School of Science and Engineering

University of Dundee

The Queen Mother Building: Meeting Room Booking System

(AC52010: MSc Project)

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December 2017

Executive Summary

AC52010 MSc Project, is the final module which comprises the MSc degree in Applied Computing. This module requires the student to undertake a project which runs for the duration of 3-4 months, of which the student is responsible for conducting independent research as well as applying their knowledge gained from areas such as software development to human computer interaction.

In regards to this project, the primary aim behind it was to develop a modern and efficient booking system for the purpose of helping the staff of the Department of Computing at the University of Dundee, to reserve meeting rooms for specific dates and time slots at the Queen Mother Building.

Although an existing system is already in place, there were many goals behind the development of this particular model that aimed to ensure it differentiated from the previous system. This included making sure that it was designed from a human computer interaction perspective as well as creating features that would help to provide the system with a more up-to-date experience for the user.

Throughout the duration of the project, the booking system had been developed and refined on a constant basis through trial and error so as to ensure that the system was built successfully in line with the requirements set by the client. This involved hours of research involving gathering information from a range of sources such as books and journals as well receiving feedback from participants who agreed to evaluate the prototype model.

Although there were many setbacks and difficulties present throughout the project, it can be said with confidence that the booking system was developed successfully along with the initial goals being achieved and user requirements being fulfilled. The project without a shadow of a doubt, proved to be a fruitful venture and learning experience, helping to demonstrate the strive and merit required to develop a fully operating and functional system.

Declaration

"I declare that the special study described in this dissertation has been carried out and the dissertation composed by me, and that the dissertation has not been accepted in fulfilment of the requirements of any other degree or professional qualification."

Samiul Chowdhury

December 2017

Certificate

"I certify that Samiul Chowdhury has satisfied the conditions of the Ordinance and Regulations and is qualified to submit this dissertation in application for the degree of Master of Science."

Dr Craig Ramsay

December 2017

Acknowledgements

I would like to personally thank Dr Craig Ramsay for his understanding, help and generosity as my supervisor. The advice and guidance that you have provided throughout this project has been magnificent and has contributed greatly towards the final product.

I would also like to thank my advisor Dr Keith Edwards for his advice, compassion and help during my time as a postgraduate student at the University of Dundee.

Finally, I would like to thank my family for all of their love and support during this very difficult time.

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1. Introduction

1.1 A new paradigm

The internet has played a significant role in revolutionizing our world and the way in which we as people conduct our everyday business and lives. For example, everything ranging from online shopping to viewing videos and communicating with others, has attributed directly from using the services of successful online companies as well as benefitting from the high speed and efficiency afforded by the internet.

This has led to significant adjustments in the way in which the average task is now conducted as well as leading to changes in the conventional means of carrying out business on a global scale. While the internet has resulted in many forms of traditional companies such as retailers going out of business, or on the other end, leading to new ventures and undiscovered territories, regardless of the whatever the outcome maybe, we as a generation have entered into what can be perfectly described as a new paradigm.

Keeping this in mind, it is now crucial to seek out newer and improved solutions to our everyday tasks and routines, in this fast paced and ever changing technological environment. Therefore, in this particular instance, it was important for me as part of this project, to develop a new modern and efficient online booking system to help replace the traditional paper based model and now the current online system being used by the Department of Computing, to book meeting rooms at the Queen Mother Building.

Over the next chapter, I will explain the process of how I decided to tackle this problem as well as discussing and approaching the various other background aspects in regards to developing this meeting room booking system. Following this, throughout the remainder of this report, I will provide more In-depth knowledge behind the specific logistics of the system such as the design to the eventual evaluation of the final product, all of which will help to provide the reader with a thorough understanding of the entire development process behind this project.

2. Background

2.1 The previous models

Initially, the Department of Computing at the University of Dundee, would use a paper based booking system to reserve meeting rooms at the Queen Mother Building. While this model was used for a number of years, at the same time, it resulted in many flaws occurring over time.

For instance, the paper based system was located on the First Floor of the Queen Mother Building which meant that in order to book a meeting room, one would need to come to this specific location to write down their booking or to simply view other bookings.

As you can imagine, the distance it would take for one to simply book a room at the Queen Mother Building, could be time consuming and inconvenient, especially if that individual was located in another part of the building or worse, in a completely different location altogether.

Furthermore, when it came to viewing or making bookings, at times staff members would sometimes face the problem of the bookings schedule not being kept up-to-date when they would arrive, resulting in them having to constantly turn the pages to find the latest week.

Another reason as to why the paper based model may not be the best solution is due to the fact that handwriting may not be legible enough to read. This could simply be due to bad handwriting or mistakes being scribbled out. But in either case, the fact was that the paper based model clearly had many problems associated with it.

Therefore, these are some of the reasons why it can be perceived and justified to develop an online solution which would benefit the many members of staff at the Department of Computing.

While an attempt has been made to replace the paper based model with an online system, the truth of the matter is that the current version is in need of an update itself. For example, if one whose expertise stems from the field of Human Computer Interaction, takes a moment to observe the current model, then he/she would be able to conclude that the current model fails to meet some of the usability heuristics for

user interface design. The usability heuristics were developed by Jacob Nielsen and comprises of 10 rules which are recommended for developers to follow in regards to building and developing applications.

For example, when you access the current online system, what you will find is that on the Homepage, there are multiple calendars on display (please see Figure 2.1.) This includes 3 months on display as well as a further date picker calendar generated when the user clicks the date box. Altogether, there are 4 multiple calendars on display- which can be considered as being overcrowding and too many to show at one time.

Furthermore, this can also frustrate the user and not help to engage with his/her understanding of the system. Therefore, when it comes to analyzing and comparing these problems with the usability heuristics, then one can see that it does not follow the recommendation of keeping an *"aesthetic and minimalistic design."* [1]

Another problem associated with the initial online system is the way in which the login mechanism comes into effect (please see Figure 2.2.) When a person accesses the system for the first time, the user can then directly view all bookings. It is only when the user decides to proceed with a reservation that the login system generates itself.

The system would be better developed if the user were to login from the outset rather than in between viewing and booking, so as to maintain full confidentiality of people being able to access the system as well as viewing and booking meeting rooms. This would help to allow the system to display information in a more logical and concise manner and would achieve a *"match between system and the real world."*[2]

The other issue that exists within the current online system is one in which double bookings can end up being made. This can lead to many problems for various staff members at the Department of Computing and simply should be avoided by a booking system, to ensure efficiency rather than to frustrate users over which party should be entitled to a meeting room. Thereby, the current system fails towards

[1] https://www.nngroup.com/articles/ten-usability-heuristics/
[2] https://www.nngroup.com/articles/ten-usability-heuristics/

meeting the principle of providing the user with good *"error prevention"*[3], which could have helped to avoid the above problem from occurring in the first place.

Furthermore, to exacerbate any further problems, the initial system unfortunately does not provide the user with an effective search mode (please see Figure 2.3) nor any indication of seeing which dates have any bookings unless the user individually clicks each date on the multiple calendars and then sees at the bottom of the page for any booked time slots. This unfortunately can be time consuming not to mention, an ineffective way of maintaining a smooth booking system. Unfortunately, both these problems fail to meet the goals of building a system where there is good *"flexibility and efficiency of use"*[4] as well as helping *"users recognize, diagnose and recover from errors."*[5]

Therefore, it is for all of the above reasons (including the paper based model) that it was proposed that a more effective and user-friendly model be developed, especially in line with a Human Computer Interaction perspective, so as to avoid the above listed problems.

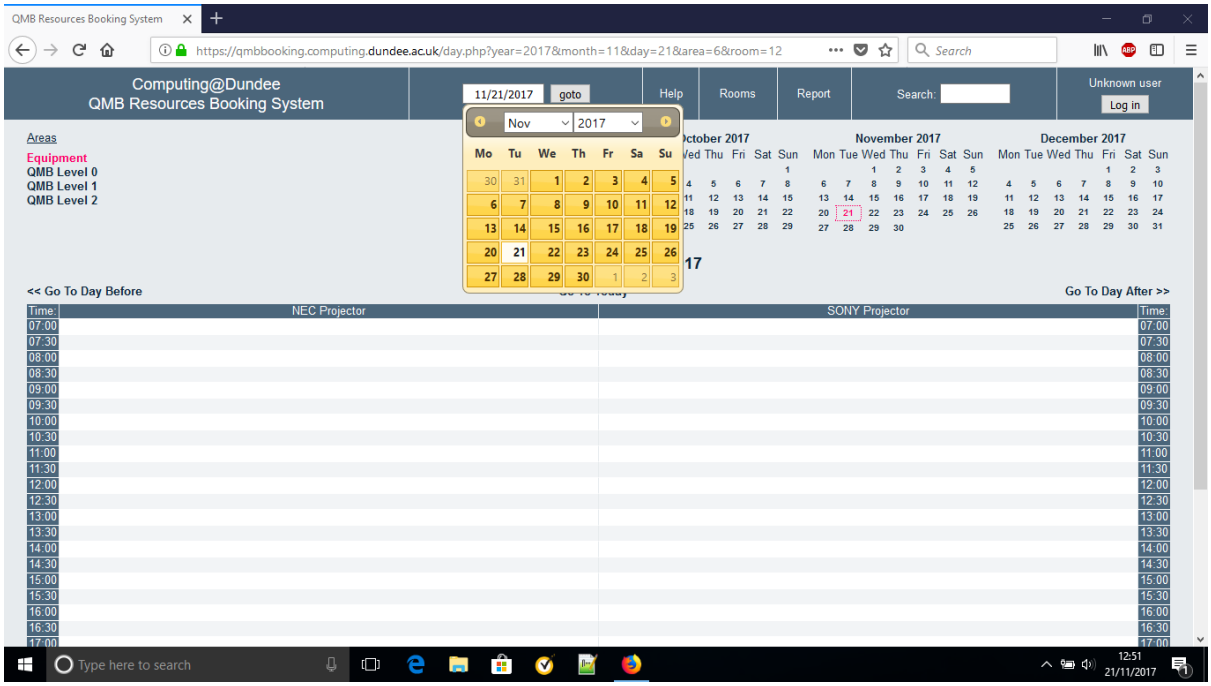

Figure 2.1: Multiple calendars are displayed at once in the initial booking system. Furthermore, none of the dates in the calendars highlight or indicate any bookings.

[3] https://www.nngroup.com/articles/ten-usability-heuristics/
[4] https://www.nngroup.com/articles/ten-usability-heuristics/
[5] https://www.nngroup.com/articles/ten-usability-heuristics/

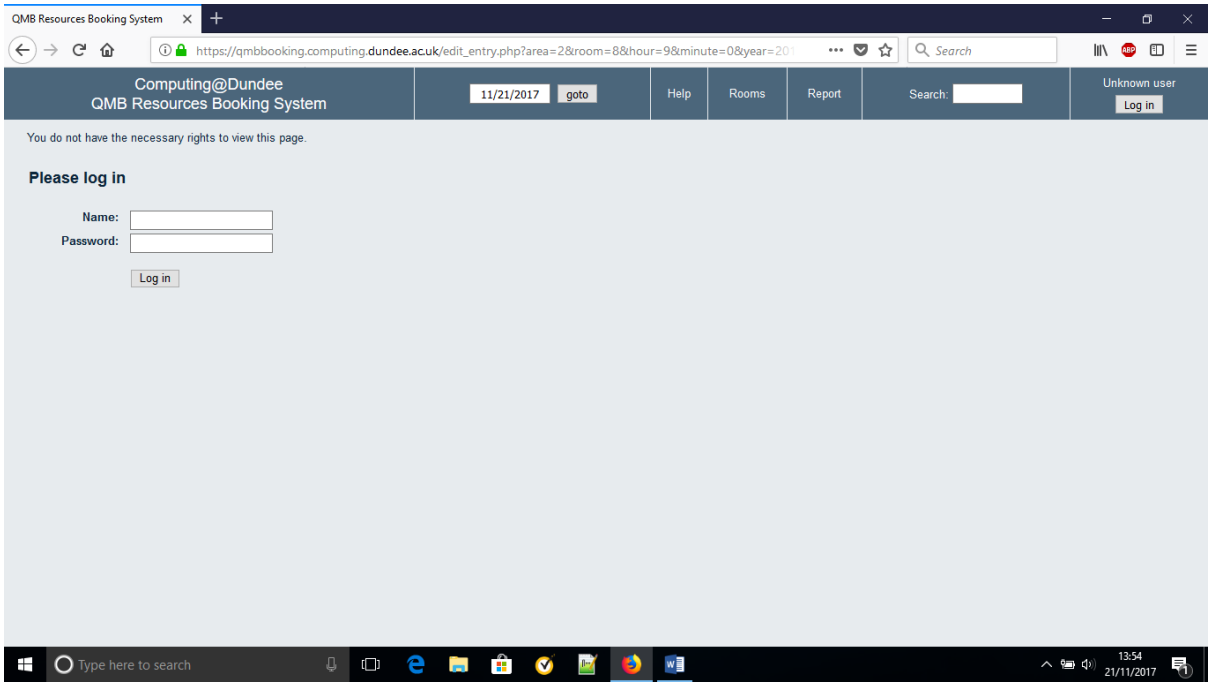

Figure 2.2: This login system appears after a user is able to see bookings, as opposed to only allowing bookings to be seen and made after the login stage.

Figure 2.3: This search mode does not return any results for anything on the 24th November 2017, despite a booking being made on this date.

2.2 The technologies

In order to build and implement this system successfully, it was imperative to have a strong understanding of the type of languages that I would be required to use in order to develop this booking system. When examining the type of languages to use, it was crucial to be able to discern the kind of environment that this project was being developed for specifically.

Since the booking system was being built to replace the current online system, it was therefore, important to have a strong grasp on what the difference was between front end development and back end development. This required me to learn about concepts such as client-side and server-side languages.

For example, when it came to the former, it was obvious that as part of the front end development, I would be required to use HTML (Hypertext Markup Language) along with CSS (Cascading Style Sheets) and JavaScript. This required me to spend a couple of months to learn these languages from a basic to advanced level.

As for the latter, I decided to use the back end development language known as PHP, which is a *"recursive acronym for PHP: Hypertext Preprocessor"* [6] along with a web server called XAMPP (version 3.2.2) which is described as *"the most popular PHP development environment."*[7] Furthermore, according to the following online sources, PHP is still considered the most popular server-side language, as the following charts indicate:

Figure 2.4: This chart illustrates the dominance of PHP over other languages.[8]

[6] http://php.net/manual/en/intro-whatis.php
[7] https://www.apachefriends.org/index.html
[8] http://blog.stoneriverelearning.com/top-5-programming-languages-used-in-web-development/

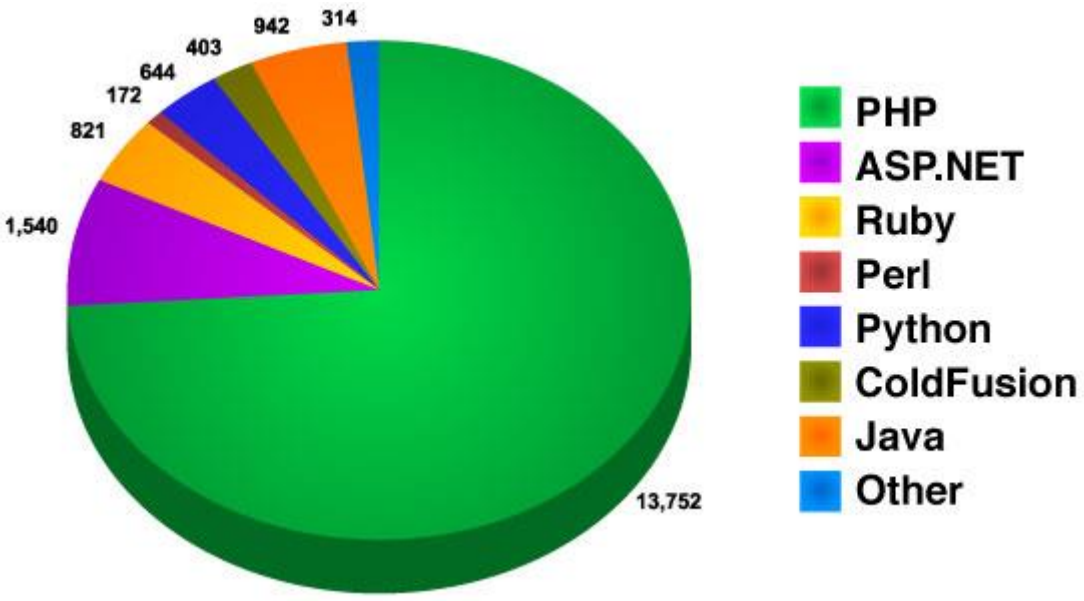

Figure 2.5: This chart shows the results of a poll conducted over 18,500 people where PHP has emerged as the most popular server-side language.[9]

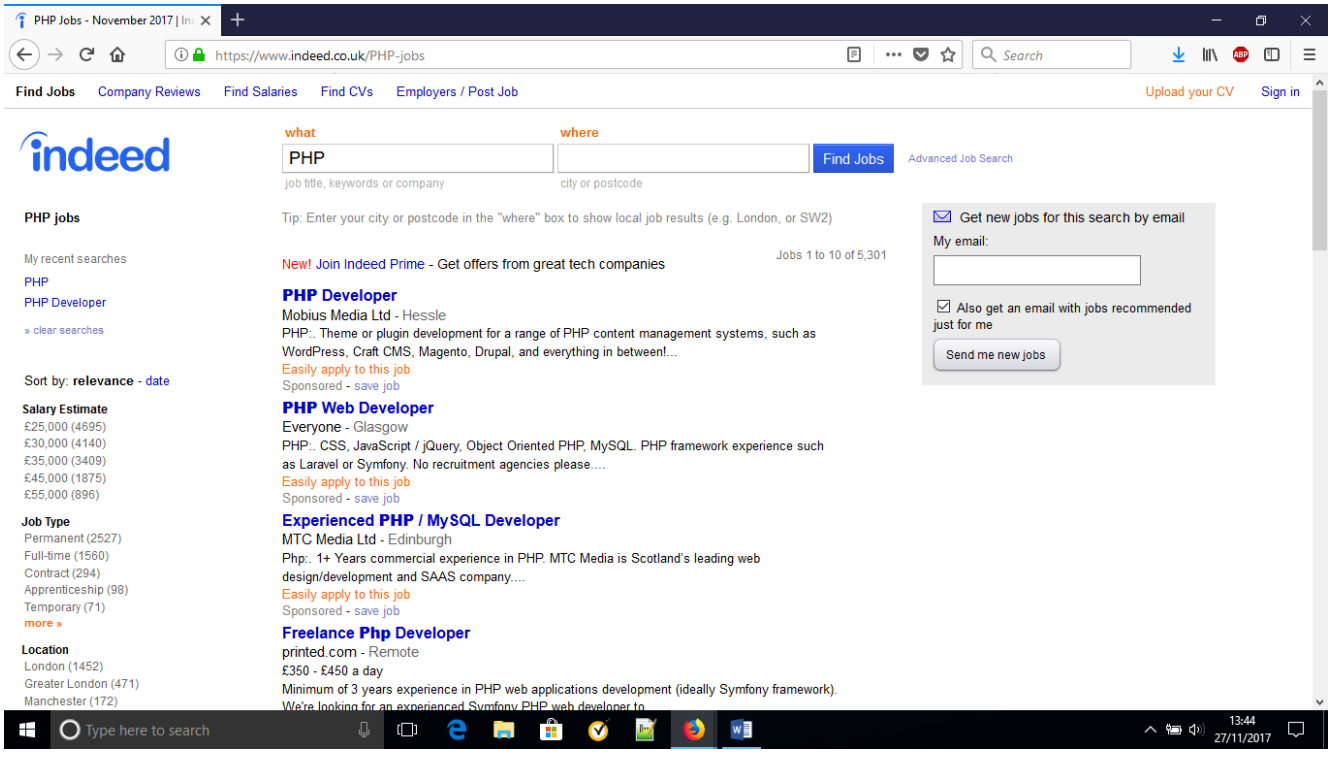

Figure 2.6: This job search across the UK indicates that there are 5,301 PHP related positions available in the UK labour market.[10]

[9] https://css-tricks.com/poll-results-server-side-language/
[10] https://www.indeed.co.uk/PHP-jobs

In addition to using PHP as a server-side language, the development of this booking system also required having to grasp a strong understanding of how to use and implement MySQL. This is considered to be *"the world's most popular open source database"*[11] and played a significant role in the development of this booking system, which I will show later in this report.

In terms of integrated development environments (IDE) for compiling the actual code for this project, I decided to go ahead and use Notepad++ (please see Figure 2.7) which describes itself as *"a free source code editor and Notepad replacement that supports several languages."*[12] This editor helped to provide a clean, bright and simplistic overall look, which in turn, made it very efficient and easy to use as opposed to the other popular IDE known as Sublime Text, where the overall design was too dark while using too many colours, thereby displaying everything in an overwhelming manner, which is very distracting when it comes to writing code.

The Notepad++ IDE truly does provide one of the best experiences to be able to write your code in order to build websites, along with the ability to easily work and switch between your front end development code (HTML, CSS and JavaScript) and your back end development code (PHP.)

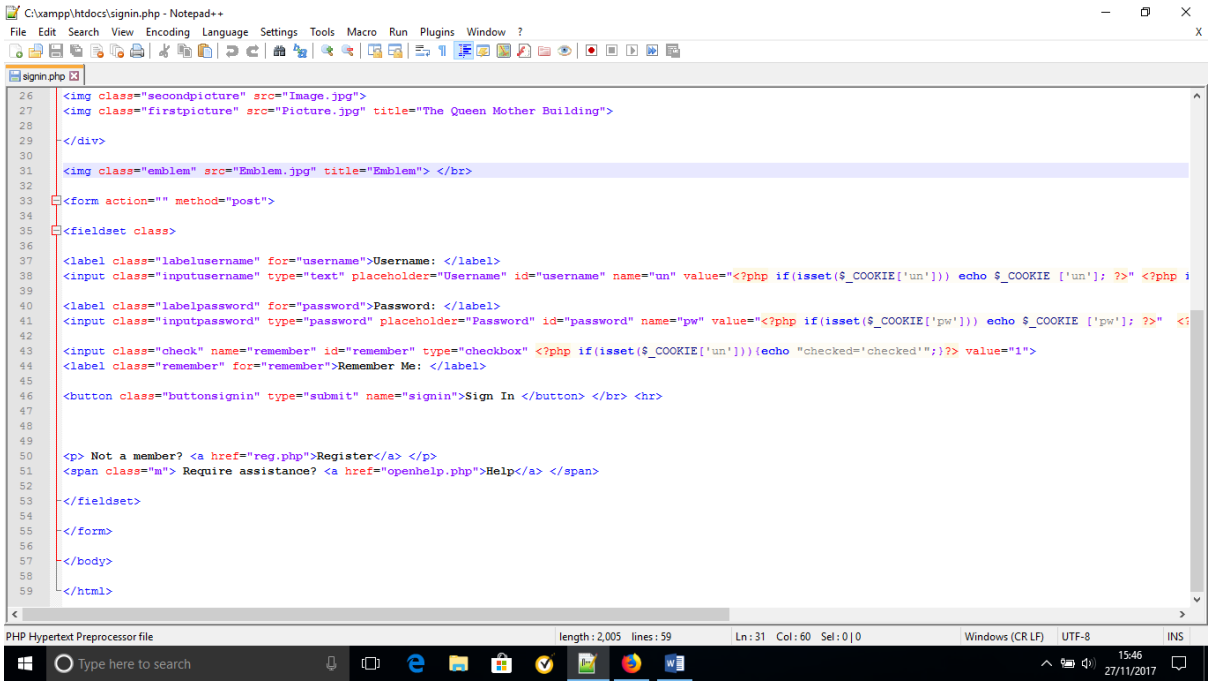

Figure 2.7: A screenshot of Notepad++. This proved to be the best IDE available.

[11] https://www.mysql.com/
[12] https://notepad-plus-plus.org/

While there were many other server-side languages available to use such as Java (along with using Java Servlets) and ASP.NET, the reason as to why I decided to choose PHP was due to the fact that this was an already well established language which provided me with the flexibility of being able to develop a booking system. Whereas with other server-side languages, due to the complex nature of these languages as well as the fact that it would take too much time to learn and understand them, I decided that PHP would be the better option to use for this project.

While PHP in itself was a new language to learn, at the same time, due to the vast amount of learning material available as well as the fact that it was easier to learn in a quicker amount of time as opposed to Java or ASP.NET, this clearly proved to be the sufficient language of choice altogether. But more importantly, after assessing and seeing the popularity of PHP being used within the industry (please see Figures 2.4, 2.5 and 2.6) it was evident that this language was still in demand and would be the perfect choice for me to use for this project as I would also be able to demonstrate my skills of using PHP, to future prospective employers.

Therefore, to conclude this chapter, once I was able to determine what I was going to require to develop this booking system in terms of the type of language and integrated development environment I would be using for this project, the next step was then to discuss the actual requirements with my client about what he wanted to see for this particular model while at the same time, keeping in mind to avoid the mistakes of the previous systems.

3. Requirements specification

3.1 Requirements of the client

When it came to building and developing this booking system, it was important to gather a list of requirements from the client in order to have a good picture of what the system should look like, as opposed to building any form of system which delivered basic functionality.

My client, who is a lecturer at the University of Dundee and works in the Department of Computing, has requested that the new online system should not only have the ability to allow individuals to book meeting rooms, but should also include other features such as providing users of the system to be able to view the types of rooms and equipment available as well the being able to interact with other users by leaving comments.

In order to develop this kind of booking system, it was essential to create a requirements specification, which can help to elaborate on precisely what is required to build this model. Furthermore, this would able to provide a clear understanding for other groups of people such as developers and testers, if they wanted to replicate the same kind of system for other uses and projects.

Therefore, when it came to developing this system, it was important to keep my client up-to-date on a weekly basis by informing him via email, of the progress made so far as well as meeting the client every 2 weeks and showing him the development of the prototype model.

This proved to be an effective way of interacting with the client and helped to reassure that constant communication was taking place- I will elaborate on this in more detail later on in this chapter. But in the meantime, as stated earlier, the starting point in regards to meeting the client, was to gather his requirements for this booking system and to then put them in the form of a requirements specification.

3.2 Requirements specification

The contents of the requirements specification proved be very detailed and therefore, can be found in the Appendices section of this report (Appendix 1.) In the meantime, I have included a summary list of the actual requirements which can provide the reader with a general overview of what the requirements specification entails when it came to developing this system.

Functional Requirements

Setup

R1: Display Sign In page
R2: Provide options to the user
R3: User selecting the “Help” option
R4: User selecting the “Register” option
R5: Display success message
R6: User clicking the “Sign In” button
R7: Display the relevant error validation messages

Homepage

R8: Display dashboard on the Homepage
R9: Display navigation bar on the Homepage
R10: Display University of Dundee emblem

Book

R11: User hovering over the “Book” option
R12: User selecting a sub menu in the “Book” option
R13: User changes the month
R14: User selects the month and year in the URL
R15: Display calendar legend
R16: Calendar highlights today’s date
R17: User hovers over a date in the calendar
R18: User selects a date in the calendar

R19: User clicks the “Book” button
R20: User clicks the “Proceed” button - invalid bookings
R21: User clicks the “Proceed” button – valid bookings
R22: Display Queen Mother Building’s floors and equipment as links.
R23: Display a “Homepage” button and “Help” button

View

R24: User selecting the “View” option
R25: User selects an equipment or meeting room
R26: Display a “Homepage” button and “Help” button
R27: User selecting the “Search” option
R28: Return message indicating no results have been found
R29: Return search results
R30: Display a “Homepage” button and “Help” button

Comment

R31: User selecting the “Comment” option
R32: Display a comment box
R33: User clicks “Submit” button

Help

R34: Display a “Homepage” button and “Help” button
R35: User selecting the “Help” option

Non-Functional Requirements

R36: Access times
R37: Reliability
R38: Documentation standards

3.3 Software lifecycle

When it came to the development process of this booking system, it was vital to consider the type of software lifecycle I would be operating under, in order to ensure that the product would be completed successfully. When deciding on this process, I had to consider two of the primary lifecycles which are used within the industry, and to analyse their advantages and drawbacks. This would in turn help to provide me with an insight as to which one offered the most flexibility in terms of developing and refining the end product.

The first software lifecycle I researched was the Waterfall approach (please see Figure 3.1.) This is considered as a classic and successful lifecycle which has been used for a longtime in software engineering. However, as time has passed on and with software becoming more advanced and complex than ever before, this model has been deemed by many as not being able to accommodate to the needs of the modern age.

One of the problems associated with this model is the fact that it follows a strict approach of having to complete one stage before moving onto the next. This can be considered as a hindering process because unfortunately, many circumstances and changes outside our control may occur that can impact on the development process.

For example, a change may occur in some context such as the environment or a governing legislation that could ultimately result in modifications having to be made to the product in order to accommodate to these changes. This could potentially lead to a loss of money for the company developing the product as well as result in further demoralization for those within the development team.

In order to help avoid or reduce the above problems from occurring, it was better for me to adapt an alternative lifecycle to the Waterfall approach model- the iterative lifecycle. This lifecycle, unlike the Waterfall lifecycle where a full requirements specification is provided before development commences, allows development to proceed in increments. This lifecycle encourages software to be delivered in smaller focused stages, where each increment can be reviewed and adapted towards feedback so as to ensure a smoother way of being able to progress throughout the development phase.

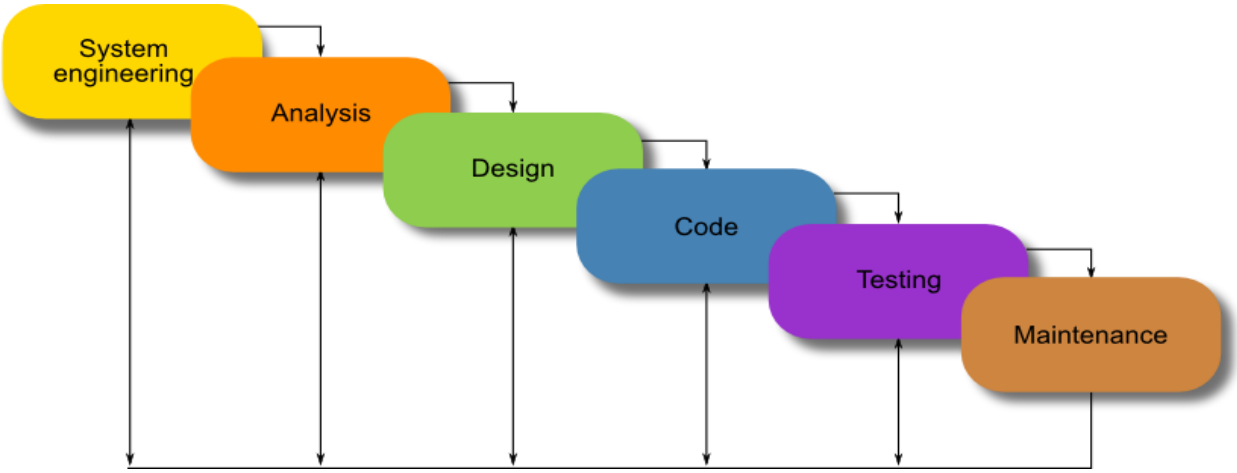

Figure 3.1: The waterfall approach model, where each stage must be completed before moving onto the next one.[13]

The many advantages of the iterative approach model include the following:

- It can accommodate to the many changes in circumstances that can occur outside our control. This lifecycle is crucial towards anticipating the ever demanding changes in technology.
- Any serious misunderstandings such as design inconsistencies and integration issues can be identified early in the development process.
- It can help to encourage developing confidence and credibility within a product.
- This model can also help provide a more realistic assessment scale in regards to what is currently happening in the project, where progress can be measured by the percentage of code that has been successfully completed.

Therefore, for all of the above reasons as well as the fact that I would need to communicate with my client on a weekly basis and meet him directly every fortnight, it was important that I adopted the iterative lifecycle for the development process of the booking system.

[13] https://airbrake.io/blog/sdlc/waterfall-model

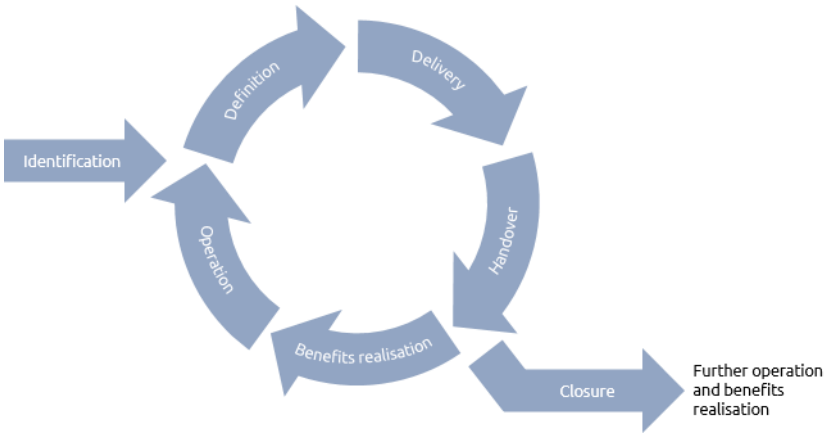

Figure 3.2: An illustration of the iterative lifecycle. This model is considered to be more effective for many different types of projects.[14]

3.4 Project Plan

After gathering the user requirements, maintaining regular contact with my client and working on the meeting room booking system based on an iterative lifecycle, it was crucial for me to able to develop a project plan.

The plan for me was to firstly complete the prototype system, and then to ask staff members to evaluate the system afterwards. Once this was completed, I would then proceed towards completing my project report for this booking system. I was required to document all of the timeframes I would be working under in order to complete this system.

Therefore, to assist with process, I decided to use a Gantt Chart (please see Figure 3.3.) This is a popular form of chart used widely in the software engineering community and provided me with an effective way to illustrate my project schedule as well as display and highlight the start and end dates for each segment of the project that I was working on.

While there were many setbacks and other personal problems which I was going though during the project, I can nonetheless state with confidence that each increment of the project was completed successfully.

[14] https://www.praxisframework.org/en/knowledge/life-cycle

Task	Start Date	End Date	Duration
Task 1: Setup	07/08/2017	31/08/2017	25 days
Task 2: Homepage	01/09/2017	08/09/2017	8 days
Task 3: Booking	11/09/2017	22/10/2017	42 days
Task 4: View	23/10/2017	29/10/2017	7 days
Task 5: Search	30/10/2017	05/11/2017	7 days
Task 6: Comment	06/11/2017	12/11/2017	7 days
Task 7: Help	13/11/2017	19/11/2017	7 days
Task 8: Evaluation	24/11/2017	24/11/2017	1 day
Task 9: Report	24/11/2017	08/12/2017	15 days

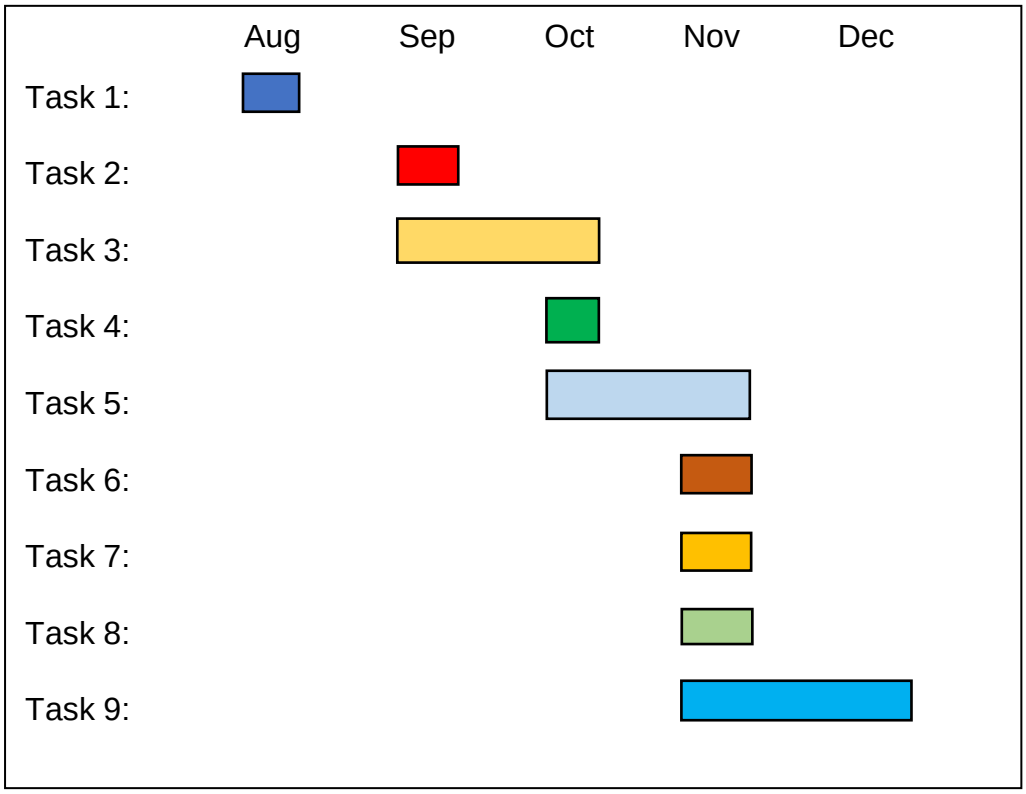

Figure 3.3: A Gantt Chart indicating the time scales for each task as well as representing them in the form of a bar chart.

4. Design

4.1 System operation

After gathering the requirements of the client, it was then essential to be able to demonstrate the operation of the booking system. For example, a diagram is considered as an essential stepping stone in the development process for many software engineers as this can assist with the conceptualization and eventual fruition of how a system is to behave and work.

Therefore, a clear way to illustrate the functioning of this booking system in a simple yet effective manner, would be to show it in the form of an Entity-Relationship (ER) diagram. This model can be described as *"a graphical representation of entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems."*[15]

In regards to this booking system, the ER diagram (which can be found on the next page) highlights how the system is to operate by showing the relationships (projected in the form of a rhombus) that exist between the user and the bookings (represented in the form a rectangle), where both entities can be identified by their unique ID, which is stored in the database.

Furthermore, the cardinality, which can be described as *"how many instances of an entity relate to one instance of another entity"*[16] are represented in the ER diagram by using the notation style referred to as "Martin Style". I felt that this was the easiest and most effective way to describe the many number of instances that exist in the ER diagram.

In addition to this, the ER diagram also shows the attributes that are associated with each entity (pictured in the form of an oval) that are stored within the database, all of which helps to ensure that the operation of this booking system is running efficiently and in line with the expected requirements of the client.

[15] https://www.webopedia.com/TERM/E/entity_relationship_diagram.html
[16] https://www.smartdraw.com/entity-relationship-diagram/

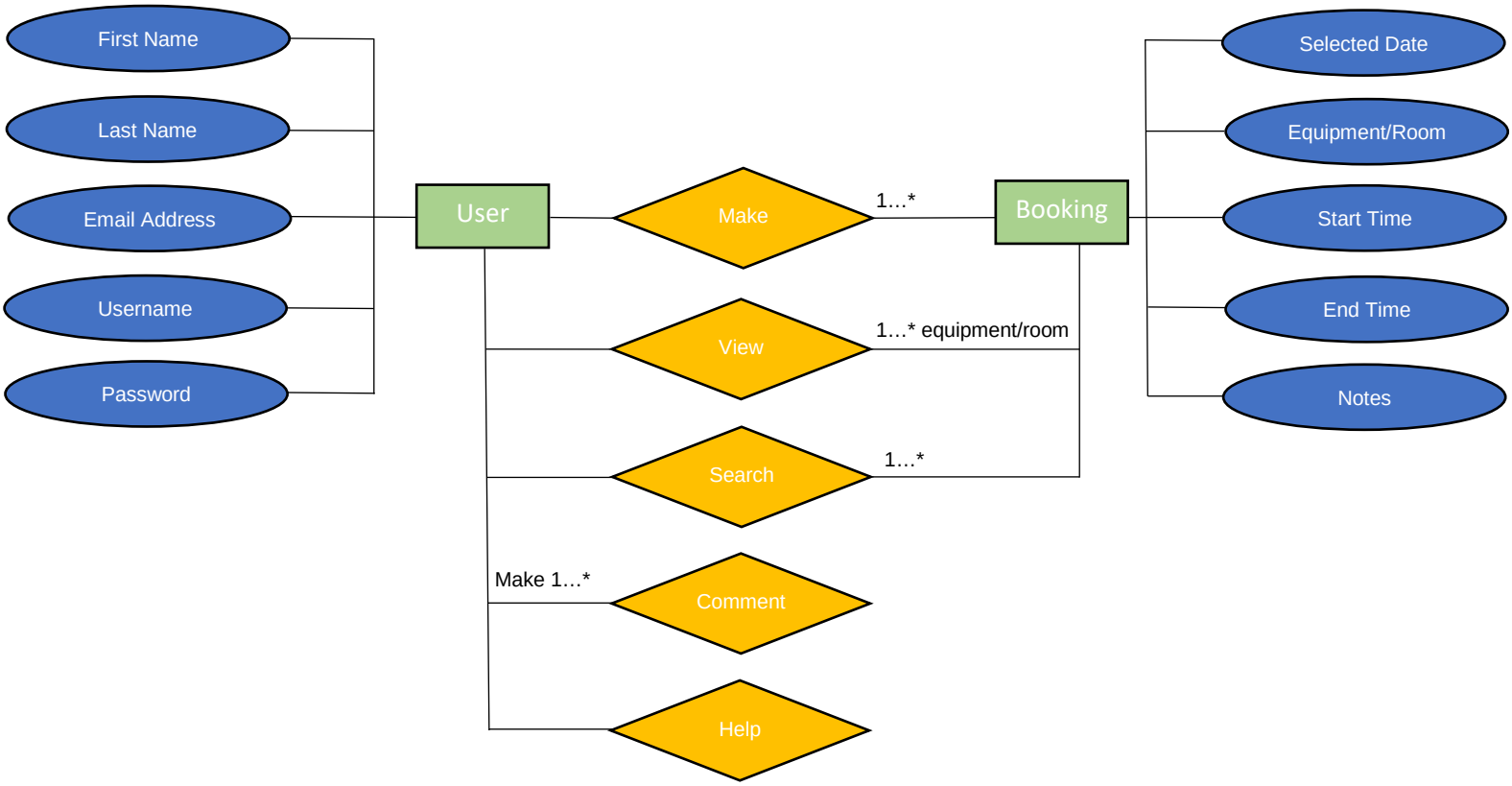

Figure 4.1: An ER diagram representing the meeting room booking system.

Another way to describe the operation of the booking system is to demonstrate it in the form of a use case specification. The use case specification provides a complete sequence of actions required to achieve the end goal. In regards to the operation of this booking system, I have decided to elaborate on the functioning of each of the system's elements by describing the basic flow of events and alternative flow of events.

The basic flow of events essentially describes the basic sequence of steps required to be fulfilled in order to reach the end goal while the alternative flow of events goes through the basic flow of events but at the same, identifies where something is to go wrong. Therefore, it was important to describe both types of flow events in order to explain the system operation when using a use case specification.

As the flow of events proved to be very detailed, I have decided to incorporate this within the Appendices section of this report (Appendix 2.) But to summarise, this appendix includes charts demonstrating how the basic and alternative flow of events operate, along with a vivid description of both flow of events that are applicable for each element of the system.

4.2 Wireframes

The next step towards developing this meeting room booking system was to create a series of wireframes. When it came to researching this topic, I refreshed my knowledge on this area by looking back to my experience of using this concept for an assignment I did for the User Experience module, back in Semester 1 of my postgraduate degree.

The purpose of the wireframes was to help provide a visualization guide on how the system should look and feel for the client. When drawing the wireframes, it was imperative to keep in mind that when building the system, I would need to avoid the mistakes from the previous online model and to create this one from a human computer interaction perspective. This required me to focus on some of the principles developed by Jacob Nielson mentioned earlier in the second chapter of this report.

Developing the wireframes were in itself, a time consuming process because while I had the requirements of the client gathered, at the same, this required me to analyse and carefully decide on where the specific logistics and elements of the system would be placed and how it would be displayed to the user.

On the next page, you will be able to see the detail of the wireframes, where each one represents an essential function of this booking system. The wireframes help to illustrate the initial conceptualization I had in mind along with a step by step process of how some of the functions such as the booking mode, would operate.

Therefore, when it came to accommodating the needs of the client, I would create these designs and then seek the client’s approval when I showed him these wireframes. Again, by meeting him regularly based on iterative lifecycle, I was able to easily work on these designs with confidence knowing that the final product would meet the needs of the client.

Setup

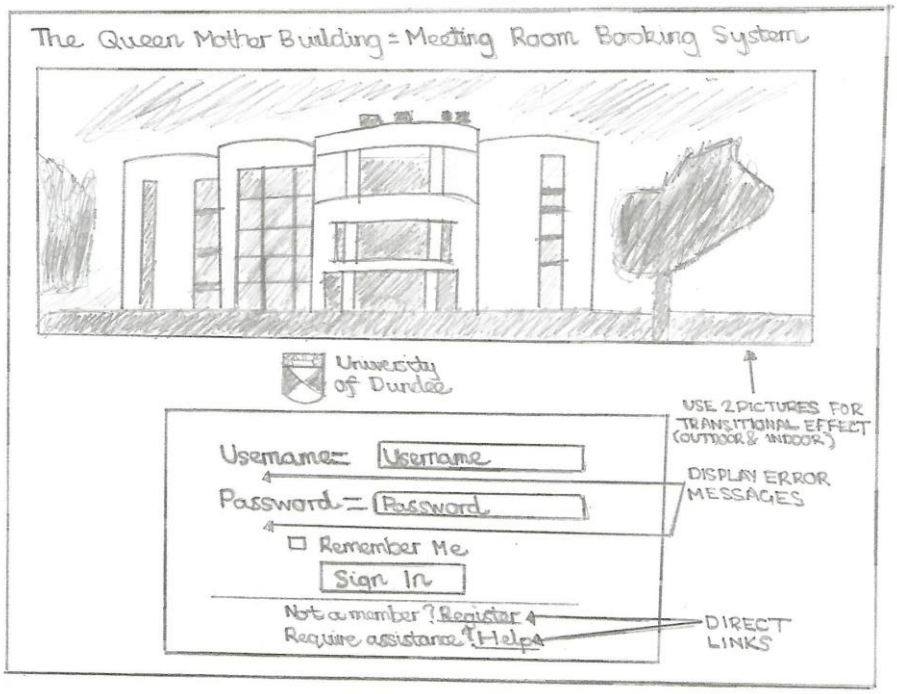

Figure 4.2: Design for the Sign In page. Where the error messages are to appear, helps to keep in line with the usability heuristic of good "*error preventions"*[17] being provided, while conforming to the usability heuristic known as "*recognition rather than recall"*[18], where all the options are visibly displayed including access to the Help menu.

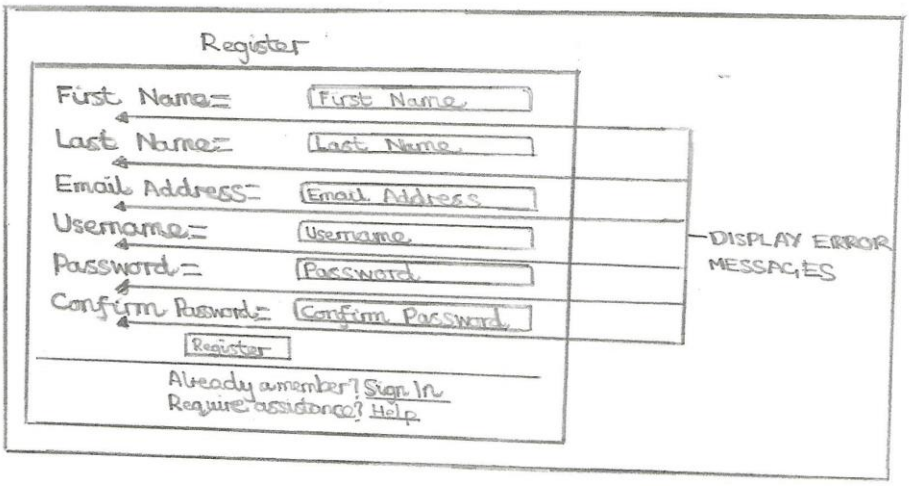

Figure 4.3: The "Registration" page, staying in line with the same usability heuristics.

[17] https://www.nngroup.com/articles/ten-usability-heuristics/
[18] https://www.nngroup.com/articles/ten-usability-heuristics/

Homepage

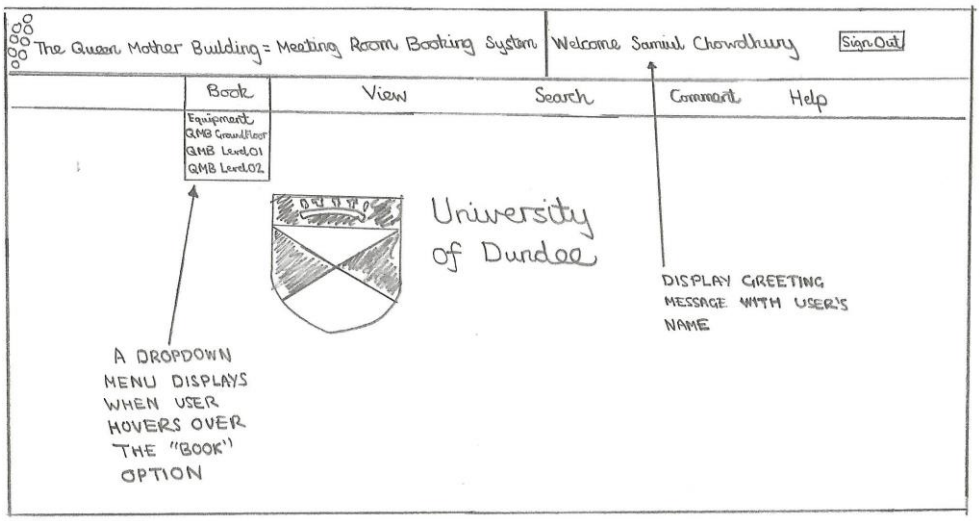

Figure 4.4: The design for the Homepage. It provides an "*aesthetic and minimalist design"*[19] while avoiding any overcrowding of the screen which occurred with the previous online model.

Book

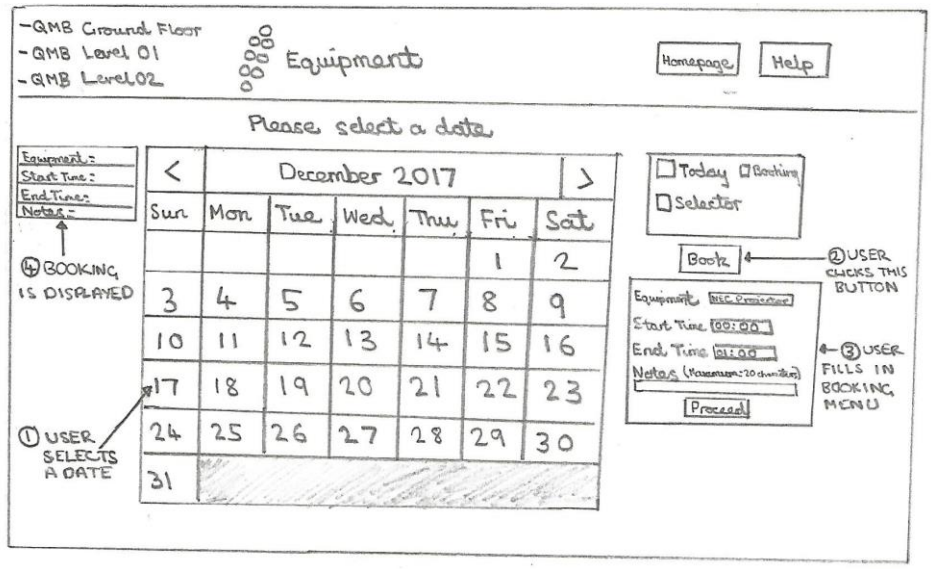

Figure 4.5: This design helps to meet the usability heuristic of helping to provide "*flexibility and efficiency of use"*[20], as well as helping the user to "*recognize, diagnose and recover from errors"*[21].

[19] https://www.nngroup.com/articles/ten-usability-heuristics/
[20] https://www.nngroup.com/articles/ten-usability-heuristics/
[21] https://www.nngroup.com/articles/ten-usability-heuristics/

View

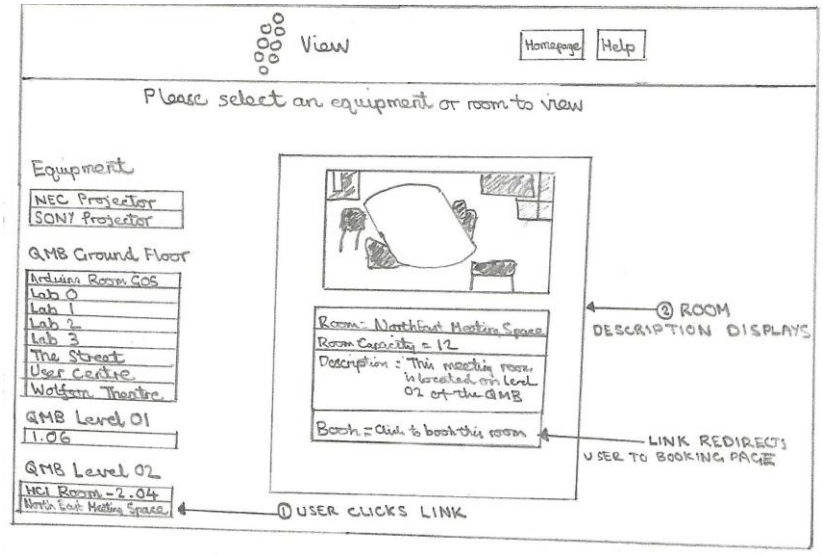

Figure 4.6: The "View" option helps to meet the usability heuristic of "*match between system and the real world"*[22] where information is shown in a natural order with easy to understand terms in the description box of the selected equipment/room.

Search

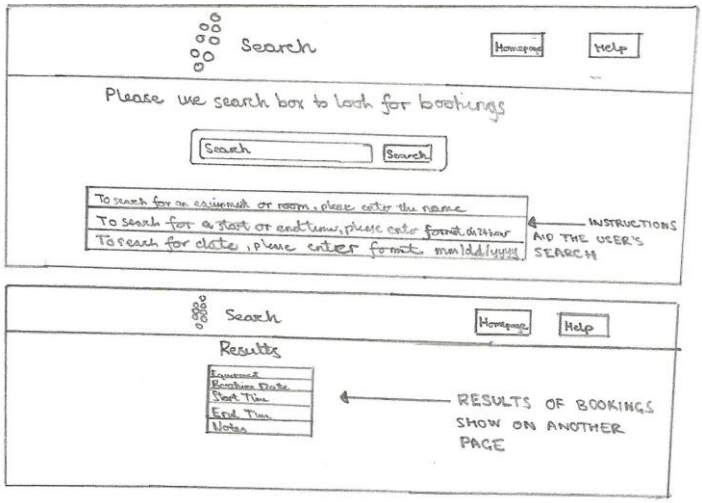

Figure 4.7: The "Search" menu uses 2 separate pages. The first one allows the user to look for bookings while the second page displays the results. This menu provides *"flexibility and efficiency of use"*[23] and helps users to "*recognize, diagnose and recover from errors"*[24].

[22] https://www.nngroup.com/articles/ten-usability-heuristics/
[23] https://www.nngroup.com/articles/ten-usability-heuristics/
[24] https://www.nngroup.com/articles/ten-usability-heuristics/

Comment

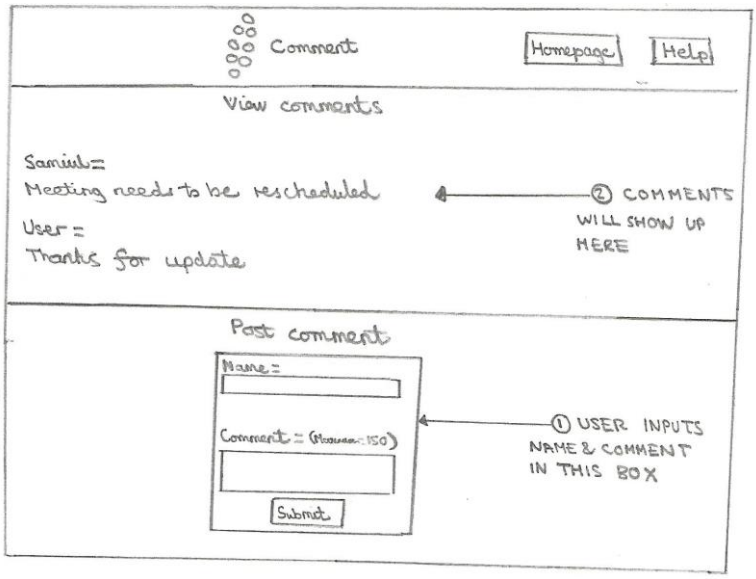

Figure 4.8: The comment section helps to meet the usability heuristics of *"match between system and the real world"*[25] and "*consistency and standards*"[26] where natural language is used to describe the design of this page.

Help

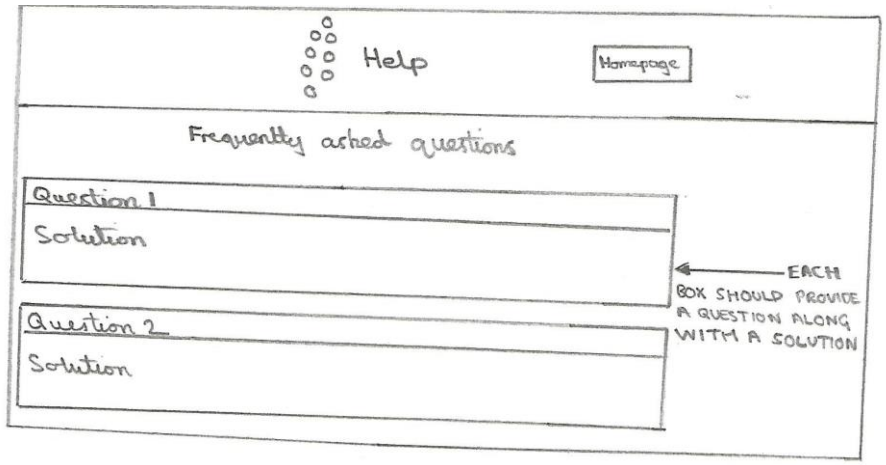

Figure 4.9: The "Help" menu aims to answer most of the frequently asked questions users may have regarding the use of this system. It can be accessed in every part of the system, thereby, meeting the usability heuristic of *"help and documentation"*[27] being provided to the user.

[25] https://www.nngroup.com/articles/ten-usability-heuristics/
[26] https://www.nngroup.com/articles/ten-usability-heuristics/
[27] https://www.nngroup.com/articles/ten-usability-heuristics/

4.3 Security

It can be said without a doubt, that security has major role to play in the development of this system. From all of society's infrastructure such as power grids to the banking system, security is considered as a top priority as these are some examples of what are targeted by those with malicious intentions. As technology becomes more powerful and prevalent in our society, then it is not surprising to see that security has become a top trend topic in today's news.

There are many companies who have had personal information belonging to customer's that have been stolen as a result of a security breach. One example is the recent incident which occurred at the credit reference company known as Equifax, where a security breach had *"revealed the names, Social Security numbers, birth dates and addresses of almost half the US population."*[28]

Another example where a security breach occurred was at the web services provider company called Yahoo, where *"3 billion email users were likely compromised."*[29] These two stories are examples of the growing number of incidents which happen when security is not updated or maintained on a regular basis.

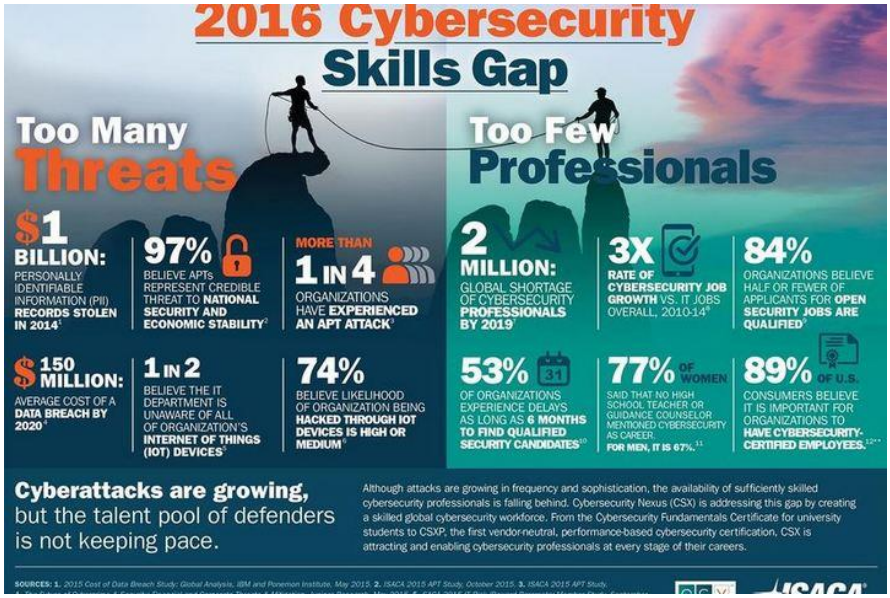

Figure 4.16: A fact sheet which highlights the skills shortage faced by the information security sector.[30]

[28] https://www.techworld.com/security/uks-most-infamous-data-breaches-3604586/
[29] https://www.techworld.com/security/uks-most-infamous-data-breaches-3604586/
[30] http://www.eweek.com/security/industry-group-exposes-skills-gap-for-cyber-security-jobs

But as well as highlighting these examples as to why security breaches are a top priority issue, it is also important to place emphasis on the professional conduct that is expected to be met and maintained by software engineers and those in similar roles within the information technology industry.

For example, the British Computing Society (BCS) stipulates a series of obligations within their code of conduct, of which one is to *"carry out your professional responsibilities with due care and diligence in accordance with the Relevant Authority's requirements whilst exercising your professional judgement at all times."*[31] Therefore, software engineers must remember to be competent in their field as well as respecting confidentiality. Furthermore, professionals working within this sector must be fully aware of legislation governing this field and that any misconduct or negligence on their part, can have severe ramifications.

It is also crucial to mention that there are many statutes which govern the area of crimes being conducted within the technology industry. For example, The Computer Misuse Act 1990 states that a person can be guilty if *"he causes a computer to perform any function with intent to secure access to any program or data held in any computer."*[32]

In addition to this, The Data Protection Act 1998, makes it clear that in regards to sensitive data being held about clients, the individual has the right *"to be informed by any data controller whether personal data of which that individual is the data subject are being processed by or on behalf of that data controller."*[33]

Therefore, with all of the above mentioned information regarding security, it was important for me to ensure that the same high standard expected in the industry, was applied towards this project. In order to ensure that safety measures were being implemented during the development of this system, I was required to learn many of the security functions provided by PHP.

$_GET and $_POST: When it came to using these variables, it was crucial to recognize the key difference between the both of them.

[31] http://www.bcs.org/category/6030
[32] https://www.legislation.gov.uk/ukpga/1990/18/section/1
[33] https://www.legislation.gov.uk/ukpga/1998/29/section/7

The former variable is one which is used for transmitting any information which you would like to display in the browser's URL. In other words, any information transmitted with this method, will be visible for others to see. This can be useful in some circumstances, but for personal information, it should be avoided at all costs. In regards to this project, the $_GET variable was useful when it came to providing the user with the flexibility to change the month and year of the booking calendar via the URL.

In regards, to the latter variable, this was primarily used the most as security was designated as a top priority in this project. Unlike the $_GET variable, the $_POST variable is used to transmit information which will not be displayed in the URL. In other words, any information transmitted with this method, will be not be visible for others to see. This method was used when it came to transmitting personal information from the user's registration form being sent to the database. In addition to this, it was also used when the user would log into the system.

mysqli_real_escape_string: A very important function built into PHP, which helps to *"escape special characters in a string for use in an SQL statement, taking into account the current* charset *of the connection."*[34] This PHP function helps to ensure that SQL injections (which are malicious code intended to be inserted into a database) are prevented from being executed. This security measure was used in parts of this booking system such as the "Registration" page as well as the notes input within the booking menu.

htmlspecialchars: Another essential feature of PHP which is generally recommended by professionals to only be used at the time of retrieving information from a database. The purpose of this function is to *"convert special characters to HTML entities"*[35] and to essentially, prevent the browser from being confused and executing malicious browser code. This was essential to use when it came to retrieving information from the database for features such as displaying the user's name on the dashboard of the Homepage and for displaying booking information.

[34] http://php.net/manual/en/mysqli.real-escape-string.php
[35] http://php.net/manual/en/faq.passwords.php

Password hashing: This was very important to use when it came ensuring that the user's password could not be read when stored in the database. When it comes to password hashing, PHP offers many forms of hashing mechanisms.

However, PHP guidelines have recommended that users do not use the password hashing mechanisms known as md5() and sha1() which have been traditionally used for a long time. The reason why is *"because of how quickly a modern computer can "reverse" these hashing algorithms."*[36]

Therefore, when building this system, I decided to use the function known as password_hash, which essentially converts and scrambles the user's password to a series of random numbers, letters and symbols, rendering the user's password from being readable. This then in turn would be unhashed using the password_verify function which is used by the system to compare the user's password input with what is stored in the database, at the time of login.

Sign In: When it came to the user signing into the system, it was crucial to ensure that security was maintained at this stage of using the system. For example, when the user inputs the password into the relevant input box, the password is not revealed but disguised by the bullet points which is generally expected in any password input box.

In addition to this, when it came to invalid details being entered by the user, rather than the system indicating to the user precisely what wrong input was entered (whether it was the username or password) the system will simply state "Incorrect combination." This is to help prevent any form of unauthorized access as only the legitimate user should be aware of what errors were made on his/her part.

Furthermore, to prevent any further unauthorized access being made to the system, I managed to create a termination code, which would prevent any unauthorized user from being able to circumvent the login system by directly typing in the name of the PHP page into the URL. If any attempts are made doing this, then then the user will simply come across a termination page stating "Authorisation is required to access this page." Therefore, the only people who can access areas of the system such as the booking and comment sections, are members of this system.

[36] http://php.net/manual/en/faq.passwords.php

After completing the design phase and consulting with my client about how the system would look and operate, I was now ready to proceed with the implementation and testing of the system, where I would be able to go ahead and engage with the actual the front and back end development, required for this project.

5. Implementation and testing

5.1 Validation checks and storing details

The aim of this chapter is to highlight some of the important functions of this system and how they operate behind the scenes. When it came to the actual programming for this system, the first task for me was to build an efficient login system. This would be the first step that the user must go through in order to access the main Homepage. As mentioned earlier in the second chapter, the previous online system would allow a user to be able to directly view the bookings and then ask him/her to sign in when attempting to make an actual reservation of a meeting room or equipment.

To create a more smoother and easier process for the user, it made sense to simply login from the outset rather than in between viewing and booking. Therefore, the challenge of building a login system, required me to grasp an understanding of not only PHP, but also how MySQL operated as a database query language.

In essence, for this stage of the development process, what I was required to do was to allow the user to be able to register his/her details on the Registration page. The registration form would not only allow the user to input their personal details, but to also validate the information they entered. The validation checks were crucial as it helps to establish a more professional environment in regards to form processing.

For the validation checks, there were 6 different types of checks incorporated into the form. I will explain each of these by firstly listing the type of validation check present in the form, followed by the algorithm behind the functioning of it and a description of what it does for the system.

Validation check 1:	Empty input check

Algorithm:
(Example for one input box)
	if(empty($fn)){
	$fnerror= “*First Name is required”;
	}

Description:	When checking for empty inputs, the first step was to create 2 variables as these would later be used to store the user input and display the error message. So, with the above example, the

	variable used to store the user's first name was called $fn and the second variable to display the error message was called $fnerror. If the system detected no input for the first name ($fn) then the message "*First name is required" ($fnerror) would display. This check was conducted for all the input fields on the Registration form: first name; last name; email address; username, password and confirm password. Furthermore, this validation check has also been used for the Sign In page when the user has to enter a username and password to log into the system.
Validation check 2:	Letters and white space for first and last name

Algorithm:	if (!preg_match("/^[a-zA-Z]*$/",$fn)) {
	$fnerror = "*Letters and white space are only permissible";
	}

Description:	This algorithm helps to ensure that only letters and white spaces can be used in the first and last name input boxes. If the user were to use something like numbers, then the error message "*Letters and white space are only permissible" would display.
Validation check 3:	Valid email format

Algorithm:	if (!filter_var($ea, FILTER_VALIDATE_EMAIL)) {
	$eaerror = "*Use valid email format";
	}

Description:	This algorithm helped to ensure that the user would only be allowed to input a valid email address recognized by the system.
Validation check 4:	Username availability

Algorithm:	$sql="SELECT * FROM users WHERE username='$un'";
	$result= mysqli_query($dbconnection, $sql);
	$results=mysqli_num_rows($result);
	if($results>0) {
	$unerror="*Username has been taken";
	}
	}

Description:	This algorithm, which uses both PHP and a MySQL database query, searches for any matches of the username input by the user, in the database used to store users. If a match has been found, then the system will display the message “*Username has been taken.”
Validation check 5:	Both passwords should match

Algorithm:	if($cpw!=$pw and !empty($pw) and !empty($cpw)){
	$cpwerror=”*Enter both passwords correctly”;
	}

Description:	This algorithm helped to ensure that when the user enters a password and has to confirm the password again, if any different inputs are detected in either password box, then the system would display the message “”*Enter both passwords correctly.”
Validation check 6:	Incorrect details entered to log into system
Algorithm:	if($unerror=="" and $pwerror==""){ $sql="SELECT * FROM users WHERE username='$un'"; $result=mysqli_query($dbconnection, $sql);

	$resultCheck=mysqli_num_rows($result);
	if($resultCheck<1){
	$iderror="*Incorrect combination";
	}

Description:	This algorithm takes the username and password entered at the Sign In page and then compares them with what is stored in the database which contains users' details. If there are no matches found, then the system will display the message "Incorrect combination."

Following the registration process, once the details had been successfully validated, the system was then required to store them in a database. For this part of the development process, I created a database called "register" along with an attached table called "booking." It was within this database that the personal details entered on the "Registration" page, were stored securely. Moreover, when it came to storing the user's password, it was imperative to ensure that it was hashed so as to render it unreadable for anyone accessing the database.

Task:	Password hashing
Algorithm:	$hp=password_hash($pw, PASSWORD_DEFAULT);
Description:	This algorithm ensured that the password was scrambled.

Finally, the code below illustrates how the data was stored in the database and then redirecting the user to a message indicating that the account was created successfully.

Task:	Storing user's details in database
Algorithm:	if($fnerror=="" and $lnerror=="" and $eaerror=="" and $unerror=="" and $pwerror=="" and $cpwerror==""){ $sqlinsert="INSERT INTO users (first_name, last_name, email_address, username, password) VALUES ('$fn', '$ln', '$ea', '$un', '$hp')";

	mysqli_query($dbconnection, $sqlinsert);
	header('Location:success.php');
	}

Description:	This stores the user's details in the database, following validation.

5.2 Making a booking

The process of making a booking was designed in a manner so as to allow an efficient experience for the user. This meant that in order to meet this goal, there would also need to be in place booking rules which would prevent any invalid bookings from being made so as to avoid any conflicts between the users of this system. The table below highlights the 4 different types of conditions which would prevent the system from being able to book a meeting room.

Condition 1:	Same Start and End Times

Algorithm:	if($start==$end){
	echo " Start and End times are the same ";
	}

Description:	This ensures that the system will not allow any bookings to be made if the user's Start Time is the same as the End Time. For example, Start Time is 12:00 and End Time is 12:00. If this is the case, then the system will display the message "Start and End Times are the same."
Condition 2:	End time not being after the Start Time

Algorithm:	if($start>$end){
	echo " End Time must be after the Start Time ";
	}

Description:	This ensures that the system will not allow any bookings to be made if the user sets an End Time not being after the Start Time. For example, Start Time is 14:00 and End Time is 12:00.

	If this is the case, then the system will display the message “End Time must be after the Start Time.”
Condition 3:	Double bookings

Algorithm:	$sql="SELECT * FROM bookings WHERE equipment='$equipment' AND start_time='$start' AND selected_date='$eventdate'";
	$result= mysqli_query($dbconnection, $sql);
	$results=mysqli_num_rows($result);
	if($results>0) {
	echo " Booking slot not available ";
	}

Description:	This ensures that the system will not allow any bookings to be made if booking a room has already been done for the same date and time slot. For example, user selects a date, and attempts to book a room with the Start Time being 12:00, even though this has already been done. If this is the case, then the system will display the message “Booking slot not available.”
Condition 4:	Overlapping bookings

Algorithm:	$sql="SELECT * FROM bookings WHERE selected_date='$eventdate' AND equipment='$equipment' AND '$start' < end_time AND '$end' >start_time ";
	$result= mysqli_query($dbconnection, $sql);
	$results=mysqli_num_rows($result);
	if($results>0) {
	echo " Booking overlap ";
	}

Description:	This ensures that the system will not allow any bookings to be made if it overlaps with another booking. For example, user selects a date and attempts to book a room beginning at 14:00,

	even though another booking for this room exists on the same day, starting at 12:00 and ending at 16:00. If this is the case, then the system will display the error message “Booking overlap.”

If the system can make a valid booking where none of the above listed conditions are present, then the system will display a message to the user indicating that the booking was a success, along with displaying the bookings to the left side of the calendar.

Task:	Make booking

Algorithm:	$sqlinsert="insert into bookings (equipment,start_time,end_time,notes,selected_date,date_added) values ('".$equipment."','".$start."','".$end."','".$notes."','".$eventdate."',now())";
	$resultinsert=mysqli_query($dbconnection,$sqlinsert);
	
	if($resultinsert){
	echo " Booking was successful ";
	}

Description:	This code ensures that a booking is made successfully and stored in the database. The system will also display the message “Booking was successful.”
Task:	Display booking
Algorithm:	$sqlEvent="select * from bookings where selected_date='".$month."/".$day."/".$year."'order by equipment, start_time asc"; $resultEvents=mysqli_query($dbconnection,$sqlEvent); echo " "; while($events=mysqli_fetch_array($resultEvents)){

	echo "Equipment: ".htmlspecialchars($events['equipment'])." "; echo "Start Time: ".htmlspecialchars($events['start_time'])." "; echo "End Time: ".htmlspecialchars($events['end_time'])." "; echo "Notes: ".htmlspecialchars($events['notes'])." "; echo" "; }
Description:	This code displays the booking made by the user on the left side of the calendar.

5.3 Searching for bookings

The searching function in the system provides the user with the flexibility of being able to look for bookings without having to necessarily go through every booking calendar. In order to enable this feature, this required me to implement 3 elements- the ability to retrieve search results, display the results and also the option of displaying the valid response for no results being found.

Task:	Search for bookings
Algorithm: **(Example for one database)**	if (isset($_POST['submit-search'])){ $search=mysqli_real_escape_string($conn, $_POST['search']); $sql="SELECT * FROM bookings WHERE equipment LIKE'%$search%' OR start_time LIKE '%$search%'OR end_time LIKE '%$search%'OR selected_date LIKE '%$search%'order by equipment, selected_date, start_time asc"; $result=mysqli_query($conn, $sql); $queryResult=mysqli_num_rows($result);

Description:	This algorithm searches for results from the database which is used to store bookings of equipment.
Task:	Display results

Algorithm:
(Example for one database)
	if($queryResult>0){
	
	while($row=mysqli_fetch_assoc($result)){
	echo "
	Equipment: ".htmlspecialchars($row['equipment'])."
	
	Booking Date: ".htmlspecialchars($row['selected_date'])."
	
	Start Time: ".htmlspecialchars($row['start_time'])."
	
	End Time: ".htmlspecialchars($row['end_time'])."
	
	Notes: ".htmlspecialchars($row['notes'])."
	
	";
	}

Description:	This algorithm displays the results of any bookings it finds in the database used to store bookings of equipment.
Task:	If no input has been detected in search box

Algorithm:	if(empty($_POST['search'])){
	echo "No results were found";
	}

Description:	This algorithm is used to display the message “No results were found” if the user has clicked the Search button without typing anything into the search box.
Task:	If no results have been found

Algorithm:	if($queryResult==0 and $queryResultt==0 and $queryResulttt==0 and $queryResulttttt==0){
	echo "No results were found";
	}

Description:	This algorithm is used to display the message “No results were found” if the system cannot find anything valid from any of the databases, based on the user’s input.

5.4 The challenges

Overall, while trying to implement this system, there were some challenges present when it came ensuring that the booking process was effective. For example, designing the algorithm for preventing overlapping bookings, was quite difficult as this required researching the different styles of variables that would need to be used as well as having to go back and forth between using PHP code and MySQL query language. The logic behind this particular condition was a little difficult to grasp at first, but proved to be the most effective way for the system to prevent any overlapping bookings from being made altogether.

In addition to this, when it came to displaying the “No results were found” message in regards to the searching function, this in itself proved to be challenging as well, since this message would initially appear at the wrong time. For example, even though something was found, this message would nonetheless still show up. Therefore, this required me to come up with a way to develop a unique code (please see above) which combined the use of all 4 databases used to store the bookings of rooms and equipment, and to ensure that the message only displayed at the right time.

It can be said with confidence that while these were some challenges which took some time to resolve, nonetheless, they proved to be very effective and useful solutions to help ensure that the booking system was efficient and successful.

6. Evaluation

6.1 Submitting the ethics material

As part of this project, one of the important tasks that would need to be fulfilled was to carry out an evaluation of the prototype system. Once I had completed the prototype model, I decided to proceed with recruiting volunteers to test the system as this would help to provide a strong insight as to whether the booking system had met the needs of potential users.

Therefore, the first step for me in regards to this task, was to email the Ethics Committee a request to be able to engage with volunteers for the evaluation of the system. This involved me having to send the Committee a large set of files which can be described as the following:

- **Checklist 1 & 2:** This required to me answer questions about the risks behind this project and how it would affect the participant.
- **Participant information sheet:** This provided all of the information regarding the system and what the evaluation would entail. It also explained all of the rights of the participant as well explaining the confidentiality behind the data being gathered.
- **Consent form:** This form was required to be signed by the participant explaining that they understood the information sheet attached and would provide their consent to engage in this evaluation.
- **Email samples:** This sheet provided two samples of the emails which would be dispatched to the staff members of the Department of Computing. The first email would be an informal email and the second email would be a formal email containing a participant information sheet and consent form.
- **Form A:** This was the official application requesting the Ethics Committee for approval of recruiting volunteers to evaluate the system. The form explains in detail aspects such as what the project is about, how the evaluation would work and what would happen to data being collected.
- **Questionnaires:** This folder contained the two different types of questionnaire that would be used for the evaluation- System Usability Scale and NASA TLX.

After the application had been sent to the Ethics Committee, the initial response I had received required me to make some alterations to the participant information sheet which required more elaboration on some aspects of the project. Once this had been done and submitted, the Ethics Committee had finally granted their approval to proceed with recruiting volunteers for the project.

All of the material listed above, can be found in the Appendices section of this report (Appendix 4.)

6.2 Meeting the participants

The next stage of the process was to send out the email samples to the staff members of the Department of Computing, asking for their participation of evaluating the prototype model. Although it was difficult to receive a large number of responses from the many staff members which may due to their busy schedules, nonetheless I can say that some did choose to participate with the evaluation. This was in large thanks to my Supervisor, who was able to utilize the staff email list to distribute my informal email invitation.

After sending out all of the relevant material such as the participant information sheet and consent form to those who were interested in testing out the system as well as receiving their consent forms back, it was important to be able to schedule the evaluations to be conducted at a time and date of their convenience. For me it was essential to accommodate to their preferences, as this would mean that the evaluation would be able to be conducted in a relaxed environment thereby, helping to provide more effective results.

Therefore, when it came to the actual evaluations, although the locations and meetups of different participants had varied, nonetheless this had allowed the participants to be able to use the system with confidence knowing that their time and location of choice would be accepted.

6.3 Conducting the evaluation

After meeting the participants, it was essential to be able to make sure that I was complying with what was stipulated in the participant information sheet. This involved me explaining to the volunteers about their rights and what would happen in regards to data retention of the results gathered. Following this, I would then go on to ask

them to carry out a series of tasks, where the first one would involve them using the booking system with no assistance while the second task would require them to follow a set of instructions. Both sets of tasks would be conducted while I would observe their reactions of using the system.

While I was watching the participants carry out their evaluations, I had observed that their general reaction was pleasing when it came to using the system. For example, some of the participants complimented the background design of the Homepage featuring the University of Dundee emblem, while others responded favorably to the clear visual design of the manner in which the bookings were displayed to the user.

Furthermore, when it came to the actual booking process the participants were satisfied to see that the booking rules were operational when they had attempted to make an invalid booking. Again, this was essential in order to produce an efficient and effective booking system, which was something that was missing in the previous online model.

Below you can see a NASA TLX chart, which provides a highlight of the participants responses as to how they felt when using the system. This questionnaire would use a series of categories to measure performance. To simply put, the lower the score, the more efficient the system is while the opposite would mean it is not adequate for use.

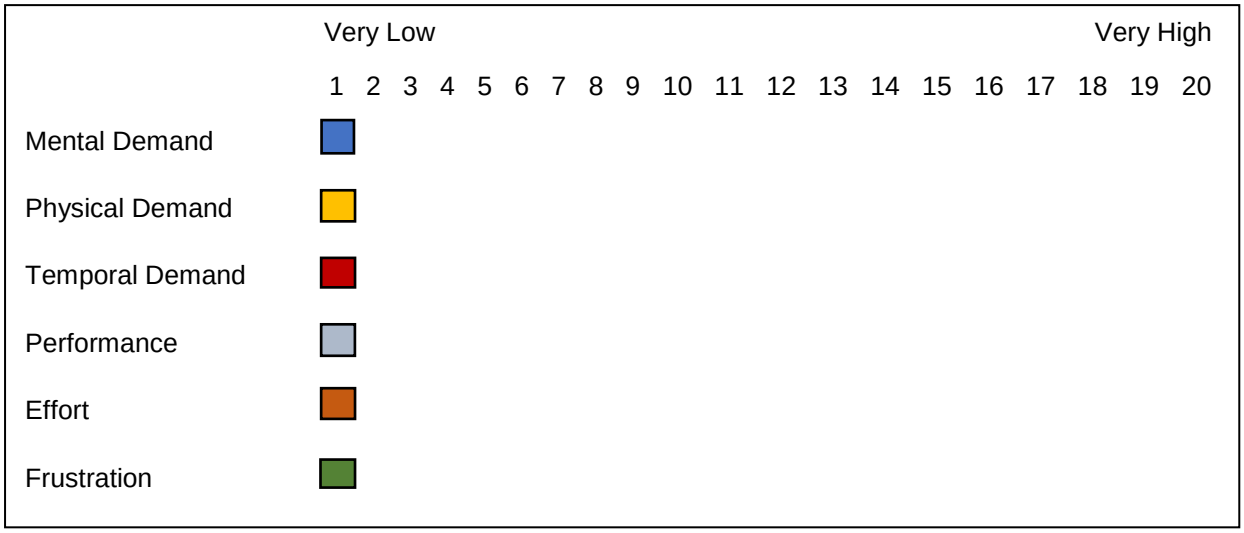

Figure 6.1: The results of this NASA TLX highlights that the system was very usable amongst the participants and did not provide any major cause for concern.

In addition to the NASA TLX questionnaire, I had asked the participants to fill in a System Usability Scale questionnaire which in general, received the same responses in terms of usability.

	Strongly Disagree				Strongly Agree
I think I would like to use this website.					X
I found this website unnecessarily complex.	X				
I though this website was easy to use.					X
I think that I would need assistance to be able to use this website.	X				
I found the various functions in this website well integrated.					X
I thought there was too much inconsistency in this website.	X				
I would imagine that most people would learn to use this website very quickly.					X
I found this website very cumbersome/awkward to use.	X				
I felt very confident using this website.					X
I needed to learn a lot of things before I could get going with this website.	X				

Figure 6.2: The Usability Scale highlights the same pattern amongst the volunteers who found that that system was very adequate to use.

6.4 Further improvements

Once the evaluation was completed and results were gathered in the questionnaires, my last task was to ask the volunteers on where they believed that improvements could be made to the system. This was an essential task to be fulfilled as part of the evaluation, since it would allow for the system to become more better equipped to accommodate to the needs of users in the future, should an enhanced and more

advanced version were to ever be developed. Although the system was perceived as a success amongst the participants, it was still believed that there were some areas which could be improved upon as shown in the table below:

Area of improvement:	Description:
Permanent hover effect over selected date in booking calendar	Allow a permanent hover effect to stay in place once the user selected a date. This would in turn, allow the user to recognise that the date he/she has clicked, has indeed been selected.
Automatic generation for next hour	When the user has selected a Start Time, the End Time should be able to generate automatically to the next hour. For example, if the user selected 14:00 as Start Time, then the End Time should automatically start from 15:00.
Booking events should automatically show when user hovers over booking date	When the user hovers over a date containing a booking, then the system should automatically display the booked rooms and equipment for that date.
Booking display should be restricted to names of equipment and meeting rooms	To help save real estate space, it was suggested that in the event there were too many bookings, the system should simply display the name of the booked equipment or meeting room where if the user clicks the name, then the booking details would automatically expand.
Be able to select month and year in calendar rather than URL	If the user wanted to select a specific year or month, then this feature should be provided in the calendar itself, rather than having to go into the URL to do so.
Prevent bookings before today's date from being made	The system should prevent users from being able to make bookings in the past, meaning anything before today's date. There should an error message for this feature.
Recurring meeting schedule	A feature should be built into the system to allow the user to set up a recurring meeting schedule.

7. Completion

7.1 The final product

Once the evaluations were completed the next step for me was to highlight the end product to my client. After being able to demonstrate the full functionality and operation of the meeting room booking system, I am able to state that the client was satisfied with the end product. While the previous chapter helped to highlight some of the areas where improvements can be made, nonetheless, it can be said that the existing end product achieved the basic requirements of the client.

The system was designed in line with the requirements specification and wireframes being kept in mind throughout the whole development process as well as the other essential elements such as security. Below I have attached screenshots which help to demonstrate the final product being operated.

Setup

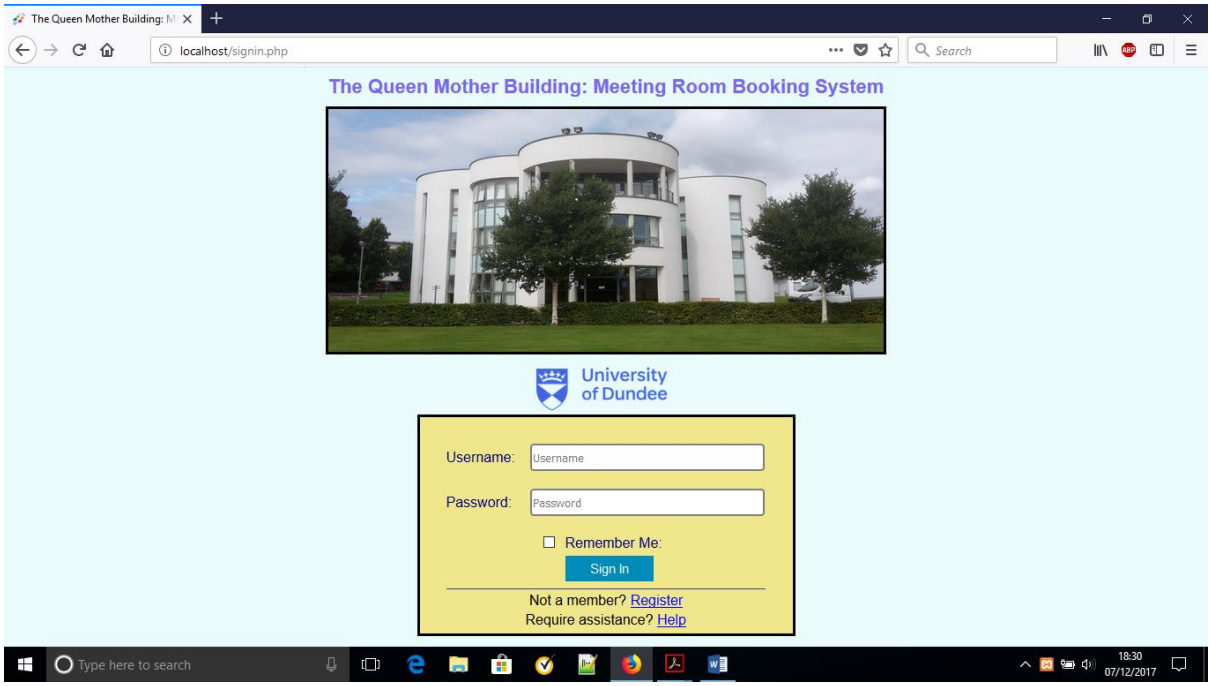

Figure 7.1: The Sign In page featuring all of the necessary options to help the user.

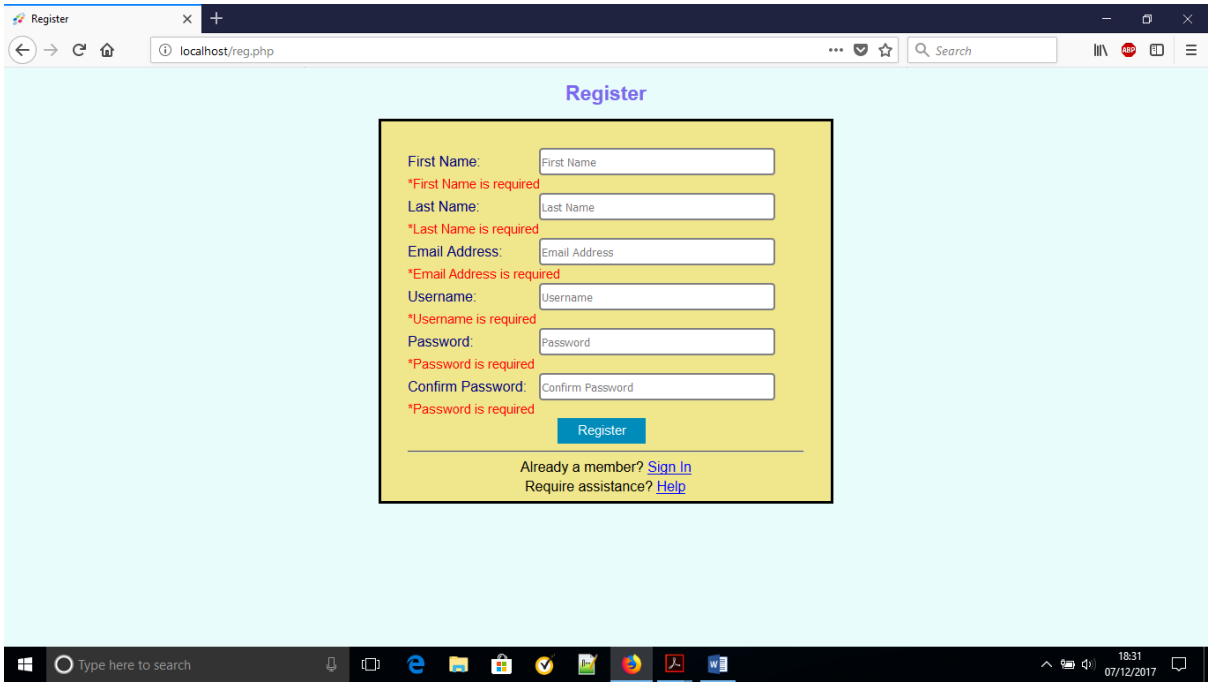

Figure 7.2: The Registration page showing the necessary validation checks.

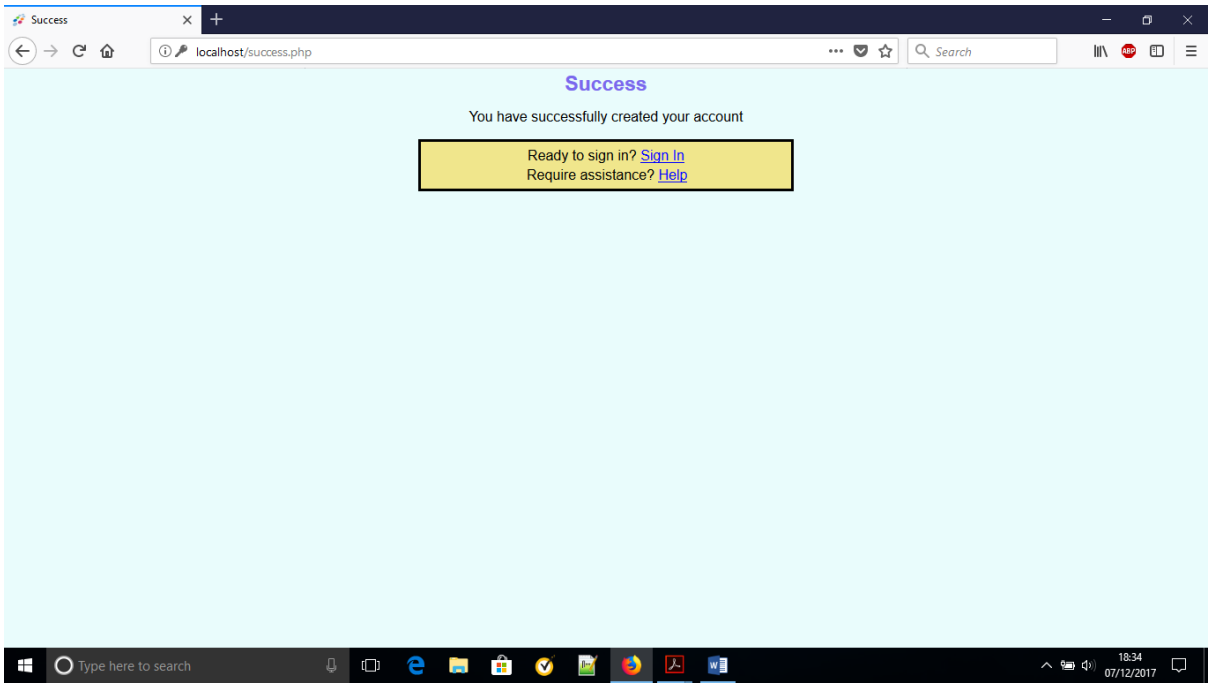

Figure 7.3: Message indicating that an account has been created with the option of going back to the Sign In page and access to the help menu.

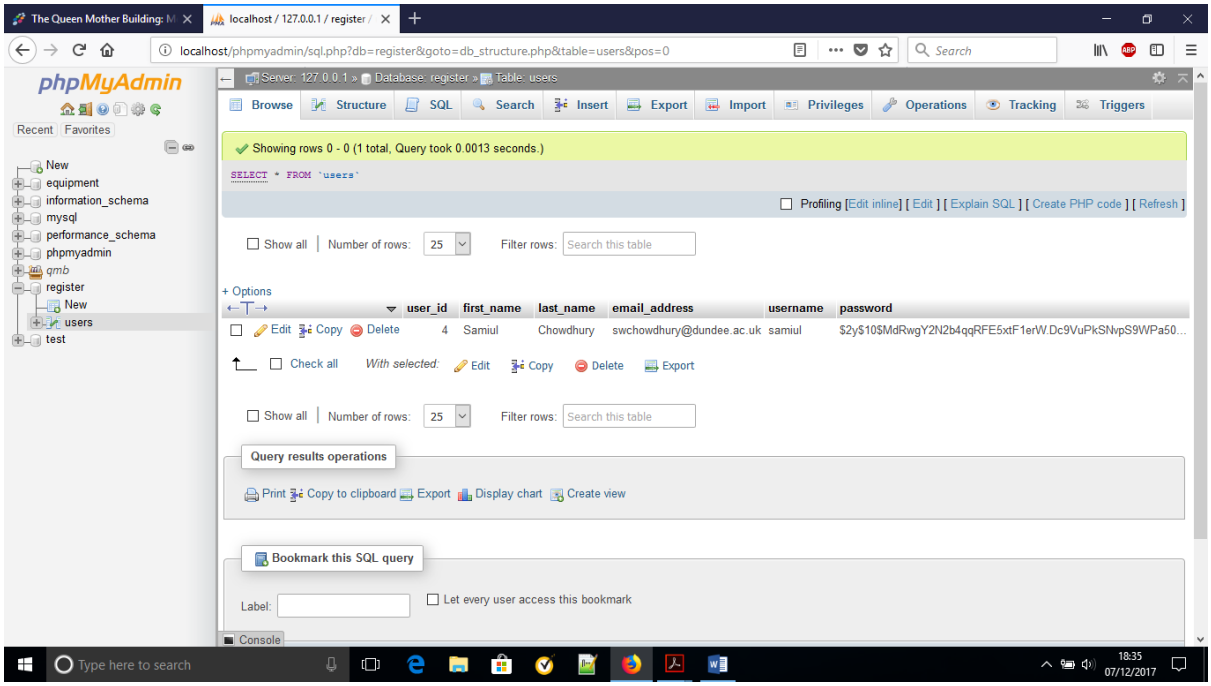

Figure 7.4: This database has stored the user account details along with the user's password being hashed.

Homepage

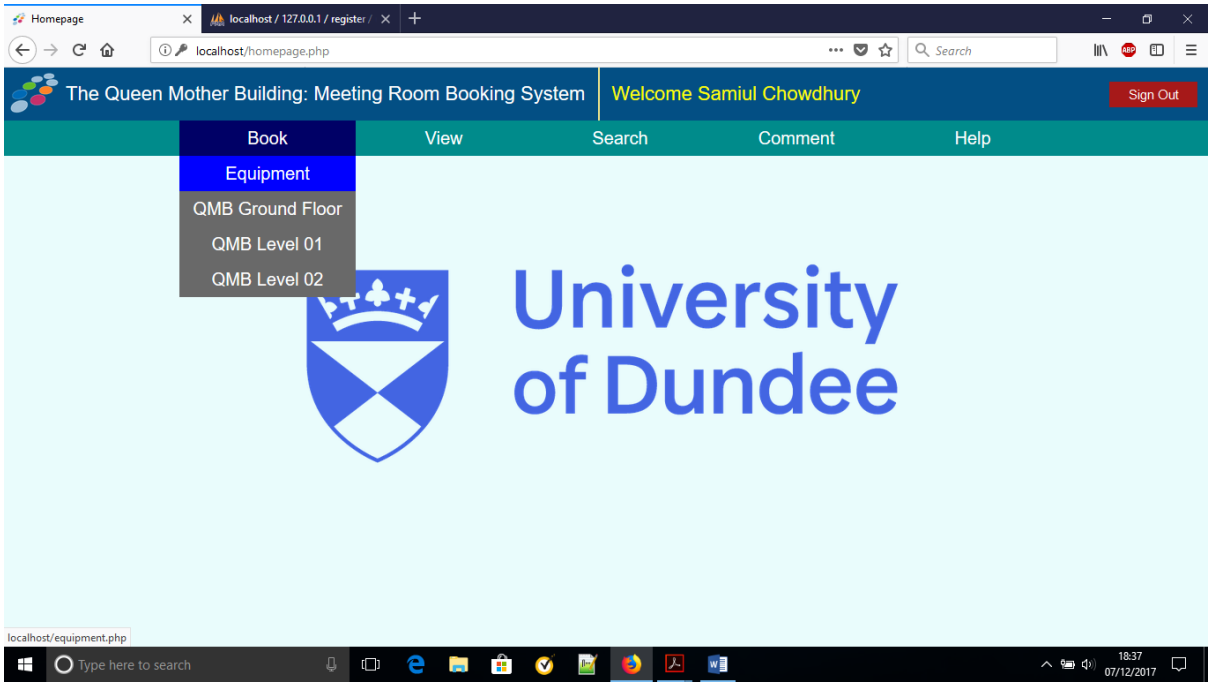

Figure 7.5: The Homepage displays the user's name in the dashboard along with a dropdown menu to book an equipment or meeting room. Furthermore, the Homepage also features a Sign Out button along with a unique navigation bar to access the other options of the system.

Book

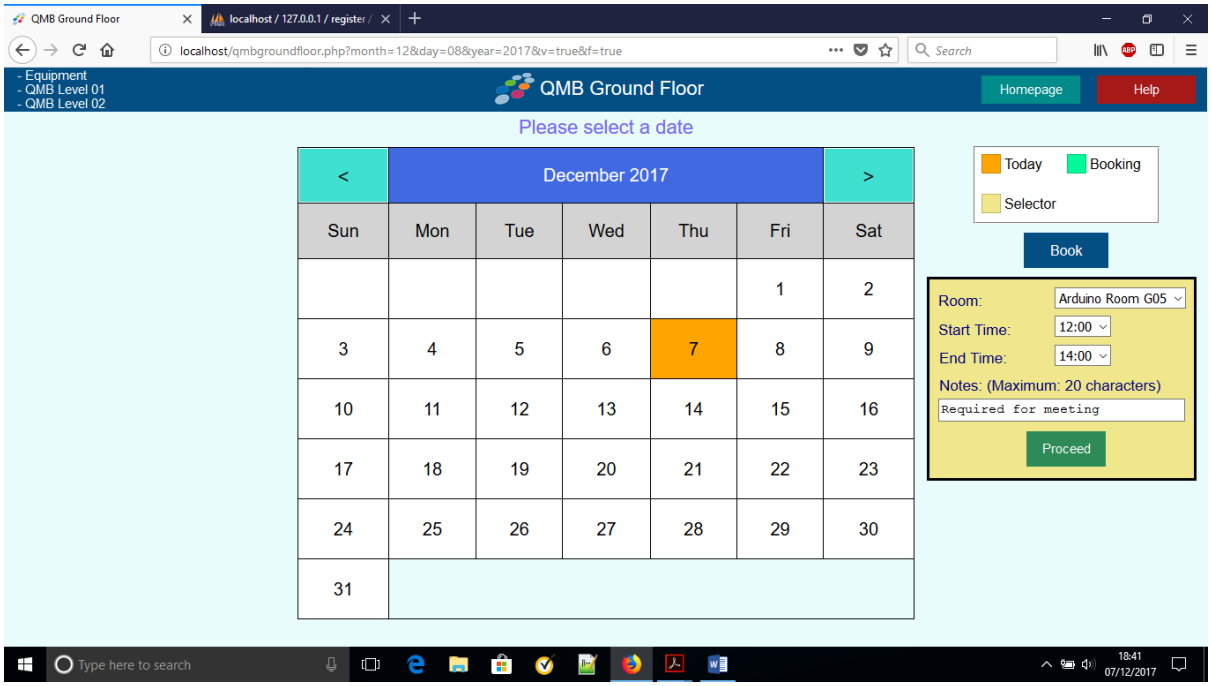

Figure 7.6: The user has selected the relevant options and left a note using the booking menu.

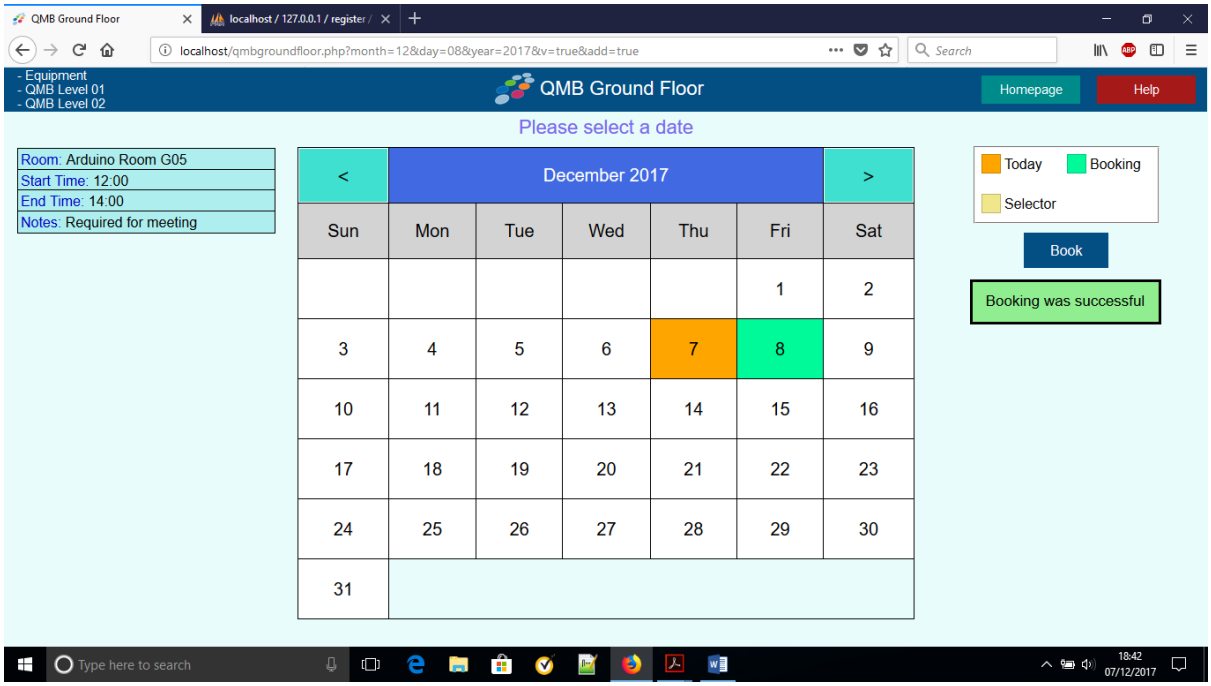

Figure 7.7: The system has managed to successfully book a meeting room. A message indicates this as well as highlighting the booking date and displaying the details.

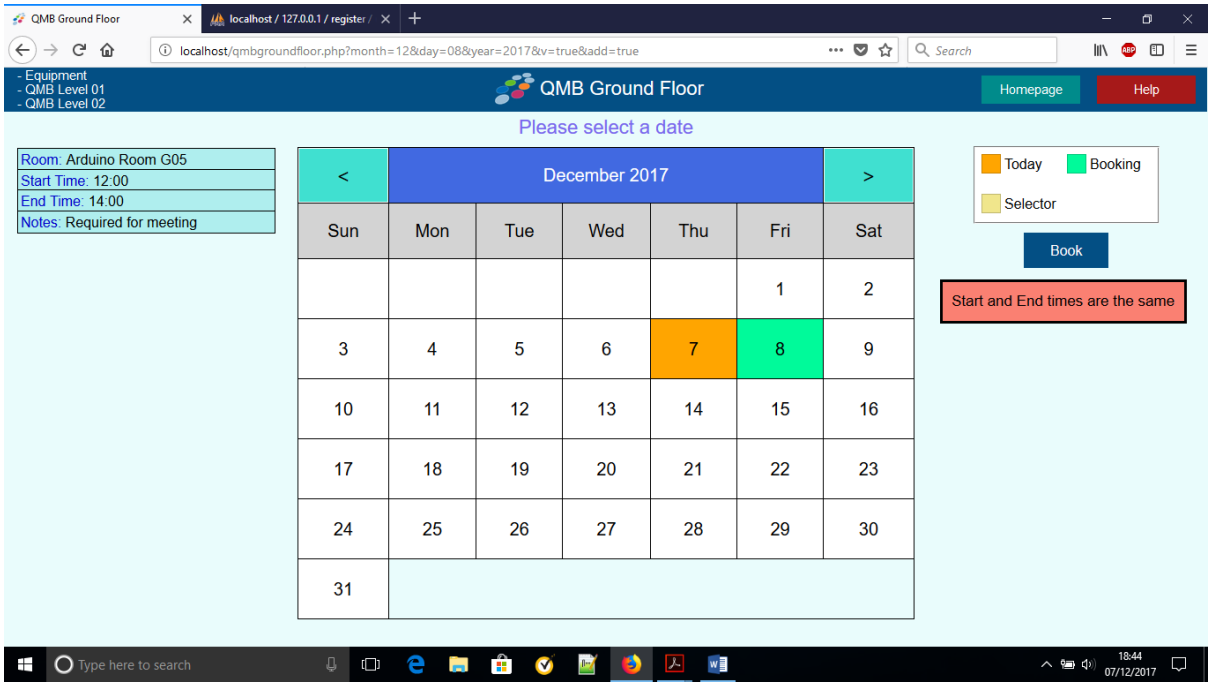

Figure 7.8: An example of an invalid booking attempting to be made (where Start Time and End Time are the same.)

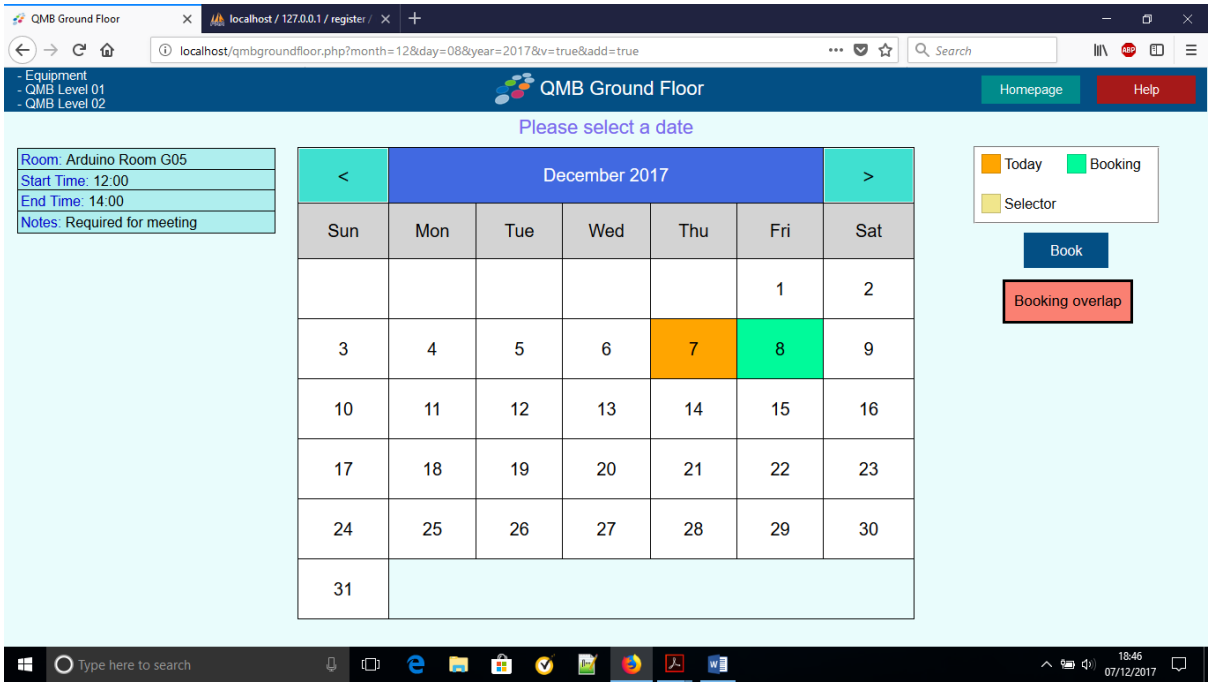

Figure 7.9: Another example of an invalid booking being prevented by the system (where the booking being made would overlap another booking.)

View

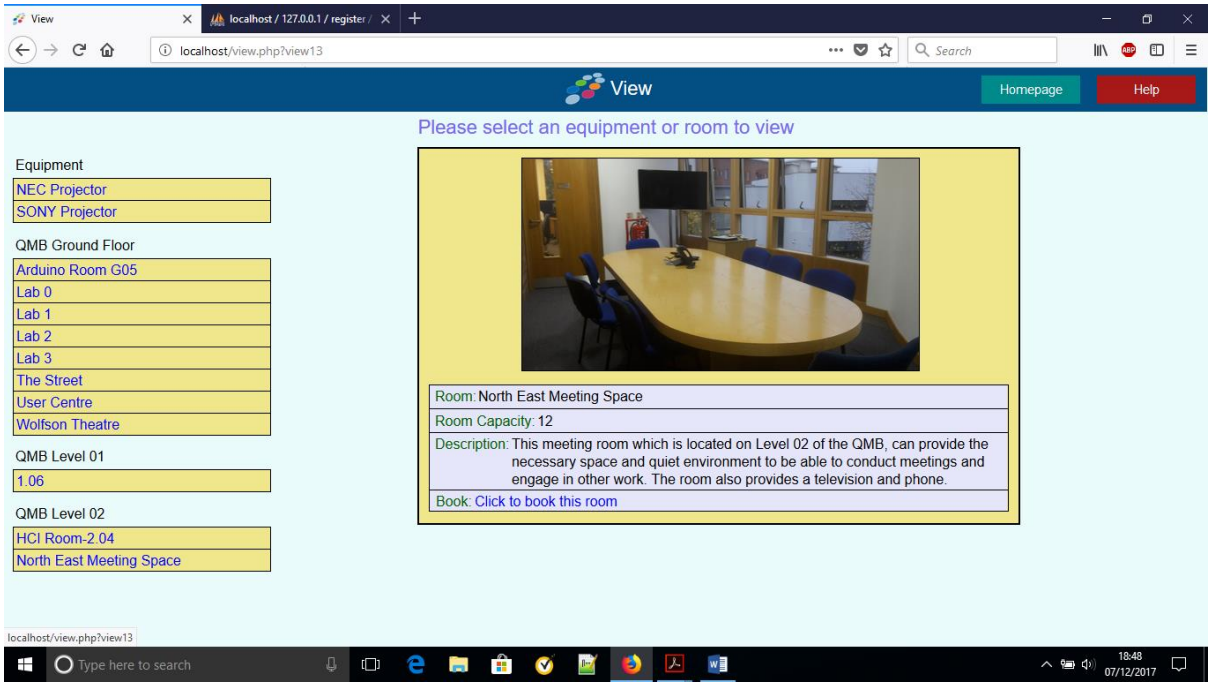

Figure 7.10: The “View” option offers the user the ability to view a description of the meeting rooms and equipment available in the QMB, as well as a direct link to proceed with a booking.

Search

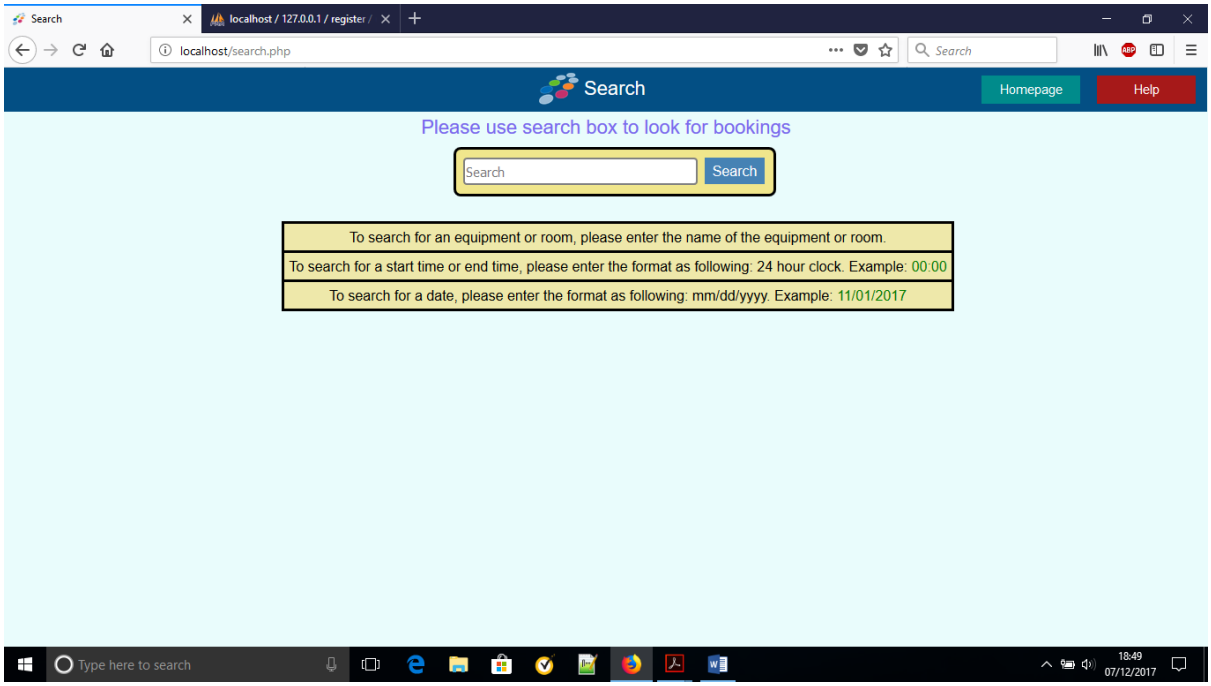

Figure 7.11: The “Search” option providing instructions to help narrow results.

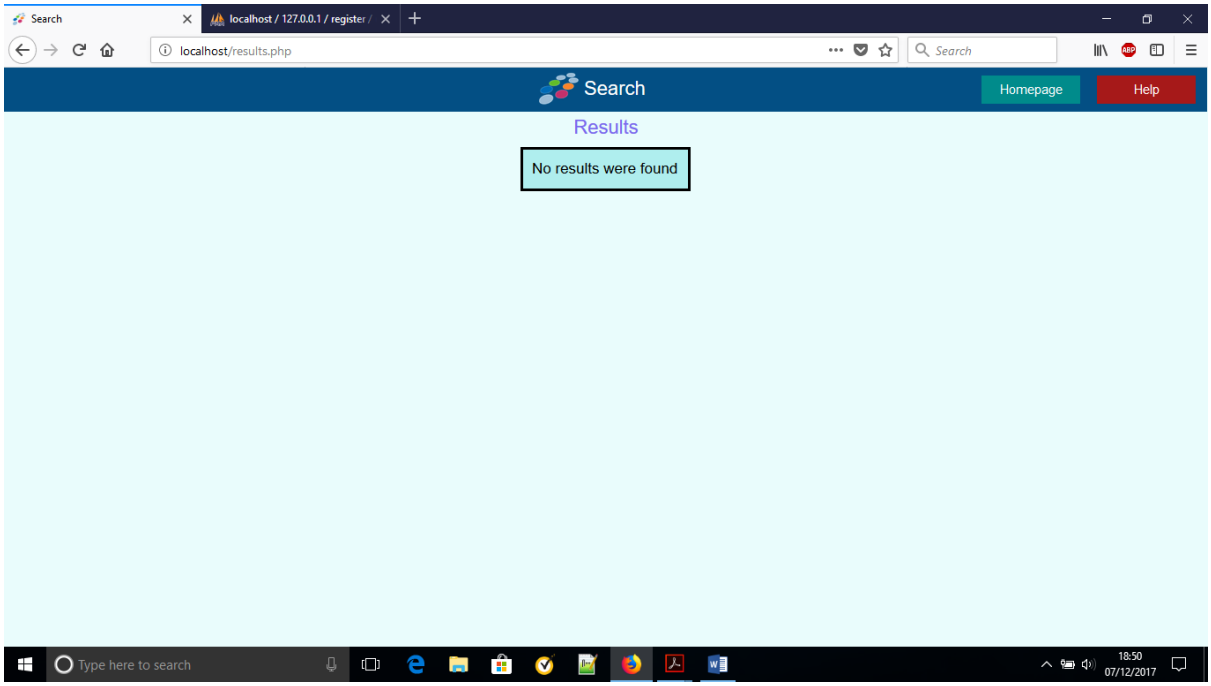

Figure 7.12: The system displaying to the user that no results have been found based on his/her input.

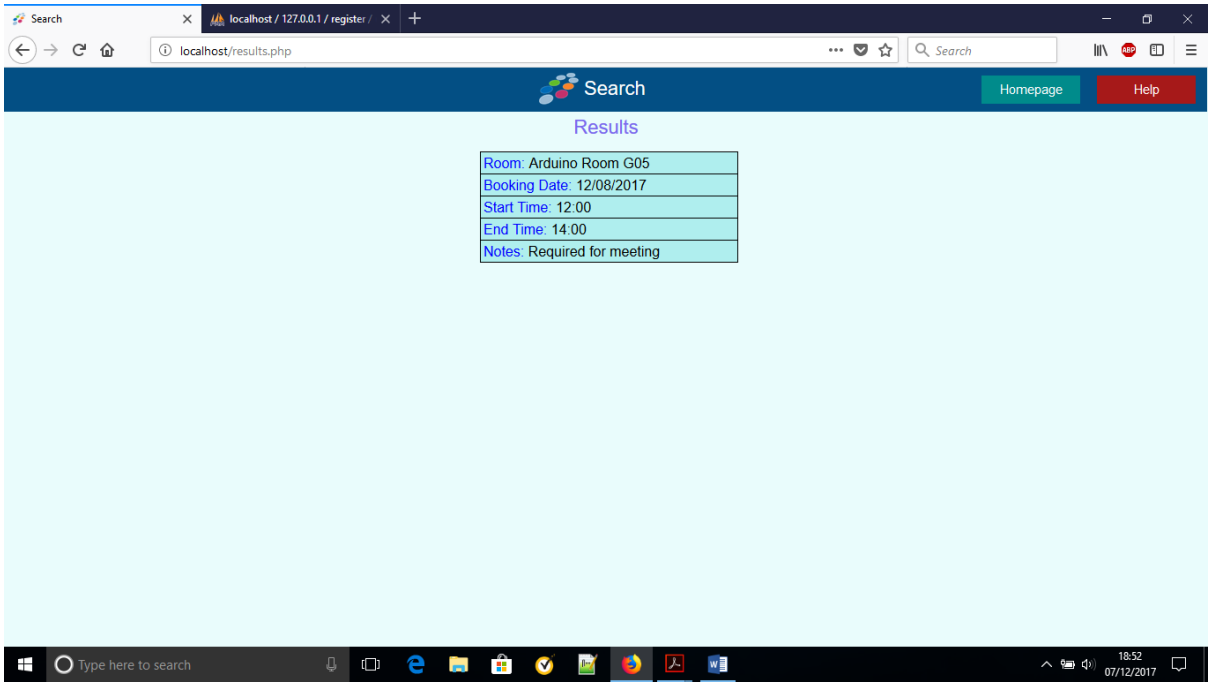

Figure 7.13: The system successfully finding a result based on the user's input.

Comment

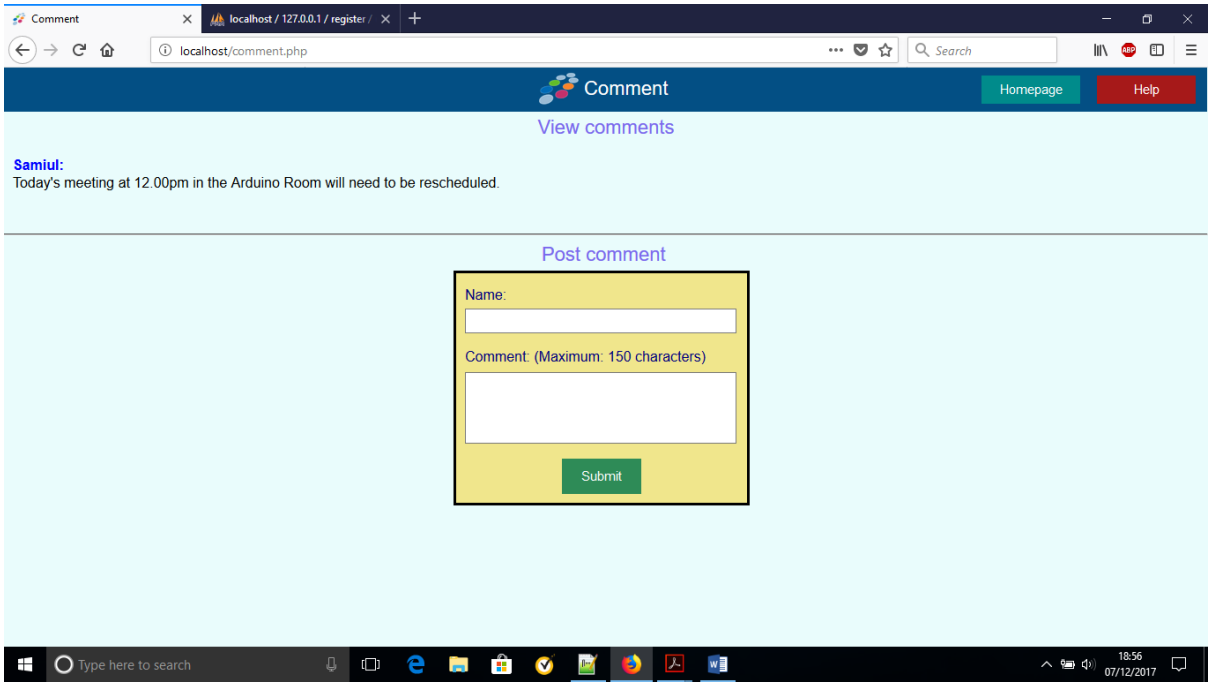

Figure 7.14: The “Comment” option provides users with the ability to interact and leave messages for others to read.

Help

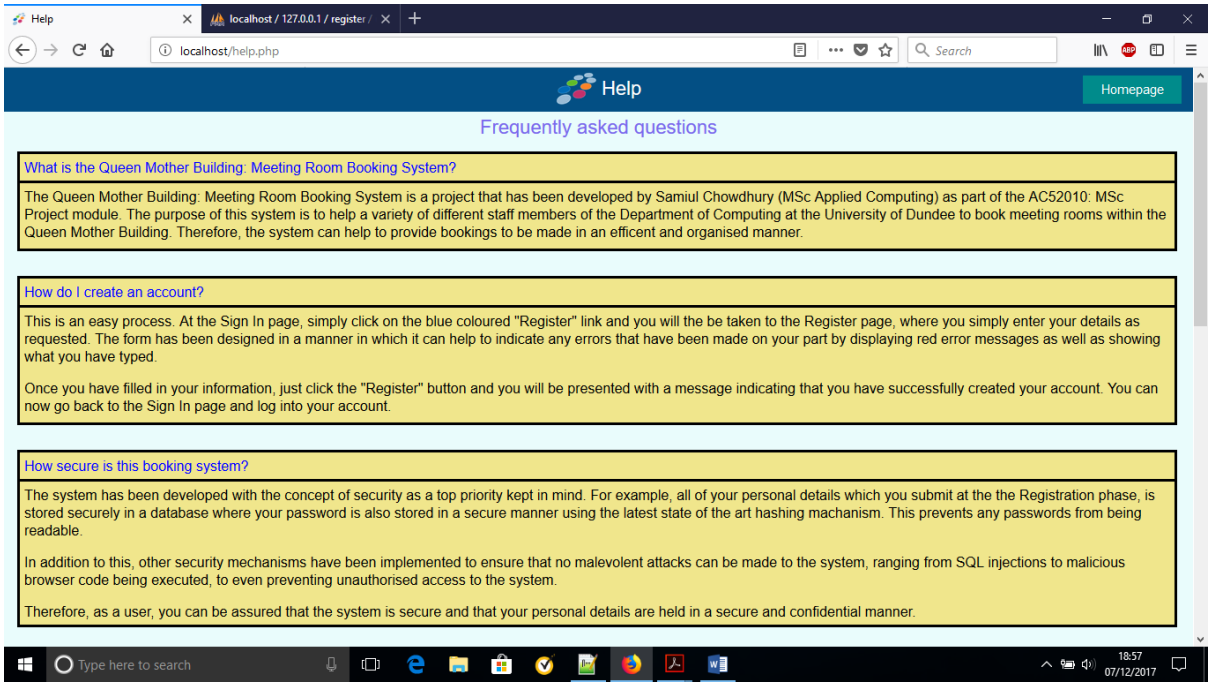

Figure 7.15: The “Help” menu provides a simple yet concise guide to the user on how to operate the system.

Security

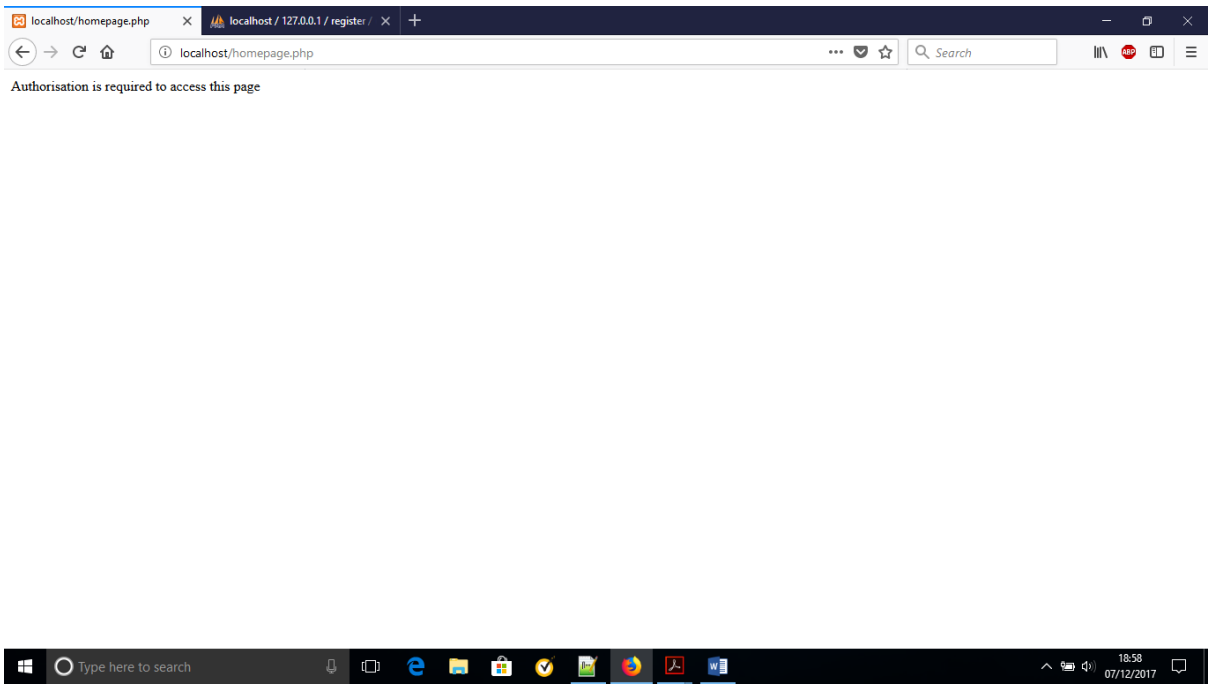

Figure 7.16: This screenshot demonstrates the security of this system, where unauthorized users cannot access the system.

All of the screenshots provided help to provide a good demonstration and understanding of the system. It illustrates the difference between the previous online model (as shown in the second chapter) and how it helps to provide the user with a unique and enriched experience of being able to reserve meeting rooms and equipment within the Queen Mother Building, as well as being provided with the confidence of knowing that security has been taken very seriously when developing this system.

8. Appraisal

8.1 The successful aspects

When looking back on this experience, it allowed me to think about the many aspects of developing this system which I can say that I am proud of accomplishing while other areas which could have been completed in a more efficient manner. The many highlights which helped to verify that the project was a success, included the fact that the system had been built very securely.

As mentioned before, security is a top priority where many companies fail in, resulting in millions of pounds being lost as a result of negligence and not keeping up to date with modern security practices and frameworks. For me personally, while developing this system, I can say that the system was developed successfully in terms of ensuring that confidentiality was maintained by preventing the common forms of attacks made to booking systems through the use of SQL injections and executing malicious browser code.

In addition to this, by developing a secure login system in conjunction with preventing any unauthorized access to the system, this new online system without a doubt, has helped to maintain its integrity and a professional edge altogether.

Another area which I feel has helped to contribute towards the success of the system was the booking validation rules, which helped to overcome the problem associated with the previous online model. By being able to develop unique codes which would prevent bookings such as those with the same start and end time as well overlapping with other reservations, this attributed towards the success of the system in terms of operational merit and avoiding conflicts of interests between the users of this system.

Finally, the other element which I felt contributed towards the success of this project was the ability to develop a functioning calendar. While it was far from being perfect, the reality was that it accomplished the goal of highlighting and displaying a booking menu along with the booked rooms and equipment being shown at the left side of the calendar.

Therefore, in regards to the features which I have mentioned above, they have with strong certainty, helped me to verify that the booking system was a success in line with meeting the requirements of the client.

8.2 What could have changed

After discussing the successful aspects of the project, it was also crucial for me to be able to discuss some of the elements which I feel could have been done in a more effective manner or improved on an overall level.

In terms of design, I personally felt that if I were to do this project again, then there are some aspects of the calendar which I feel could have been improved. For example, I would definitely change the way in which the user can change the month and year, without having to resort towards using the URL by building a feature in the calendar to do this. Furthermore, if the user were to hover over a date, then I would have created a box that would automatically display bookings that have been made. Again, these have been highlighted in the sixth chapter of this report but nonetheless, should be mentioned here.

In terms of time management, while I was able to complete all of the relevant tasks (as shown in the Gantt Chart in the third chapter) I feel that there may have been a chance to complete the project a little faster. However, I feel that this may have been the result of not being able to locate the precise teaching material on certain topics due to the difficulty of its availability. Therefore, to help find certain solutions, required me to consult with other professionals through online forums. If I had consulted with others earlier rather than spending too much time reading through books which did not have all of the sufficient answers to my questions, then the project may have been complete on a faster timescale.

A final aspect of the project which I feel I could have improved upon was the completion of the ethics submission material. Due to the constraining time pressure as well as having to extend more time towards completing certain functions of the booking system, this unfortunately rendered in having to submit the ethics material at a much later date. While the submission was successful, the process of completing the ethics submission was time consuming and resulted in having to stop working on the system at the most crucial stage of development. Therefore, if I were to do this project all over again, then the first task before even proceeding with the development of this system, would be to complete and submit the ethics material as the first major task of this project.

9. Summary and conclusions

9.1 The overall experience

The MSc Project proved to be a very challenging and at the same time, rewarding experience for me as a student. The development of this system showed me that in order to build a project of this magnitude, one would need to research, think outside the box and plan his/her time very carefully.

It helped me to be able to approach an idea in the realm of software engineering, in a very organized and disciplined manner where every logistic and element matters and can have a significant impact throughout the development process.

Furthermore, the skills which I acquired and utilized to my advantage such independent research, building communication with the client and participants as well as learning the process of constant debugging and refining code, helped to me understand and appreciate these core skills which are absolutely essential for working in the industry.

In addition to this, while this project helped me to develop my independent working skills, at the same time, it allowed me to reflect on the fact as to why team work is an essential element within the information technology sector. Due to the significantly large workload that many companies face in regards to developing projects as well as having to face tight deadlines, it helps one to realise why teamwork is a necessity for large scale projects. But nonetheless, the notion of being able to work independently is also a vital skill required for one’s ability to become self reliant.

Therefore, moving forward, I can say with confidence that everything which I have learnt and managed to accomplish in this project, has helped to provide me with a strong and better insight on what to expect in terms of industry standards and available opportunities in the employment sector. The development of a project can no doubt, help to shape one’s confidence and creativity in terms of pursuing opportunities, in the ever growing field of information technology.

10. Recommendations for future works

10.1 Building a forgotten password generator

A feature which can be created by developers for this system is an option which allows the user to be able to create a new password in the event the user cannot remember the original one. This is an important feature which is found in almost every system which incorporates a login system. Due to time constraints and difficulty of implementing this measure, the current system does not have this option. Therefore, this is a crucial feature which should be considered by developers who would like to recreate this system.

10.2 Delete a booking

Another important feature which developers can consider for this system is providing the ability for a user to delete a booking. Many bookings may need to be cancelled therefore, to help provide the booking slot to somebody else, the user could have the ability to delete his/her booking. While this feature may be useful for users, at the same time, it is recommended to only be included where there is an environment based on trust- that is no one will intentionally sabotage each other by abusing the booking system by deleting each other's bookings.

10.3 Display user's bookings for current day on Homepage

While the system can display bookings with the use of the calendar as well as allowing the user to search for reservations using the search mode, it may also provide even more convenience for the user if he/she can view bookings they may have that day, directly in the Homepage. Therefore, developers can incorporate a feature in the Homepage which can use a calendar feature similar to that used in the Book section, but one which displays bookings the user has for the current day, in a separate dashboard at the bottom of the screen.

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Appendix 1: Requirements specification

Conformance Glossary

The following keywords are used to differentiate between different levels of requirements and optionality, as defined in IEEE Standard 830-1993.

Shall	Indicates a mandatory requirement. To ensure interoperability with other products conforming to this standard, all mandatory requirements must be followed strictly with no deviation.
Should	Indicates a recommended but not mandatory requirement. Allows flexibility of choice between several possible alternatives while indicating a strongly preferred alternative. Indicates that a certain course of action is desirable but not mandatory, or indicates that a certain course of action is deprecated but not prohibited.
May	Indicates a suggested course of action without implying preference over any other possible course of action.

Glossary

Terminology:	**Definition:**
Remember Me	This allows the system to store account details at the Sign In page, making it easier to log into the system without having to manually fill in account details every single time.

Functional Requirements

Setup

R1: Display Sign In page

Description: The system **shall** display the Sign In page with the title “Queen Mother Building: Meeting Room Booking System” along with a transitional background picture.

Rationale: This provides the user with a clear presentation of the system’s Sign In page as well an idea of the what the Queen Mother Building looks like from an outside and inside perspective.

R2: Provide options to the user

Description: The system **shall** display the available options of registering, signing in (with an optional “Remember Me” function) and providing access to a help menu.

Rationale: This allows the user to be provided with a good and easy understanding of the what the available choices are at the Sign In page.

R3: User selecting the “Help” option

Description: The system **shall** display a help menu explaining how to use the booking system.

Rationale: This helps to ensure that the user is able to understand how to operate every aspect of the system.

R4: User selecting the “Register” option

Description: The system **shall** present the user with a registration form when the user selects the “Register” option. This will request the user for: first name; last name; email address; username, password and to confirm password.

Rationale: This will enable the user to fill in his/her personal details to allow the system to create an account.

R5: Display success message

Description: The system **shall** display a message indicating that the user's account has been created successfully after the user has submitted the registration form along with option of returning back to the Sign In page and access to the Help menu.

Rationale: This helps to keep the user informed throughout the whole registration phase as to what is going on and what can be done next.

R6: User clicking the "Sign In" button

Description: The system **shall** allow the user to access the Homepage once the correct username and password has been entered.

Rationale: This is a standard security procedure which every user must follow, where the system should be able to recognize a valid username and password before allowing access to the Homepage.

R7: Display the relevant error validation messages

Description: The system **shall** provide the user with error messages should the user's input be considered as incorrect when filling in the registration form or signing in to access the system.

Rationale: This allows the user to be correctly informed and aware of any errors on his/her part when creating an account or signing into the system.

Homepage

R8: Display dashboard on the Homepage

Description: The system **shall** display a dashboard containing the name of this system, a greeting message with the user's name and an option to sign out of the system.

Rationale: The emphasis here is to ensure that the user is aware that he/she has successfully logged into the system and has the ability to leave whenever he/she desires.

R9: Display navigation bar on the Homepage

Description: The system **shall** incorporate a navigation bar below the dashboard with the options of: booking meeting rooms or equipment; viewing meeting rooms or

equipment; searching for bookings; being able to leave comments and accessing a help menu.

Rationale: The navigation menu will provide a clear and presentable view of the options available for the user to access within the system.

R10: Display University of Dundee emblem

Description: The system **should** display the University of Dundee emblem below the navigation bar in a large size.

Rationale: This can help to remind the user of the fact that the booking system for Queen Mother Building, is associated with the University of Dundee.

Book

R11: User hovering over the “Book” option

Description: The system **shall** display a dropdown menu containing 4 sub menus corresponding to the equipment and the floors of the Queen Mother Building.

Rationale: The dropdown menu style helps to keep everything in a neat and organized manner for the user to easily see and access the sub menus available.

R12: User selecting a sub menu in the “Book” option

Description: The system **shall** display a booking calendar for the corresponding sub menu selected by the user.

Rationale: The calendars are different and unique for each sub menu thereby preventing the user from being overwhelmed by too many equipment and meeting rooms being displayed at once.

R13: User changes the month

Description: The system **shall** allow the user to change the month by clicking a previous button or forward button.

Rationale: This ensures that the user can easily go back and forth between months when scanning the calendar.

R14: User selects the month and year in the URL

Description: The system **should** provide the user with the option of selecting the month and year manually in the URL.

Rationale: This helps to provide more flexibility for the user when it comes to choosing the desired month and year.

R15: Display calendar legend

Description: The system **shall** provide a legend defining the color blocks used in the calendar: today's date; booking and selector when hovering over a date.

Rationale: This provides the user with the benefit of being able to understand what each color block in the calendar represents.

R16: Calendar highlights today's date

Description: The system **shall** highlight today's date in the calendar.

Rationale: The provides the user with the benefit of being able to identify today's date.

R17: User hovers over a date in the calendar

Description: The system **shall** highlight the date the user decides to hover over.

Rationale: This provides clarity for the user when it comes to viewing the date in the calendar.

R18: User selects a date in the calendar

Description: The system **shall** display a booking button when a date has been selected by the user.

Rationale: The user will need to click this button when booking a room or equipment for the selected date.

R19: User clicks the "Book" button

Description: The system **shall** generate a booking menu displaying: the equipment/rooms; the start time; the end time; a note field and a proceed button.

Rationale: As part of the booking process, the user must be able to select from the required options.

R20: User clicks the “Proceed” button - invalid bookings

Description: The system **shall** provide valid error messages and prevent bookings that contain: the same start and time; end time being earlier than the start time; overlapping booking and slots already taken.

Rationale: This helps to maintain a smooth and perfectly functioning booking system as well avoiding any booking conflicts.

R21: User clicks the “Proceed” button – valid bookings

Description: The system **shall** display a success message, highlight the date in the calendar where a booking has been made and show the booking details.

Rationale: This will help to indicate to the user that a booking has been successfully been made and can easily be viewed at any time by simply clicking the highlighted date.

R22: Display Queen Mother Building’s floors and equipment as links.

Description: The system **shall** provide clickable links to the Queen Mother Building’s other floors/equipment on the current calendar page.

Rationale: This ensures that the user is given the benefit of instantly switching and navigating between floors and equipment without having to always go back to the Homepage and accessing the dropdown menu.

R23: Display a “Homepage” button and “Help” button

Description: The system shall allow the user to be able to go back to the Homepage or access the system’s help menu by clicking the available buttons.

Rationale: This helps to provide the user with the advantage of easily going back to the Homepage without having to resort towards using the back page browser button as well as being able to seek help directly on how to operate the systems.

View

R24: User selecting the “View” option

Description: The system **shall** display clickable links to all of the Queen Mother Building's available meeting rooms and equipment if the user selects the "View" option on the Homepage.

Rationale: The user is redirected to the part of the system where he/she has the benefit of viewing each unique equipment and meeting room before having to proceed with a booking.

R25: User selects an equipment or meeting room

Description: The system **shall** display an image of the selected equipment or meeting room, along with a description and available link for booking.

Rationale: The advantage here is that the user is given a clear idea of what each equipment or meeting room looks like as well as information such as room capacity and the ability to directly click the available link taking him/her to the booking page.

R26: Display a "Homepage" button and "Help" button

Description: The system shall allow the user to be able to go back to the Homepage or access the system's help menu by clicking the available buttons.

Rationale: This helps to provide the user with the advantage of easily going back to the Homepage without having to resort towards using the back page browser button as well as being able to seek help directly on how to operate the systems.

Search

R27: User selecting the "Search" option

Description: The **shall** display a search box along with instructions on how to secure an accurate search result for the user.

Rationale: This is provided to give the user the benefit of being able to search for meetings without having to scan through the calendars in the booking section of the system. Furthermore, the instructions will help the user to narrow and find accurate search results as well as being prevented from overwhelming search results- which can be generated by a search option.

R28: Return message indicating no results have been found

Description: The system **shall** provide a message to the user indicating that nothing has been found if no bookings can be returned by the search.

Rationale: This helps to provide the user with an accurate indicator that nothing has been found as opposed to simply returning a blank search results page. It is important to help keep the user informed of everything that is happening.

R29: Return search results

Description: The system **shall** return the user with bookings that have been made, based on the relevant input provided by the user in the search box.

Rationale: The results page will display the bookings that have been made and provides the benefit of the user not having to go through each particular calendar to look for a particular booking.

R30: Display a “Homepage” button and “Help” button

Description: The system shall allow the user to be able to go back to the Homepage or access the system’s help menu by clicking the available buttons.

Rationale: This helps to provide the user with the advantage of easily going back to the Homepage without having to resort towards using the back page browser button as well as being able to seek help directly on how to operate the systems.

Comment

R31: User selecting the “Comment” option

Description: The system **shall** display a page containing comments that can be left and viewed by members of the system if the user selects the “Comment” option on the Homepage.

Rationale: The user is redirected to a comments page where he/she has the benefit of being able to interact with other members of the system by leaving messages.

R32: Display a comment box

Description: The system **shall** provide a comment box containing an input box for the user’s name and a text box for the user’s message.

Rationale: This ensures that the user is provided with the ability to leave his/her name and a message for others to see in the comment section.

R33: User clicks “Submit” button

Description: The system **shall** display user’s names and comments at the top of the page after the user clicks the “Submit” button.

Rationale: This allows the user to easily submit his/her comment as well as being able to view them on the same page.

Help

R34: Display a “Homepage” button and “Help” button

Description: The system shall allow the user to be able to go back to the Homepage or access the system’s help menu by clicking the available buttons.

Rationale: This helps to provide the user with the advantage of easily going back to the Homepage without having to resort towards using the back page browser button as well as being able to seek help directly on how to operate the systems.

R35: User selecting the “Help” option

Description: The system **shall** display a help menu explaining how to use the booking system.

Rationale: This helps to ensure that the user is able to understand how to operate every aspect of the system.

Non-Functional Requirements

R36: Access times

Description: The average time to access the all the options and features in this system **shall** not take longer than 3 seconds.

Rationale: It is crucial to ensure that all the options and features within the system can be accessed very quickly and function at high speed as this is essential in order to ensure that this booking system is a success.

R37: Reliability

Description: The system **shall** be able to deliver accurate results in terms of validation errors, displaying bookings and search results.

Rationale: This is very important to be able to ensure that the system functions properly and can be deemed as being usable.

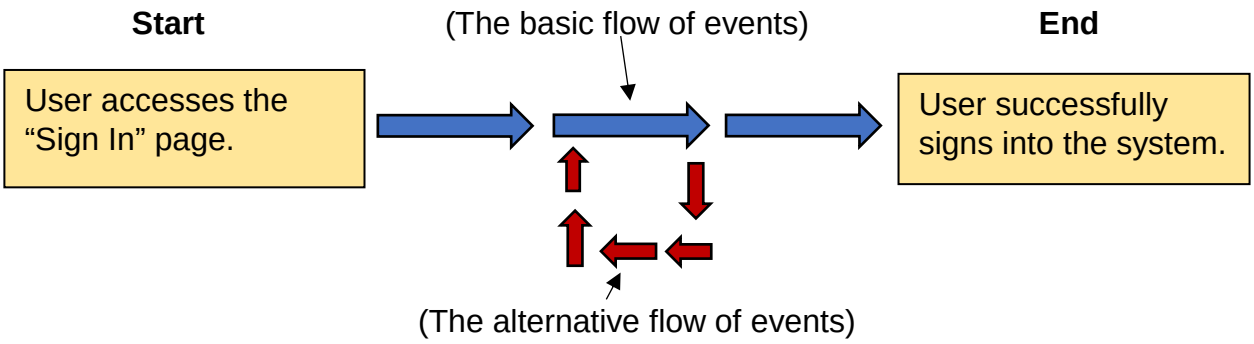
R38: Documentation standards

Description: The system **shall** conform to IEEE Standard 830-1993.

Rationale: This helps to ensure that the appropriate keywords are used and other essential standards are followed.

Appendix 2: Use case specifications

Setup



Basic flow of events

The use case begins when the user accesses the "Sign In" page	
System:	Displays the "Sign In" page when the user has chosen to access it.
User:	Clicks the "Register" button.
System:	Displays the register form requesting the user's first name, last name, email address, username and password.
User:	Fills in the form and clicks the "Submit" button. **(A1)**
System:	Returns message indicating that account has been successfully created.
User:	Returns to "Sign In" page and enters username and password and then clicks the "Sign In" button. **(A2)**
System:	Verifies the details entered are correct and displays the Homepage.

Alternative flow of events

A1- User does not enter valid details on the "Registration" page

A2- User does not enter valid details on the "Sign In" page

A1- User does not enter valid details on the “Registration” page

The user has entered details on the “Registration” page which cannot be validated.

System:	Displays error messages where the user will need to re-enter his/her details.

Return to basic flow of events where error occurred.

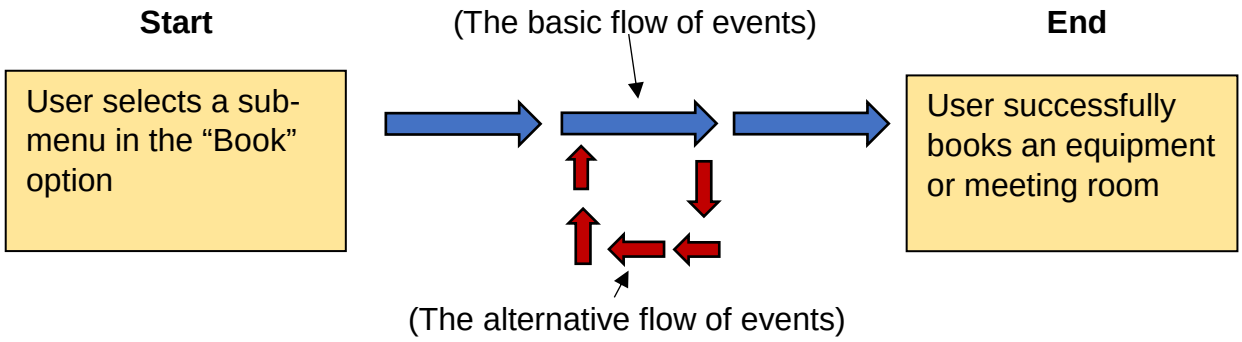
A2- User does not enter valid details on the “Sign In” page

The user has entered details on the “Sign In” page which cannot be validated.

System:	Displays error messages where the user will need to re-enter his/her details.

Return to basic flow of events where error occurred.

Book



Basic flow of events

The use case begins when the user selects a sub menu in the “Book” option	
System:	Displays the booking calendar.
User:	Clicks a date on the calendar.
System:	Displays the “book” button.
User:	Clicks the “book” button.
System:	Returns a booking menu containing the following options: names of the equipment/meeting rooms; start time; end time and note field.
User:	Selects the relevant options and clicks the “Proceed” button. **(A1)**

System:	Displays a message indicating that booking was successful, highlights booking date and shows the booking details.

Alternative flow of events

A1- User has selected invalid start and end times in the booking menu.

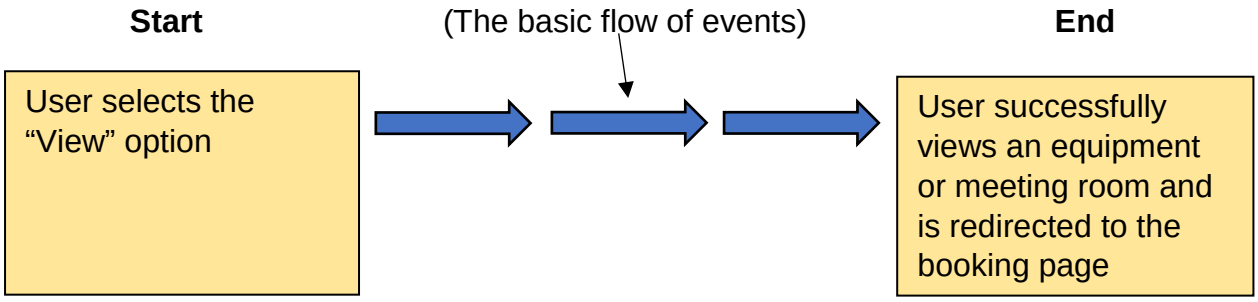
A1- User has selected invalid start and end times in the booking menu.

The user has attempted to book an equipment/room where the start time and end time are invalid. The system will prevent the following bookings from being made: same start and end times; earlier end time than start time; overlapping bookings and unavailable slots.

System:	Displays error message where the user will need to select an alternative start and end time.

Return to basic flow of events where error occurred.

View



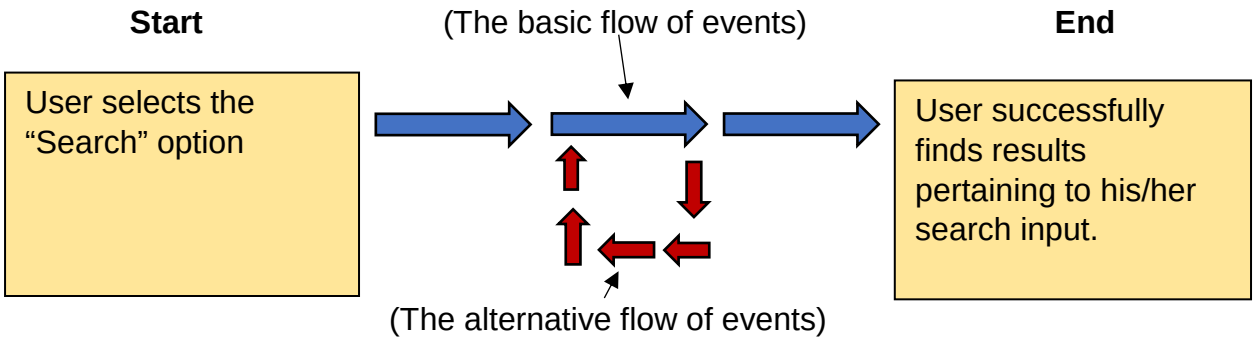
Basic flow of events

The use case begins when the user selects the "View" option	
System:	Displays the links to all the viewable equipment and meeting rooms.
User:	Clicks a link to view an equipment or meeting room.

System:	Displays the selected equipment/meeting room and shows an image along with a description and booking link.
User:	Clicks the booking link.
System:	Redirects the user to the booking calendar of the relevant equipment/meeting room.

There is no alternative flow of events applicable for this function.

Search



Basic flow of events

The use case begins when the user selects the "Search" option	
System:	Displays a search box along with a series of instructions to aid the user with his/her search.
User:	Inputs a search request in the search box. **(A1)**
System:	The system returns list of bookings based on the user's search input.

Alternative flow of events

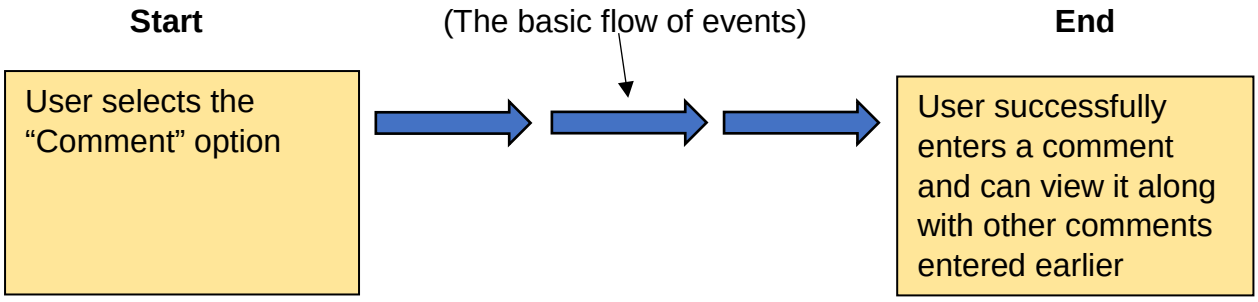
A1- User clicks the "Search" button without entering anything in the search box or has entered something where system cannot find related results.

The user has attempted to carry out a search without having entered anything into the search box or entered something that cannot be recognized by system, and then proceeds to click the “Search” button.

System:	Displays message indicating to the user that no search results could be found.

Return to basic flow of events where error occurred.

Comment

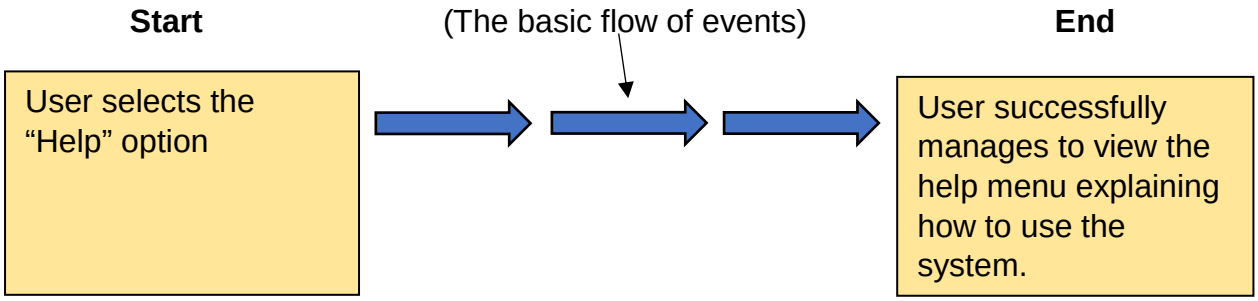


Basic flow of events

The use case begins when the user selects the “Comment” option	
System:	Displays page with comments entered earlier along with a comment box.
User:	Enters name, comment and then clicks the “Submit” button.
System:	Displays the user’s comment in the comment section of the page.

There is no alternative flow of events applicable for this function.

Help



Basic flow of events

The use case begins when the user selects the "Help" option	
System:	Displays the help menu of this system.

There is no alternative flow of events applicable for this function.

Appendix 3: Minutes of meetings

07/08/2017

-Met with client and discussed the requirements of what he wants to see for the new booking system.

21/08/2017

-Discussed additional requirements from the client.

04/09/2017

-Showed client the wireframes of the system.

18/09/2017

-Showed progression of the system. This included the completed login system.

02/10/2017

-Discussed the how the booking function would operate.

16/10/2017

-Met client and took pictures of all the rooms in the Queen Mother Building.

30/10/2017

-Discussed the ethics submission material.

13/11/2017

-Showed the features completed so far to the client.

27/11/2017

-Demonstrated the completed system to the client

Appendix 4: Ethics submission material

The ethics submission material is comprised of the following:

-Checklist 1

-Checklist 2

-Consent form

-Email samples

-Form A

-Participant information sheet

-NASA TLX questionnaire

-System Usability questionnaire

I have also included the approval letter from the Ethics Committee.

University of Dundee

Ethical Approval for Non-Clinical Research Involving Human Participants

CHECKLIST 1: Does your project require ethical approval?

Section A: Questions*	**YES**	**NO**
Is your project only concerned with quality assurance (e.g., assessment of teaching practices)?		✓
Is it only an audit of standard practice (not involving identifiable records)?		✓
Does your project only use publically available information, documents or data (unless involving sensitive information, access to which could reasonably be perceived as unethical or immoral)?		✓

If you have answered YES to any of the questions in Section A, your project will not require ethical approval. If you have answered NO to all of the questions, then please go to Section B.

Section B: Questions*	**YES**	**NO**
Does the project involve collecting primary data from, or about, living human beings?	✓	
Does the project involve analysing primary or unpublished data from, or about, living human beings?		✓
Does the project involve collecting or analysing primary or unpublished data about people who have recently died, other than data that are already in the public domain?		✓
Does the project involve collecting or analysing primary or unpublished data about or from organisations or agencies of any kind, other than data that are already in the public domain?		✓

If you answered NO to ALL of the questions you will not require formal ethical approval. If you have answered YES to ANY of these questions, please proceed to Checklist 2.

* If your project does not require ethical approval, you may still wish to obtain approval from the Convenor of the relevant School Research Ethics Committee (SREC) in order to meet possible journal requirements regarding statements on ethical approval if you intend to publish your results.

University of Dundee

Ethical Approval for Non-Clinical Research Involving Human Participants

CHECKLIST 2: Is your project 'low' or 'medium' or 'high' risk?

(to be submitted together with the relevant application form)

Questions	YES	NO
Will your research involve children under 18?		✓
Will your research involve vulnerable participants (e.g., participants who are unable to consent or have a cognitive impairment or learning difficulties, prisoners or others in custodial care)?		✓
Will your research involve participants in unequal relationships with the researcher(s) (e.g. your own students)?		✓
Will any invasive or potentially harmful procedures of any kind be used (e.g. administration of drugs, placebos or other substances*)?		✓
Will tissue samples (including blood) be obtained from participants?		✓
Is there a risk of physical discomfort or pain to participants?		✓
Will the research involve working with any substances and/or equipment which may be considered hazardous?		✓
Will the research involve psychological intervention?		✓
Is there a risk of psychological or emotional distress to participants?		✓
Is there a risk that participants may reveal previous, current or proposed illegal acts?		✓
Will the study involve covert observation (i.e. participation without consent or knowledge at the time) and/or deception of any sort?		✓
Will it be possible to link information or data back to individual participants in any way?		✓
Will financial inducements (other than reasonable compensation for time or small rewards such as vouchers) be offered to participants?		✓
Will the study involve discussion of sensitive or potentially sensitive topics (e.g. sexual activity, drug use, personal lives)?		✓
Will the research involve access to data that requires permission from the appropriate authorities before use (e.g. data held by the police)?		✓
Is there a risk that the safety of the researcher may be compromised (e.g. lone working, working in potentially dangerous environments)?		✓

* Note that research involving administration of drugs or other substances may need NHS REC approval.

If you have answered **NO to ALL of these questions** please use **Form A** (low risk) to complete your application.

If you have answered **YES to ANY of these questions** please use **Form B** (medium/high risk) to complete your application.

Please submit this checklist with your application.

Consent Form

AC52010: MSc Project -The Queen Mother Building: Meeting Room Booking System

Please tick the appropriate boxes	**Yes**
Taking Part	
I have read and understood the project information sheet dated DD/MM/YYYY.	☐
I have been given the opportunity to ask questions about the project.	☐
I agree to take part in the project.	☐
I understand that my taking part is voluntary; I can withdraw from the study at any time and I do not have to give any reasons for why I no longer want to take part.	☐
I understand that my words may be quoted in publications, reports, web pages, and other research outputs *(if applicable; e.g. for interviews).*	☐
Use of the information I provide beyond this project	
I agree for the data I provide to be archived at the University of Dundee	☐
I understand that other researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form.	☐
I understand that other genuine researchers may use my words in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.	☐

_____ _____ _____

Name of participant [printed] Signature Date

Contact Details:

Samiul Chowdhury (Student)
swchowdhury@dundee.ac.uk

Dr Craig Ramsay (Supervisor)
cdramsay@dundee.ac.uk

Computing, School of Science & Engineering
University of Dundee,
Dundee,
DD1 4HN

Contact: +44(0)1382 386559

Email Samples

A variety of different staff members of the Department of Computing, will firstly be sent an informal email asking them if they would be interested in participating in an evaluation of an online meeting room booking system being developed for the Queen Mother Building.

If the staff member responds to the email with an interest, then then a formal email will be sent inviting the individual to participate in an evaluation for the above system, where an information sheet explaining everything in more detail and also, a consent form, will be attached to this formal email.

Please find below samples of both emails.

Thank you.

-Samiul Chowdhury (MSc Applied Computing)

-Dr Craig Ramsay (Supervisor)

Informal Email

Dear Sir/Madam,

My name is Samiul Chowdhury and I am currently an MSc Applied Computing student at the University of Dundee.

I am writing this email to kindly ask if you would be interested in participating in an evaluation of an online booking system for meeting rooms at the Queen Mother Building, which I am currently developing as part of my MSc Project?

The evaluation will require a variety of different staff members to test out the system in order to find out whether it is fit for purpose and if there are any improvements that can be made. Therefore, your participation and personal feedback would be very appreciated and contribute greatly towards the development of this system.

If you are interested and would like to hear more, then please let me know by responding to this email, and I will happily send you a formal email, containing an invite, an information sheet providing more information about the evaluation and consent form.

If you have any further questions, then please do not hesitate to contact me. I will happily respond back to any queries you may have regarding this evaluation or any other relevant matter.

Thank you for taking the time to read this. It is appreciated.

Yours Faithfully,

Samiul Chowdhury

(MSc Applied Computing)

Formal Email

Dear Sir/Madam,

Thank you for expressing your interest in the evaluation of the system which I am developing for my project.

This email hereby invites you formally to participate in an evaluation.

I am developing an online booking system for meeting rooms for the Queen Mother Building. The system is currently being developed as of now, and as soon as the prototype has been finalised, a formal arrangement will be made for you via email to evaluate the system.

In the meantime, please find the attached documents:

-Information Sheet: This provides a detailed explanation of what to expect for the evaluation and will answer many questions you may have regarding this evaluation. If there are any other questions you have that have not been explained in this information sheet, then please do not hesitate to contact me or my supervisor.

-Consent Form: This form will be required to be signed by you, if you decide to participate with the evaluation. Please do read the information sheet fully before you decide to provide consent. Again, if you would like to have any other relevant questions answered before signing this form, then please do not hesitate to contact me.

If you have decided to participate in the evaluation, then please sign the attached consent form and send it back via email to this email address. Postal information can be found in the attached information sheet.

Thank you for taking the time to read this email. Your feedback is very much appreciated and will contribute greatly towards the development of this system.

Yours Faithfully,

Samiul Chowdhury (MSc Applied Computing)
swchowdhury@dundee.ac.uk

Dr Craig Ramsay (Supervisor)
cdramsay@dundee.ac.uk

University of Dundee

Ethical Approval for Non-Clinical Research Involving Human Participants

FORM A: Application for ethical approval for low risk projects

Name	**Samiul Chowdhury**
School	**Science and Engineering**
University e-mail Address	**swchowdhury@dundee.ac.uk**
Title of Project	**AC52010: MSc Project** **The Queen Mother Building: Meeting Room Booking System**
Co-Investigators (with organisational affiliation)	
Projected Start Date	**07/08/17**
Estimated End Date	**18/12/17**
Funder (if applicable):	

Students Only	
Name of Supervisor	**Dr Craig Ramsay**
Degree (e.g. BA, BSc, MA, MSc, MPhil, PhD)	**MSc Applied Computing**

Please provide an overview of the research project providing a short explanation of the issues the project will address and why they are an important area of research.

Please write this section in a way that is accessible to a person who is not an expert in your field.

AC52010 MSc Project, is the final module which comprises the MSc degree in Applied Computing. This module requires the student to undertake a project which runs for the duration of 3-4 months, of which the student is responsible for conducting independent research as well as applying their knowledge gained from areas such as software development to human computer interaction.

The purpose of this project is to develop a meeting room booking system for the Queen Mother Building. The system will help to address the issue of assisting people with booking specific rooms for certain dates as well as providing further functionality such as searching for meetings and leaving comments for others to read.

Therefore, this area of research is considered important as it not only helps one to gain important knowledge from areas such as database systems and web development, but also allows these skills to be applied towards building and developing similar systems across a vast range of industries.

What are the aims and objectives of the project?

The aim of this project is to develop an efficient and modern meeting room booking system for the Queen Mother Building and to ensure that it is developed with the primary requirements of the user in mind, as well making sure that it is designed from a human computer interaction perspective.

Please describe the design of your study and the research methods including information about any tasks or measuring instruments (validated or otherwise) that you will be using. *If you are using non-validated instruments (e.g., surveys or questionnaires you have designed, interview questions, observation protocols for ethnographic work or topic lists for unstructured data collection) please attach a copy to this ethics application.*

The system is being developed with the required needs of the client being kept in mind, throughout the entire process. Therefore, to help ensure that this end is met, it will need to be constantly revised and improved upon during its development phase via close liaison with the client in order to help tailor the efficiency of the system in line with the client's requirements.

In terms of subsequent evaluation, it is important to receive feedback from the intended end users of the system, e.g. members of the Department of Computing in a variety of different staff roles such as researchers and lecturers. This is required in order to help provide a better understanding of whether the system offers an effective and positive experience, or if there are some constructive criticisms which can therefore be used to improve the final, overall system.

Therefore, a final evaluation of the system will be conducted with the target end user group to ascertain the effectiveness of the system in relation to characteristics such as accessibility, usability, performance and general overall feel. All of this information will then be used to help make any further necessary changes and updates to the system.

The following approach is proposed for the final evaluation with the target end user group:

1)- The observer will allow the participant to explore the system while taking notes on his/her reactions and responses to using the system while providing any relevant guidance and assistance if requested by the user.

2)- The observer may also ask the user to carry out tasks such as searching for a specific meeting room and seeing its availability on a certain date, or simply be asked to make an appointment using the system. This will help to determine whether it is fit for purpose and can at the very least, provide the necessary functionality required for the system to work.

To assist with this evaluation, the participant will be required to complete the System Usability Scale and NASA TLX questionnaires. To conclude, the overall evaluation process will require the following steps to be fulfilled:

1)- Participants will be sent an informal email asking them if they would like to participate in evaluating the system.

2)- Should they express their interest, they will then be sent a formal email which will contain an information sheet along with the relevant consent form, requiring their approval before proceeding any further.

3)- Once the necessary consent has been received, the participant will then be invited to participate on a day of his/her choosing as well as a location of their convenience.

4)- On the day of the evaluation, the participant will be presented with a personal computer which will contain the system. All instructions and relevant guidance will be provided in advance of the evaluation. In addition, the rights of the participant will be mentioned before the start of the evaluation. It is estimated that the duration of this evaluation can last anywhere between 20-30 minutes.

5)- The participant will then carry out the evaluation of the system while the observer takes notes as well as be asked to complete an order of tasks.

6)- Once the evaluation has been completed, the test user will then be required to complete the relevant System Usability Scale and NASA TLX questionnaires, outlining their overall experience of using the system.

7)- Finally the participants will be personally thanked for their contributions as well as being reminded again of their rights of this evaluation. Following this, the evaluation will then be officially concluded.

How will participants be identified and recruited?

Please provide details on how and by whom they will be contacted and how they can opt into the research; please also add information on any exclusion criteria should they apply. Please attach the wording of any emails, letters, social media adverts or other written approaches that you may use for recruitment purposes.

The main demographic in regards of developing this system, is aimed for staff members of the Department of Computing (although others are also welcome to use the system) as the goal of the project is to allow the booking of meeting rooms in the Queen Mother Building.

The manner in which invitations shall be made is primarily through the use of email in which a general idea of what is required will be explained. Following this, should the participant be willing to participate, then the formal steps as outlined above, will follow.

The evaluation will require a variety of different staff members (ideally 10) from the Department of Computing, who are familiar with the layout of the Queen Mother Building.

To clarify: the evaluation will be limited to staff members within the Department of Computing at the University of Dundee.

How will you obtain informed consent?

Please explain how and when participants will be informed about the scope of the research and what their involvement would entail. If consent is not obtained in written format (e.g., consent by participation for surveys or questionnaires), please provide details. If the project

involves video- or audio-recording explicit consent will need to be given. Please provide the participant information sheet and consent form with this application.

As explained above, the first step will be to send an informal email, asking if the participant would be interested in engaging with the evaluation for this project. If the participant expresses interest, then a formal email will be sent, with the attached information sheet which explains the evaluation in more detail. In addition, a consent form will be attached, requiring the participant's approval before any further steps are taken.

The staff member will also be given the opportunity to ask any questions prior to submitting the relevant consent form and proceeding with the evaluation. It should also be noted that prior to and after the evaluation being concluded, the participant will also be informed of his/her rights and what will be done regarding the collection of data during the evaluation.

Data storage and access

Please explain your outcome measures and the type of data you will be collecting, where the data will be stored and whether data has been collected anonymously or has been anonymised for storage, who has access to the data and for how long you intend to keep the data.

In terms of data being collected about the participant, the information which will be gathered are informal notes taken from the observer monitoring the evaluation as well as the data collected from the System Usability Scale and NASA TLX questionnaires.

The participant will of course, be informed of his/her rights before and after the evaluation.

Furthermore, any personal information such as full name, email address, username and password, being stored in a database to create accounts to access the booking system, shall be deleted following the evaluation.

Are any other permissions (e.g., clearance under the Protecting Vulnerable Groups Scheme (PVG)) required? If so which?

No.

Does the research involve fieldwork in or outside the UK? Have necessary risk assessments be carried out? If not, please state when you will be likely to conduct the risk assessment.

No.

Are there any other ethical considerations relating to your project which have not been covered above? If so, please explain.

No.

By signing below I declare that I have read the University Code of Practice for Non-Clinical Research on Human Participants and that my research abides by these guidelines.

Principal Investigator or student

Name	Date
Samiul Chowdhury	27th October 2017

Supervisor (if applicable)

Name Craig Ramsay Date 17th October, 2017

PARTICIPANT INFORMATION SHEET

AC52010: MSc Project -The Queen Mother Building: Meeting Room Booking System

INVITATION TO TAKE PART IN A RESEARCH STUDY

You have been invited to participate in the evaluation of a meeting room booking system which is being developed for the Queen Mother Building at the University of Dundee. Therefore, before you decide to take part, it is recommended that you read the following information to help you have an understanding of the background of this project and what your role will involve. If you have any further questions, then please do not hesitate to contact me. Thank you.

-Samiul Chowdhury (MSc Applied Computing)

-Supervisor: Dr Craig Ramsay

WHAT TO EXPECT

This project is being taken as the final module which makes up the MSc degree in Applied Computing (AC52010: MSc Project.) The aim behind this project is to develop an efficient and modern booking system for meeting rooms, at the Queen Mother Building, while taking the time to ensure that it is developed from a human computer interaction perspective. The system will provide the user with the ability to book specific meeting rooms on certain dates while allowing the user to engage with further functionality built into the system such as searching for specific meetings and being able to leave comments. All of this has been designed in a manner to help provide the user with an enriched experience.

As a participant, you will be required to use the system to book a meeting room of your choice at the Queen Mother Building as well as use the other functions, while the observer will watch and take notes. In addition to this, you may be asked to carry out certain tasks on the system such as searching for a specific room and checking its availability, or simply making an appointment using the system, where further notes will be taken regarding this test. Finally, once you have finished using the system, you will be requested to complete a System Usability Scale and NASA TLX questionnaire, where you will have the opportunity to put down your feelings and experience of using the system.

All of the above information recorded throughout the entire evaluation will help to provide further feedback towards improvements which can be made to the system. Therefore, your participation will be considered to be very significant and contribute greatly towards this project.

TIME COMMITMENT

The date, time and location of the evaluation, should you decide to participate, will be made at the discretion of your own choosing and convenience. This is important as the evaluation must be done to accommodate your needs, so as to help provide the most effective results afterwards.

The evaluation is expected to run for a duration of around 20-30 minutes, where you may be required to carry out at least 2 sessions of testing the system- one session for your own independent testing of the system and another session for following a series of instructed tasks.

It is also important to state that the evaluation will only take place once development of the prototype has been completed.

COST, REIMBURSEMENT AND COMPENSATION
The user should also be aware that participation to evaluate this system is entirely based on a voluntary basis.

RISKS
The user will not face any risks whatsoever in regards to using this booking system. I hope you will have an enjoyable experience during this evaluation.

TERMINATION OF PARTICIPATION
It is crucial to state that the participant for this evaluation reserves the right to terminate his/her participation at any time without having to provide any explanation. Therefore, should you feel the need to withdraw any time during the evaluation, your decision will be respected.

In terms of information that has been gathered up to the point of withdrawal, all information collected will be discarded and not used in anyway whatsoever in the project.

CONFIDENTIALITY/ANONYMITY
The participant will be required to create a username and password of his/her choice (along with having to register their full name and email address) for the purpose of creating an account in order to use the system.

This will be collected during the registration phase of the project, where the data will be stored securely in a database. Once registered, the username and password will be required by the system in order to be able to access it.

Following the conclusion of the evaluation, the user can be assured that all personal information in regards to the above, will be immediately deleted and removed from the database by the observer, who will be responsible for handling and deleting this information.

In regards to data being collected based on questionnaires and informal notes being taken by the observer, all of this information will be handled in a confidential manner and will be simply be used to help make any further improvements to the system as well as being incorporated into the final project report, where anonymity will be guaranteed.

It is also imperative to mention that the user will be explained of his/her rights as well as what will happen to the data collected, prior to and after the evaluation. Again, as mentioned above, should the user withdraw from the evaluation, then all information recorded, will simply be discarded altogether.

FOR FURTHER INFORMATION ABOUT THIS RESEARCH STUDY
If you have any further questions or need more information, then please do not hesitate to contact me at the following email address: swchowdhury@dundee.ac.uk

Furthermore, my supervisor for this project, Dr Craig Ramsay, can also be contacted at the following email address: cdramsay@dundee.ac.uk

Any postal queries can be sent to the following address:

Computing, School of Science & Engineering
University of Dundee,

Dundee,
DD1 4HN

Contact: +44(0)1382 386559

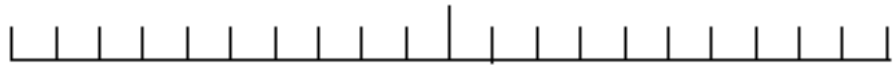
The University Research Ethics Committee of the University of Dundee has reviewed and approved this research study.

NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date

Mental Demand — How mentally demanding was the task?



Very Low — Very High

Physical Demand — How physically demanding was the task?

Very Low — Very High

Temporal Demand — How hurried or rushed was the pace of the task?

Very Low — Very High

Performance — How successful were you in accomplishing what you were asked to do?

Perfect — Failure

Effort — How hard did you have to work to accomplish your level of performance?

Very Low — Very High

Frustration — How insecure, discouraged, irritated, stressed, and annoyed wereyou?

Very Low — Very High

Participant ID: _____ Site: _____ Date: ___/___/___

System Usability Scale

Instructions: For each of the following statements, mark one box that best describes your reactions to the website *today*.

		Strongly Disagree				Strongly Agree
1.	I think that I would like to use this website frequently.	☐	☐	☐	☐	☐
2.	I found this website unnecessarily complex.	☐	☐	☐	☐	☐
3.	I thought this website was easy to use.	☐	☐	☐	☐	☐
4.	I think that I would need assistance to be able to use this website.	☐	☐	☐	☐	☐
5.	I found the various functions in this website were well integrated.	☐	☐	☐	☐	☐
6.	I thought there was too much inconsistency in this website.	☐	☐	☐	☐	☐
7.	I would imagine that most people would learn to use this website very quickly.	☐	☐	☐	☐	☐
8.	I found this website very cumbersome/awkward to use.	☐	☐	☐	☐	☐
9.	I felt very confident using this website.	☐	☐	☐	☐	☐
10.	I needed to learn a lot of things before I could get going with this website.	☐	☐	☐	☐	☐

Please provide any comments about this website:

University of Dundee

Research Ethics Committee
School of Science and Engineering
University of Dundee
Dundee
DD1 4HN

6 November 2017

Dear Samiul

Application Number: 17- MSc-046
Title: The Queen Mother Building: Meeting Room Booking System

I am writing to advise you that your ethics application has been reviewed and approved on behalf of the School of Science and Engineering Research Ethics Committee.

Approval is valid for three years from the date of this letter. Should your study continue beyond this point, please request a renewal of the approval.

Any changes to the approved documentation (e.g., study protocol, information sheet, consent form) must be approved by this SREC.

Yours sincerely

Professor Annalu Waller OBE MBCS MIPEM
Convener: School of Science and Engineering Ethics Committee

Research Ethics Committee
School of Science and Engineering
UNIVERSITY OF DUNDEE
Dundee DD1 4HN Scotland UK

Administrator: Mrs Kathleen Cummins
k.ycummins@dundee.ac.uk
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Appendix 5: System files

In this appendix, I have provided a list of system files which were used for the development of the Queen Mother Building: Meeting Room Booking System. The system files below can be found in the htdocs folder.

File name	File type	Description
106.php	PHP file	Used for the “View” option
106style	CSS file	Used for the “View” option
204	JPG file	Used for the “View” option
Arduino	JPG file	Used for the “View” option
arduino.php	PHP file	Used for the “View” option
arduinostyle	CSS file	Used for the “View” option
calender.php	PHP file	Used for the “Book” option- first sub menu
calender2.php	PHP file	Used for the “Book” option- second sub menu
calender2style	CSS file	Used for the “Book” option- second sub menu
calender3.php	PHP file	Used for the “Book” option- third sub menu
calender3style	CSS file	Used for the “Book” option- third sub menu
calender4.php	PHP file	Used for the “Book” option- fourth sub menu
calender4style	CSS file	Used for the “Book” option- fourth sub menu
calenderstyle	CSS file	Used for the “Book” option- first sub menu
comment.php	PHP file	Used for “Comment” option
comments.php	PHP file	Used for “Comment” option

commentstyle	CSS file	Used for “Comment” option
Emblem	JPG file	Used for the “Sign In” page and Homepage
equipment.php	PHP file	Used for the “Book” option-first sub menu
equipmentstyle	CSS file	Used for the “Book” option-first sub menu
eventform.php	PHP file	Used for the “Book” option-first sub menu
eventform2.php	PHP file	Used for the “Book” option-second sub menu
eventform2style	CSS file	Used for the “Book” option-second sub menu
eventform3.php	PHP file	Used for the “Book” option-third sub menu
eventform3style	CSS file	Used for the “Book” option-third sub menu
eventform4.php	PHP file	Used for the “Book” option-fourth sub menu
eventform4style	CSS file	Used for the “Book” option-fourth sub menu
eventformstyle	CSS file	Used for the “Book” option-first sub menu
hciroom.php	PHP file	Used for the “View” option-first sub menu
hciroomstyle	CSS file	Used for the “View” option-first sub menu
help.php	PHP file	Used for the “Help” menu
helpstyle	CSS file	Used for the “Help” menu
homepage.php	PHP file	Used for the Homepage
homepagestyle	CSS file	Used for the Homepage

Icon	JPG file	The Queen Mother Building logo
Image	JPG file	Used for Homepage and “View” option
lab0	JPG file	Used for the “View” option
lab0.php	PHP file	Used for the “View” option
lab0style	CSS file	Used for the “View” option
lab1	JPG file	Used for the “View” option
lab1.php	PHP file	Used for the “View” option
lab1style	CSS file	Used for the “View” option
lab2	JPG file	Used for the “View” option
lab2.php	PHP file	Used for the “View” option
lab2style	CSS file	Used for the “View” option
lab3	JPG file	Used for the “View” option
lab3.php	PHP file	Used for the “View” option
lab3style	CSS file	Used for the “View” option
nec.php	PHP file	Used for the “View” option
NECprojector	JPG file	Used for the “View” option
necstyle	CSS file	Used for the “View” option
northeast	JPG file	Used for the “View” option
northeast.php	PHP file	Used for the “View” option
openhelp.php	PHP file	Used for help menu-not logged in
openhelpstyle	CSS file	Used for help menu-not logged in
Picture	JPG file	Used for “Sign In” page
qmbgroundfloor.php	PHP file	Used for the “Book” option-second sub menu
qmbgroundfloorstyle	CSS file	Used for the “Book” option-second sub menu
qmblevel01.php	PHP file	Used for the “Book” option-third sub menu

qmblevel01style	CSS file	Used for the “Book” option-third sub menu
qmblevel02.php	PHP file	Used for the “Book” option-fourth sub menu
qmblevel02style	CSS file	Used for the “Book” option-fourth sub menu
reg.php	PHP file	Used for the “Registration” page
regstyle	CSS file	Used for the “Registration” page
results.php	PHP file	Used for the “Search” option
resultstyle	CSS file	Used for the “Search” option
search.php	PHP file	Used for the “Search” option
searchstyle	CSS file	Used for the “Search” option
signin.php	PHP file	Used for the “Sign In” page
signinstyle	CSS file	Used for the “Sign In” page
sony	JPG file	Used for the “View” option
sony.php	PHP file	Used for the “View” option
sonystyle	CSS file	Used for the “View” option
street	JPG file	Used for the “View” option
success.php	PHP file	Used for the success page
successstyle	CSS style	Used for the success page
thestreet.php	PHP file	Used for the “View” option
thestreetstyle	CSS file	Used for the “View” option
usercentre	JPG file	Used for the “View” option
usercentre.php	PHP file	Used for the “View” option
usercentrestyle	CSS file	Used for the “View” option

view.php	PHP file	Used for the “View” option
viewstyle	CSS file	Used for the “View” option
Wolfsontheatre	JPG file	Used for the “View” option
wolfsontheatre.php	PHP file	Used for the “View” option
wolfsontheatrestyle	CSS file	Used for the “View” option

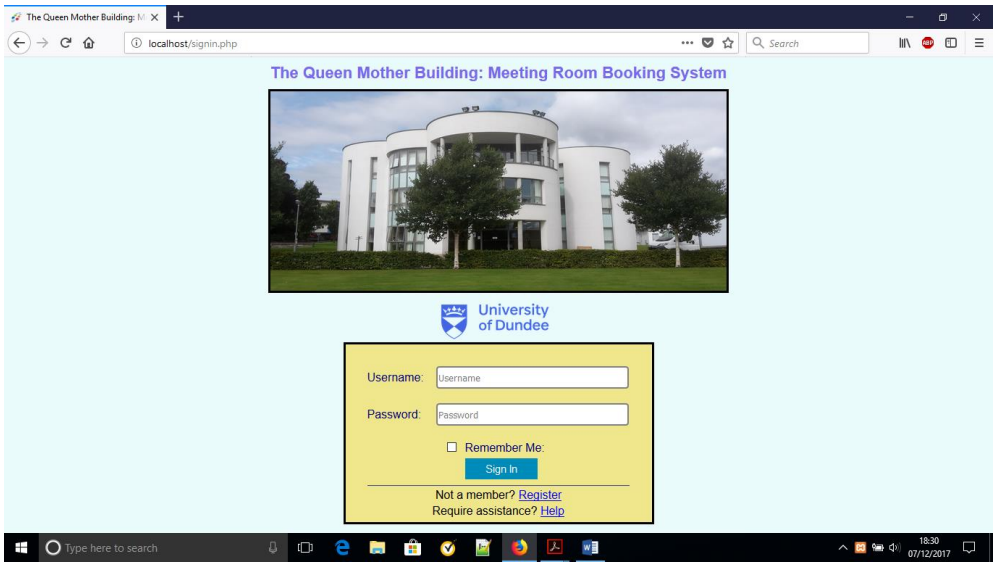
In order for the system to work, the user will be required to recreate the databases used within the system.

Appendix 6: User Manual

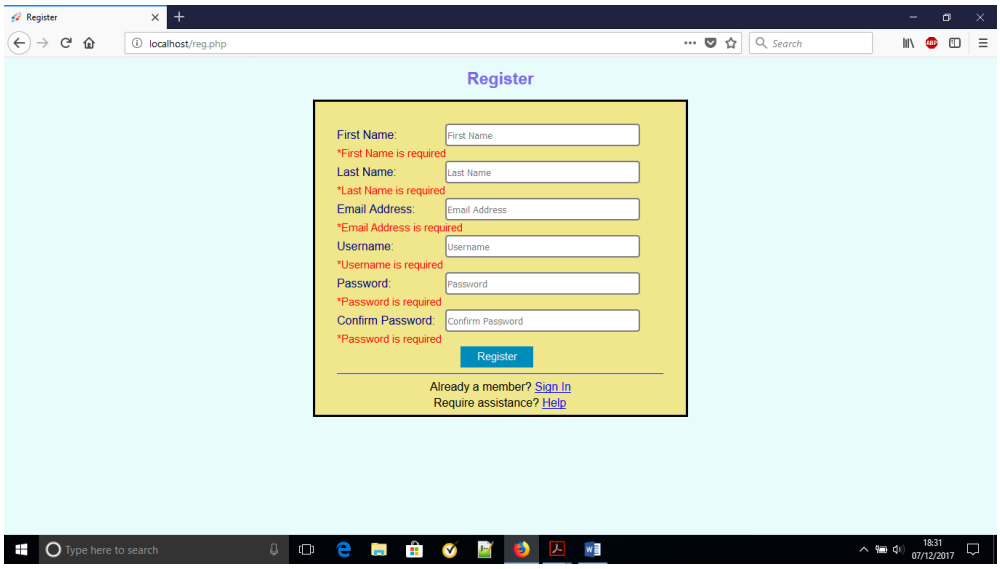
The Queen Mother Building: Meeting Room Booking System

This booking system allows you to reserve booking rooms and equipment of the Queen Mother Building at specific dates and timeslots.

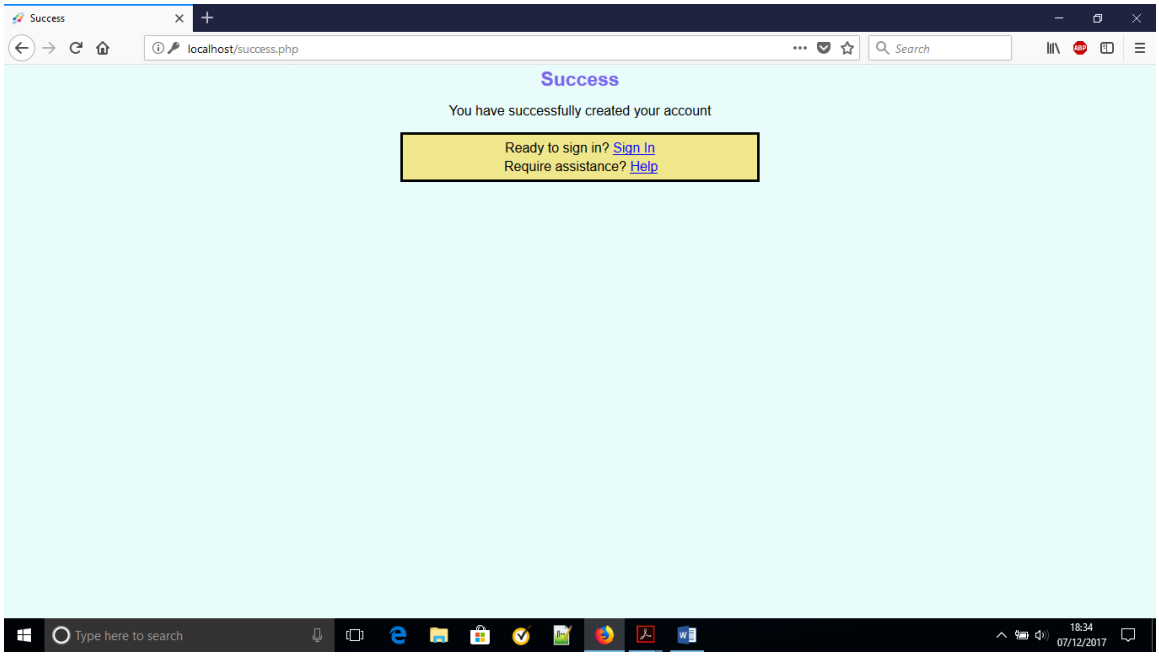
1) How to set up



-At the Sign In page you are presented with the above display. Please select the Register link which will take you to the Registration page.



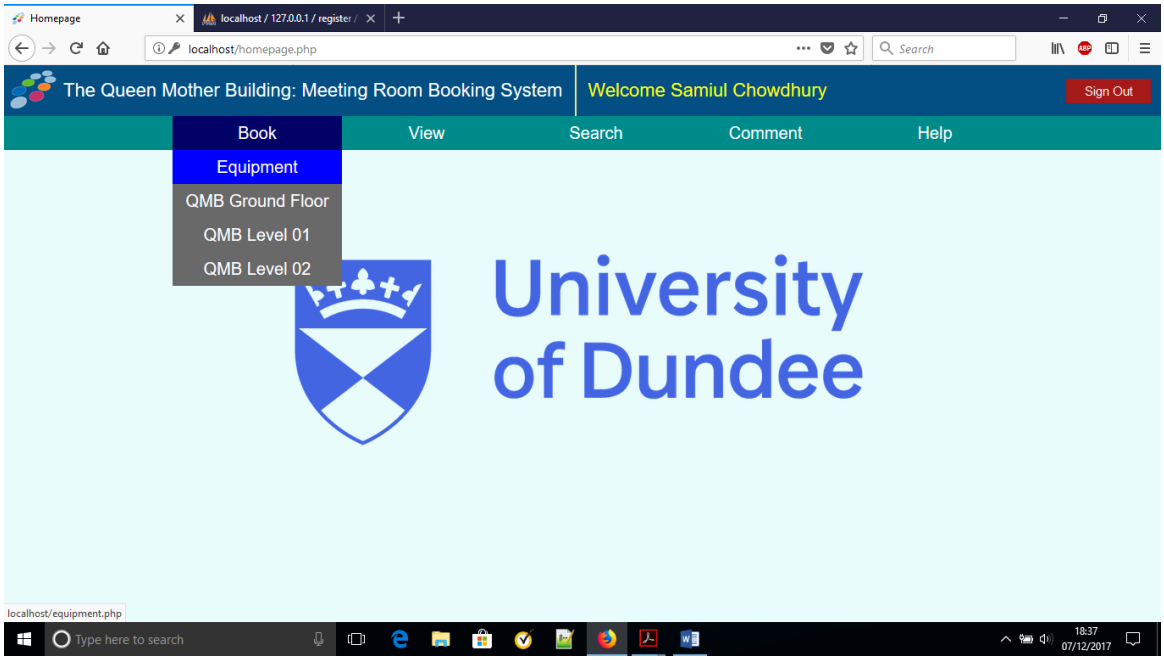
-Simply fill in your details and when you have finished just click the Register button.



-The next screen you see will tell you that you have completed creating an account. Simply click the Sign In link and you will be taken back to the Sign In page.

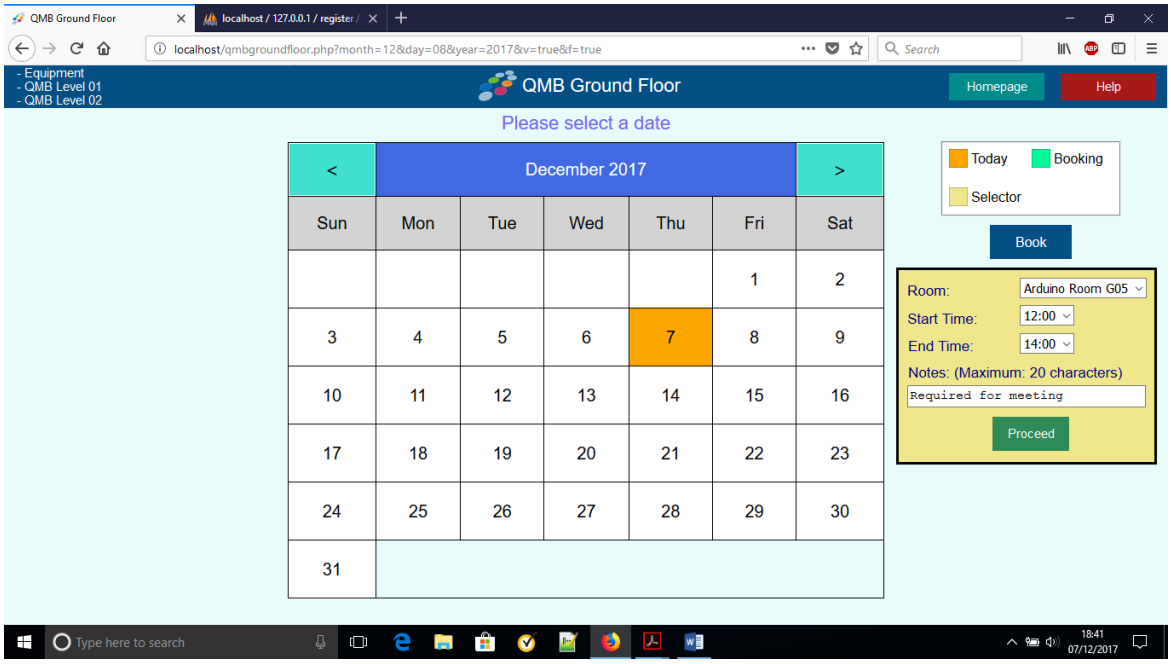
-Enter your details and you will successfully be logged into the system.

2) Navigating the Homepage



-On the Homepage you are presented with a greeting message, navigation bar and option to Sign out of the system. When you want to leave the system, simply clock the Sign Out button located on the top right section of the screen.

3) Making a booking



-Simply hover over the Book menu and select a floor or equipment.

-You will see a booking calendar. To navigate the calendar simply click the left or right arrow.

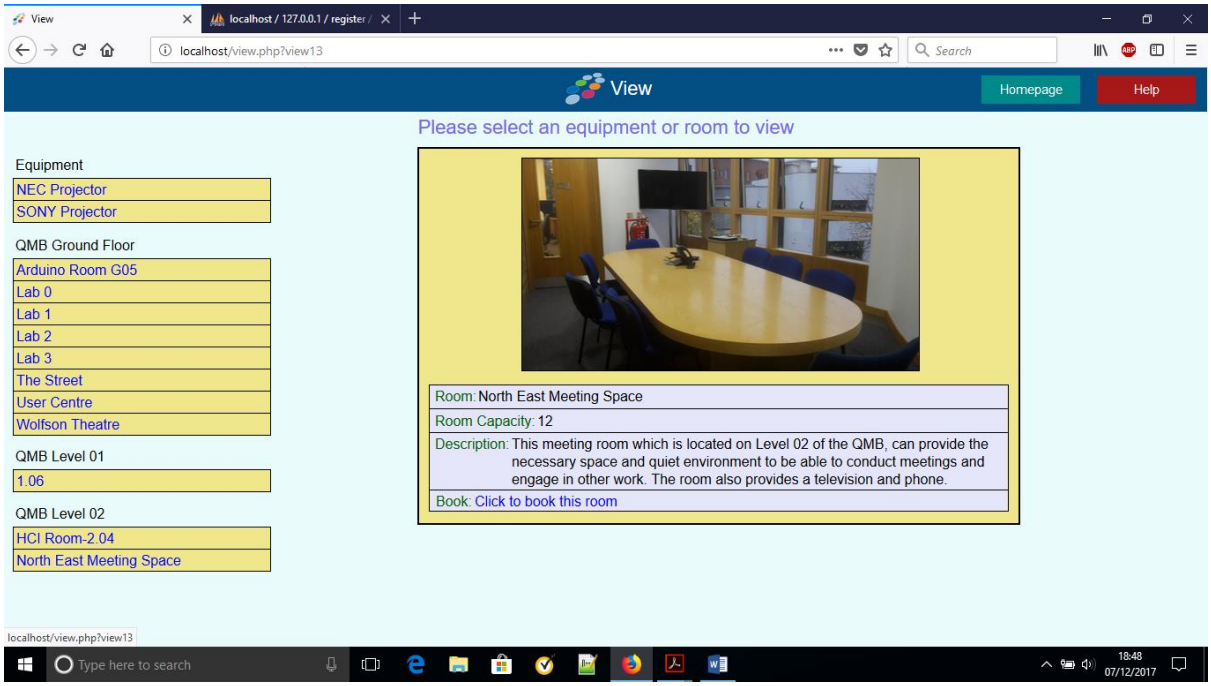
-To make a booking, hover over a date in the calendar and click it. A “Book” button will display to the right of the calendar under the Legend. Click it and a booking menu will display.

-Select from the dropdown menu your options and leave a note if you like. When you are ready to go ahead with your booking, just click the “Proceed” button.

-Once your booking has been made, you will see a message along with the date you chose, highlight and the booking details displayed to the left of the calendar.

-To change location, simply click the white links displayed on the top left side of the screen.

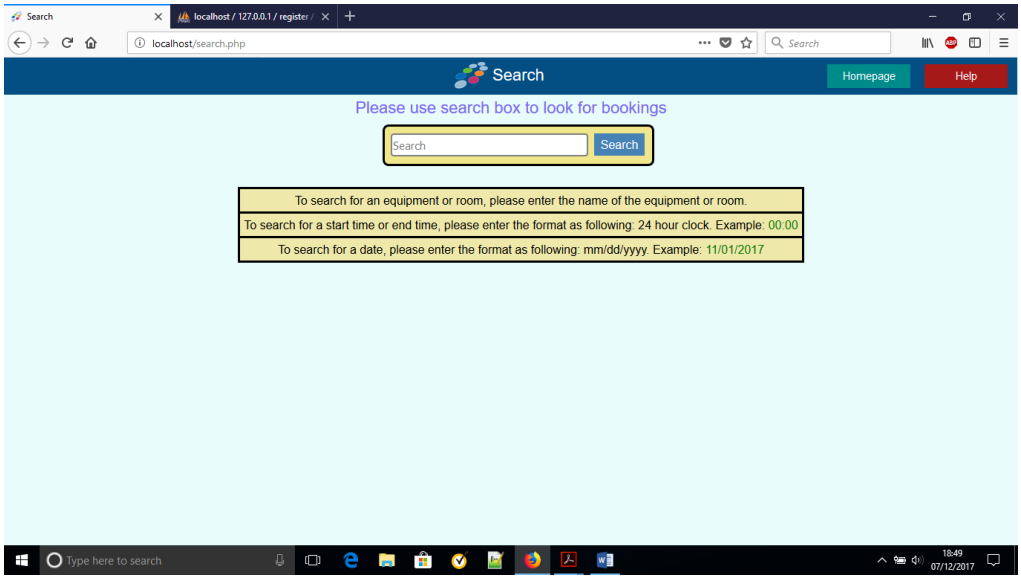
4) View a room



-To view a room, select the View option in the Homepage. Following this, just click a link on the left side of the screen and you will see a description on the right side.

-To proceed with booking a room simply click the link titled “Click to book this room” and you will be taken to the booking calendar for that room.

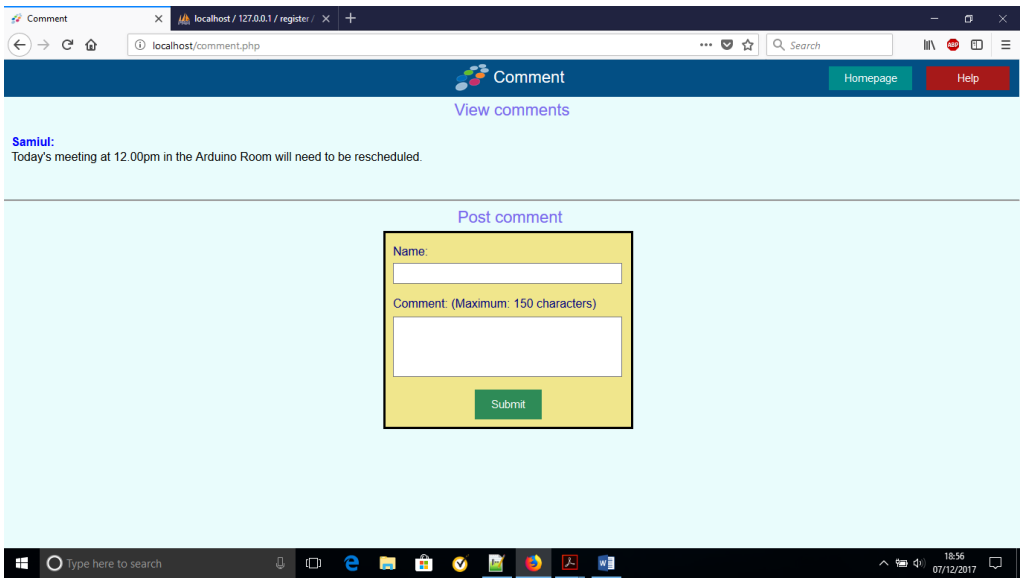
5) Search for bookings



-To search for bookings, simply choose the Search option on the Homepage. Following this you will see the above screen. The provided instructions can help narrow your search results.

-When you have entered your data into the search box, just click the “Search” button and the system will display results based on your input.

6) Make a comment

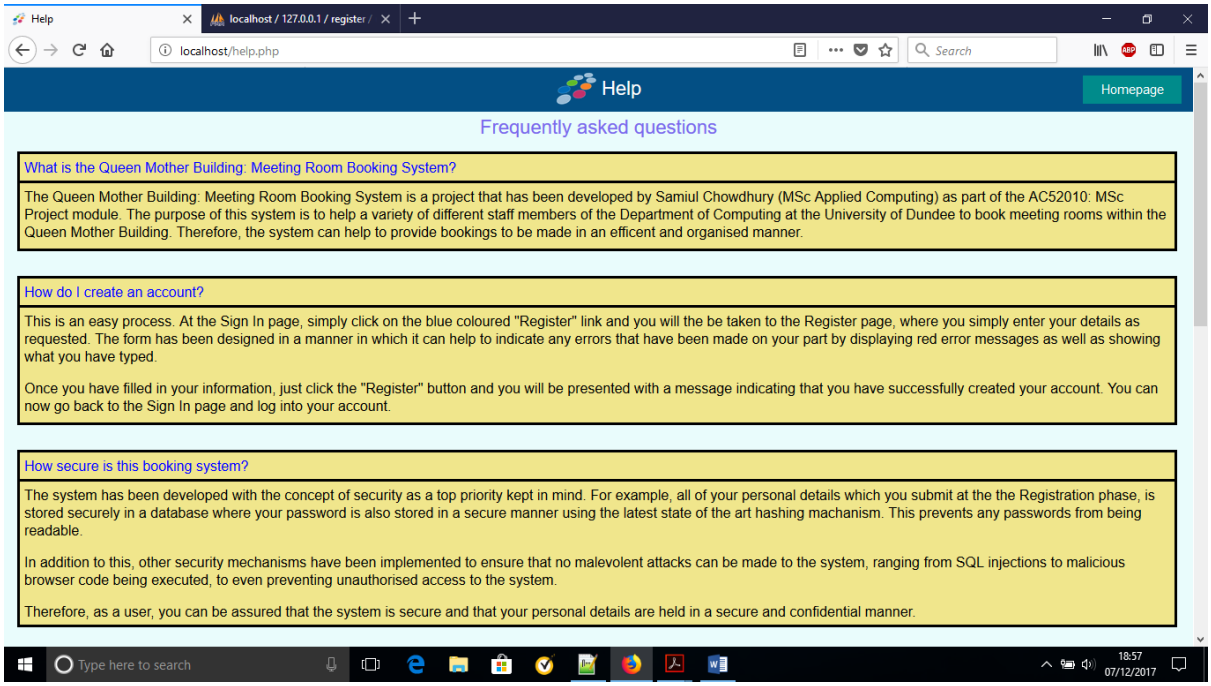


-To make a comment, please select the “Comment” option on the Homepage.

-Simply leave your name in the “Name” input box and your comment in the “Comment” box and click the “Submit” button.

-Your message will then display on the top section of the screen.

5) Access the Help menu



-This can easily be accessed in all sections of the system. Just click the Help button either on the Homepage or other sections of the system (located in the top right side of the screen) and you will be presented with a help menu.

-The help menu can answer common questions about how to operate this system.