

COM814: Project 2015-16

Smart Attendance System

Dissertation

School of Computing & Information Engineering

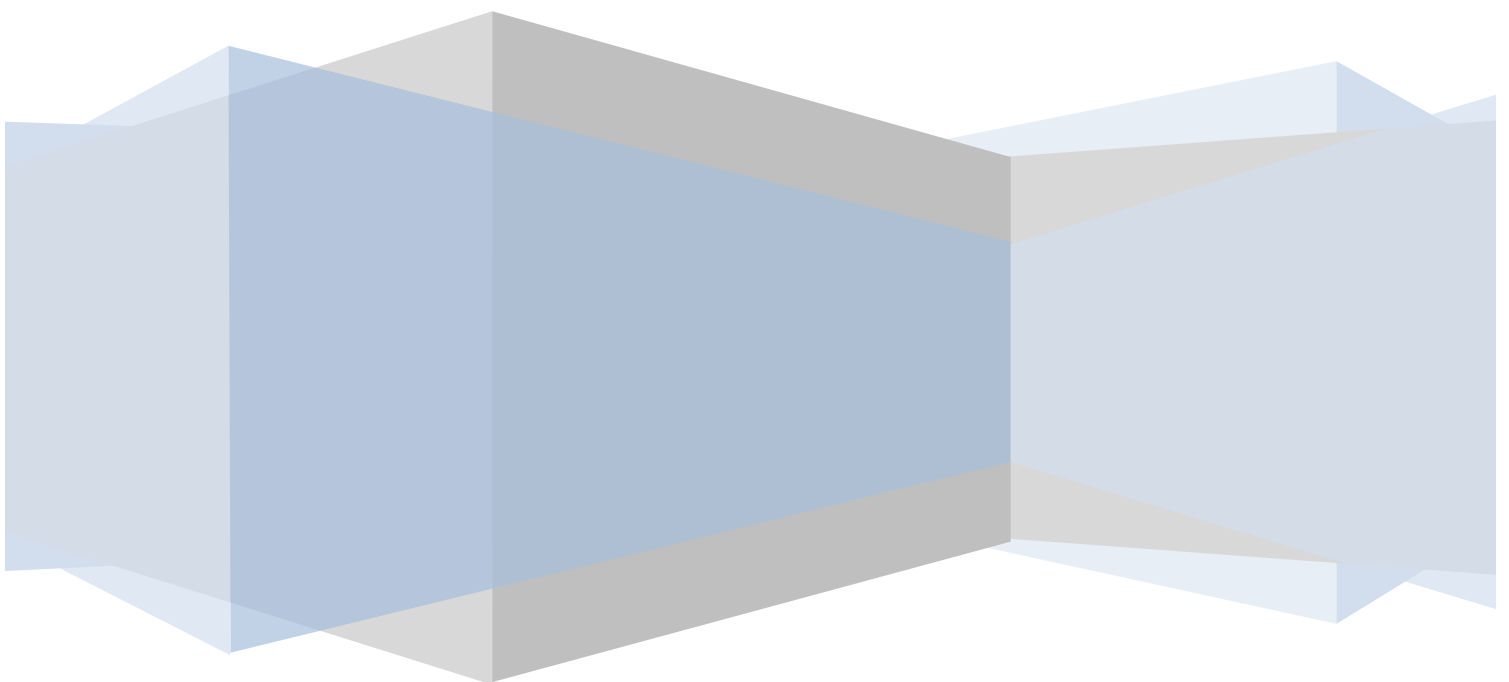
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[Smart Attendance System]

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Abstract

The problem that this project intends to solve is the issues surrounding student attendance at university. The current method in which attendance is taken at university is considered outdated and ineffective. It allows students ways and means of signing in for classes which they are not attending. Providing a more effective system of administering attendance would provide an incentive for students to attend class. Improved attendances will hopefully lead to an improved level of academic performance. The proposed solution to this problem is to develop a website capable of registering and storing student attendance. The website will store this information on a database connected to the website. The website will also offer administrative features to allow university staff to manage the system. It will also contain a section for lecturers to review the attendance figures of their students. The website created has three user sections which include student, lecturer and administrator. Each user has access to different features of the website. The admin section allows for the registering of students and lecturers. The administrator can also edit and remove records from the database. The student area allows for the user to register their attendance which will be stored in the database as a Boolean variable. The lecturer will have access to attendance information of students in the database.

This dissertation will provide a detailed account of the following stages of the project. Firstly, it will provide an introduction addressing the problem at hand, the solution and the work carried out as a result. Next will be an analysis section which will outline the research undertaken prior to development and the possible solutions that were available. The following chapter will explore and review the system requirements. The design chapter will chronicle the development of the UI, database, and software architecture. The implementation of the system will analyse how it was created and the steps that were taken during development. The testing phase will illustrate the functionality of the system and verify the effectiveness of the software. The final section will be a reflective look at the project as a whole. It will conclude and assess the project collectively and provide any recommendations for the system from a post development perspective.

Chapter 1: Introduction

The problem that will be addressed in this report surrounds the issues with monitoring and recording student attendance at university. Student's with a higher attendance record tend to outperform those who have poorer attendance at university. This may not be the same for all student's but there is clear evidence to suggest that improved attendance improves academic performance as a collective. This is backed up by research carried out by the social science department at the University of Warwick. Their research suggests that *'missing class has an adverse effect on student performance, but only for 'high ability' students: missing 10% of classes is associated with a 1-2 percentage point lower mark for this group of students.'*¹ Although this research only demonstrates a significant effect on the more 'academic' students it still proves that improving attendance will improve the overall performance of a class.

As well as improving academic performance through better attendance there is also now a requirement for student's to maintain a certain level of attendance. This is the case for international students at the University of Newcastle. They have a policy *'to meet the Home office requirements for tier 4 sponsorship means that all international students studying at Newcastle University must maintain an overall attendance of 80%.'*² This demonstrates the importance of student attendance in certain scenarios and the need to have an effective means of monitoring and recording student attendance. In this case not meeting the attendance requirement for an international student may result in the cancellation of their visa. This demonstrates the seriousness that the Home Office takes attendance and the need for accurate monitoring. The student loans company have also emphasised the importance of improving student attendance. From their perspective improving attendance will have a positive effect on academic performance. This in turn will produce more successful graduates who will begin paying back their loans sooner. The University of Nottingham have stated that *'external pressure for both the Home Office and the Student Loans Company'*³ forced them to enhance their approach to monitoring attendance.

The current method employed this year's professional software development MSc is a paper based system. The sheet is circulated around the lecture theatre, classroom or lab with the student required to sign their name beside their B number. The lecturer is usually the one who distributes the sign in sheet to students. It is then their responsibility to transport the sheet to the admin staff in the school office. There are several problems with the current way that attendance is monitored and recorded. Firstly, if anything happens to the attendance sheet (lost or stolen) that day's attendance record is gone. It is also very easy for students to sign in for their friends who are not present at a particular lecture. This is extremely common practice and it is impossible for the lecturer to ensure that only the student's present are signing in. Once the lecture or class has finished it is up to the lecturer to pass on the attendance sheet to the admin staff at the school office. The attendance sheet is then processed by the admin staff and manually entered into a database. This can be a tedious and time consuming task for the admin staff. Due to the flaws in the current attendance system the data collected is often inaccurate. In fact, it may not reflect the actual attendance of a class over the course of an academic year.

To address the problem of student attendance a technological solution seems to be the most practical way to tackle the issue. The solution proposed to deal with this problem comes in the form of a website. The website will aim to provide a solution to many of the problems previously outlined with regards to attendance. It will hopefully provide features for students, lecturers and the administration staff at the school office. From a student perspective the objective is to allow them to sign in for a class which will in turn register and store their attendance in a database. To achieve this the use of a GPS function will be required. The aim is to verify if the student is within a certain radius of a specified location at the point of sign in. This will ensure that students are not signing in for class from a location other than where they are supposed to be. Implementing the GPS function is one of the primary objectives of this project and will provide a solution to the problem discussed previously. In 1994 US President Bill Clinton ratified GPS as a dual use technology and since then it has become a vital tool in civilian applications.

The collective dependence on GPS cannot be understated and has revolutionised the way we navigate across the earth. There are a wide range of industries that have implemented GPS into their services. These include detecting tectonics, robotics, air traffic tracking and geotagging to name a few. What is certain is that *'GPS has facilitated the growth of almost all the infrastructures that shape our lives.'*⁴ The objective is to use GPS to determine the location of student's using the smart attendance system. The website will also offer unique functionality for the university lecturer's. The aim is to allow lecturer's to view their student's attendance information. This will allow them to assess which students are not attending class to a satisfactory level.

Designing a database that can hold the required information in order for it to function and communicate with the website is essential. The website will need to hold student and lecturer information as well as other records. The plan is to organise the required information so that it can be accessed, managed, and updated with ease. The objective is to design a relational database management system that can accommodate the information sent to it from the website. The RDBMS will store data sent from the website in specified tables. It is essential that the system offers functionality for more than just students and lecturers. This is why It was decided to create a section specifically for staff at the school office to administer the system. The aim is to grant administration staff special privileges so they can manage the system efficiently. This will primarily involve allowing them to add, edit and remove student and lecturer records from the database. This is an essential component of the system and will allow it to managed by only users with administrator permissions. The system administrator will be responsible for maintaining the database and managing records. From a security perspective the system administrator will be responsible for user access to the system. The system admin will make sure that each user as the correct level of access to the website. This is essential in order to maintain a secure website and database system and prevent any unauthorised access.

In order to begin development a degree of planning and preparation was required. This firstly involved identifying which programming languages would be required in order to develop the system. This would require a significant amount of independent learning through online tutorials. These included sites such as Team Tree house, W3 Schools and various YouTube tutorials. W3 Schools was especially useful as it was free and provided a step by step demonstration of what the code was doing. Throughout the independent learning stage of this project W3 Schools was extremely helpful as it *'let the user learn almost everything like which tag is for what and more.'*⁵ Throughout the project a substantial amount of work has been undertaken in order to develop the final system. The work has predominantly been focussed on research, design and implementation. Through extensive research it was decided that GPS was the most efficient way of recording a student's attendance. As simplistic and easy to navigate UI was essential and the initial design was illustrated in prototype stage. The core work of adding functionality to the website was added progressively. User login in functions were added and demonstrated in the prototype website. The final system has added further functional requirements deemed essential to the website.

The remainder of this dissertation will take an in depth look at how the final system was created. Firstly, an analysis of the problem at hand and the research that went into devising a viable solution. A review of attendance systems that have already been developed and put into practice. Assessing these systems and explaining why this particular approach was taken to tackle the problem. The report will state the systems functional requirements and cover the design of the website as a whole. How it was implemented will be further discussed as the report progresses. As the dissertation nears the conclusion it will provide a detailed testing and evaluation section. This will measure the system against the system requirements sets out previously. It will also verify if the software is functioning correctly and as it should be. The report will end with a conclusion summarising the project as a whole and any necessary critiques. It will also make recommendations on what could have been done differently and any constraints that arose during the project.

Chapter 2: Analysis

This section will document the research and analysis that went into finding a viable solution to the problem of student attendance. Investigating current technological methods that have been adopted to manage and monitor student attendance. This will shed some light on why the decision was made to implement GPS as a solution. It will also go into detail about the other solutions that were considered in the design and analysis report. Discussing the ideas that were researched in the early stages of the project illustrate the problem solving process that occurred. This was extremely important process that led to the final decision on the preferred solution to the problem. This chapter will focus upon research carried out earlier on in the project and will explain why certain decisions were made. It will show the background material researched to formulate a cohesive technological solution to the student attendance problem.

Research was one of the first tasks to be carried out during the project and a very important one. The aim was to look at the problem from different perspectives and how it affects each individual. In this case I focussed on students, lecturer's and the administration staff at the university. An analysis of the current attendance system was required and the daily procedure that was carried out. The research and analysis in this report only focusses on the attendance methods carried out by this year's MSc in Professional Software Development. Throughout the academic year attendance records were administered using a paper based system. It involved a paper sign in sheet that was circulated around the lecture theatre or computer lab. The sign in sheet is usually passed out by the lecturer and is then transferred to the school office. Here the admin team will process the attendance data taken for that day. There are several problems with a paper based attendance system. Firstly, the sign in sheet can easily be lost or stolen. This in turn could potentially destroy a day's attendance record. Secondly, it adds extra responsibility and time consumption for lecturer's. This is time that could be spent focussed on teaching. The system also has security flaws and there is no way of knowing if students are signing in their friends for classes that they are not attending. These are all issues that have been observed and documented about the use of a paper based attendance system.

To effectively come up with a solution to the problem an investigation into any technological attendance systems currently in use would be beneficial. There are currently a variety of paperless attendance systems in use by academic institutions. The following section will look further into current solutions and how they are implemented into their respected institutions. The first solution I am going to be analysing is the Student Attendance Monitoring (SAM) System which has been implemented by The University of Sheffield. Similar to the solution proposed in this project the SAM System is accessed via the University web page. This can be done by either directly accessing the attendance website or by going through the Universities online learning resource system called 'MUSE'. The system operates using two different types of attendance monitoring data types. These are attendance data and check point data which are both used as part of the SAM system. The attendance data is collected by each department within the university and can be done using various data recording methods. Check point data is slightly different in which departments are required to verify 2-3 checkpoints which inform whether students are attending class. This must be done after students have registered for the year.

The SAM system has four methods in which student attendance data can be recorded. The first method is by using attendance registers generated by the Content Management Interoperability Service (CMIS). The CMIS *'enables class registers to be printed and/or updated online.'*⁶ This is not too dissimilar from the current method used during this year's MSc using a paper based attendance register. The second method is using the SAM web system to update attendance during one on one student meetings. This allows lecturers to update the system confirming student attendance at one to one meetings. The SAM system also allows departments within the university to upload attendance data. This creates flexibility for departments who are storing attendance using Microsoft Excel. The final data recording method that can be used alongside the SAM System is by using the check point facility system. This method of data recording is the most viable method as it requires students to be in a specific location at the point of registering their attendance.

The checkpoint facility is a University requirement for every department and creates an incentive for students to attend their class. It also creates more of an urgency for each department to ensure their attendance monitoring is up to scratch. The SAM system also as additional functionality which allows departments to *'use the attendance reports facility in the central SAM system to view and analyse the data for cohorts/groups of students and for individual students.'*⁷ This is a feature that would be greatly beneficial to this project as lecturer's and staff could examine attendance data in more detail. Although the check point system is something new and innovative it is not a full proof method with only 2-3 set up by each department per year. It also only monitors cohorts of students with many slipping through the proverbial net of this system.

How students react to a new attendance monitoring system is also a factor that should be taken into consideration. In 2006 a technological solution to student attendance was implemented in a number of academic institutions across the UK. A clock in system was introduced similar to those used in various workplaces. The system functioned using *'a baton which is passed around students, who log in via a keyring carrying their university enrolment number. Specialist advisers can follow up students' attendance records.'*⁸ This system was used in both Napier University in Edinburgh and the University of Glamorgan. It did however come under heavy criticism by students who felt the system was highly unethical. So strongly was ill feeling toward the new system it prompted The National Union of Students to *'brand the scheme draconian, saying they were being tagged like criminals.'*⁹ This is a delicate situation which drew a lot of anger and frustration from the student population. Adhering to the Universities ethical code of conduct is of paramount importance when carrying out a project such as this one. When dealing with the whereabouts of students on a regular basis certain rights and regulations must be protected. This is an issue that has become even more relevant today with companies like google and uber widely criticised for the misuse of their user's data location.

Another solution that is already being put to use is the Onyx Student Attendance Monitoring System which is developed by the company Telepen. Similar to the SAM system at the University of Sheffield Onyx allows for *'the automated collection of student attendance and engagement data and are designed to aide student retention.'*¹⁰ The Onyx system is also specifically designed to assist in monitoring overseas student's whose Visa validity is based upon their attendance at their course. The system operates using a web based user interface and allows users to import student attendances via a Microsoft excel or CSV file. The Onyx system has additional functionality such as automated email service for a wide range of email addresses. It also has a feature that flags up students who have a significant amount of repeated absences. The Onyx SAM system however does not have any full proof method of ensuring students are physically in their correct class. Their system allows for the input of attendance data to their system but does not offer a new way of recording that attendance.

The research into solutions implemented and tested by other academic institutions has been greatly beneficial to this project. It has had a profound effect on the approach taken to finding a solution to the problem of student attendance at University. After considerable research and analysis into current solutions it was decided that there were three viable solutions to consider. The first solution that was proposed was implementing a system that required students to sign in for their classes using a One Time Authorization Code. The next idea that was proposed to solve the problem of student attendance was by using a QR code feature. The student would theoretically scan the QR code put on display by their lecturer using their smart phones. This would then automatically sign the student in for that specific class. The final idea put forward was implementing a geo location system. This would allow students to sign in for their class only if their physical location matched the location of their class. These were all viable solutions to the problem outlined. The following section will take a more in depth look at each proposed solution. It will also explain why the decision was made to adopt one of the solutions rather than the others.

The first idea that was initially proposed as a viable solution was by implementing a sign in system using a QR code. QR (Quick Response) codes are a machine readable type of bar code that can be used for many purposes. QR codes are relatively easy to scan and can hold more data than traditional bar codes. QR codes have many uses including boarding passes, virtual stores, payments, encryption and website log ins. Ryanair utilise QR codes on mobile's and smart watches which are then used as a boarding pass. The idea behind using QR codes in a smart attendance system is a simple process. Theoretically the student will firstly log into their user area using their B number and password. The lecturer will then display a QR code on the interactive whiteboard within the lecture theatre. The students will then scan the QR code which will automatically sign them into that particular lecture. The attendance data will then be sent to the systems database.

A similar system has already been tested by Google in 2012. The test *'let users scan a QR code from a special Google Web Page. The QR code will return a web page on the user's phone and once that URL is tapped, the desktop browser will automatically redirect to the user's logged-in Google Account without requiring a password.'*¹¹ This demonstrates the effectiveness of using a QR code to quickly perform a simple task. In this case it would be used to quickly take student attendance at a university lecture. There were several promising features of implementing a QR based attendance system. However, there were some serious concerns about using QR codes as a solution to student attendance. The following will analyse the pros and cons of using QR codes. First of all, QR codes offer fast readability which would be greatly beneficial to a system that requires efficiency. They also have significantly larger storage capacity than traditional bar codes which could be useful. QR codes are trackable and have a variety of uses in everyday life. They are also extremely cost effective and would be a fairly cheap solution to implement on a wide scale. These are all fairly helpful features of QR codes however, there are considerable concerns about using QR codes in smart attendance system.

First of all, not all devices will have an integrated camera required to scan a QR code. There are also smartphones that do have QR code scanners pre-installed. The student will also have to spend time taking a photo to scan the QR code correctly. If the student has an obstructed view or glare may affect their ability to scan the QR code. Not many people use QR codes on a daily basis and some companies are discontinuing their use due to lack of user engagement. There is also the issue of students sending the QR codes to one another making it an easy loophole to avoid going to class. Security is another problem that has been raised which has affected other institutions. This was the case when a member of Poland's Computer Emergency Response Team was able to generate fake QR codes. This allowed him to gain access to first class lounges in an Istanbul airport. He stated *'it took 10 seconds to create a boarding pass.... And it doesn't even have to look legit because you're not in contact with any humans.'*¹² This is one example of the security frailties that are synonymous with QR codes.

The next solution that was proposed was by using a One Time Authorisation Code as a method to record student attendance. A One Time Authorization Code (OTAC) is used to validate a user's identity and to permit access. The code issued is only valid for one session and is a secure way to validate the user's identity. OTAC have many uses including unblocking email accounts, banking and accessing networks. However, they are primarily used to verify user identity. OTAC's are used frequently by banks to ensure online transactions are as secure as they can be. MasterCard uses a similar security protocol which works by *'providing you with a One Time Authorization Code (OTAC) for every transaction, which needs to be entered to complete each of your online transactions.'*¹³ OTAC are very secure and it is easy to understand why banks utilise in this way in order to maintain a secure service for their customers.

To implement an OTAC in a smart attendance system it would follow a similar procedure mentioned in the previous section. Again the user would log in using their B number and password. This time however the lecturer would display an OTAC unique for that particular lecture. The student would then enter the OTAC which would then mark their attendance at that particular lecture. The attendance information for that class would also be sent and stored in a database. OTAC's are generally very secure but they are not invulnerable to cyber-attacks. This was the case most recently when the malware 'Android.Bankosy' stole OTAC's sent to Android devices. Hackers used the malware to *'collect system specific information and send it to the command and control (C&C) server. After registering the android device in the server, the malware uses an ID to communicate further with the server and receive command from there.'*¹⁴ This highlights that OTAC's are not completely secure. However, it would be surprising if a student used a similar method just to sign into a lecture.

Using a OTAC function in a smart attendance system has the potential to be an effective solution the problem. However, there are positive and negative features that go along with implementing a OTAC into the system. The positive impact of using an OTAC in the system is that it is cost effective and does not transmit the user's password over the network. The student does not have to remember the OTAC or keep a record of it. OTAC's do not have the same predictability of a password created by a user. This ensures that the OTAC generated for a specific class remains secure. A OTAC can only be used once during a single session and will not be valid for future classes. There are some significant flaws when adopting a OTAC as a solution to this particular problem. Students attending a lecture can forward the OTAC to those not present. If there is a problem generating the OTAC it creates an issue with recording the attendance for that class. OTAC have to be changed every session which will result in a significant amount of codes needed during an academic week. OTAC offer an effective way of recording student attendance. However, it is not full proof enough to encourage students to attend class regularly. His is mainly down to the ways a means students can get around the system.

The final idea that was put forward as a potential solution to tackle the problem of student attendance was by implementing a geo-location based system. Using the location based service of the student's device may provide a highly effective means verifying that they are attending class at the point of sign in. Location based services (LBS) are a type of computer program that requires the user's geographical location in order to function properly. LBS are becoming increasingly popular and companies are taking advantage of the benefits they provide. Mobile devices are an extremely effective way of tracking a person's movements. Many apps now require the user to give permission to their app in order for them to function effectively. These include weather, maps and taxi applications among others. For example, a weather application needs to access LBS in order to provide the local weather forecast.

Apps that require LBS are increasingly popular with dating and 'find your phone' styled apps on the rise. According to Markets and Markets, *'location based services are forecasted to grow from \$8.12 billion in 2014 to \$39.87 billion in 2019, at a compound annual growth rate (CAGR) of 37.5%.'*¹⁵ This demonstrates how important LBS are becoming to app development and the mobile sector. There are however some ethical issues when using LBS, the main one being privacy. Tracking an individual's location via their smart phone can be a serious infringement of their privacy when used for anything other than what the user has authorized. There have been cases where location data has been leaked to unauthorized third parties. These *'concerns over the confidentiality of smartphone data have led to the creation of mobile devices specifically aimed at protecting users' data, including Silent Circle's Blackphone and Blackberry's Leap.'*¹⁶ Privacy has become a serious risk to companies who use LBS to their customers. The taxi service company Uber have recently come under scrutiny with the way in which it manages its location based services. There appears to be potential in using location based services in a smart attendance system.

In order to use LBS in a smart attendance system it would require the student's permission. Once the student has authorized that the system can use their LBS they must then be able to sign in for their class. This can be achieved by logging in with their B number and password. The system will verify their location is correct and send their updated attendance record to a database. Like the previously outlines potential solutions there are good and bad features of using a geo location based system. The pros of using the student's location based information include the requirement of the student to be physically in the lecture theatre to sign in for class. Using a geo location based sign in system removes the need for lecturer participation during attendance recording procedure. Theoretically it should be a fast and effective way of recording attendance at a lecture. It also gives students an increased incentive to attend classes. There are however, a few issues that may be problematic when using LBS. Firstly it requires the student to grant permission for the system to use the LBS on their device. Student can sign in for class then leave at the first opportunity. They can also get close enough to the class room in order to sign in without actually entering the lecture theatre or classroom. There are also important privacy and legal issues to consider when using LBS. These must be taken into consideration and the Universities code of conduct must be followed when doing so.

The decision was taken to implement the geo-location based system for this particular project. This is primarily due to the loopholes that students could exploit in the other solutions. Both the QR code and the OTAC solutions both lacked the ability to physically verify the student's location at the point of sign in. It is because of this that the decision was made to remove them as viable solutions to the student attendance problem. Although there have been issues surrounding the use of location based services. It is abundantly clear that it is the best possible solution that has been put forward during the analysis and design phase of this project. The next chapter of this dissertation will analyse and identify the functional requirements for the system.

Chapter 3: Requirements Analysis

The aim of this project is to develop a smart attendance system to help solve the ongoing problem with student attendance at university. The idea that has been proposed is a geo-location based system. The primary function of the system will allow students to sign in for class using geo-location verification. However, students are not the only individuals who will be accessing and using the smart attendance system. The system will also be used by both lecturer's at the university as well as the administration staff at the school office. The system will be split into three different user areas for students, lecturer's and administrators. Each user will have specific functions available to them. The functional requirements of each user are documented in figure 1 below.

Administrator	Lecturer	Student
Must be able to sign into the system using a username and password.	Must be able to sign into the system using a username and password.	Must be able to sign into the system using a username and password.
Must be able to register new users to the system. (both students and lecturers)	Use the GPS button verify their location.	Use the GPS button verify their location.
Must be able to edit the records of both students and lecturers.	To view the attendance data of students in the database.	
Must be able to delete the records of both student's and lecturers.		
Must be able to set the location of each class.		

Figure 3.1: Illustrates the functional requirements for each user area of the smart attendance website.

Chapter 4: Design

This chapter will be addressing the design phase of the project and what it entailed. This will include the design of the user interface, software architecture and database design. It will also feature other high level descriptions of my system complete with data definitions and explanations of any algorithms used. The design section of my system should explain in detail how the system was created. This chapter will also cover the various decisions that were made during the design phase. More importantly it will explain why each decision was taken. The section will also include graphical representation of the system through block diagrams, navigational charts and design schema for the database. Screen shots will also be included in this section to illustrate how the system was designed. It will also explain the rationale behind the HCI guidelines that were followed throughout the design procedure. The following will chronicle every aspect of the design stage of this project.

The importance of a good user interface design cannot be understated. The look, feel and usability of the website will have a profound impact on the user's experience. The UID should allow the user to operate the website effortlessly and efficiently. During the basic design of the interface a number of practices were followed to ensure the website was easy to use and navigate. The UID was kept as simple as possible as it makes users feel comfortable in using and navigating the website. The layout and design are consistent throughout each page of the website making it look and feel more professional. The colour scheme and texture of the site also remains consistent throughout each page giving it an aesthetically pleasing feel. Navigation is kept basic with the buttons positioned horizontally towards the top of the screen. During the design of the interface it is important to know your audience '*understand their goals, skills, preferences and tendencies*'¹⁷. These are all important aspects to consider when developing a good UID. During the design phase the focus was primarily on the user's general interaction, information display and data entry when using the website. Focussing on these three areas is a result of following HCI guidelines. These guidelines are heavily influenced by '*Shneiderman's Eight Golden Rules*' and '*Norman's Seven Principles*'.

During the design of the website significant attention was paid to the user's general interaction. The guidelines followed for this particular area include consistency, simplicity, easy to remember information, excuse mistakes and use of simple language. Information displayed on the website is also a vitally important aspect with regards to the design. It is extremely important that *'information provided by the HCI should not be incomplete or unclear or else the application will not meet the requirements of the user.'*¹⁸ This demonstrates how important displaying the appropriate information is. Other important information display guidelines that were adhered to include not overloading the user with information, provide error displays and make information easy to see. Data entry is also an important feature of maintaining a good HCI. It requires a reduced number of input actions by the user as well as maintaining balance between data entry and information display. It is also imperative for good HCI that the user cannot input inappropriate data during an action. These are all HCI guidelines that have been followed during the design of this system. They allowed for a professional and aesthetically pleasing UI design.

As mentioned in the previous report the UI was designed for a range of devices and screen sizes. To ensure the website was compatible on various devices with contrasting screen ratios the flex-box model system was adopted. The flex-box model offers a flexible way to design the layout of the website. However, the most important feature of the flex-box model is that it automatically adjusts to fit on a variety of screen sizes. W3 schools' states that flex-box *'ensures that elements behave predictably when the page layout must accommodate different screen sizes and different display devices.'*¹⁹ This means that no matter what kind of device the student is using the website's layout will not be affected by the size of the screen. Another advantage is that *'the latest versions of all major browsers include flexbox support'*²⁰ This decreases the likelihood that students will have problems with the layout of the user interface no matter what web browser they are using.

The flex-box model offers a flexible way to design the layout of the website. However, the most important feature of the flex-box model is that it automatically adjusts to fit on a variety of screen sizes. W3 schools' states that flex-box '*ensures that elements behave predictably when the page layout must accommodate different screen sizes and different display devices.*'²¹ This means that no matter what kind of device the student is using the website's layout will not be affected by the size of the screen. Another advantage is that '*the latest versions of all major browsers include flexbox support*'²² This decreases the likelihood that students will have problems with the layout of the user interface no matter what web browser they are using. Figure 2 below is a screen shot of my prototype system which is using the flex-box model in its CSS file.

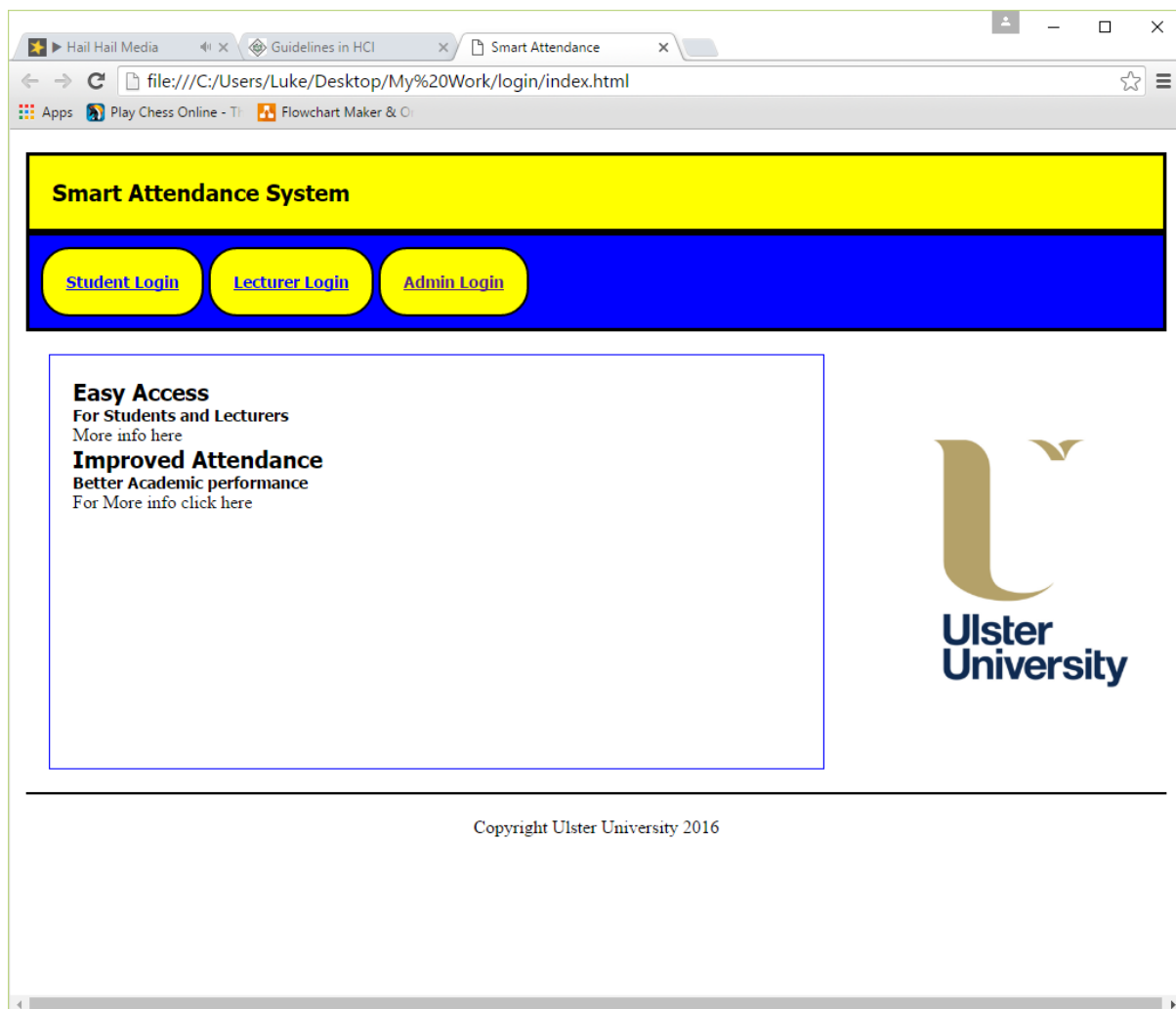


Figure 4.1: Screen shot of prototype system using the flex-box model system.

There have been significant changes made to the UI of the website since the development of the prototype. These are changes that were influenced by implementing an improved HCI experience for the user. First and foremost, the colour scheme was changed to create a more professional look. The original colour scheme displayed in figure 2 is blue and yellow on a white canvas with black font. It was decided that this colour scheme was not visually appealing or professional. It was this rationale that influenced the decision to change the colour scheme. The new colour scheme was a simple sky blue with white font. It also has grey outline features around the box model. The next design development that differs from the prototype is the websites navigation. To create a more seamless navigational experience for the user a dropdown menu was added to each button in the header section of the website. After the user logs in to their area there are new links on the drop down menu of each button. The links displayed depend on which user is signed into the system. The next development in the UI design that differs from the prototype is the index page of the website. The initial index page the website is displayed in figure 2. However, it was decided an entrance page to the system would provide a professional and authentic feel to the website as a whole. Figure 3 below is a screen shot of the index page which acts as an entrance page to the system.

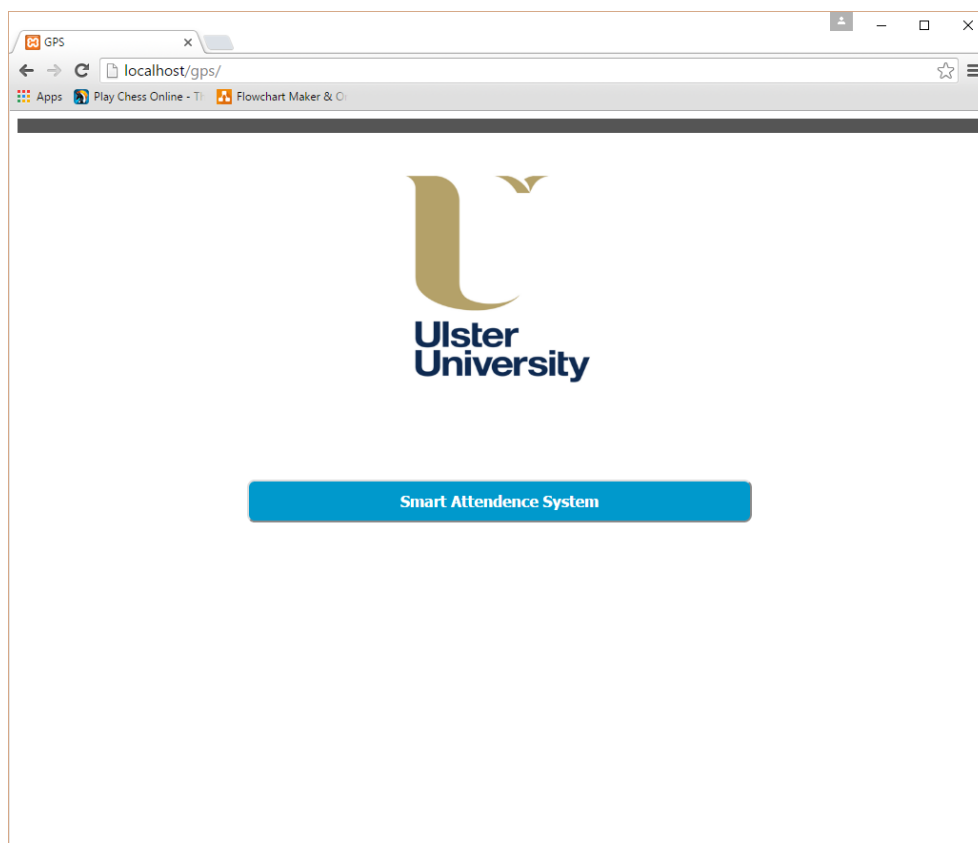
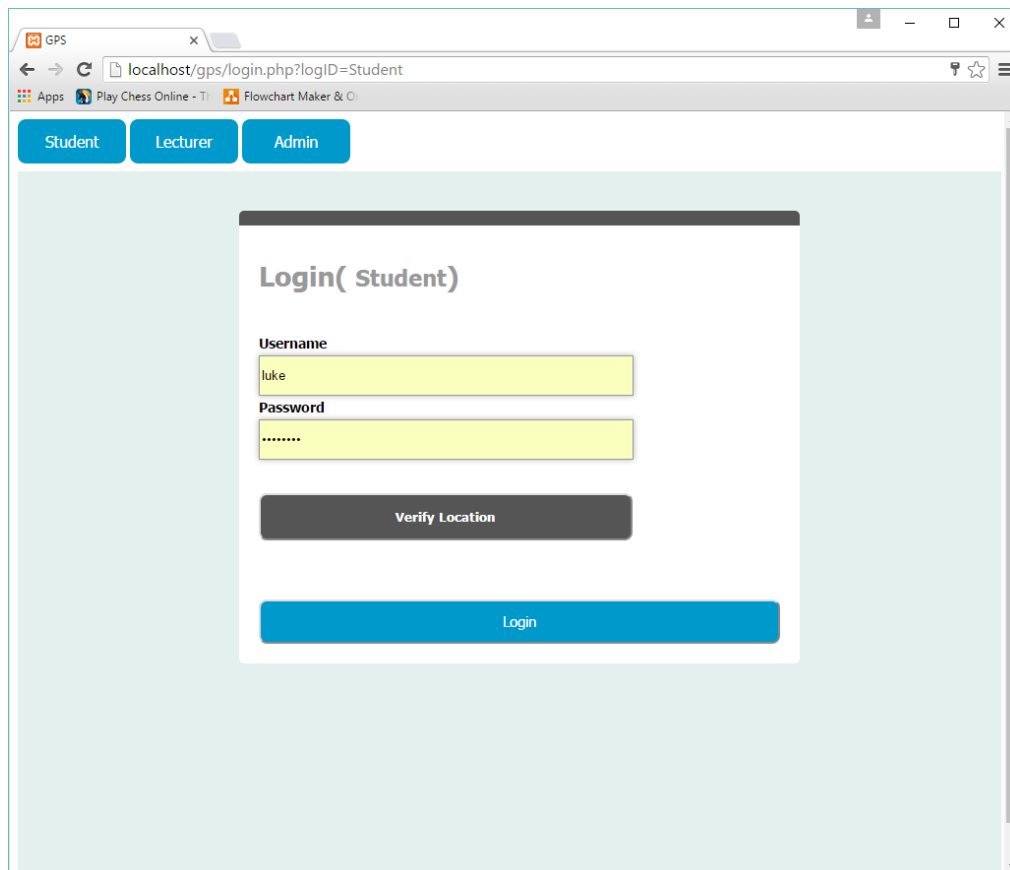


Figure 4.2: Screen shot of the entrance page to the system.

The layout for the login pages for each user are fairly similar. They all require the user to enter their username and password. However, the student and lecturer log in both contain a GPS button which acts as a location verification tool. Figure 4 is an example of a login page for a student using the system.



The screenshot shows a web browser window with the address bar displaying 'localhost/gps/login.php?logID=Student'. The browser's tab is labeled 'GPS'. Below the address bar, there are three blue buttons: 'Student', 'Lecturer', and 'Admin'. The 'Student' button is selected. The main content area has a light blue background. In the center, there is a white box with a dark grey header that reads 'Login(Student)'. Inside this box, there are two input fields: 'Username' with the text 'luke' and 'Password' with masked characters '*****'. Below these fields is a dark grey button labeled 'Verify Location'. At the bottom of the white box is a large blue button labeled 'Login'.

Figure 4.3: Screen shot of the student login page.

Once logged into the system the users will have access to the appropriate features of the system. In this case the student will be able to sign in for class. The lecturer will be able to do the same as well as view the attendance information of their students. The admin staff will have the highest level of access to the system. This allows them to add new users to the system as well as edit and delete student records. The screen shot in figure 5 is an example of an administrator editing a record in the system.

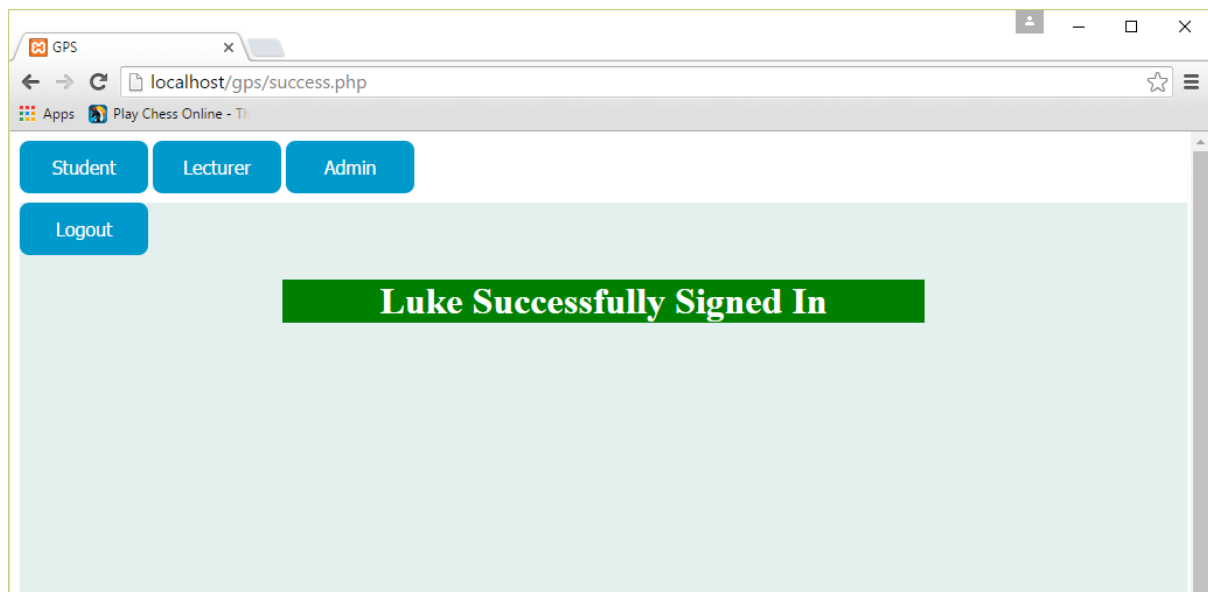
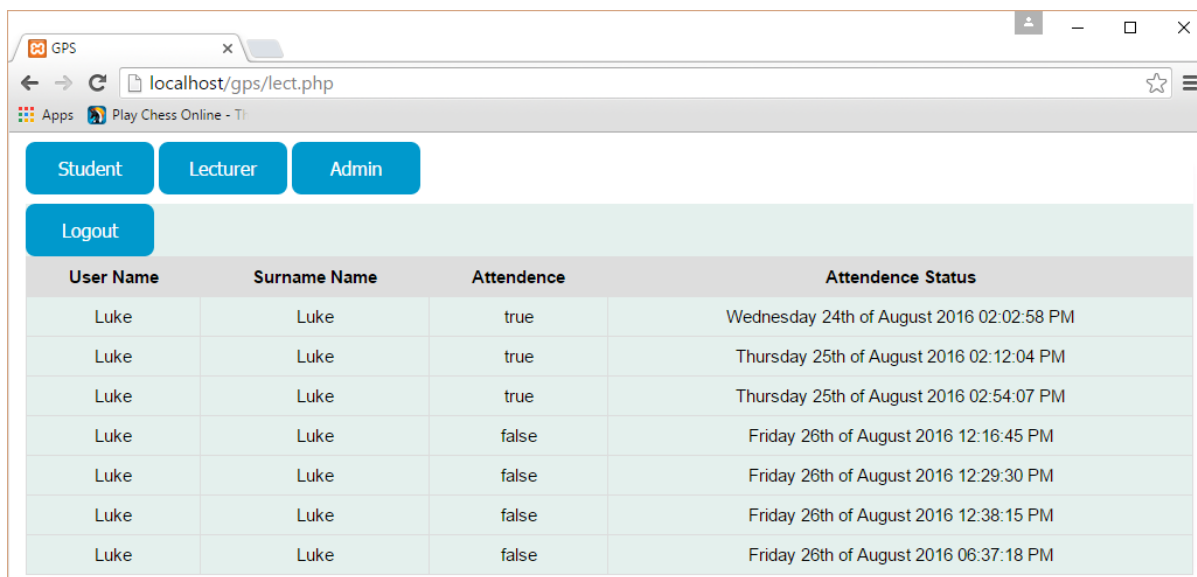


Figure 4.4: Screen shot of the student page after successful sign in.

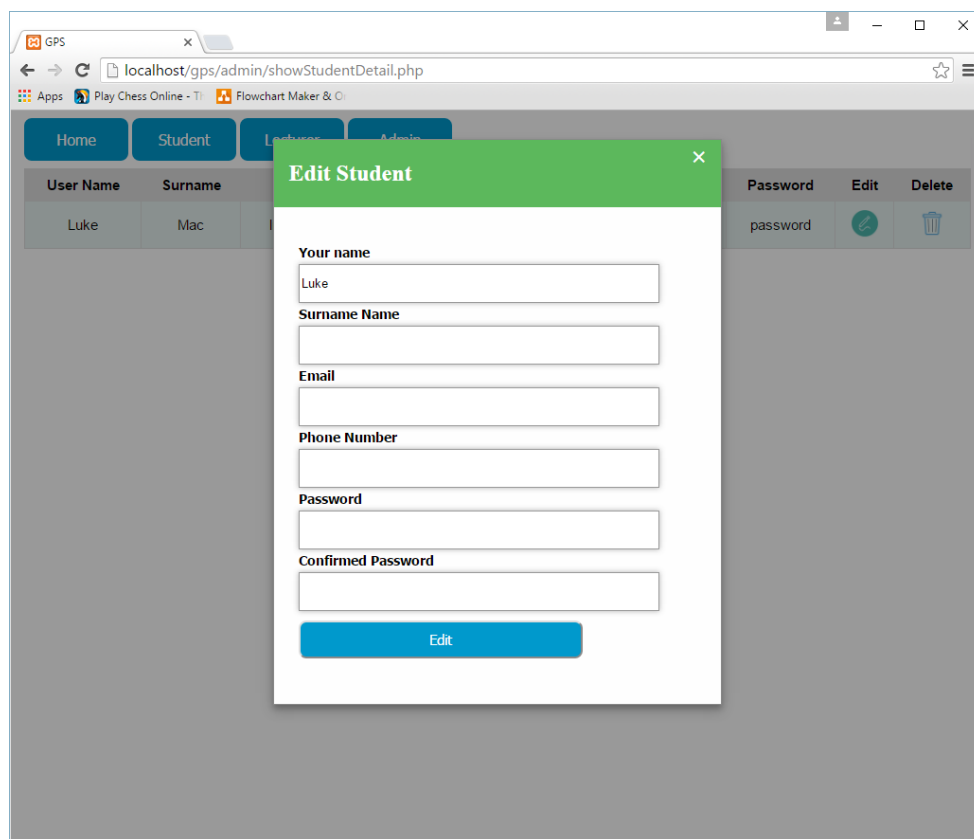
A screenshot of a web browser window showing a student sign-up page. The browser's address bar displays 'localhost/gps/admin/signUp.php?logID=Student'. The page has a light blue background. At the top, there are four blue buttons: 'Home', 'Student', 'Lecturer', and 'Admin'. The main content area features a white box with a dark grey header 'Sign Up (Student)'. Below the header, there are six input fields: 'Your name', 'Surname Name', 'Email', 'Phone Number', 'Password', and 'Confirmed Password'. Below these fields is a dark grey button labeled 'Set Location'. At the bottom of the white box is a blue button labeled 'Register'.

Figure 4.5: Screen shot of the student sign up page.



User Name	Surname Name	Attendance	Attendance Status
Luke	Luke	true	Wednesday 24th of August 2016 02:02:58 PM
Luke	Luke	true	Thursday 25th of August 2016 02:12:04 PM
Luke	Luke	true	Thursday 25th of August 2016 02:54:07 PM
Luke	Luke	false	Friday 26th of August 2016 12:16:45 PM
Luke	Luke	false	Friday 26th of August 2016 12:29:30 PM
Luke	Luke	false	Friday 26th of August 2016 12:38:15 PM
Luke	Luke	false	Friday 26th of August 2016 06:37:18 PM

Figure 4.6: Screen shot of the attendance info for lecturer's.



Home

Student

Lecturer

Admin

User Name	Surname	Password	Edit	Delete
Luke	Mac	password		

Edit Student

Your name

Surname Name

Email

Phone Number

Password

Confirmed Password

Edit

Figure 4.7: Screen shot of the show student detail page.

To maintain consistency in the design of the UI each page used the style ID's that were saved in the CSS file style.css. This ensured that every page would be using the same style ID's continuously. Figure 6 below is an extract from my CSS file containing two style id's.

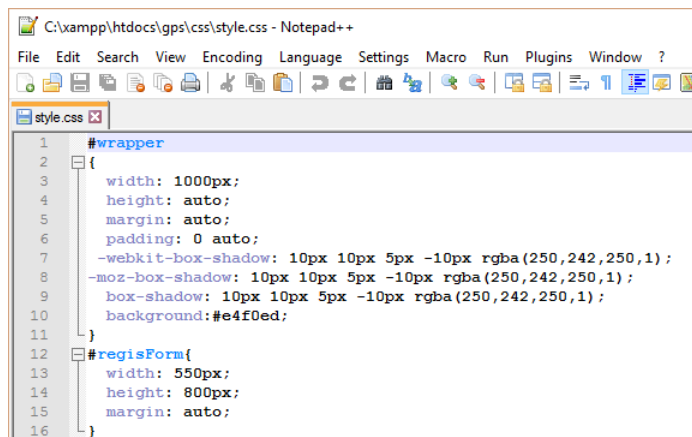


Figure 4.8: An extract from CSS file (style.css).

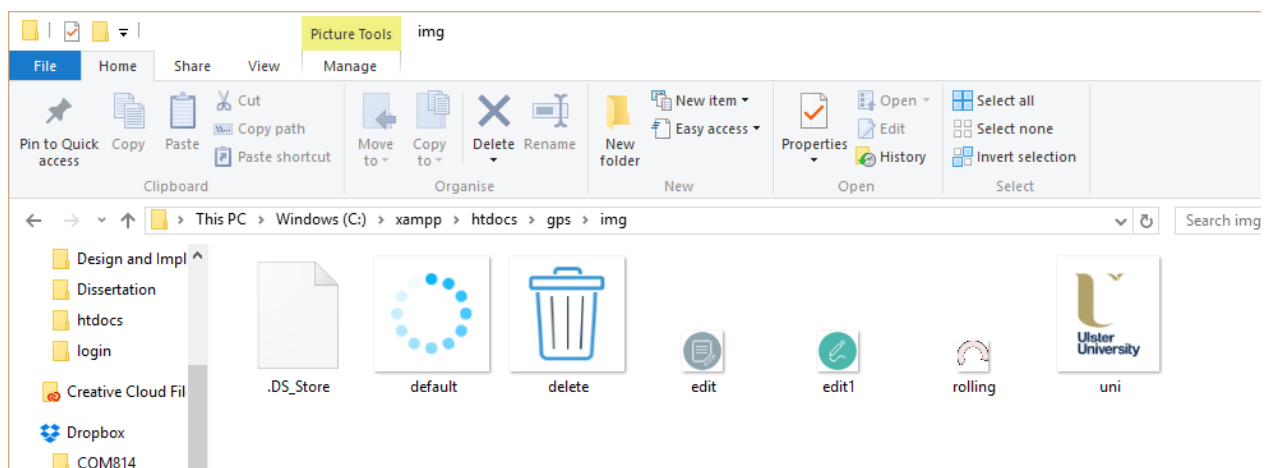


Figure 4.9: A screenshot from my image file.

The system has significantly improved since the prototype. In particular site navigation has become a more efficient process for users. To illustrate the improvements made to site navigation the following site map was created. Figure 6 provides visual representation of the websites navigation system.

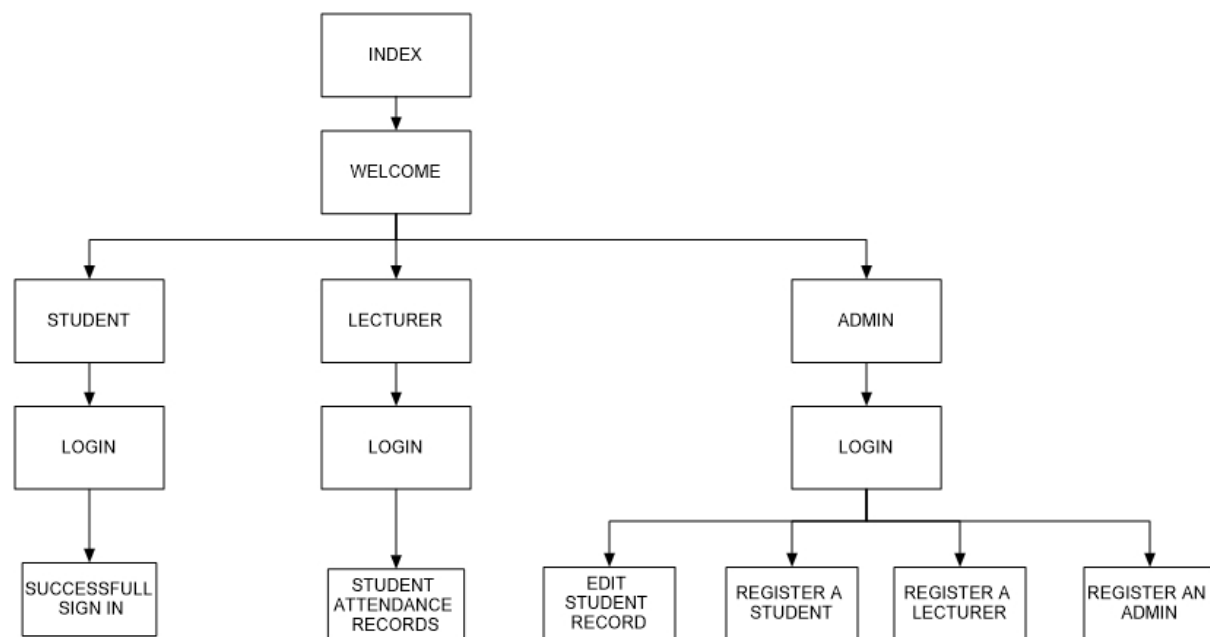


Figure 4.10: Sitemap of Smart Attendance website.

In order for the website to have any kind of functionality a database is needed to store and manage user information. This is especially vital for the log in procedure of the website which needs to verify user names and passwords stored in the database. The database requires all the user related data for students, lecturers and administrators. The data is then separated and the entities defined. It was then placed into tables with the appropriate primary and foreign keys assigned. There were three entities chosen for the smart attendance website. They include admin, login_page and _attendance. The information stored in the database is required for various aspects of the websites functionality. This will be explained in further detail in the implementation section.

This database is significantly different to the one created for the prototype. First of all, I have remove the student grades and course director features from the system entirely. This decision was taken during a meeting with the second marker and supervisor for this project. Also the user details of student's and lecturers were placed into one table rather than having individual tables for each user. Admin staff have their own table as they have different level of access to lecturer's and students using the system. The final table is the attendance table which will hold the attendance status of both students and lecturer's. The following illustrates the structure of my database including all three of the entities used to store the data. It shows the attributes, primary key and foreign key selection of each entity in the database.

Field	Type
ad_id*	int (11)
ad_user	varchar (200)
ad_password	varchar (200)

Figure 4.11: admin table.

Field	Type
us_id*	int (11)
_user	varchar (200)
_sname	varchar (200)
_email	varchar (200)
us_num#	int (11)
_location	varchar (200)
_password	varchar (200)
_latitude#	double
_longitude#	double
lo_status	varchar (100)

Figure 4.12: login_page table.

Field	Type
att_id*	int (11)
att_stID#	int (11)
att_type	varchar (200)
att_status	varchar (100)
att_time	varchar (200)

Figure 4.13: _attendance table.

Chapter 5: Implementation

This section of the report will provide an insight into how and why certain aspects of the system were implemented and how it was carried out. This will involve describing the approach that was taken to development. The type of methodology that was followed when developing the system. This chapter will also state what was learned from the prototype created earlier in the year. It will then go into detail in how the prototype influenced the changes that were made during development. Furthermore, it will identify the rationale behind the steps that were made in order to arrive at the final system. There were certain aspects of this project that required specific tools in order to progress with the development process. This will be addressed in this section as well as the new technology and languages that were learned and essential in creating the final system. The final part of this chapter will take an in depth look at the significant aspects of code produced. It will provide detailed explanation of its functionality and how it was integrated in to the final system.

The first part of implementation that this section will address is the approach that was taken to the development process. The methodology that was chosen for this project was the modified waterfall model. This was a vital part of the project which will be explained in more detail later. The modified waterfall model has the same basic structure as the pure waterfall model. However, the modified waterfall model allows for more flexibility throughout each stage of development. In particular, it allows for the overlapping of each stage of development which enables changes to be made with greater ease. There are advantages to adopting this methodology. Firstly, it is very flexible, also *'if there is personnel continuity between the phases, documentation can be substantially reduced.'*²³ There are however some disadvantages to using this model. Certain milestones in development are more ambiguous than with pure waterfall. The modified waterfall methodology was selected as it allowed increased flexibility. It allowed for the change from a mobile app to a website. It also allowed for the change of features in the system as well the schema of the database. It was also a methodology suited to an individual project such as this. Figure 14 is a graphical representation of the modified waterfall methodology used in this project.

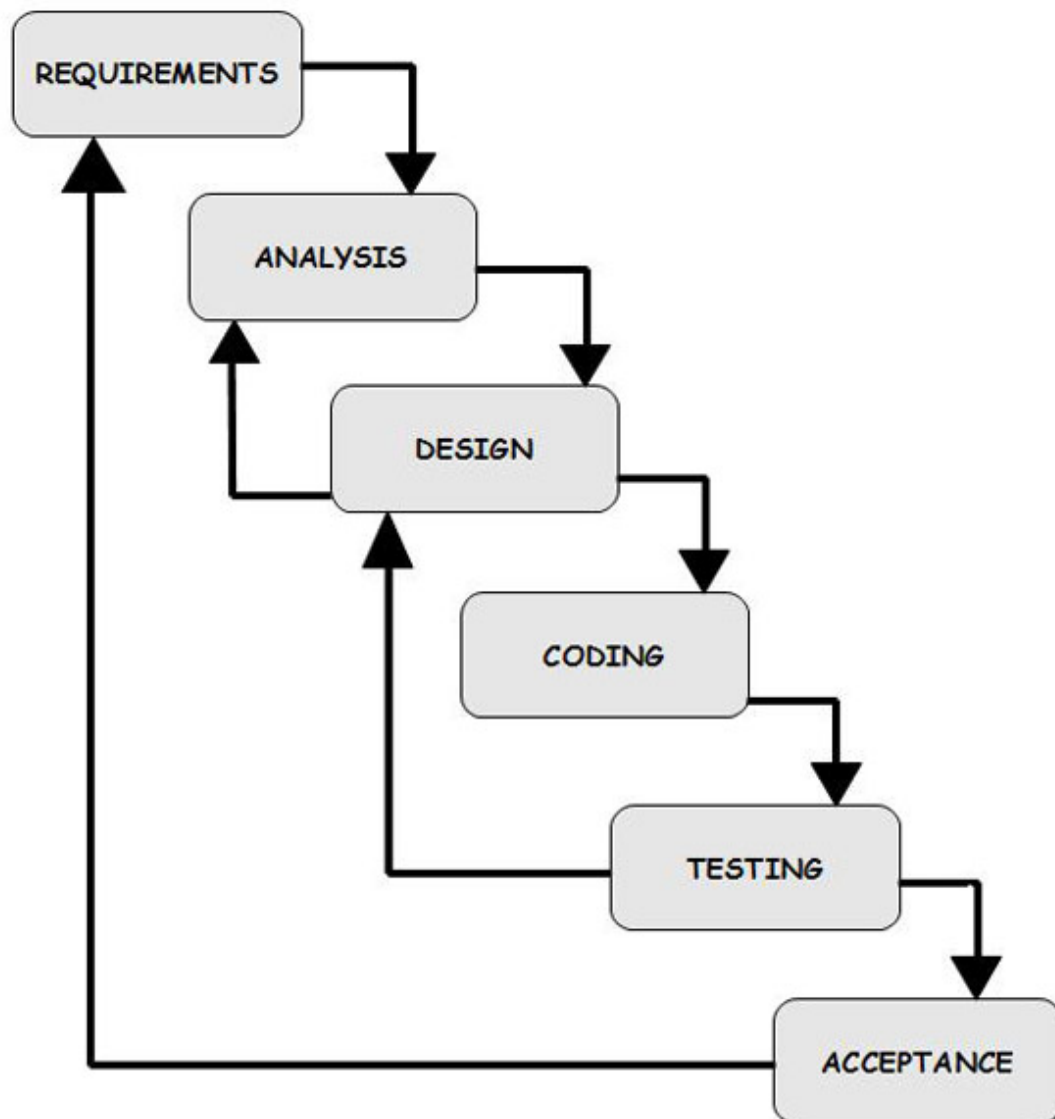


Figure 5.1: Diagram of modified waterfall methodology.

The invaluable feature of using the modified waterfall model was flexibility. It was put to use on more than one occasion during this project. It allowed me to make various changes during each stage of development. Changing the format of the solution from an app to a website is a prime example of what the modified waterfall model allowed me to do. The following section will analyse the changes that were made that were a direct result of the prototype that was developed.

There were several things learned after the creation of a prototype system earlier in the development stage. Firstly, there were a number of features that needed to be added in order to complete the system. The prototype only contained the functionality to sign a user into the system. The essentially functional requirements were to sign a student into class using GPS to verify their location. This was eventually integrated in to the final system. There were changes that were needed to be carried out to the prototype system. The first change that was made was to the UI interface design. The prototype design layout largely remained the same. However, the visual features of the design were greatly changed and improved. The colour scheme was changed in order to make it more aesthetically appealing to the user and provide a more professional look. After presenting the prototype to the project supervisor and second marker it was decided that certain features should be dropped from the system. The first of these was the inclusion of student grades in the system. This was considered to be extra work and it was decided to focus on the core requirements of the system. The same goes for having an access point for a course director in the system. Again time constraints resulted in this particular feature being dropped.

There were also significant changes made to the system as a result of presenting the prototype to the project supervisor and second marker. This is with regards to the student login system. The prototype system was using separate tables in the database to store the login information for each user. This was deemed unnecessary during a meeting and the required changes were made as a result. The exception was the login information of the admin users which was stored in a separate table. This is because the admin user has a different level of access to the system. They also have a different level of authorization and functionality when using the website. These functions include adding users to the system and the ability to edit and delete records. By analysing the prototype, it revealed what functional requirements needed to be added to the system. It also showed what changes were needed to be made to improve the website. The next part of this chapter will review the steps that were taken in order to create the final system.

The decision to change the format of the system from a mobile app to website resulted in the need to gain the technical skills to do so. In this case it required me to learn new programming languages that were essential in web development. The core programming languages that were identified as being of paramount importance to develop a website were HTML5, CSS, PHP and JavaScript. It was decided early in second semester to change the format of the system. This was primarily due to cross platform issues that were raised during meetings with the project supervisor. However, I had no previous experience in web development. The core language that was taught in first semester was Java. This in turn required me to become relatively proficient in web development in a short space of time. It was recommended by my then project supervisor Jennifer Moody to explore online learning resources such as W3 Schools and Treehouse. The decision was then made to put significant effort into learning HTML5, PHP, CSS and JavaScript during the Easter break.

It was during the break of second semester that was spent learning new programming languages using online tutorials. W3 schools was one of the most helpful learning tools which assisted in my understanding of the fundamentals of web development. W3 School's has been described as *'the best website to learn coding online as you kind find a great user interface as well as loads of course.'*²⁴ This allowed me to get the grips with basics with simple instructions and easy to follow tutorials. However, I found Treehouse tutorials the most helpful resource when learning new programming languages. It has been described as *'highly focussed on tech/computer-centric subjects (HTML, CSS, app building and more).'*²⁵ Another learning tool that I found extremely helpful was the new Boston's YouTube channel. This was especially helpful when learning PHP which is the core language used in the smart attendance system. It was essential to learn these programming languages prior to the development stage of the project. The next section of this chapter will take an in depth look at each page of the website. It will focus on the significant aspects of the code produced. It will explain how it works in relation to the function of the smart attendance system.

The following section will provide a detailed explanation of the most significant aspects of the code in this system. It will review the relevance and functionality of each page but spend considerably more time on the complex parts of the system. The files in this system consist of HTML, CSS, PHP and JavaScript. The files are separated into different sections relevant to their functions. They include the files for student and lecturer functions, admin functions, JavaScript, CSS and images. Many files in this system are written mostly in HTML but are saved as a PHP file. This is done so that the file can also carry out PHP functions. The first part of this section will focus on the files used for student and lecturer functions. The index file is written in HTML and serves as an entrance to the smart attendance system. It contains the university logo and a button that links the user to the welcome page. The welcome file is written in PHP and includes both the main header and footer of the website as well as a welcome message to the user. The login page is written in PHP and allows for students, lecturers and admin to login to the system. It also includes the header and footer of the website. The file includes a form that allows for the user to login to their user area. The logout file in this system is written in PHP and allows for students and lecturers to logout by redirecting them to the index page.

The header file is written in both PHP and HTML and displays the drop down buttons at the top of the website. The first three lines of this file are written in PHP in order to start the session. The rest of this file is written in HTML which is used to create the drop down buttons which link to other pages in the website. The footer file is more complicated than the header file. It contains functions to register new users to the system and to log users into their areas. It also contains a function that acts as an email validation. This is to ensure that when email addresses are entered they are done so in the correct format. Figure 15 shows an extract of code that assists in registration process. It prompts the user to enter details of new user to be registered to the system.

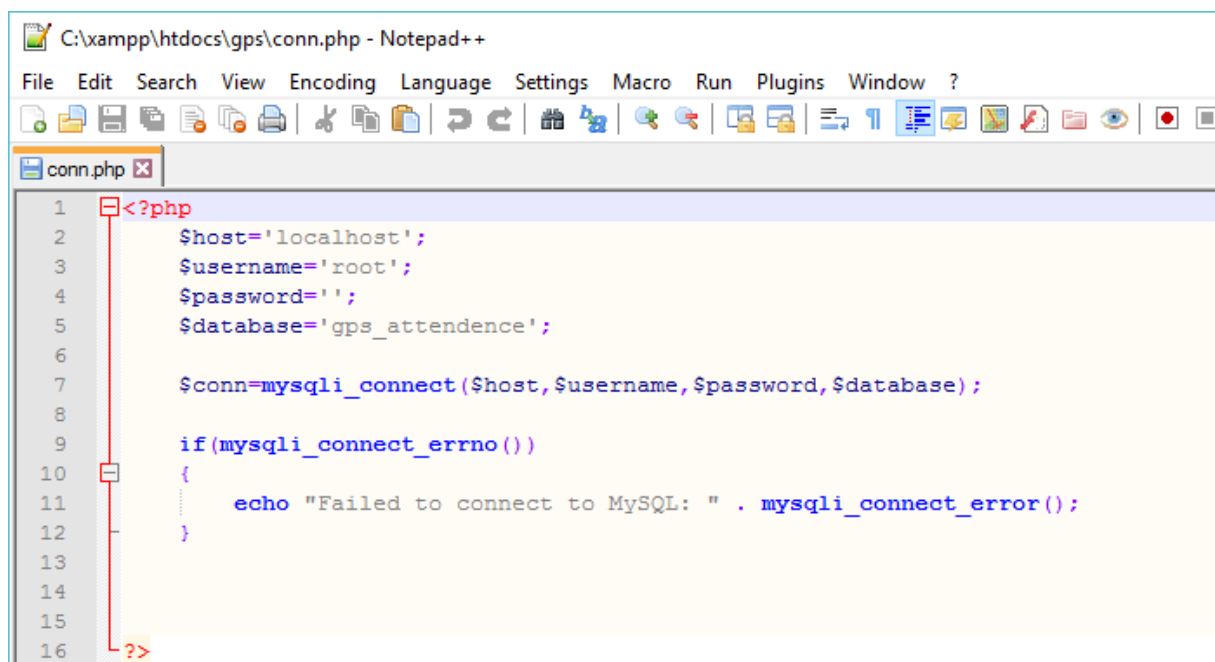
```

if(name=='')
{
    document.getElementById('signUpFo').innerHTML='Register';
    $("#name").css('border-color','red');
    document.getElementById('error').innerHTML=" * Enter Your Name";
}else if(sname=='')
{
    document.getElementById('signUpFo').innerHTML='Register';
    $("#name").css('border-color','white');
    $("#sname").css('border-color','red');
    document.getElementById('error').innerHTML=" * Enter Surname Name";
}else if(email=='')
{
    $("#sname").css('border-color','white');
    document.getElementById('signUpFo').innerHTML='Register';
    $("#email").css('border-color','red');
    document.getElementById('error').innerHTML=" * Enter Email";
}else if(validateEmail(email)==false)
{
    document.getElementById('signUpFo').innerHTML='Register';
    document.getElementById('error').innerHTML=" * Email Must be Valid";
    document.getElementById('success').innerHTML="";
}

```

Figure 5.2: Code used to register new users.

The conn file is written in PHP and serves its purpose by setting up a connection between the website and the database over a server. It connects to server using the hostname, username, password and database name. Figure 16 shows the PHP file which creates this connection.



```

C:\xampp\htdocs\gps\conn.php - Notepad++
File Edit Search View Encoding Language Settings Macro Run Plugins Window ?
conn.php
1 <?php
2     $host='localhost';
3     $username='root';
4     $password='';
5     $database='gps_attendance';
6
7     $conn=mysqli_connect($host,$username,$password,$database);
8
9     if(mysqli_connect_errno())
10    {
11        echo "Failed to connect to MySQL: " . mysqli_connect_error();
12    }
13
14
15
16 ?>

```

Figure 5.3: PHP file setting up connection to database.

The success file is also written in PHP and verifies that a student has successfully signed into the system displaying their name. The insert data page is written in PHP and uses the conn file to insert data into the login page. The insert data ds file then uses the data entered in the login page and inserts it into the login_page table in the database. This process is demonstrated in Figure 17 below.

```

1  <?php
2
3  include_once('conn.php');
4  session_start();
5
6  if(
7      isset($_POST['name']) &&
8      isset($_POST['sname']) &&
9      isset($_POST['email']) &&
10     isset($_POST['password']) &&
11     isset($_POST['locationV']) &&
12     isset($_POST['latitude']) &&
13     isset($_POST['longitude'])
14 )
15 {
16     $name=$_POST['name'];
17     $sname=$_POST['sname'];
18     $email=$_POST['email'];
19     $password=$_POST['password'];
20     $locationV=$_POST['locationV'];
21     $latitude=$_POST['latitude'];
22     $longitude=$_POST['longitude'];
23     $sql="INSERT INTO login_page VALUES('','$name','$sname','$email','$password','$locationV','$latitude','$longitude')";
24     $query=mysqli_query($conn,$sql);
25     if(!$query)
26     {
27         echo 0;
28     }else
29     {
30         echo 1;
31     }
32 }
33 ?>

```

PHP Hypertext Preprocessor file length : 704 lines : 32 Ln : 17 Col : 32 Sel : 0 | 0 UNIX UTF-8 INS

Figure 5.4: PHP file inserting data into database.

The function file is written in PHP and carries out various functions within the website. These include editing and deleting a student from the system. It also verifies if the longitude and latitude are the same as the one stored in the database. If so it will mark the student's attendance as true.

They are called using the on click function. The lect file uses the conn file in order to connect to the database. It then takes the students username, surname, attendance and attendance stats and displays it in a table. The home file is written in PHP and I used to link the user back to index page. The next section will cover the files that are specifically created for the administration side of the system. These files are all stored in a folder called admin. The edit form file in the admin folder is written in PHP and allows the user to enter the details of a new admin user. The footer file within the admin folder calls fetch location, get location and show position functions. It also has a sign up function so new admin users can be added. Similar to the footer file in the previous section it also has a function to validate the email address entered.

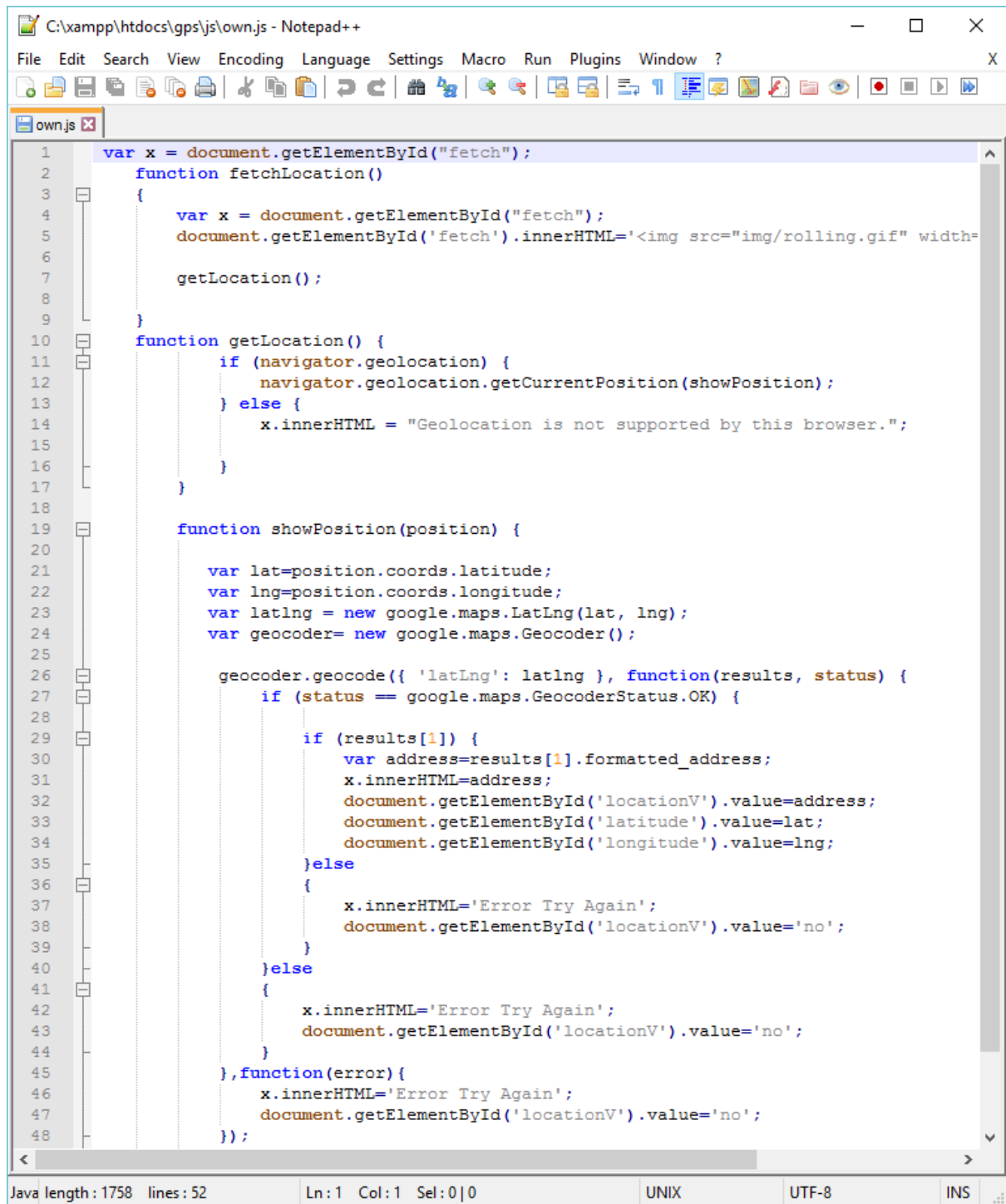
The header file in the admin folder is also similar to the previous header file. The first three lines are written in PHP to begin the session. It is then followed by HTML and CSS containing the drop down buttons like in the previous header file. However, this file has different links in the drop down menu that only the admin users will be able to access. These are student account, student details, lecturer account and admin account. The index file in the admin section is in PHP format and includes both the header and footer files. It also contains a welcome message for the admin user once they have successfully logged into their area. The logout PHP file in the admin folder operates in the same manner as the previously mentioned logout file. The show student detail file is written in both HTML and PHP. The first section is written in HTML and CSS and is responsible for how the students details are displayed to the user. In this case that is in a table format. The second section written in PHP takes the students details from the login_page in the database and inserts it in the table for the user to view. The final section uses the edit and delete functions from the function PHP file. The sign up file is written in PHP and contains a form for the admin to sign up a new user to the system. This file is used for registering new students, lecturers and administrators to the system. Figure 18 below shows part of the form that was created in order for the admin member to enter the details of the new user to be registered.

```
13
14  <?><div id="regisForm">
15      <form name="FormData" id="registerSubmit">
16          <div>
17              <h1 style="color:#999;">Sign Up
18              <?php
19                  if($logID!='')
20                  {
21                      echo ' ( <small>' . $logID . '</small> ) ' ;
22                  }
23              <?>
24              </h1>
25              <span id="error" style="color:red;"></span>
26              <span id="success" style="color:green;"></span><br>
27              <label>
28                  <span>Your name</span><input id="name" type="text" name="name" />
29              </label>
30              <label>
31                  <span>Surname Name</span><input id="sname" type="text" name="sname" />
32              </label>
33              <label>
34                  <span>Email</span><input id="email" type="text" name="email" />
35              </label>
36              <label>
37                  <span>Phone Number</span><input id="number" type="text" name="number" />
38              </label>
39              <label>
40                  <span>Password</span><input id="password" type="password" name="password" />
41              </label>
42              <label>
43                  <span>Confirmed Password</span><input id="cpassword" type="password" name="cp" />
44              </label>
45              <label style="margin-top:5px;">
46                  <span style="margin-top:20px;"></span><br>
47                  <button type="button" id="fetch" onclick="fetchLocation()" style="background-color: #999; color: white; padding: 5px 10px;" />
48              </label>
49          </div>
50      </form>
51  </div>
```

PHP Hypertext | length: 1980 | lines: 72 | Ln: 1 Col: 1 Sel: 0 | 0 | UNIX | UTF-8 | INS

Figure 5.5: Registration form in signUp.PHP file.

There are also three JavaScript files that are stored in a separate folder called js. They are jquery.min, map and own. JQuery.min contains the version of jQuery used in the system. The map JavaScript file contains the google maps source code with the google api key inserted. The JavaScript file own is used to create the several functions that the website uses and that other PHP files use. These are the get location and show position functions and are vital to calculate the user's longitude and latitude. The JavaScript file own is displayed in Figure 19 below.



```
1  var x = document.getElementById("fetch");
2  function fetchLocation()
3  {
4      var x = document.getElementById("fetch");
5      document.getElementById('fetch').innerHTML='26</sup> In this case the chapter will focus on three testing methodologies synonymous with web application testing practices. These involve usability, user acceptance and functional. Each of these testing methodologies are vitally important in establishing a system that is ready for user interaction. Each of these testing phases address important features of the system and will provide an indication to how effective the system is at providing a solution to the problem. The testing phase for each section is displayed in a table format.

The first phase of testing will be the usability of the system and will provide an indication if the system is ready for user interaction. It will primarily cover the testing of navigation between pages. This is important to create a user friendly experience. The below table is the usability testing process that was carried out.

| Testing Criteria                                  | Page            | Error        | Resolution                  |
|---------------------------------------------------|-----------------|--------------|-----------------------------|
| Navigational Button:<br>'Smart Attendance System' | index.php       | N/A          | N/A                         |
| Navigational Button:<br>'Admin Login'             | welcome.php     | N/A          | N/A                         |
| Navigational Button:<br>'Lecturer Login'          | welcome.php     | N/A          | N/A                         |
| Navigational Button:<br>'Student Login'           | welcome.php     | N/A          | N/A                         |
| Navigational Button:<br>'Admin Account'           | admin/index.php | N/A          | N/A                         |
| Navigational Button:<br>'Admin Logout'            | admin/index.php | N/A          | N/A                         |
| Navigational Button:<br>'Lecturer Account'        | admin/index.php | N/A          | N/A                         |
| Navigational Button:<br>'Student Account'         | admin/index.php | N/A          | N/A                         |
| Navigational Button:<br>'Student Detail'          | admin/index.php | N/A          | N/A                         |
| Navigational Button:<br>'Home'                    | admin/index.php | Unresponsive | Link button to<br>index.php |



|                                           |             |     |     |
|-------------------------------------------|-------------|-----|-----|
| Navigational Button:<br>'Lecturer Logout' | lect.php    | N/A | N/A |
| Navigational Button:<br>'Student Logout'  | success.php | N/A | N/A |

Figure 6.1: Usability testing table.

The next stage of testing will involve the user acceptance of the system. This will ensure that the system will meet the expectations of the user. It will make sure the website is fit for user interaction and ready to be deployed. The system will be tested using the Alpha type of user acceptance testing.

| Testing Criteria                              | Compatible | Errors |
|-----------------------------------------------|------------|--------|
| Browser Compatibility:<br>'Google Chrome'     | Yes        | N/A    |
| Browser Compatibility:<br>'Microsoft Edge'    | Yes        | N/A    |
| Browser Compatibility:<br>'Internet Explorer' | Yes        | N/A    |
| Browser Compatibility:<br>'Safari'            | Yes        | N/A    |
| Browser Compatibility:<br>'Firefox'           | Yes        | N/A    |

Figure 6.2: User acceptance testing table.

The final stage of testing is focussed on the functional requirements of the system. This is to ensure that all individual functions in the system are working as they should be. The following tables list the functional tests that were carried out on the system to ensure the website is working correctly and effectively. The first table in the functional testing process is the database testing phase. The database is to log users into the system, register new users and store attendance data. The following tests were taken to verify the data was sent to the database correctly.

| Testing Criteria             | Success | Errors                         | Resolution       |
|------------------------------|---------|--------------------------------|------------------|
| Admin Login                  | Pass    | N/A                            | N/A              |
| Lecturer Login               | Pass    | N/A                            | N/A              |
| Student Login<br>(for class) | Pass    | N/A                            | N/A              |
| Sign up Admin                | Fail    | Registers user in wrong table. | Correct Software |
| Sign up Lecturer             | Pass    | N/A                            | N/A              |
| Sign up Student              | Pass    | N/A                            | N/A              |
| Student Details              | Pass    | N/A                            | N/A              |
| Edit Student Details         | Fail    | Non Responsive                 | Correct Software |
| Delete Student               | Pass    | N/A                            | N/A              |

Figure 6.3: Database functionality testing table.

The next stage in the functionality testing phase is to ensure that the boundary conditions are working correctly. They should flag an error and display a message when incorrect data has been entered into a form. The following table tests the boundary conditions that are supposed to be operating in the system.

| Testing Criteria   | Page             | Incorrect Data Entry | Error Message                 |
|--------------------|------------------|----------------------|-------------------------------|
| Enter Email        | admin/signup.php | Yes                  | *Email must be valid          |
| Enter Phone Number | admin/signup.php | Yes                  | *Enter valid number           |
| Confirmed Password | admin/signup.php | Yes                  | *Password must be same        |
| Admin Username     | login.php        | Yes                  | *Error pop up                 |
| Admin Password     | login.php        | Yes                  | *Error pop up                 |
| Lecturer Username  | login.php        | Yes                  | *Email must be valid          |
| Lecturer Password  | login.php        | Yes                  | *Error pop up 'no user found' |
| Student Username   | login.php        | Yes                  | *Email must be valid          |
| Student Password   | login.php        | Yes                  | *Error pop up 'no user found' |

Figure 6.4: Boundary conditions testing table.

There are also boundary conditions in place for no data entry into forms when registering a new user. In a scenario when the user has not entered data into a field an error message will appear prompting the user to enter data into that specific field. The next test that will be carried out will be for individual functionality. This will cover the geo location features of the system and will verify their correctness.

| Testing Criteria                      | Page             | Success | Resolution |
|---------------------------------------|------------------|---------|------------|
| Set Location Button:<br>'Student'     | admin/signUp.php | Pass    | N/A        |
| Set Location Button:<br>'Lecturer'    | admin/signUp.php | Pass    | N/A        |
| Set Location Button:<br>'Admin'       | admin/signUp.php | Pass    | N/A        |
| Verify Location Button:<br>'Student'  | login.php        | Pass    | N/A        |
| Verify Location Button:<br>'Lecturer' | login.php        | Pass    | N/A        |

Figure 6.5: Individual functionality testing table.

This section will evaluate the system collectively and provide an assessment of its value to its intended users. The final system created has significant value to its intended users. It provides the user with a solution to managing student attendance. It offers a new way for students to verify and register their attendance at class. It also provides functionality for both admin staff and lecturers. Admin staff can operate and manage the system by adding and removing users. Lecturers are able to view student attendance information which is a valuable function. This system is successful in achieving the core requirements that were set out prior to development. These include allowing each user to login to the system, registering new users, students registering attendance via GPS function, view attendance data and remove student records etc. However, there are several functional requirements that were not integrated successfully into the system. These are functions that were initially intended to be present in the system. These functions do not feature or are not functional for various reasons. I will now go into further detail of the functional requirements that were not implemented in the final system.

Firstly, the GPS function that allowed the student to register their attendance did not function how it was initially intended to. The GPS function in the final system would only register a student's attendance as true if their longitude and latitude (obtained by the verify location button) matched the geographic co-ordinates stored in the database. This goes some way in providing a geo location solution to the problem. However, students will be in lecture theatres that are quite big and the exact geographic co-ordinates will not be the same for every part of a lecture leather. It was this reason why it was proposed that a radius calculation should be implemented. The thinking behind this was that a student within a certain radius of the geographical co-ordinates stored in the database could mark their attendance as true. However, due to technical reasons and time constraints this requirement never made it into the final system. It was considered a significant functional requirement of the system. It is therefore extremely disappointing that this was never successfully implemented.

There was also the intention to implement specific classes and modules for students. This data would be stored in the database and provide attendance data for each module. This in turn would provide lecturers with more unique data and differentiate collective attendance of each module. Another important functional requirement that did not operate as intended was the ability for the admin user to edit student details. This was supposed to be an important feature for the admin user. Again, this functional requirement was not successfully implemented in the final system. The form to edit a student record in the system is present but it is nonresponsive and does not change any user data in the database. This was also the case for registering a new admin user. Instead of registering an admin to the admin table in the database it would register them to the login table. This was an error that was flagged late on in development and due to time constraints was not able to be rectified. It was also unfortunate that the email notification feature was not able to be implemented. This feature was supposed to send an automated email to the student whose attendance had dropped below a certain threshold. This idea was consequently dropped due to the technical requirements and other functional requirements taking precedence. The final system provides a basic attendance system but fails to implement certain features previously outlined due to various reasons.

## **Chapter 7: Conclusions and Recommendation**

This final chapter will provide a summary of the project undertaken overall and provide a critical assessment. It will shed some light on how things were done and any problems that were encountered along the way. The project itself was a learning experience and as a result some mistakes were made along the way. This section of the report will analyse those mistakes and the lessons learned as a result. Using hindsight this chapter will discuss what might have been done differently in order to make the project more successful. The project required continuous planning and these plans changed as the project moved forward. This will also be something that will be addressed in this section. As well as the previously outlined topics that will be assessed in this chapter it will also provide a series of recommendations. These recommendations will be put forward using hindsight to suggest what improvements could be made to the final system. This final chapter will end with a summary of the projects success with regards to the initial objectives that were set out in chapter one.

This section will analyse the work undertaken overall for this project. It began just before Christmas last year when the MSc class completed two workshops. These workshops were designed to prepare the class for their projects. The reason for the early preparation was to get ready for the Design and Analysis report that was due in at the end of January. Over the Christmas holidays contact with the project supervisor Jennifer Moody was made. It was during these correspondence that several ideas were put forward as potential solutions to the student attendance problem. The project initially was earmarked to be an android application. This was primarily down to the fact that that java was the only programming language taught in the first semester of the MSc course. The design and analysis report also narrowed down the ideas to three potential solutions. These included a OTAC, QR code and GPS. It was with the latter idea that was eventually selected to progress with. The project changed significantly after a meeting with the project supervisor and second marker to review the design and analysis report. It was during this meeting that it was decided that due to cross platform issues that came with developing an android app it was better suited to develop a website.

The project supervisor recommended several online learning tutorials to assist in becoming proficient in web development. The core languages were consequently identified as vital in order to develop a website. The tutorials used have previously been mentioned in this report and covered the basics in HTML, CSS, PHP and JavaScript. These were important tools that were essential during the development stage of this project. Shortly after the meeting reviewing the design and analysis report it was confirmed that the current project supervisor was leaving. Dr Zheng Shuai was assigned to this project as a replacement and a line of communication was consequently opened. After a successful hand over meeting with Shuai the next stage of the project began. This was the design and implementation report that also required a prototype to accompany it. It was in this meeting that it was confirmed what features were to be included in the prototype. The prototype website would contain basic design features with the ability to login users using information stored in a database. This was implemented and presented to both the project supervisor and second marker shortly after the end of the second semester.

It was in this presentation that certain aspects of the prototype be revised when implementing the final system. These included the over complicated database and the inclusion of a course director and student grades. After this meeting the primary focus was on implementing the GPS function to the system. This was the idea selected as the solution in earlier reports. As well as the GPS to sing students in for class the final system was have other features. These include registering new users, editing/deleting student records and viewing attendance information. The project was successful to a certain extent but it did fail to implement certain requirements outlined earlier in the project. These include the radius calculation for the GPs verification and the editing of student details. The lessons learned from the failure to implemented these requirements are primarily to do with time management. Managing time more efficiently throughout this project would have allowed for issues such as the radius calculation and problems with editing student details to be dealt with accordingly. Certain aspects of the project done differently may have improved the quality of the final system.

Creating a more functional prototype would most certainly helped solving the problems that arose later on during development. Coming to a decision on the solution to the problem earlier on in the project rather than contemplating three different concepts. These are things that perhaps done differently may have improved the quality of the final system. There are also some recommendations that I feel may improve upon the final system. These include features that were intended to be present in the system and new recommendations entirely.

#### Recommendations:

- 1) Email Alert – This was initially outlined as a potential feature in this system. An email alert system would be greatly beneficial to both students and admin staff. It would inform them both if attendance dropped below a satisfactory level.
- 2) Radius – This also was supposed to implemented into this system. However, it would most effective if each classroom and lecture theatre contained specific radius. This would prevent students from missing seminars in smaller classrooms.
- 3) Student Absence Function – This recommendation would provide students with the means to upload an absence prior to a class. This would then exempt them from the particular class and not affect their attendance record. (Only after the approval of the school office).
- 4) Time/Location change – This would allow a lecturer or admin staff member to change the time or location of a class.
- 5) Class alteration notifications – If and when an alteration has been made to class location or time the student will be notified.
- 6) Content Accessibility – This recommended feature would only allow students presently signed into a class accessibility to content such as lecture slides etc.

This project has achieved many of the goals and objectives set out during the planning stages. It has developed an attendance system for students, lecturers and admin staff. It has provided a GPS verification system to ensure students are present. Although not all requirements were met the core functions of this system were successfully implemented.



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