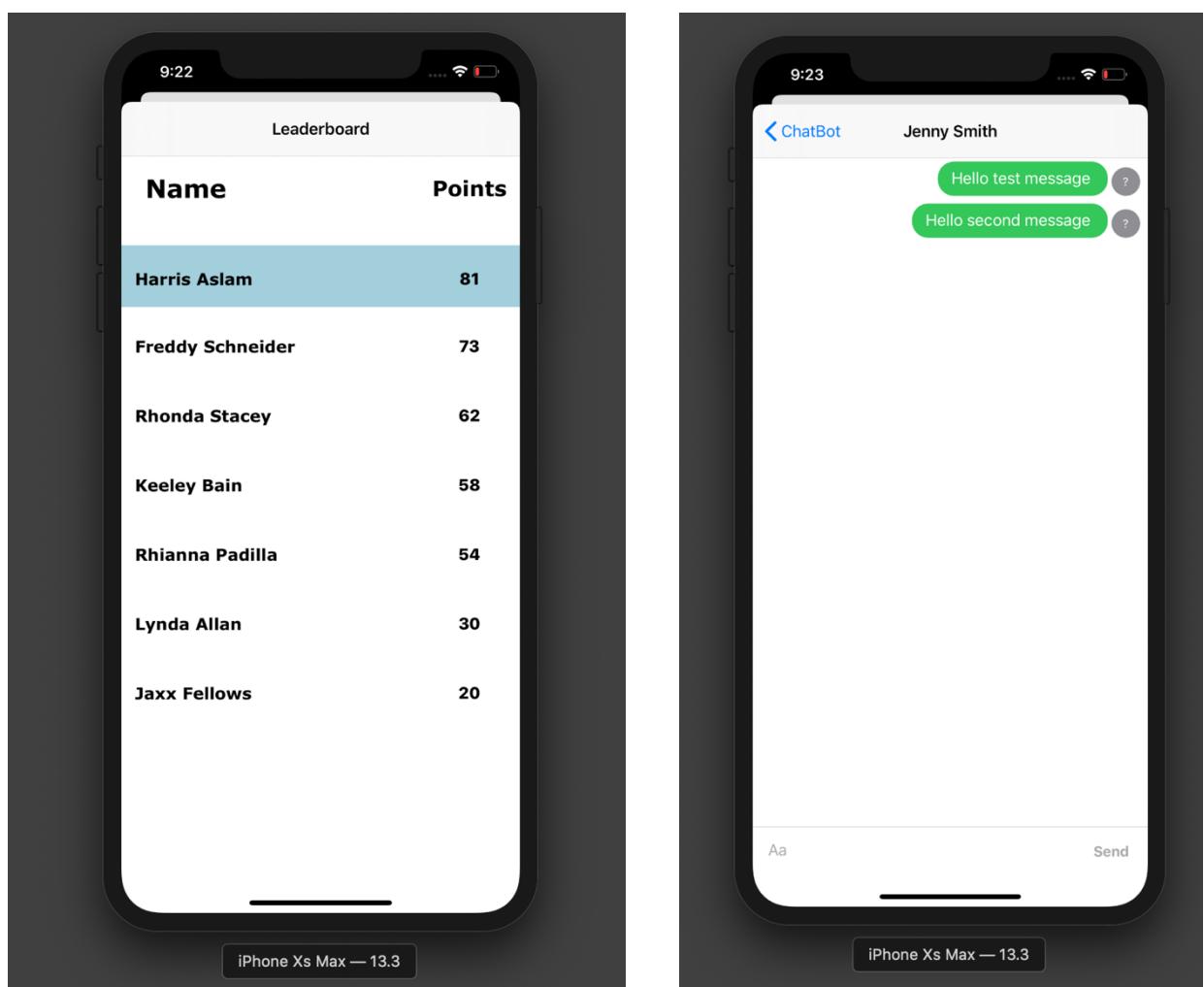
The third sprint was another good one for the implementation as managed to take advantage of users location context and develop a map which displayed the yoga and mindfulness studios. No changes to the project plan were required, the product backlog had been fulfilled. The started implementation of the chat page also commenced and the prototype was moving in the right direction after the mishap in the second sprint.

## 5.4 – Sprint 4 (21.06.20 – 09.07.20)

### 5.4.1 – Development

Here we are going to look at the completed elements of the fourth and last sprint. One added feature was the implementation of the leaderboard which would appoint points to the user for simply using the application and carrying out tasks such as filling in the daily review or performing a yoga class. The other implementation was showing how a chat page would work so that the user could send messages directly to other members of their team.

Also done in this sprint was a full review of the application and its features, this was to compare the application to the original aims and objectives set out at the beginning to see how the application was carried out and if these objectives were met or not. This would be further analysed in the evaluation and conclusion later on in the report.



**Figure 16, Figure 17 – Development progress in sprint 4**

#### **5.4.2 – Classes created**

sendMessage class

This class would be the functionality to send messages to other users.

#### **5.4.3 – Testing**

Unit testing was not carried out here.

**UI testing** – In this section, there was the use of different UI functions such as labels, buttons, input messages, navigation/view controllers opening. So, to make sure that the functionality of these operations was all in check and that they ran without any issues was really important. Through this testing it was found that some of the text in the leaderboard was a bit small and size of elements needed to be formatted better and the required changes were made so that the overall look of the user interface was clean.

#### **5.4.4 – Sprint Review**

The final sprint was a huge relief as the prototype had now been finished to a standard where it could be presented as a prototype that demonstrated its purpose for this study. The addition of a leaderboard and a chat page really adds to the overall of the whole project and makes it more complete. It was somewhat unfortunate not to get the yoga / mindfulness videos working but there are huge positives to be taken out of this prototype for what it is trying to achieve.

Looking at the functional requirements, some of them have been met and achieved through the project. There was a lot of research that went into this project and to come away with this amount of work has been really pleasing because it was both tough but also enjoyable.

## **Further Testing**

**Integration testing** – was also carried out for this prototype. The reason for doing so is that individual modules which are then combined with other modules can be tested to make sure they work together. Integration testing was executed as there are classes in the prototype that were reliant on other classes, so ensuring that when these functions were run they worked seamlessly together without errors was key to the success of the program. In this development the createReviewScore Class is reliant on the information taken from the DailyReview Class as the program needed to generate a score from the answers that were provided by the user.

**Acceptance testing** – is a testing method that was wanted to be used within this project. The reason being is that a judgment is made on whether the prototype's meets the specified requirements thus determining if the prototype is ready to be shipped out for use. In performing acceptance testing it requires all the functional requirements the project had set out to have been achieved. The testing would usually be carried out by actual potential users however due to this not being able to happen due to lockdown and the coronavirus pandemic it was done by the developer. It was found that the program did not pass the acceptance test as the program is a prototype and needs to be worked on further this due to the being some issues in the implementation stage.

## **Conclusion**

In regards to the implementation stage of this project, the development of a prototype for this study was a success. There were many challenges throughout the process and some challenges proved too difficult to be able to get over. However, the overall application was deemed a success as it was just meant to demonstrate the ability of how a context aware application could be developed to aid athletes with their mental health on and off the pitch in order to make them perform better.

There was also the issue with the lack of unit testing in the project which arose from there being issues in performing such testing using Swift. This proved difficult to get through but with the amount of other testing carried out, it has been deemed that the program does work as expected without fear of failure.

The prototype was also then uploaded to GitHub. The reason for doing this was for version control but also in hope that work can be carried on which will be discussed in the future work part of the dissertation.

## Chapter 6 – Evaluation

In this section an evaluation of the prototype will be provided to critically analyse the success of the project. Also, to be discussed are any difficulties faced throughout the project. One thing that needs to be addressed is that there had been hopes to conduct external evaluations on the prototype in order to find out what the athletes thought of the application. However, due to the coronavirus pandemic this was not possible. So, despite wanting to be able to do it, there is hope that credit is not taken away for not being able to do so due to circumstances out with my control.

### **6.1 Evaluation**

#### **6.1.1 Overall Project Review**

Looking back to the beginning of the project it was simple to understand why such a product should have been created. Due to the motivation behind the project discussed in Chapter 1, having that added incentive to develop such an application made the overall process very enjoyable and kept quality high throughout the project.

The initial planning stage proved to be very successful in terms of quickly understanding the requirements of the project and how to go about developing the prototype. Having a clear schedule in place through the use of a Gantt Chart and Task Timeline (**Appendix 4**) allowed for there to be a clear visual representation of when tasks needed to be completed. However, due to the coronavirus pandemic and various extenuating circumstances the Gantt Chart schedule did have to be modified and updated. From the beginning it was clear that the Scrum methodology for software development would be implemented as the model works really well in current day development cycles due to the use of sprints, which enable a product to be built in small manageable pieces until the product is complete. These sprints had been shown in the Gantt Chart and some of the work did manage to be completed in the initial time plan but again, due to the coronavirus pandemic a lot of the work was pushed back. This led to a delay in project completion as the initial date in April was to be extended till August.

In terms of ensuring that the project was continuously being worked on there was evidence of this in the diary sheets (**Appendix 3**). These diary sheets were also helpful when in communication with the supervisor in the meetings that were held to discuss progress. These meetings held true importance to the overall success of the project as being able to receive great feedback on the work completed helped to ensure the project came to a successful completion. The support and guidance provided by the supervisor ensured that the project didn't fall off track apart from in areas of extenuating circumstances of which Dr Xiaodong was made aware and was very accommodating in these times of difficulties. Just before the Christmas break an initial project review meeting was held in which the progress of the project was conducted by both the supervisor and the second marker. This meeting was really important as having both the supervisor and the second markers feedback proved to be significant to the completion of the project. Having them both in agreement with the idea of the project further enhanced the motivation to complete the project. This meeting was recorded in the (**Appendix 1**).

### **6.1.2 Project Aims, Achievements and Difficulties**

The overall aim of this dissertation was to study context awareness applications and also mental health in sport and combine the knowledge to develop an iOS prototype application that can aid athletes in their sport through a context aware application. Looking at this aim it is fair to say that the objective has been met. The challenge to combine the use of context awareness into this type of application did prove to be very difficult but it was an extremely positive learning process.

Learning about context awareness techniques and implementing them through the use of Apple's different frameworks that work around context proved to be a thoroughly enjoyable process. It was also an achievement despite the hardships faced in implementing a first iOS application as the entire process was a completely new environment.

Reading into mental health in sport was also a very valuable and important analysis of how yoga and mindfulness helps to relieve individuals of such mental strain through the art of meditative practices. This knowledge provided a breakthrough in

understanding on a personal level. The difficulty was transferring this into the prototype – the use of a daily wellness diary is one method that will help to keep users on track by being able to monitor their scores each day. However, the yoga and mindfulness page could have been expanded unfortunately due to a lot of trial and error getting these pages to work proved very difficult. To the point where it was not understood where the programming went wrong, even though accurate research had been conducted into the required problem.

In the beginning there was some difficulties around researching this topic as there was limited literature resources around this subject. This was known going into the project and was also a huge motivator to carrying out such a project. Being able to combine research from two sectors for a dissertation and combine them together in order to show how one could make a difference in the other would open up new areas for research to be had and an important one on a personal level.

Another difficulty during the project was understanding how to test the application on a live device. After the first sprint had been completed and tested using the Xcode simulator it was time to test the first sprint prototype on the iPhone XS Max, however after a lot of effort it did not work. To understand why it did not work, a lot of research was carried out online and it was found that an Apple developer account was required in order to do so. This was very frustrating as this account was not free so the project was not able to be tested on a live device nor shared to potential users for testing as it would have cost a monthly subscription in order to do so. The positive here is that due to the quality of the simulator and as the prototype worked using the Xcode simulator it can be said that the product will work if transferred to an application.

Other difficulties were unforeseen personal extenuating circumstances than difficulties regarding the project itself. However, through hard work, perseverance and amazing support from the project supervisor and the university these obstacles were dealt with in a positive manner and enabled the project to be completed.

### **6.1.3 Learning Outcomes**

These learning outcomes have been taken from the Module Introduction file on Moodle and will be discussed now to determine whether they have been met or not.

**LO1 – Manage a substantial individual project, including planning, documentation and control.**

In terms of this learning outcome, it can be proudly said that this outcome was achieved. There were regular meetings with my supervisor Dr Xiaodong Liu where I would take the lead and discuss my progress and when there couldn't be a meeting I would contact by email. In order to keep track of the weekly progress, a diary logbook was kept which provided details about the work carried out in each week. There is also information about the goals for that week as well as any comments provided by the supervisor.

There was a sensible project plan put into place through the creation of a Gantt Chart (Appendix 4). This broke the project down into manageable sections. There were some changes that needed to be made to this schedule as there were some unforeseen circumstances such as personal issues and the coronavirus pandemic which majorly affected the normality of life. These changes were shown in a updated Gantt Chart (Appendix 4 (12.3)).

The vast majority of the project was carried out by myself which allowed me to take full ownership of the project and also show that I could manage a big project like this. However, feedback provided from Dr Xiaodong was helpful, aiding to the success of the project and his endorsement of my idea gave me the motivation I needed to carry out the project.

**LO2 – Construct a focused problem statement and conduct a suitable investigation, including literature or technology review, into the context of that problem.**

The idea is definitely of importance in today's world as has been discussed in the literature review around mental health in sport and how context awareness applications can be used. Combining the two into one application did have its challenges as has been discussed in the report. The research proved to be challenging due to the lack of information around the dissertation topic area in current literature, but individual research was done on the subject's mental health in sport and context awareness as well and context awareness in healthcare to try and analyse the situation properly. These challenges were all dealt with proper professionalism to ensure that a thorough level of work including planning, design, implementation and evaluation could be carried out to solve the problem at hand.

**LO3 – Demonstrate professional competence by applying appropriate theory and practice to the analysis, design, implementation and evaluation of a non-trivial set of deliverables.**

The goals of the project was to determine right from the very start that this project was about creating a prototype application that could help athletes deal with any mental health issues through the use of a context aware application. This prototype has done that in a way that daily wellness scores can be tracked and recorded to see the changes in an athlete's wellness as well as using context to try and promote yoga / mindfulness techniques to the athlete.

The project was difficult as there was not a massive amount of literature around this subject but that was one of the principal reasons to undertake this project in order to combine information from two separate sectors and show how it could make a difference. I feel this was achieved and in turn it opens up another avenue for further study and research.

For this project it made sense to use the Scrum Agile approach to carry out the development process. The prototype was developed in 4 sprints, using the planning,

design, implementation, testing and review structure for each version of the prototype to be released until it was finished. In doing so a memorable product has been created.

This project was created because of a personal experience I went through as an international cricketer after getting injured and dealing with depression and anxiety. With a fear of talking to other people about it and just saying I was fine when I wasn't I now wished there was a product like this that could monitor daily scores and feed them back to coaches so they could get a better understanding of where I was at mentally as there tends to just be a focus on the physical side of sport. Having Dr Xiaodong and second marker Andrea Scott support this idea positively motivated me to achieve the target of developing such an application.

**LO4 – Show a capacity for self-appraisal by analysing the strengths and weaknesses of the project process and outcomes with reference to the initial objectives and to the work of others.**

The project progress can be shown throughout this whole report starting from the initial stages right through to when the project was completed and the aims of the project had been critically discussed in Chapter 6 and 7. Also discussed in these two chapters are the successes of the project and what was learned through the whole process. It also outlines the difficulties that were faced throughout the project with an honest projection of these difficulties and how they affected the work as well as how they were coped and dealt with. Finally, in Chapter 7, the future work has been discussed which expresses how the project can be taken even further to provide benefit in more ways, which just shows the potential of this project.

**LO5 – Provide evidence of the foregoing in the form of a report.**

Any evidence required can be found in this report. This report contains all supporting evidence to suggest that the work has been carried out to a high standard focussing on meeting the required standards in terms of quality of information as well as presenting this information in an acceptable format. There has been understanding and knowledge brought through from various modules covered throughout the university course to provide a well-rounded approach to this dissertation.

## **LO6 – Defend the work orally at the Viva Voce examination and by means of a poster presentation.**

Unfortunately, there could not be a Viva Voce or poster presentation due to the coronavirus outbreak causing universities to shut down for students, but hopefully the work provided displays how much effort has been put in to achieve the aims and objectives of the project.

### **6.2 Athlete Evaluation of Prototype**

Unfortunately, due to the coronavirus incident the prototype could not be evaluated by athletes as the restrictions of lockdown did not allow for meet ups and gatherings, so gaining an evaluation through first-hand users who would have been the ‘athletes’ was not possible. Instead an honest personal analysis of the app will be provided in the hope to make up for this.

The prototype application is well made and very easy to use. The user interface is strongly developed as it contains the required functionality and is clear and easy to use. All the relevant features have been implemented into the required pages apart from the yoga and mindfulness video page. There was a big issue with implementing these two pages so unfortunately they could not be completed no matter how hard I tried to work on them the containers wouldn’t work for some reason and the video files wouldn’t play in the containers. This proved to be the biggest issue in the whole development of the project and it was extremely frustrating that it could not be solved before submission of the application. However, the success of the project far outweighs this negative, with a bit more work and a little bit of guidance I believe this issue can be solved. The rest of the application is a huge success. With this application being a first attempt at iOS development, gaining an understanding of the basic principles of creating software for iOS devices in the Swift programming language was an extremely beneficial experience. I am proud to have been able to conduct a study into several important aspects of life in the shape of context awareness computing as well as mental health in sport. For this reason I am satisfied with the topic I chose and believe that the work carried out was and has proven to be worthwhile doing. Even though the prototype is not fully completed, to be able to come up with a prototype product that can demonstrate just how context awareness can be used in order to further the support athletes can have when dealing with mental health issues, is something I am really delighted about.

## Chapter 7 – Conclusion

### 7.1 Conclusions

At the beginning of the project the main reasons for undertaking this project were discussed. When the motivations behind the project are looked at, it is clear to see why such a project would be beneficial for not only this topic but for opening up new conversation around how technology can further evolve other aspects of life in particular mental health in sport. The overall goal was to conduct this research and develop and iOS prototype application which would gather some context awareness using the sensors embedded within an Apple iPhone device. After this, a literature review was carried out to get a deeper and educated analysis of the current situation regarding mental health in sport and how yoga / mindfulness practices aid this. The other research was done on; context awareness, what this meant and context awareness's importance in healthcare. In doing this research it enabled an understanding on how context awareness would be implemented in a mobile application.

The planning stage and design stages were then discussed in which the approach to the development was decided and explained. It also showed the valid reasoning behind using Scrum for the approach which was due to its many strengths in terms of how the prototype could be developed in sprints and also the flexibility Scrum allows for in development. Going hand-in-hand with the three-tiered client server type architecture further enhanced the project allowing for clear boundaries in terms of how each phase of development was handled. Once all this had been decided, the actual design of the program was decided, discussing the features required, including functional and non-functional requirements. The functional requirements were portrayed through the use of UML design constructs such as Class and Use Case Diagrams. There was also the use of wireframes to provide a conceptual visualisation of how the program would be laid out.

As the project moved to the implementation stage, for the majority of it there was no difficulties. As the project idea was pretty clear, moving forward with implementation went well, especially the wellness review page which acts as the backbone of the application as it is where the user logs their daily thoughts and feelings. The implementation was completed in 4 development sprints. The first sprint went well with

the database and login access set up. As this was done quicker than anticipated, some development of the wellness review page also was completed in this sprint. There were little difficulties in this sprint, the only issue incurred where around testing on a live iPhone device, however it was found this was due to not having paid an Apple Developer subscription.

The second sprint and third sprint were definitely more challenging as there was more focus on implementing context profiling with the daily wellness tracker and developing the yoga/mindfulness pages which was difficult to do and as has been discussed earlier did not work as well as initially intended. This was a big disappointment in the project as it would have been a really useful technique to implement. However, as the development was just a prototype, the implementation of these products can be taken further in the future.

The fourth and final sprint was really just about adding any extra additional features to the application that were requested by the users in the initial survey that was sent out. This included a chat page and a leaderboard. Implementing these features was really just to add some extra elements to the application. In order to help create more of an enjoyable user experience, this is important when developing applications that you want the user to keep on using.

Unfortunately, there was no user feedback due to the coronavirus not allowing for this research to be conducted. However, at the end of the project a working context aware prototype had been developed for athletes to use.

## 7.2 Future Work

With the aims and objectives having been met, upon reflection there are ways in which this project could be improved further in order to increase functionality.

One area which was one of the motivations around doing this project was being able to carry out a study on athletes before and after they used the application. However, due to the coronavirus pandemic and lockdown shutting down all personal access to people outside of homes along with all sports coming to a standstill across the world, the application could not be given to athletes in order for this study to be carried out. Not being able to carry out the experiment to measure how an athlete's mental health was before using such an application and then comparing those results to the scores of the athlete after using the application to see if there was any differences especially improvements in scores which had been tracked by the daily wellness recorder was hugely disappointing. Conducting this experiment would have provided key knowledge on whether a context awareness application could positively contribute towards the mental health of an athlete. This information would have been very influential in gaining more useful knowledge around mental health and sport as there is currently limited work on this area. This is definitely a future work on and one that can be carried out once the world begins to return to its normal state of affairs, however, this may take some time due to the uncertainty around the virus.

Another future work would be to introduce more context to the application. An additional method that would further make this application successful is the implementation of the athlete's weekly schedule. In order to do so, the athlete would be required to be an avid user of their personal calendar on their mobile device in order for this functionality to work. What would be proposed is that the calendar would be read in by the prototype and the application would then create context from the data held in the calendar. For example, if the athlete has a particularly high load day on Monday and then a calmer day on Tuesday – the application would read in this information and then prompt the user to do a much more chilled out yoga session such as a Yin or Restorative class which is more stretch based rather than physically demanding in order to provide a balance for their bodies. This could also work the other way in saying that if the user has 2 "off days" where they don't have any hard training scheduled, then the application would recommend a more physically challenging session such as a Flow or Power class.

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## Appendix 1 – Initial Project Overview (IPO)

[Harris Aslam]

[40169846]

### **Initial Project Overview**

#### **SOC10101 Honours Project (40 Credits)**

**Title of Project:** A study into the effect yoga and mindfulness has on the wellbeing and performance of high performing cricketers with the development of a yoga-based iOS mobile application.

**Overview of Project Content and Milestones:** To develop a yoga application which will be a hub of video yoga classes and mindfulness to aid the performance of cricketers in their sport both on and off the field. This is an area that needs to be looked at due to how mentally and physically draining the sport is despite the current perception of the game. This study will also be a new study as there doesn't appear to be many sources available at the moment, so will open a new area of research.

Research at the start to begin gathering information and research at the end to see the difference yoga makes. Reading current literature and getting an idea from that and actively trying to expand the current knowledge. Research into iOS development. Designing the app, looking into how the backend of iOS development works. Developing the front end of the app. Implementing the application. Testing the software.

**The Main Deliverable(s):** By the end of the project the aim is to create and demonstrate a useable iOS application. The application should be of use and aid athletes in their high-performance lifestyle by providing them an accessible yoga studio platform in their own hands which they can use in their own time.

A report will also be written to prove why this particular application is important and to gain an understanding of the epidemic regarding yoga and cricket which will allow for a greater understanding of how we can use technology to help raise the performance of athletes through a digitalised yoga platform.

**The Target Audience for the Deliverable(s):** This application will be of use to athletes, people in the yoga industry (so yoga studio owners, yoga teachers), sports psychologists, physiologists, sports coaches and S&C staff, and other researchers interested in this area.

**Information Sources that Provide a Context for the Project:** Previous literature, Tribe Yoga, Cricket Scotland, yoga / wellbeing apps on the app store, university lecturers, yoga teachers, yoga students, cricketers, S&C coaches, sports doctors.

**The Work to be Undertaken:** To complete this project the following work will need to be carried out:

- A study into the current research and determine from this, what the situation regarding yoga and sport is like at the moment. Through reading journals, performing interviews with athletes, looking at past investigations available on the web and current applications.
- Looking at current applications which are linked to sports and mindfulness and judging them, how will this one be different and offer more.
- Research the best methodologies and then perhaps the most challenging part of the whole project is to actually make use of the collated information and develop the application. This is a big factor as the application needs to offer the user a lot of different functionalities but also be easy and enjoyable to use, especially to make them constantly reuse as much as possible.

**Additional Information / Knowledge Required:** To carry out the project I will need to make use of many modules I have studied for example project management, data analysis, agile methodology, mobile app development, software development, testing software, object-orientated programming. As well as this I will need to research and understand how to use Xcode and Swift for iOS app development as it is new for me including working with iOS SDK, view controllers, SwiftUI.

**The Importance of the Project:** The importance of this project is that very little research has been carried out in this topic, making it unique. It will allow for the development of an application that if created successfully, really impact the market and reach a specific sporting audience in a new way. By allowing athletes to access personalised yoga wherever they are. Also, a project like this enables further study into an area of passion for me, as a career in mobile development is the field I would like to pursue. So, developing a mobile application and learning about the procedures and process of doing so on a subject area of three things I love (technology, cricket and yoga) is a motivator for me to complete this project to the best of my ability.

**The Key Challenge(s) to be Overcome:** In a project like this the main challenge will be creating the application. As it is a new area of development for me. So, learning the correct procedures and methodologies for mobile app creation will be really important. As well as working with mobile databases to save the app information and yoga videos. The key here is ensuring the application is pulling information from the database correctly and dynamically. As I have no experience with iOS development, learning the best and correct processes as well as the fundamentals of iOS development will be the challenge.

## Appendix 2 – Interim Report Meeting Review

### **SOC10101 Honours Project (40 Credits)**

#### **Week 9 Report**

**Student Name:** Harris Aslam

**Supervisor:** Xigedong Liu

**Second Marker:** Andrea Scott

**Date of Meeting:** 26/11/19

Can the student provide evidence of attending supervision meetings by means of project diary sheets or other equivalent mechanism? **yes** **no\***

If not, please comment on any reasons presented

Please comment on the progress made so far

Yes on track with the project & time plan.

Is the progress satisfactory? **yes** **no\***

Can the student articulate their aims and objectives? **yes** **no\***

If yes then please comment on them, otherwise write down your suggestions.

Clear aim & objectives : mobile application with scope (prototype) with possible additional requirement functionally.

\* Please circle one answer; if no is circled then this must be amplified in the space provided

Does the student have a plan of work? **yes** **no\***

If yes then please comment on that plan otherwise write down your suggestions.

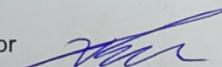
Plan literature review up to Christmas,  
+ Run Sprints for app (design / implementation)  
+ Then proceed after Holidays.

Does the student know how they are going to evaluate their work? **yes** **no\***

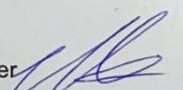
If yes then please comment otherwise write down your suggestions.

- Can compare to other Yoga apps  
Mindfulness - nothing out there at present.
- > Has content / target audience users which will be used throughout process of evaluation. (+ Yoga Teachers)
- Any other recommendations as to the future direction of the project
  - Be mindful of keeping records & providing time to write up the Concise Report Document.

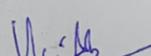
Signatures: Supervisor



Second Marker



Student



The student should submit a copy of this form to Moodle immediately after the review meeting; A copy should also appear as an appendix in the final dissertation.

\* Please circle one answer; if **no** is circled then this **must** be amplified in the space provided

## Appendix 3 – Diary Sheets

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PROJECT DIARY

**Student:** Harris Aslam

**Supervisor:** Dr Xiaodong Liu

**Date:** 16/09/19

**Last diary date:** NA

### **Objectives:**

Week 2 –

- Meeting with supervisor and fill in project registration form
- Have come up with a good academic project idea

### **Progress:**

Complete these two areas

Felt a little bit behind, as I had not completed this initial work before summer. However, was motivated to get the work done and I did come up with a good idea, One that is of interest to me which is important to ensure I am able to get the work done to a high quality standard.

### **Supervisor's Comments:**

Have a few good ideas however need to make sure they work well together in order to achieve a first class grade.

# **EDINBURGH NAPIER UNIVERSITY**

## **SCHOOL OF COMPUTING**

### **PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Dr Xiaodong Liu

**Date:** 23/09/19

**Last diary date:** 16/09/19

#### **Objectives:**

Week 3 –

Start working on the IPO as needs to be completed by week 4

Continue finding research on the project area like books and journal articles, as they will help when it comes to the literature review.

#### **Progress:**

IPO draft completed and sent to Xiaodong for feedback.

Research going well finding some relevant articles on Library Search.

There appears to be a lack of research in this area (yoga / mindfulness and sport / cricket). This means it is difficult to find strong evidence from other researchers but opens up more questions as to why there is not more research done in this topic area.

#### **Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Dr Xiaodong Liu

**Date:** 30/09/19

**Last diary date:** 23/09/19

**Objectives:**

Week 4 –

Have submitted in the IPO

Continue finding research on the project area like books and journal articles, as they will help when it comes to the literature review and have a stronger idea of the way the project needs to be approached.

**Progress:**

IPO has been submitted

**Supervisor's Comments:**

Happy that IPO now been submitted

# EDINBURGH NAPIER UNIVERSITY

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### PROJECT DIARY

**Student:** Harris Aslam

**Supervisor:** Dr Xiaodong Liu

**Date:** 07/10/19

**Last diary date:** 30/09/19

#### Objectives:

Week 5 –

Waiting for feedback in the IPO

Continue finding research on the project area like books and journal articles, as they will help when it comes to the literature review and have a stronger idea of the way the project needs to be approached.

#### Project Plan

- Identify key dates
- Establish the amount of time required for each activity
- Distinguish between *activities* and *outputs*
- Identify critical points for the project
- Always be current – regular revisions are necessary

#### Progress:

Felt a little bit behind as I hadn't go this stuff done before summer. However, was motivated to get the work done and I did.

#### Supervisor's Comments:

Glad IPO has been submitted and project seems to have a good plan.

# **EDINBURGH NAPIER UNIVERSITY**

## **SCHOOL OF COMPUTING**

### **PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Dr Xiaodong Liu

**Date:** 14/10/19

**Last diary date:** 07/10/19

#### **Objectives:**

Begin reading into mental health in sport and gaining an understanding around how an athletes mental health can affect their performance on the pitch but also how mental health affects them off the pitch too.

#### **Progress:**

Read some journals on mental health in sport and also looking at software engineering constructs.

Felt a bit better. Happy with idea and the research so far.

#### **Supervisor's Comments:**

Consider context-aware computing as a possible technique to enhance the application. Include it as a separate section in your literature review.

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**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Dr Xiaodong Liu

**Date:** 21/10/19

**Last diary date:** 14/10/19

**Objectives:**

Action on project plan

Lit Review work

Begin writing the introduction, abstract and the chapter on mental health

**Progress:**

Read more journals on mental health in sport

Read journals on context awareness

Making good progress and I am happy with where I am at.

**Supervisor's Comments:**

Happy with progress.

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**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student: Harris Aslam**

**Supervisor: Xiaodong Liu**

**Date: 28/10/19 - 18/11/19**

**Last diary date: 21/10/19**

**Objectives:**

- Lit Review work all these weeks

These weeks have been combined as I was just working on the literature review which consisted of the same things each week. In terms of reading literature around mental health in sport and also context awareness application's and analysing the information.

**Progress:**

Literature Review completed.

**Supervisor's Comments:**

There was no comments left by Dr Xiaodong this week

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 25/11/19

**Last diary date:** 18/11/19

**Objectives:**

Prep for interim report meeting show lit review work and project plan.

**Progress:**

Literature review is 80% complete just need to add a little bit more detail and then sort out the references.

Feel like I am in a good place going into the interim report meeting with supervisor and second marker.

Have done some good work and managed to write a literature review around the subject area.

**Supervisor's Comments:**

There was no comments left by Dr Xiaodong this week

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**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 02/12/19

**Last diary date:** 25/11/19

**Objectives:**

Interim meeting

Decide to focus on exams now and then restart work after Christmas.

**Progress:**

Lit Review complete (chapter 2)

Interim report complete

Received really positive feedback from supervisor (Dr Xiaodong) and second marker (Andrea Scott). Made me feel even better they were both happy about my idea and the work I had put in to the literature review.

Also grateful they allowed me time to try and focus on exams.

**Supervisor's Comments:**

Good progress.

Happy with idea.

Need to make sure do some work over Christmas.

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 09/12/19 – 23/12/19

**Last diary date:** 02/12/19

**Objectives:**

Exam focus no work carried out on dissertation – this was agreed with the supervisor and second marker

**Progress:**

No progress due to focussing on exams

**Supervisor's Comments:**

n/a

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 30/12/19 – 26/01/20

**Last diary date:** 09/12/19

**Objectives:**

Extenuating circumstance with sister's wedding and other stuff so for a few weeks couldn't do work at all unfortunately.

**Progress:**

I spoke to student support and Susie Brown from the Dual Careers program and they helped me get some help in this area.

**Supervisor's Comments:**

Harris was unable to work this was supported by documents from student support.

# **EDINBURGH NAPIER UNIVERSITY**

## **SCHOOL OF COMPUTING**

### **PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 27/01/20

**Last diary date:** 30/12/19

#### **Objectives:**

start chapter 1  
begin first sprint

#### **Progress:**

Began working on the chapter 1 and talking about the background / motivation of the project. As well as what I wanted to achieve from the study and how the study would be conducted.

Began the first sprint of the development.

Yeah happy with the progress of the this week done some good work. Have made a solid start on the report and the first sprint which involved setting everything up to be ready.

#### **Supervisor's Comments:**

There was no comments left by Dr Xiaodong this week

# EDINBURGH NAPIER UNIVERSITY

## SCHOOL OF COMPUTING

### PROJECT DIARY

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 03/02/20

**Last diary date:** 27/01/20

#### Objectives:

Complete chapter 1 and 2  
Half way through first sprint

#### Progress:

Finish up chapter 1 talking about the aims and objectives as well as the scope of the project. Whilst also discussing how information would be found.

Finish up chapter 2 (literature review)

Progress made in implementing the start of the daily tracker.

Another good week with the chapter 1 and 2 now finished.

Had some issues in terms of the coding with the first sprint in development but managed to get through them by researching more about swift code and understanding the required variable types and such.

#### Supervisor's Comments:

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**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 10/02/20

**Last diary date:** 03/02/20

**Objectives:**

chapter 1 and 2 finished  
First sprint finished

**Progress:**

The first two chapters of the dissertation are now done and have been completed.

The first sprint has been completed and tested.

First sprint done and reviewed. Next sprint to start

**Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 17/02/20

**Last diary date:** 10/02/20

**Objectives:**

Start chapter 3 / 4  
Start second sprint

**Progress:**

Began working on the chapter 3 and talking about the approach for the project. Here needed to mention used of agile and what programming language would be used.

Began the second sprint of the development.

Intro and start of chapter 3 underway.

**Supervisor's Comments:**

# **EDINBURGH NAPIER UNIVERSITY**

## **SCHOOL OF COMPUTING**

### **PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 24/02/20

**Last diary date:** 17/02/20

#### **Objectives:**

Continue working on chapter 3 / 4  
Continue second sprint

#### **Progress:**

Finish up chapter 3 talking about the approach and finalised a sprint report of what each sprint will entail, even though there is already a rough idea going into the sprints already. Whilst also discussing challenges with context awareness and the quality of information found.

Start up chapter 4 which is about design of the project. There was already the idea behind what to do, it's more just explaining it in more details in this chapter.

Daily tracker implemented.

#### **Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 02/03/20

**Last diary date:** 24/02/20

**Objectives:**

chapter 3 / 4 complete  
second sprint complete

**Progress:**

Finish up chapter 4 (design)  
Talking about the requirements of the project, the functional and non-functional requirements.  
Including the wireframes which talks about why the design has been chosen  
  
Daily tracker tested and finished.  
start of the map page implementation showing yoga / mindfulness centres.

**Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 09/03/20

**Last diary date:** 02/03/20

**Objectives:**

Review of chapter 1, 2, 3, 4 and the first 2 sprints

**Progress:**

Read over all the first 4 chapters as well as making sure the current programming work has been carried out well.

Some issues in implementation including how to get the unit testing to work as it is a little bit confusing so a big issue there.

Happy with the first 4 chapters of work though it all makes sense and adds benefit to the project and it is moving in the right direction.

**Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 16/03/20

**Last diary date:** 09/03/20

**Objectives:**

Start chapter 5 implementation  
Start third sprint

**Progress:**

Begin documenting the first sprint in the chapter 5 of the dissertation  
  
Start the 3<sup>rd</sup> sprint which is about taking advantage of some of the sensors the phone has.  
Implementing the yoga/mindfulness pages.

**Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 23/03/20 – 06/04/20

**Last diary date:** 16/03/20

**Objectives:**

Corona virus lockdown – and then I got ill for 2 weeks

**Progress:**

Very little progress made

Done a little bit of work on chapter 5 like some documentation of the work carried out, but was very ill.

**Supervisor's Comments:**

# EDINBURGH NAPIER UNIVERSITY

## SCHOOL OF COMPUTING

### PROJECT DIARY

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 13/04/20

**Last diary date:** 23/03/20

#### **Objectives:**

chapter 5 continue working  
continue third sprint from where left off

#### **Progress:**

Continuation of the documenting first sprint in the chapter 5 of the dissertation.

3<sup>rd</sup> sprint of implementation has provided issues about the yoga / mindfulness pages. Having trouble with the videos view holder it just wasn't accepting the file and holding it in place which was really frustrating and couldn't figure out why that was. This really put me back. Was difficult to ask for help and tried to research a lot online as well as follow tutorials on there but it just made it very difficult so didn't manage to sort it out.

#### **Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 20/04/20 – 04/05/20

**Last diary date:** 13/04/20

**Objectives:**

Exam focus

**Progress:**

No dissertation progress made as it was exams during this period

**Supervisor's Comments:**

# **EDINBURGH NAPIER UNIVERSITY**

## **SCHOOL OF COMPUTING**

### **PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 11/05/20

**Last diary date:** 20/05/20

#### **Objectives:**

Review of chapter 1, 2, 3, 4 and 5 so far adding any extra details making sure they are good.

Checking first 3 sprints

#### **Progress:**

Read over all the first 5 chapters as well as making sure the current programming work has been carried out well. There were some changes made to the 2<sup>nd</sup> chapter adding some more information to the literature review to provide more concept about the field of study.

The issues in implementing the yoga / mindfulness pages was again reviewed and worked on however a solution could not be brought forward.

Overall now happy with the 4 chapters and half completed chapter 5 chapters. The information surrounding the environments backs up what is trying to be proven. And there is evidence of that provided.

#### **Supervisor's Comments:**

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**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 01/06/20 – 15/06/20

**Last diary date:** 25/05/20

**Objectives:**

Again got really badly ill had to get tested for corona luckily was negative

**Progress:**

Again little progress made as I got unwell really badly.

Done a little bit of work on the implementation here and there trying to tidy up pieces of the application but didn't manage to do a lot.

**Supervisor's Comments:**

# EDINBURGH NAPIER UNIVERSITY

## SCHOOL OF COMPUTING

### PROJECT DIARY

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 15/06/20

**Last diary date:** 08/06/20

#### **Objectives:**

Working on sprint 4

Trying to complete chapter 5 now

#### **Progress:**

Start of sprint 4 – implementing a chat page and a leaderboard to collate points for the user filling in the daily wellness charts and also for using the application.

Because I had the issue of not being able to implement the yoga/mindfulness videos couldn't implement the feature that allowed the users leaderboard score to be updated.

There were issues with the chat feature when implementing it with Firebase.

Focus on trying to get chapter 5 completed.

#### **Supervisor's Comments:**

**EDINBURGH NAPIER UNIVERSITY**

**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 22/06/20

**Last diary date:** 15/06/20

**Objectives:**

Working on sprint 4

Complete chapter 5

**Progress:**

sprint 4 – continue with the implementing a chat page and a leaderboard.

Also trying to test a lot of the application to ensure it is working to standard and is able to withstand any issues.

chapter 5 discussion.

**Supervisor's Comments:**

n/a

**EDINBURGH NAPIER UNIVERSITY**

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**PROJECT DIARY**

**Student: Harris Aslam**

**Supervisor: Xiaodong Liu**

**Date: 06/07/20**

**Last diary date: 29/06/20**

**Objectives:**

Review of sprint 4

**Progress:**

Check the current program to making sure the current programming work has been carried out well. There were some changes made to the program to ensure it worked slightly better and adding some more information to the dissertation to provide a more detailed outlook.

Overall now slightly disheartened by the issues faced in implementation but happy a prototype has been developed with the insight of how such an application can aid the performance of an athlete and an understanding can now be had about how this technology may make a difference in sport.

**Supervisor's Comments:**

n/a

# EDINBURGH NAPIER UNIVERSITY

## SCHOOL OF COMPUTING

### PROJECT DIARY

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 13/07/20

**Last diary date:** 06/07/20

#### **Objectives:**

Work on chapter 6 and 7 which are evaluation and conclusion

#### **Progress:**

Write the evaluation to critically analyse the success of the context aware project whilst comparing it to the original aims and objectives. Also, to be discussed are any difficulties faced throughout the project.

No external evaluations could be conducted on the prototype which was extremely disappointing in order to find out what the athletes thought of the application.

#### **Supervisor's Comments:**

Need to fix the position of abstract

present more of your own view on the effect and quality of the prototype.

Rename "Chapter 8 - References" to "References"

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**SCHOOL OF COMPUTING**

**PROJECT DIARY**

**Student:** Harris Aslam

**Supervisor:** Xiaodong Liu

**Date:** 20/07/20

**Last diary date:** 13/07/20

**Objectives:**

Completed changes advised by Dr Xiaodong

Full review of product

**Progress:**

Total review of project has been completed to ensure confidence in it.

**Supervisor's Comments:**

There was no comments left by Dr Xiaodong this week

## Appendix 4 – Code

```
//  
// Utilities.swift  
// Diss2020  
//  
// Created by Harris Aslam on 14/07/2020.  
// Copyright © 2020 Harris Aslam. All rights reserved.  
  
import Foundation  
import UIKit  
  
class Utilities {  
  
    static func styleTextField(_ textfield:UITextField) {  
  
        // Create the bottom line  
        let bottomLine = CALayer()  
  
        bottomLine.frame = CGRect(x: 0, y: textfield.frame.height - 2, width: textfield.frame.width, height: 2)  
  
        bottomLine.backgroundColor = UIColor.init(red: 48/255, green: 173/255, blue: 99/255, alpha: 1).cgColor  
  
        // Remove border on text field  
        textfield.borderStyle = .none  
  
        // Add the line to the text field  
        textfield.layer.addSublayer(bottomLine)  
    }  
  
    static func styleFilledButton(_ button:UIButton) {  
  
        // Filled rounded corner style  
        button.backgroundColor = UIColor.init(red: 48/255, green: 173/255, blue: 99/255, alpha: 1)  
        button.layer.cornerRadius = 25.0  
        button.tintColor = UIColor.white  
    }  
  
    static func styleHollowButton(_ button:UIButton) {  
  
        // Hollow rounded corner style  
        button.layer.borderWidth = 2  
        button.layer.borderColor = UIColor.black.cgColor  
        button.layer.cornerRadius = 25.0  
        button.tintColor = UIColor.black  
    }  
  
    static func isPasswordValid(_ password : String) -> Bool {  
  
        let passwordTest = NSPredicate(format: "SELF MATCHES %@", "^(?=.*[a-z])(?=.*[$@#$!%*?&])[A-Za-z\\d$@$#!%*?&]{8,}")  
        return passwordTest.evaluate(with: password)  
    }  
}
```

```
1 //  
2 //  Constants.swift  
3 // Diss2020  
4 //  
5 // Created by Harris Aslam on 16/03/2020.  
6 // Copyright © 2020 Harris Aslam. All rights reserved.  
7 //  
8  
9 import Foundation  
10  
11 struct Constants {  
12  
13     struct Storyboard {  
14  
15         static let WellnessViewController = "WellnessVC"  
16         static let HomeViewController = "HomeVC"  
17         static let LoginViewController = "LoginVC"  
18     }  
19 }  
20
```

```
1 //  
2 //  CardView.swift  
3 // Diss2020  
4 //  
5 // Created by Harris Aslam on 26/03/2020.  
6 // Copyright © 2020 Harris Aslam. All rights reserved.  
7 //  
8  
9 import UIKit  
10  
11 @IBDesignable class CardView: UIView {  
12  
13     @IBInspectable var cornerRadius : CGFloat = 10  
14  
15     @IBInspectable var shadowOffsetWidth : CGFloat = 0  
16  
17     @IBInspectable var shadowOffsetHeight : CGFloat = 5  
18  
19     @IBInspectable var shadowColor : UIColor = UIColor.black  
20  
21     @IBInspectable var shadowOpacity : CGFloat = 0.6  
22  
23  
24  
25     override func layoutSubviews() {  
26  
27         layer.cornerRadius = cornerRadius  
28  
29         layer.shadowColor = shadowColor.cgColor  
30  
31         layer.shadowOffset = CGSize(width: shadowOffsetWidth, height: shadowOffsetHeight)  
32  
33         let shadowPath = UIBezierPath(roundedRect: bounds, cornerRadius: cornerRadius)  
34  
35         layer.shadowPath = shadowPath.cgPath  
36  
37         layer.shadowOpacity = Float(shadowOpacity)  
38  
39     }  
40 }  
41  
42
```

```

1 // 
2 //  ViewController.swift
3 //  Diss2020
4 //
5 //  Created by Harris Aslam on 16/03/2020.
6 //  Copyright © 2020 Harris Aslam. All rights reserved.
7 //
8
9 import UIKit
0 import AVKit
1
2 class ViewController: UIViewController {
3
4     var videoPlayer : AVPlayer?
5     var videoPlayerLayer: AVPlayerLayer?
6
7     @IBOutlet weak var signUpButton: UIButton!
8     @IBOutlet weak var loginButton: UIButton!
9
10    override func viewDidLoad() {
11        super.viewDidLoad()
12        // Do any additional setup after loading the view.
13
14        setUpElements()
15    }
16
17    override func viewWillAppear(_ animated: Bool) {
18
19        // Make the navigation bar background clear
20        navigationController?.navigationBar.setBackgroundImage(UIImage(), for: .default)
21        navigationController?.navigationBar.shadowImage = UIImage()
22        navigationController?.navigationBar.isTranslucent = true
23
24        // Display Video
25        setUpVideo()
26    }
27
28    func setUpElements(){
29        Utilities.styleFilledButton(signUpButton)
30        Utilities.styleHollowButton(loginButton)
31    }
32

```

```

func setUpElements(){
    Utilities.styleFilledButton(signUpButton)
    Utilities.styleHollowButton(loginButton)
}

func setUpVideo() {
    // Get the path to the resource in the bundle
    let bundlePath = Bundle.main.path(forResource: "loginbg", ofType: "mp4")

    guard bundlePath != nil else {
        return
    }

    // Create a URL from it
    let url = URL(fileURLWithPath: bundlePath!)

    // Create the video player item
    let item = AVPlayerItem(url: url)

    // Create the player
    videoPlayer = AVPlayer(playerItem: item)

    // Create the layer
    videoPlayerLayer = AVPlayerLayer(player: videoPlayer!)

    // Adjust the size and frame
    videoPlayerLayer?.frame = CGRect(x: -self.view.frame.size.width*1.5, y: 0, width: self.view.frame.size.width*4, height: self.view.frame.size.height)

    view.layer.insertSublayer(videoPlayerLayer!, at: 0)

    // Add it to the view and play it
    videoPlayer?.playImmediately(atRate: 0.3)
}
}


```

```

1 // 
2 //  SignUpViewController.swift
3 //  Diss2020
4 //
5 //  Created by Harris Aslam on 16/03/2020.
6 //  Copyright © 2020 Harris Aslam. All rights reserved.
7 //
8
9 import UIKit
10 import FirebaseAuth
11 import Firebase
12 import FirebaseFirestore
13
14 class SignUpViewController: UIViewController {
15
16
17     @IBOutlet weak var firstNameTextField: UITextField!
18     @IBOutlet weak var lastNameTextField: UITextField!
19     @IBOutlet weak var emailTextField: UITextField!
20     @IBOutlet weak var passwordTextField: UITextField!
21     @IBOutlet weak var signUpButton: UIButton!
22     @IBOutlet weak var errorLabel: UILabel!
23
24     override func viewDidLoad() {
25         super.viewDidLoad()
26
27         // Do any additional setup after loading the view.
28
29         setUpElements()
30         self.hideKeyboardWhenTappedAround()
31     }
32
33     func hideKeyboardWhenTappedAround() {
34         let tapGesture = UITapGestureRecognizer(target: self, action: #selector(hideKeyboard))
35         view.addGestureRecognizer(tapGesture)
36     }
37
38     @objc func hideKeyboard() {
39         view.endEditing(true)
40     }
41
42     func setUpElements(){
43         errorLabel.alpha = 0
44
45         Utilities.styleTextField(firstNameTextField)
46         Utilities.styleTextField(lastNameTextField)
47         Utilities.styleTextField(emailTextField)
48         Utilities.styleTextField(passwordTextField)
49         Utilities.styleFilledButton(signUpButton)
50     }

```

```

51     func validateFields() -> String {
52         if firstNameTextField.text?.trimmingCharacters(in: .whitespacesAndNewlines) == "" ||
53             lastNameTextField.text?.trimmingCharacters(in: .whitespacesAndNewlines) == "" ||
54             emailTextField.text?.trimmingCharacters(in: .whitespacesAndNewlines) == "" ||
55             passwordTextField.text?.trimmingCharacters(in: .whitespacesAndNewlines) == ""
56         {
57             return "Please fill in all fields"
58         }
59
60         let cleanedPassword = passwordTextField.text!.trimmingCharacters(in: .whitespacesAndNewlines)
61
62         if Utilities.isPasswordValid(cleanedPassword) == false {
63             return "Password invalid"
64         }
65
66
67         return nil
68     }
69
70
71     @IBAction func signUpTapped(_ sender: Any) {
72
73         let error = validateFields()
74
75         if error != nil {
76             showError(error!)
77         }
78         else {
79
80             let firstName = firstNameTextField!.text!.trimmingCharacters(in: .whitespacesAndNewlines)
81             let lastName = lastNameTextField.text!.trimmingCharacters(in: .whitespacesAndNewlines)
82             let email = emailTextField.text!.trimmingCharacters(in: .whitespacesAndNewlines)
83             let password = passwordTextField.text!.trimmingCharacters(in: .whitespacesAndNewlines)
84
85
86             Auth.auth().createUser(withEmail: email, password: password) { (result, err) in
87
88                 if err != nil {
89
90                     let errorMessage = err?.localizedDescription
91                     self.showError(errorMessage!)
92                 }
93                 else {
94
95                     let db = Firestore.firestore()
96
97                     db.collection("users").addDocument(data: ["firstname" : firstName, "surname" : lastName, "uid" : result!.user.uid ]) { (error) in
98                         if error != nil
99                         {
100                             self.showError("Error saving user data")
101                         }
102                     }
103                     // Transition to home screen
104                     self.transitionToLogin()
105                 }
106             }
107         }
108     }
109 }
```

```

110
111     func showError(_ message: String) {
112         errorLabel.text = message
113         errorLabel.alpha = 1
114     }
115
116     func transitionToLogin()
117     {
118         let loginViewController = storyboard?.instantiateViewController(identifier: ConstantsStoryboard.LoginViewController) as? LoginViewController
119
120         view.window?.rootViewController = loginViewController
121         view.window?.makeKeyAndVisible()
122     }
123
124 }
125
```

```

1 // LoginViewController.swift
2 // Diss2020
3 //
4 //
5 // Created by Harris Aslam on 16/03/2020.
6 // Copyright © 2020 Harris Aslam. All rights reserved.
7 //
8
9 import UIKit
10 import FirebaseAuth
11
12 class LoginViewController: UIViewController {
13
14     @IBOutlet weak var emailTextField: UITextField!
15     @IBOutlet weak var passwordTextField: UITextField!
16
17     @IBOutlet weak var loginButton: UIButton!
18     @IBOutlet weak var errorLabel: UILabel!
19
20     override func viewDidLoad() {
21         super.viewDidLoad()
22
23         // Do any additional setup after loading the view.
24
25         setUpElements()
26         self.hideKeyboardWhenTappedAround()
27     }
28
29     func setUpElements(){
30         errorLabel.alpha = 0
31
32         Utilities.styleTextField(emailTextField)
33         Utilities.styleTextField(passwordTextField)
34         Utilities.styleFilledButton(loginButton)
35     }
36
37     func hideKeyboardWhenTappedAround() {
38         let tapGesture = UITapGestureRecognizer(target: self, action: #selector(hideKeyboard))
39         view.addGestureRecognizer(tapGesture)
40     }
41
42     @objc func hideKeyboard() {
43         view.endEditing(true)
44     }
45
46     @IBAction func loginButtonTapped(_ sender: Any) {
47
48         let email = emailTextField.text!.trimmingCharacters(in: .whitespacesAndNewlines)
49         let password = passwordTextField.text!.trimmingCharacters(in: .whitespacesAndNewlines)
50
51         Auth.auth().signIn(withEmail: email, password: password) { (result, error) in
52             if error != nil{
53                 self.errorLabel.text = error?.localizedDescription
54                 self.errorLabel.alpha = 1
55             }
56             else {
57                 self.transitionToHome()
58             }
59         }
60     }
61
62     func transitionToHome(){
63     {
64         let homeViewController = storyboard?.instantiateViewController(identifier: ConstantsStoryboard.HomeViewController) as? HomeViewController
65
66         view.window?.rootViewController = homeViewController
67         view.window?.makeKeyAndVisible()
68     }
69 }
70

```

```

1 // 
2 //  HomeViewController.swift
3 //  Diss2020
4 //
5 //  Created by Harris Aslam on 16/03/2020.
6 //  Copyright © 2020 Harris Aslam. All rights reserved.
7 //
8
9 import UIKit
10
11 class WellnessViewController: UIViewController {
12
13     @IBOutlet weak var sleepSlider: UISlider!
14     @IBOutlet weak var sleepLabel: UILabel!
15
16     @IBOutlet weak var muscleSlider: UISlider!
17     @IBOutlet weak var muscleLabel: UILabel!
18
19     @IBOutlet weak var fatigueSlider: UISlider!
20     @IBOutlet weak var fatigueLabel: UILabel!
21
22     @IBOutlet weak var stressSlider: UISlider!
23     @IBOutlet weak var stressLabel: UILabel!
24
25     @IBOutlet weak var willToTrainSlider: UISlider!
26     @IBOutlet weak var willToTrainLabel: UILabel!
27
28     @IBOutlet weak var InjurySC: UISegmentedControl!
29     @IBOutlet weak var InjuryTextField: UITextField!
30
31     @IBOutlet weak var IllnessSC: UISegmentedControl!
32     @IBOutlet weak var IllnessTextField: UITextField!
33
34     @IBOutlet weak var wokeUpButton: UIView!
35     @IBOutlet weak var wokeUpDateLabel: UILabel!
36     @IBOutlet weak var wokeUpLabel: UILabel!
37     @IBOutlet weak var wokeUpTime: UILabel!
38
39
40     @IBOutlet weak var wentToBedButton: UIButton!
41     @IBOutlet weak var wentToBedDateLabel: UILabel!
42     @IBOutlet weak var wentToBedTime: UILabel!
43     @IBOutlet weak var wentToBedLabel: UILabel!
44
45     @IBOutlet weak var wentToBedPickerView: UIView!
46     @IBOutlet weak var wokeUpView: UIView!
47
48     @IBOutlet weak var wentToBedPicker: UIDatePicker!
49     @IBOutlet weak var wokeUpPicker: UIDatePicker!
50
51     @IBOutlet weak var hoursSleptLabel: UILabel!
52

```

```

53     override func viewDidLoad() {
54         super.viewDidLoad()
55         // Do any additional setup after loading the view.
56
57         wentToBedButton.backgroundColor = UIColor.init(red: 48/255, green: 173/255, blue: 99/255, alpha: 1)
58         wentToBedButton.layer.cornerRadius = 25.0
59         wentToBedButton.tintColor = UIColor.white
60
61         wokeUpButton.backgroundColor = UIColor.init(red: 48/255, green: 173/255, blue: 99/255, alpha: 1)
62         wokeUpButton.layer.cornerRadius = 25.0
63         wokeUpButton.tintColor = UIColor.white
64
65         setUpElements()
66
67         NotificationCenter.default.addObserver(self, selector: #selector(keyboardWillShow), name: UIResponder.keyboardWillShowNotification, object: nil)
68         NotificationCenter.default.addObserver(self, selector: #selector(keyboardWillHide), name: UIResponder.keyboardWillHideNotification, object: nil)
69     }
70
71     @objc func keyboardWillShow(notification: NSNotification) {
72         if let keyboardSize = (notification.userInfo?[UIResponder.keyboardFrameBeginUserInfoKey] as? NSValue)?.cgRectValue {
73             if self.view.frame.origin.y == 0 {
74                 self.view.frame.origin.y -= keyboardSize.height
75             }
76         }
77     }
78
79     @objc func keyboardWillHide(notification: NSNotification) {
80
81         self.view.frame.origin.y = 0
82
83     }
84
85     override func viewWillAppear(_ animated: Bool) {
86         hidePickerViewWhenTappedAround()
87     }
88
89     func hidePickerViewWhenTappedAround() {
90         let tap = UITapGestureRecognizer(target: self, action: #selector(doubleTapped))
91         tap.numberOfTapsRequired = 1
92         view.addGestureRecognizer(tap)
93     }
94
95     @objc func doubleTapped() {
96         hidePickers()
97     }
98

```

```

99     func setUpElements() {
100         wokeUpLabel.textColor = UIColor.white
101         wokeUpTime.textColor = UIColor.white
102         wokeUpDateLabel.textColor = UIColor.white
103
104         wentToBedLabel.textColor = UIColor.white
105         wentToBedTime.textColor = UIColor.white
106         wentToBedDateLabel.textColor = UIColor.white
107
108         let currentDateTime = Date()
109
110         let dateFormatter = DateFormatter()
111             dateFormatter.locale = Locale(identifier: "en_GB")
112             dateFormatter.setLocalizedDateFormatFromTemplate("MMMMd")
113
114             wentToBedDateLabel.text = "\(dateFormatter.string(from: currentDateTime))"
115             wokeUpDateLabel.text = "\(dateFormatter.string(from: currentDateTime))"
116
117         let timeformatter = DateFormatter()
118             timeformatter.dateFormat = "hh:mm a"
119
120         let str1 = timeformatter.string(from: currentDateTime)
121         let str2 = timeformatter.string(from: currentDateTime)
122
123             wentToBedTime.text = str1
124             wokeUpTime.text = str2
125
126             hoursSleptLabel.alpha = 0
127     }
128
129     @IBOutlet var wellnessView: UIView!
130
131
132     @IBAction func sleepSliderTouched(_ sender: UISlider) {
133
134         let currentValue = Int(sender.value)
135
136         sleepLabel.text = setSliderLabel(sliderNumber: currentValue)
137         hidePickers()
138     }
139
140     @IBAction func muscleSliderTouched(_ sender: UISlider) {
141
142         let currentValue = Int(sender.value)
143
144         muscleLabel.text = setSliderLabel(sliderNumber: currentValue)
145         hidePickers()
146     }
147
148     @IBAction func fatigueSliderTouched(_ sender: UISlider) {
149
150         let currentValue = Int(sender.value)
151
152         fatigueLabel.text = setSliderLabel(sliderNumber: currentValue)
153         hidePickers()
154     }

```

```

155
○ @IBAction func stressSliderTouched(_ sender: UISlider) {
156
157     let currentValue = Int(sender.value)
158
159     stressLabel.text = setSliderLabel(sliderNumber: currentValue)
160     hidePickers()
161 }
162
163
○ @IBAction func willToTrainSliderTouched(_ sender: UISlider) {
164
165     let currentValue = Int(sender.value)
166
167     willToTrainLabel.text = setSliderLabel(sliderNumber: currentValue)
168     hidePickers()
169 }
170
171
○ @IBAction func InjurySCTapped(_ sender: Any) {
172
173     switch InjurySC.selectedSegmentIndex
174     {
175
176         case 0:
177             InjuryTextField.isEnabled = false
178             InjuryTextField.text = ""
179
180         case 1:
181             InjuryTextField.isEnabled = true
182             default: break
183     }
184
185
○ @IBAction func IllnessSCTapped(_ sender: Any) {
186
187     switch IllnessSC.selectedSegmentIndex
188     {
189
190         case 0:
191             IllnessTextField.text = ""
192             IllnessTextField.isEnabled = false
193
194         case 1:
195             IllnessTextField.isEnabled = true
196             default: break
197     }
198
199
○ @IBAction func saveTapped(_ sender: Any) {
200     let injuryText = InjuryTextField.text
201     print(injuryText!)
202
203     let illnessText = IllnessTextField.text
204     print(illnessText!)
205
206
○ @IBAction func wentToBedTapped(_ sender: Any) {
207
208     wentToBedPickerView.alpha = 1
209     wentToBedPicker.alpha = 1
210
211
212     wokeUpPicker.alpha = 0
213     wokeUpView.alpha = 0
214     hoursSleptLabel.alpha = 1
215 }
```

```

216 ○ @IBAction func wokeUpTapped(_ sender: Any) {
218
219     wentToBedPickerView.alpha = 0
220     wentToBedPicker.alpha = 0
221
222     wokeUpPicker.alpha = 1
223     wokeUpView.alpha = 1
224     hoursSleptLabel.alpha = 1
225 }
226
227 ○ @IBAction func wokeUpPickerScroll(_ sender: Any) {
228     scrollerWorking()
229
230     let dateFormatter = DateFormatter()
231     dateFormatter.locale = Locale(identifier: "en_GB")
232     dateFormatter.setLocalizedDateFormatFromTemplate("MMMMd")
233
234     let timeformatter = DateFormatter()
235     timeformatter.dateFormat = "hh:mm a"
236
237     let endTime = timeformatter.string(from: wokeUpPicker.date)
238     let endDate = dateFormatter.string(from: wokeUpPicker.date)
239
240     wokeUpTime.text = endTime
241     wokeUpDateLabel.text = endDate
242 }
243
244 ○ @IBAction func wentToBedPickerScrolling(_ sender: Any) {
245     scrollerWorking()
246
247     let dateFormatter = DateFormatter()
248     dateFormatter.locale = Locale(identifier: "en_GB")
249     dateFormatter.setLocalizedDateFormatFromTemplate("MMMMd")
250
251     let timeformatter = DateFormatter()
252     timeformatter.dateFormat = "hh:mm a"
253
254     let startTime = timeformatter.string(from: wentToBedPicker.date)
255     let startDate = dateFormatter.string(from: wentToBedPicker.date)
256
257     wentToBedTime.text = startTime
258     wentToBedDateLabel.text = startDate
259 }
260
261
262 func findDateDiff(time1Str: String, time2Str: String) -> String {
263     let timeformatter = DateFormatter()
264     timeformatter.dateFormat = "mm/dd/yy, hh:mm a"
265
266     guard let time1 = timeformatter.date(from: time1Str),
267           let time2 = timeformatter.date(from: time2Str) else { return "" }
268
269     //You can directly use from here if you have two dates
270
271     let interval = time2.timeIntervalSince(time1)
272     let hour = interval / 3600;
273     let minute = interval.truncatingRemainder(dividingBy: 3600) / 60
274     return "\(Int(hour)) Hrs \(Int(minute)) Mins"
275
276 }
```

```

277
278     func scrollerWorking(){
279         let dateFormatter = DateFormatter()
280
281         dateFormatter.dateStyle = DateFormatter.Style.short
282         dateFormatter.timeStyle = DateFormatter.Style.short
283
284         let strDate = dateFormatter.string(from: wentToBedPicker.date)
285         let strTime = dateFormatter.string(from: wokeUpPicker.date)
286
287         hoursSleptLabel.text = findDateDiff(time1Str: strDate, time2Str: strTime)
288     }
289
290     func showPickers() {
291
292     }
293
294     func hidePickers() {
295         wokeUpPicker.alpha = 0
296         wokeUpView.alpha = 0
297
298         wentToBedPicker.alpha = 0
299         wentToBedPickerView.alpha = 0
300     }
301
302     func setSliderLabel(sliderNumber: Int) -> String{
303
304         let currentValue = sliderNumber
305
306         var text = ""
307
308         if currentValue == 0 {
309             text = "Terrible"
310         }
311         else if currentValue == 1 {
312             text = "Restless"
313         }
314         else if currentValue == 2 {
315             text = "Worse than normal"
316         }
317         else if currentValue == 3 {
318             text = "Normal"
319         }
320         else if currentValue == 4 {
321             text = "Better than normal"
322         }
323         else if currentValue == 5 {
324             text = "Fresh"
325         }
326         else if currentValue == 6 {
327             text = "Very Fresh"
328         }
329
330         return text
331     }
332
333     @IBAction func saveButtonTapped(_ sender: UIBarButtonItem) {
334         generaterScore()
335     }

```

```
385
386     func generaterScore() {
387
388         let sleep = Int(sleepSlider.value)
389         let muscle = Int(muscleSlider.value)
390         let fatigue = Int(fatigueSlider.value)
391         let stress = Int(stressSlider.value)
392         let will = Int(willToTrainSlider.value)
393
394         print(sleep)
395         print(muscle)
396         print(fatigue)
397         print(stress)
398         print(will)
399
400         let score = ((sleep + muscle + fatigue + stress + will))
401         print(score)
402
403         // create the alert
404         let alert = UIAlertController(title: "Data Saved", message: "Thank you for registering today's wellness \n Your wellness score today is: \(score)", preferredStyle:
405             UIAlertController.Style.alert)
406
407         // add an action (button)
408         alert.addAction(UIAlertAction(title: "OK", style: UIAlertAction.Style.destructive, handler: {
409             action in
410
411                 self.dismiss(animated: true, completion: nil)
412         }))
413
414         // show the alert
415         self.present(alert, animated: true, completion: nil)
416
417
418     }
419 }
```

```

1 // GoogleMapsViewController.swift
2 // Diss2020
3 //
4 //
5 // Created by Harris Aslam on 28/03/2020.
6 // Copyright © 2020 Harris Aslam. All rights reserved.
7 //
8
9 import UIKit
10 import MapKit
11 import GoogleMaps
12 import GooglePlaces
13 import CoreLocation
14
15 class GoogleMapsViewController: UIViewController, CLLocationManagerDelegate {
16
17 @IBOutlet weak var mapView: MKMapView!
18
19 var locationManager = CLLocationManager()
20
21 override func viewDidLoad() {
22     super.viewDidLoad()
23
24     mapView.showsUserLocation = true
25
26     if CLLocationManager.locationServicesEnabled() == true {
27
28         if CLLocationManager.authorizationStatus() == .restricted ||
29             CLLocationManager.authorizationStatus() == .denied ||
30             CLLocationManager.authorizationStatus() == .notDetermined {
31
32             locationManager.requestWhenInUseAuthorization()
33         }
34
35         locationManager.desiredAccuracy = 1.0
36         locationManager.delegate = self
37         locationManager.startUpdatingLocation()
38
39     } else {
40         print("Please turn on location services or GPS")
41     }
42
43
44     let annotation = MKPointAnnotation()
45     annotation.coordinate = CLLocationCoordinate2D(latitude: 55.957990, longitude: -3.184670)
46     annotation.title = "Tribe Yoga Leith Walk"
47     mapView.addAnnotation(annotation)
48
49     let annotation2 = MKPointAnnotation()
50     annotation2.coordinate = CLLocationCoordinate2D(latitude: 55.944019, longitude: -3.192406)
51     annotation2.title = "Tribe Yoga Quartermile"
52     mapView.addAnnotation(annotation2)
53
54     let annotation3 = MKPointAnnotation()
55     annotation3.coordinate = CLLocationCoordinate2D(latitude: 55.955100, longitude: -3.199530)
56     annotation3.title = "Tribe Yoga New Town"
57     mapView.addAnnotation(annotation3)
58
59     let annotation4 = MKPointAnnotation()
60     annotation4.coordinate = CLLocationCoordinate2D(latitude: 55.958400, longitude: -3.212710)
61     annotation4.title = "Mindfullybeing Scotland"
62     mapView.addAnnotation(annotation4)

```

```

64    }
65
66    func locationManager(_ manager: CLLocationManager, didUpdateLocations locations: [CLLocation])
67    {
68        let region = MKCoordinateRegion(center: CLLocationCoordinate2D(latitude: 55.953251, longitude: -3.188267), span: MKCoordinateSpan(latitudeDelta: 0.1, longitudeDelta: 0.1))
69        // self.mapView.region = region
70        self.mapView.setRegion(region, animated: true)
71    }
72
73    func locationManager(_ manager: CLLocationManager, didFailWithError error: Error) {
74        print("Unable to access your current location")
75    }
76}
77

```

```

1 // 
2 //  MessagesViewController.swift
3 //  Diss2020
4 //
5 //  Created by Harris Aslam on 05/07/2020.
6 //  Copyright © 2020 Harris Aslam. All rights reserved.
7 //
8
9 import UIKit
10 import JGProgressHUD
11
12 class MessagingViewController: UIViewController {
13
14     private let spinner = JGProgressHUD(style: .dark)
15
16     private let tableView: UITableView = {
17         let table = UITableView()
18         table.isHidden = true
19         table.register(UITableViewCell.self, forCellReuseIdentifier: "cell")
20         return table
21     }()
22
23     private let noConversationsLabel: UILabel = {
24         let label = UILabel()
25         label.text = "No Conversations!"
26         label.textAlignment = .center
27         label.textColor = .gray
28         label.font = .systemFont(ofSize: 21, weight: .medium)
29         label.isHidden = true
30         return label
31     }()
32
33     override func viewDidLoad() {
34         super.viewDidLoad()
35         navigationItem.rightBarButtonItem = UIBarButtonItem.init(barButtonSystemItem: .compose, target: self, action: #selector(didTapComposeButton))
36         view.addSubview(tableView)
37         view.addSubview(noConversationsLabel)
38
39         setUpTableView()
40         fetchConversations()
41         // Do any additional setup after loading the view.
42     }
43
44     @objc private func didTapComposeButton() {
45         let vc = NewConversationViewController()
46         let navVC = UINavigationController(rootViewController: vc)
47         present(navVC, animated: true)
48     }
49
50     override func viewDidLayoutSubviews() {
51         super.viewDidLayoutSubviews()
52         tableView.frame = view.bounds
53     }
54
55
56     override func viewDidAppear(_ animated: Bool) {
57         super.viewDidAppear(animated)
58     }

```

```
59
60     private func setUpTableView() {
61         tableView.delegate = self
62         tableView.dataSource = self
63     }
64
65     private func fetchConversations() {
66         tableView.isHidden = false
67     }
68
69
70 }
71
72 extension MessagingViewController : UITableViewDelegate, UITableViewDataSource {
73     func tableView(_ tableView: UITableView, numberOfRowsInSection section: Int) -> Int {
74         return 1
75     }
76     func tableView(_ tableView: UITableView, cellForRowAt indexPath: IndexPath) -> UITableViewCell {
77         let cell = tableView.dequeueReusableCell(withIdentifier: "cell", for: indexPath)
78         cell.textLabel?.text = "Hello World"
79         cell.accessoryType = .disclosureIndicator
80         return cell
81     }
82
83     func tableView(_ tableView: UITableView, didSelectRowAt indexPath: IndexPath) {
84         tableView.deselectRow(at: indexPath, animated: true)
85
86         let vc = ChatViewController()
87         vc.title = "Jenny Smith"
88         vc.navigationItem.largeTitleDisplayMode = .never
89         navigationController?.pushViewController(vc, animated: true)
90
91     }
92
93 }
94
```

```

1 // ChatViewController.swift
2 // Diss2020
3 //
4 //
5 // Created by Harris Aslam on 13/07/2020.
6 // Copyright © 2020 Harris Aslam. All rights reserved.
7 //
8
9 import UIKit
10 import MessageKit
11
12 struct Message: MessageType {
13     var sender: SenderType
14     var messageId: String
15     var sentDate: Date
16     var kind: MessageKind
17 }
18
19 struct Sender: SenderType {
20     var photoURL : String
21     var senderId: String
22     var displayName: String
23 }
24
25 class ChatViewController: MessagesViewController {
26
27     private var messages = [Message]()
28
29     private let selfSender = Sender(photoURL: "",
30                                     senderId: "1",
31                                     displayName: "John Smith")
32
33     override func viewDidLoad() {
34         super.viewDidLoad()
35         view.backgroundColor = .red
36
37         messages.append(Message(sender: selfSender,
38                                messageId: "1",
39                                sentDate: Date(),
40                                kind: .text("Hello test message")))
41         messages.append(Message(sender: selfSender,
42                                messageId: "1",
43                                sentDate: Date(),
44                                kind: .text("Hello second message")))
45
46         messagesCollectionView.messagesDataSource = self
47         messagesCollectionView.messagesLayoutDelegate = self
48         messagesCollectionView.messagesDisplayDelegate = self
49     }
50
51
52
53 }
54

```

```
54
55 extension ChatViewController: MessagesDataSource, MessagesLayoutDelegate, MessagesDisplayDelegate {
56     func currentSender() -> SenderType {
57         return selfSender
58     }
59
60     func messageForItem(at indexPath: IndexPath, in messagesCollectionView: MessagesCollectionView) -> MessageType {
61         return messages[indexPath.section]
62     }
63
64     func numberOfSections(in messagesCollectionView: MessagesCollectionView) -> Int {
65         return messages.count
66     }
67
```

```

1  //
2  //  NewConversationViewController.swift
3  //  Diss2020
4  //
5  //  Created by Harris Aslam on 13/07/2020.
6  //  Copyright © 2020 Harris Aslam. All rights reserved.
7  //
8
9  import UIKit
10 import JGProgressHUD
11
12 class NewConversationViewController: UIViewController {
13
14     private let searchBar: UISearchBar = {
15         let searchBar = UISearchBar()
16         searchBar.placeholder = "Search for users..."
17         return searchBar
18     }()
19
20     private let tableView: UITableView = {
21         let table = UITableView()
22         table.isHidden = true
23         table.register(UITableViewCell.self, forCellReuseIdentifier: "cell")
24         return table
25     }()
26
27     private let noResultsLabel: UILabel = {
28         let label = UILabel()
29         label.text = "No Results!"
30         label.textAlignment = .center
31         label.textColor = .green
32         label.font = .systemFont(ofSize: 21, weight: .medium)
33         label.isHidden = true
34         return label
35     }()
36
37     override func viewDidLoad() {
38         super.viewDidLoad()
39         searchBar.delegate = self
40         view.backgroundColor = .white
41         navigationController?.navigationBar.topItem?.titleView = searchBar
42         navigationItem.rightBarButtonItem = UIBarButtonItem(title: "Cancel",
43                                                       style: .done,
44                                                       target: self,
45                                                       action: #selector(dismissSelf))
46         searchBar.becomeFirstResponder()
47
48         // Do any additional setup after loading the view.
49     }
50
51     @objc private func dismissSelf() {
52         dismiss(animated: true, completion: nil)
53     }
54
55 }
56
57 extension NewConversationViewController: UISearchBarDelegate {
58
59     func searchBarSearchButtonClicked(_ searchBar: UISearchBar) {
60
61     }
62 }
```

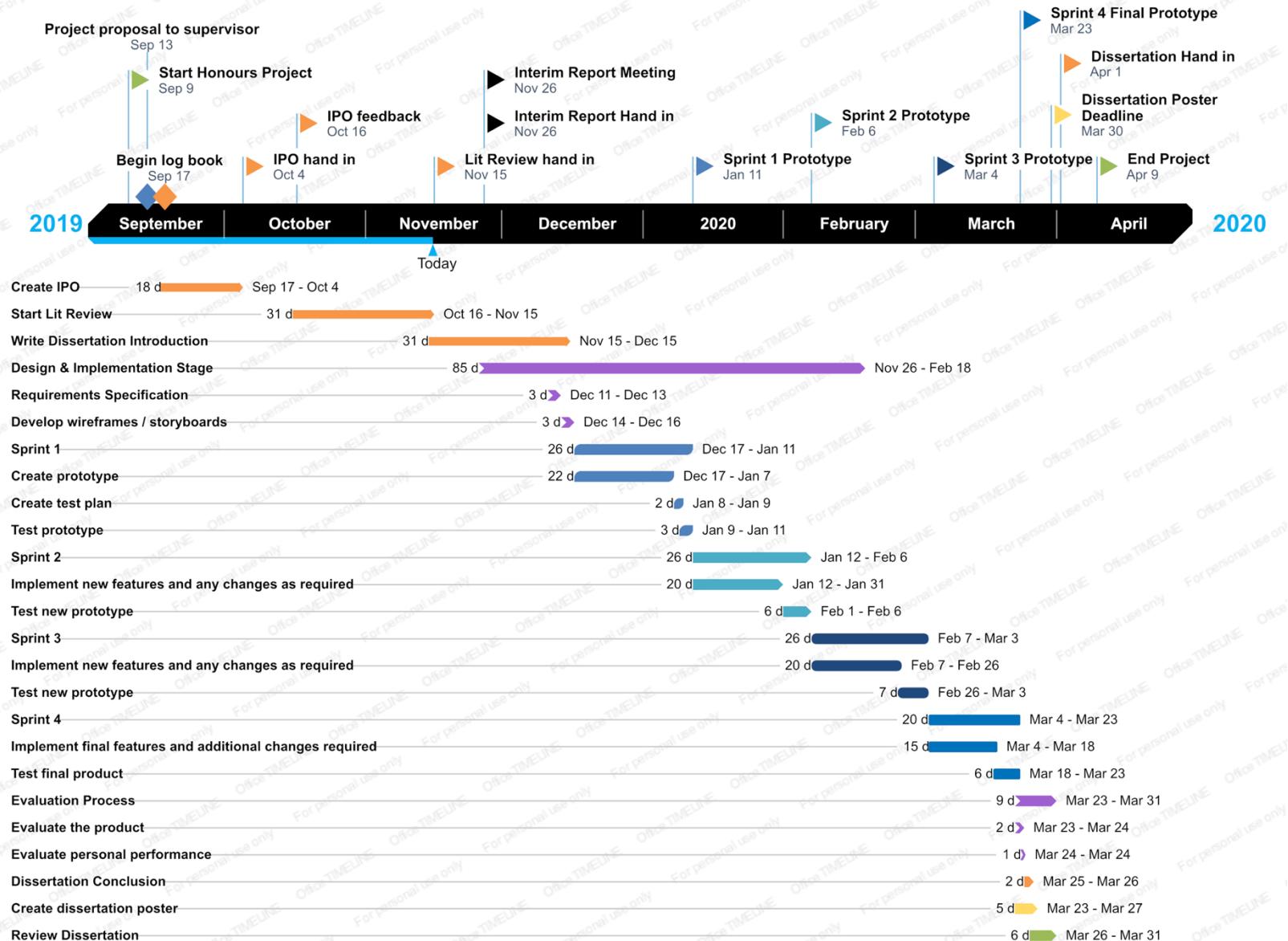
## Appendix 5 – Project Plan Gantt Chart

### 5.1 Initial Task Timeline

Title	T/M	Start	End	⌚	%
Start Honours Project	▶ M	09/09/2019	09/09/2019	-	%
Project proposal to supervisor	◆ M	13/09/2019	13/09/2019	-	100%
Begin log book	◆ M	17/09/2019	17/09/2019	-	%
Create IPO	➡ T	17/09/2019	04/10/2019	18 d	100%
IPO hand in	▶ M	04/10/2019	04/10/2019	-	100%
IPO feedback	▶ M	16/10/2019	16/10/2019	-	100%
Start Lit Review	➡ T	16/10/2019	15/11/2019	31 d	70%
Lit Review hand in	▶ M	15/11/2019	15/11/2019	-	70%
Interim Report Meeting	▶ M	26/11/2019	26/11/2019	-	%
Interim Report Hand in	▶ M	26/11/2019	26/11/2019	-	%
Write Dissertation Introduction	➡ T	15/11/2019	15/12/2019	31 d	%
Design & Implementation Stage	▶ T	26/11/2019	18/02/2020	85 d	%
Requirements Specification	▶ T	11/12/2019	13/12/2019	3 d	%
Develop wireframes / storyboards	▶ T	14/12/2019	16/12/2019	3 d	%
Sprint 1	▶ T	17/12/2019	11/01/2020	26 d	%
Create prototype	▶ T	17/12/2019	07/01/2020	22 d	%
Create test plan	▶ T	08/01/2020	10/01/2020	3 d	%
Test prototype	▶ T	10/01/2020	11/01/2020	2 d	%
Sprint 1 Prototype	▶ M	11/01/2020	11/01/2020	-	%
Sprint 2	▶ T	12/01/2020	06/02/2020	26 d	%
Implement new features and any changes as required	▶ T	12/01/2020	31/01/2020	20 d	%
Test new prototype	▶ T	01/02/2020	06/02/2020	6 d	%
Sprint 2 Prototype	▶ M	06/02/2020	06/02/2020	-	%
Sprint 3	● T	07/02/2020	03/03/2020	26 d	%
Implement new features and any changes as required	● T	07/02/2020	26/02/2020	20 d	%
Test new prototype	● T	26/02/2020	03/03/2020	7 d	%
Sprint 3 Prototype	▶ M	04/03/2020	04/03/2020	-	%
Sprint 4	● T	04/03/2020	23/03/2020	20 d	%
Implement final features and additional changes required	● T	04/03/2020	18/03/2020	15 d	%
Test final product	● T	18/03/2020	23/03/2020	6 d	%
Sprint 4 Final Prototype	▶ M	23/03/2020	23/03/2020	-	%
Evaluation Process	▶ T	23/03/2020	31/03/2020	9 d	%
Evaluate the product	▶ T	23/03/2020	24/03/2020	2 d	%
Evaluate personal performance	▶ T	24/03/2020	24/03/2020	1 d	%
Dissertation Conclusion	➡ T	25/03/2020	26/03/2020	2 d	%
Create dissertation poster	▶ T	23/03/2020	27/03/2020	5 d	%
Review Dissertation	▶ T	26/03/2020	31/03/2020	6 d	%
Dissertation Poster Deadline	▶ M	30/03/2020	30/03/2020	-	%
Dissertation Hand in	▶ M	01/04/2020	01/04/2020	-	%
End Project	▶ M	09/04/2020	09/04/2020	-	%

## 5.2 Original Gantt Chart

### Honours Project Gantt Chart



## 12.3 Updated Gantt chart to reflect actual project timeline.

