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# 1 Introduction & Background

This project serves to answer the question; Can a specialised Enterprise resource planner (ERP) Software be created to increase productivity and reduce managerial involvement therefore lowering costs?

This project will involve the creation and documentation of a web-based staff management system. This website will be aimed primarily at one small business that has a high level of staff requiring flexible work. The sites primary use will be the allocation of shifts and will enable staff to exchange shifts, without managerial involvement. The program will also involve a dedicated messaging system to improve communication.

A big question is; how much will this cost? ERP systems do not have standardised costs, but “You can roughly expect to pay anywhere from $1,500 to $4,000 per concurrent user. The number of users and the functions which are included are factors that affect the price.”( WORKWISE, 2018) this of course is much more than many small businesses can afford and could mount up to over $75000, for functionality that may not be needed. The idea of this project is to speak to a small business and enquire what specific areas can be improved in their business by making computerised with a one-off program.

After working in multiple small retail businesses, it’s clear that current systems for staff management and communications can be very antiquated, and do not make best use of current technologies. They instead rely on physical mediums such as hand drawn staff rotas and count on different social media platforms for staff communication. Using physical copies of messages and rotas come with many issues.

Will all members of staff see the information? It is impossible or laborious to determine whether all members of staff received said information. This can have an impact on the everyday running of a business. Staff may not apply for shifts as they don’t know they are available or they may not attend shifts that have been applied for, due to the only extant document being on the business premises. Using this system requires heavy managerial involvement and processing to be useable. To reduce their involvement, a dedicated website could be used to simplify the problem and increase efficiency. Instead of managers having to create paper copies of rotas and staff having to contact them to apply for or swap shifts, this can all be handled online by staff.

Many areas will need to be analysed to decide if this going to be an improvement over the current system. Interviews with a willing business may need to be conducted. Asking for instance; how much time is used directly related to employee management per diem? Would the project be cost effective to the business? And they would need to be asked how the site would need to be designed to give users the most efficient experience.

According to staff feedback, approximately 5 hours per week is spent constructing rotas and 10 hours is spend dealing with request from staff related to shift allocation and management. This can cost in excess of £8000 per year in staff payments. The idea of this project is to reduce that amount bearing in mind the costs of an entry level web developer.

# 2 Literature Review

This report and website relates to enterprise resource planners. This will involve communication aspects. To create this, knowledge of current enterprise research planners will be required, as will knowledge on website creation software, and the tools and languages required to create the website. (HOW-TO-BUILD-WEBSITES, 2018) helps with expansion of knowledge and furthering background knowledge on creating HTML pages. (OLIVIA SELLERS, 2019) furthers knowledge on advanced techniques relating to design. Knowledge of PHP is required for the regular functions of enterprise resource planners. [(ARUN GOYAL, 2015.)](https://www.octalsoftware.com/blog/enhance-your-skills-in-php-with-advanced-techniques) outlines further features of PHP that will help in the design stage of the project. JavaScript will also be required to code the functionality on the user end. The website will be designed in the design section. (ROXANNE PINTO, 2018) details good quality UX design. It outlines techniques that could be useful, and will be kept in mind throughout the design section.

A tool will be required to code the website. The tool ‘Brackets’ will be suitable for creating each page since it has the ability to code in all the required languages. [(Brackets, 2019)](http://brackets.io/) Brackets has the ability to see a live preview of the website as it is being coded, which will help with the implementation stage massively. Brackets also has ‘inline editors’ which allows the user to see all the pages of the website clearly whilst coding, and the relation between the pages.

The website will require a database, a MySQL database would be suitable which is a relational database management system. The university server has a software called ‘PHPmyadmin’ which would be used to easily create and modify database tables. This tool would mean that no actual coding of database tables would need to be done.

The database and website will need to be stored on a server somewhere and need to be live. The university server would be perfect for this as it is free to use and has a very high free file upload size. Also, it comes with ‘PHPmyadmin’ installed for free, so the database can be created and uploaded to the server with ease.

Research of other current enterprise resource planners expands the knowledge on the subject and will influence design decisions. Interviews with students at a university were done to find out information on their workplace’s enterprise resource planners. A high featured and popular enterprise resource planner on the market is McDonald’s. Their system is a high-end system used by millions of people. Certain features of the system could be chosen to go into this new website. A basic and important feature of McDonald’s system is the ability to make a shift that you have been assigned, available. This feature should be implemented in this new website. McDonald’s system has many admin options and features that can only be accessed if you log in as an admin. This would be a great security feature to incorporate into the design. Also, the ability to make shifts is very easy and convenient on McDonald’s system. Influence from this should be taken and focused on in the design of this website.

Another website that influence could be taken from is Sketchers enterprise resource planner. The shoe company’s system is very poor and lacking in features. Firstly there is no messaging system at all, meaning workers cannot contact their managers on the system, or contact people through the system regarding changing shifts. Having a messaging system would be a great addition to this new website as it would make it much more user friendly for the workers. The sketchers system also has absolutely no rota system, the only way they can see their shifts is by viewing a photograph of a piece of paper with their shifts on. This is a terrible system and shifts are the most important part of enterprise resource planners. This new website should have a page where you can view available shifts, and having further features on this page will make it stand out even more. Sketchers also has an extremely simplistic design, with almost no styling. If UX design is focused on in this new website then it will further the appeal. If all these features and more can be implemented in the website then it will be an obvious choice for companies looking for a new enterprise resource planner.

Through this literature review, an aim and a few objectives have been chosen. The first objective of the project is to be research the subject area. The literature review outlines a lot of this research, and the rest will be done through questionnaires, surveys, and reviewing other websites. The second objective is to design the website itself, with the design being informed by the research section. The third objective is to actually develop and implement what was designed in the design section, actually creating the website. The fourth and final objective will be to review the outcomes, outlining what features were implemented, then evaluating the results. The project aim is to create a web-based application enterprise resource planner with the intent of improving the system of a current business.

# 3 Aim & Objectives

Project Aim: This project aims to create a web-based application enterprise resource planner with the intent of improving the system of a current business.

Project Objectives:

* Research current online enterprise resource planners.
  + Current Online ERPs
    - What do they offer?
    - What do they cost?
    - Would they be suitable for this scenario?
  + Information from a business
    - What do they require from the site?
    - What is their current system?
  + Methods used to create a functional website
  + Appropriate servers for use
* Design the new enterprise resource planner based on research.
  + Create database schema design
  + Create preliminary sketches for site pages based on research of;
    - Current online ERPs
    - Feedback from a small business
  + Finalise design in website creator
* Develop the new enterprise resource planner & server.
  + Use appropriate code editor to create site
  + Set up server with SQL based database installed
  + Test site on suitable browser using server
* Evaluation and analysis of final product.
  + Compare finished project to existing versions
  + Anylise project cost effectiveness - how long did it take to create
  + Talk to business and ask to test
  + Ask business to complete a survey
    - does created app meet requirements?

# 4 Project Specification

## 4.1 Hardware / Software Requirements

Hardware for creating and hosting the website:

* Computer with standard peripherals;
  + Mouse.
  + Keyboard.
  + Monitor.
* Computer / server for hosting the website and database.
* Internet connection.
* Remote storage for backup / Flash drives.

Software for creating and hosting the website:

* Suitable code editor.
* Web browser (Recent).
* Online server software.
* Up to date operating system.
* Database software.

Hardware the user requires:

* Computer with standard peripherals
  + Mouse.
  + Keyboard.
  + Monitor.
* Internet connection.

Software the user requires:

* Up to date web browser.
* Up to date operating system.

A computer of only average power will be required to build, test and run the website. It must be powerful enough to comfortably run a suitable coding text editor for to be able to write the website it also must be capable of displaying the product on a suitable browser. With the Microsoft windows OS having the largest market share, it makes sense that the site should be developed on a Window 10 PC as to ensure compatibility with the most users. For the same reason, the best possible choice of browser to decide to use for testing will be Chrome, as it has had a market share of over 50% since 2015 and over 70% by the end of 2018 according to (STATISTA, 2019). The choice of text editor used to code the app is of little importance but must be free to use. Brackets would be a suitable choice as it is free and is by the creator’s own words “A modern, open source text editor that understands web design.” (Brackets, 2017)

## 4.2 Development requirements

The website will need to be designed in a way that enables the staff to preform several functions. The functions will be different depending on the user – Manager or Employee. This requires research into different technologies used in web design.

### 4.2.1 Databases

Firstly, it’s crucial a database is created with a number of tables. Research into database management systems (DBMS), shows that a standard Relational DBMS will be the most suitable choice for the requirements of this project. A RDBMS is in its nature more restrictive than newer “No SQL” databases, a schema needs to be designed before usage, this causes problems if trying to expand the database, but this site is only to provide a small number of functions, so database adaptability is not paramount. Although rigid, a RDBSM provides many benefits including increased data integrity, so it is easier to keep employee data secure. Another strength of relational databases is “Creating limits on what certain user types can access or modify is built into the structure of an RDBMS. Because of this, relational databases are well-suited to applications that require tiered access (INFOWORLD, 2019) in this scenario for example, an employee can view their account, accepting shifts and viewing available ones, while a manager could view the employees account and also make necessary alterations. With this in mind a specific RDBMS needs to be selected. Many types of RDBMS’ have been developed since the dawn of modern computing but, “Structured English Query Language (SEQUEL) developed by IBM Corporation, Inc., to use Codd’s model. SEQUEL later became SQL (still pronounced “sequel”). In 1979, Relational Software, Inc. (now Oracle) introduced the first commercially available implementation of SQL. Today, SQL is accepted as the standard RDBMS language.”(ORACLE, 2003) Making it the only logical choice. The SQL based RDBMS that will be used will be MySQL, as it has a large market share of SQL based databases and it is primarily used by small businesses (10-50 Employees) according to (IDATALABS, 2017).

### 4.2.2 Coding Languages

The choice of coding language is a basic one. If the language is usable for web development, then it is a potential choice. The main deciding factor is that of ease of use and the extent it is currently already used in web dev, denoting the ease of which information can be found to accomplish tasks and solve problems encountered during construction.

Potential Client-side Languages;

* HTML
* CSS
* JavaScript
* C++
* C#
* Python

Potential Server-side Languages;

* PHP
* ASP.NET
* RUBY
* JAVA

A numbers of web pages will be created to implement certain functions, requiring a combination of multiple languages. these pages will consist of mainly of four programming languages. HTML (A form of XML languages) will be used to create a basis for the site as it is the industry standard for describing websites using the Document Object Model API.

PHP will be implemented into the pages to communicate with the server to preform actions on the database in order to display the data. PHP is used widely and has much documentation so should any issues arise; it will be much easier to solve. According to (DATANYZE, 2019), who have a sample of over 12.7 million websites, PHP is the most used server-side script language, with 61.55% of the entire marker share, with ASP.NET being in second place with a 26.89% share. Giant businesses such as Facebook and yahoo primarily use PHP, it is also implemented in many other online ERPs such as; bitrix24, webERP and erpnext.

JavaScript will be a crucial part in the site, it will be responsible for all of the client-side functionality. It is very compatible with PHP will be used in combination to add more functionality to the site. It will interpret JSON returned from PHP scripts and display it employing AJAX functions that make use of the Document Object Model API. Again, JavaScript is the most used client-side script language, other languages do exist but are based on JS and often are merely frameworks.

CSS will also be used to style the site is a user-friendly way to increase efficiency. Also, though not crucial it would be a benefit to style the site in order to allow mobile support, if there is time to do so.

## 4.3 Functionality Requirements

An employee must be able to;

* View available shifts
* Apply for available shifts
* View accepted shifts
* Request a shift swap
* View/send messages

In Addition, a manager must also be able to;

* Add shifts to the database
* View all created shifts
* Delete from/Update shifts table

# 5 Methodology

## 5.1 Framework and design

The project is going to gather information from primary and secondary sources. Primary data will be collected through the small business that this program is being developed in mind of. Data will mainly be collected in the form of quantitative research through questionnaires using the Leichardt scale for easy analysis of the cross-sectional data. Surveys, which are of qualitative research, and interviews with selected staff will occur before the end of development and after as to be able to compare efficiency of old system and new. Secondary data will be collected mainly from library sources, Web sites and Journals. This information will be used to collect information on existing ERPs and coding practices that will be needed to build the site. The information gained from the questionnaire and survey is going to be descriptive applied research (Duckett 2011, p. 2).

## 

## 5.2 Participants

For both the questionnaire and survey, a mix of staff members from the small business will be asked to complete them. There will be some management staff, some employees. The age range is from 18 (students) to 60 years. This covers a broad range of people and these people will be selected at random.

## 5.3 Materials

The questionnaire will be in paper format to ensure immediate responses. The survey was also in paper format. The questionnaire and survey will be completed by the participants and then the results will be put onto a computer in word format.

## 5.4 Procedure

As the number of participants that will be involved in the surveys has not currently been established. It’s not clear if any analytic tools will be needed. Current assumptions predict only a small amount of people will be involved so only a simple spreadsheet application will be needed in order to store and visualise the results. Regarding gathering samples from the participants, the people will be chosen at random in an attempt to create a good cross-sectional study.

# 6 Project Management

## 6.1. Risk assessment

|  |  |  |  |
| --- | --- | --- | --- |
| Risk | Impact | Likelihood | Contingency |
| Server Malfunction | Medium | Medium | Site can still be developed without access to server, so development can continue. If problem persists then change to backup server option, to enable testing. |
| Computer Malfunction | High | Low | Research local libraries with computer support or ask to use friend/colleague’s PC - while awaiting repairs/replacement |
| Inability to preform coding task | Medium | Medium | use researched books and guides to accomplish issue or discover another way of completing the task |
| Inability to work due to illness | medium | Low | Create a flexible plan. Remove surplus areas from design. |
| Working Files Lost (Corruption Etc..) | High | Low | always keep data backed up |
| Data protection act breached | High | Low | Keep any sensitive information secure. Do not share information without expressed consent |
| Program malfunctions | Low | Low | Reinstall software / Install a backup software choice |

## 6.2. Agile Project Management

This project will use Agile project management, as it is much more flexible than other methods. It will need to be closely worked on with business and may need to be changed at times to keep with their needs.

* “The agile project promotes collaborative working, especially with the customer.
* The agile project reflects, learns and adjusts at regular intervals to ensure that the customer is always satisfied and is provided with outcomes that result in benefits.
* Agile methods integrate planning with execution, allowing an organisation to create a working mindset that helps a team respond effectively to changing requirements.” (ASSOCIATION FOR PROJECT MANAGEMENT,2017)

## 6.3. Constraints

The only foreseeable serious constraints are that of time and ability. Current predictions deem this will not be the case, but as the risk assessment highlights, things can change without notice. time constraints though can be managed with a suitable application tool. Another potential constraint is budget. The current predicted cost is nil, all software is open source and all the equipment is already available but the necessity of completing this task in a fixed time may require the replacement of hardware should issues arise. There may also be cost incurred in the rental of a host server if free alternatives prove to not be fit for use.

# 7 Professional, Legal and Ethical Issues

this project requires work with a small business, this can raise many issues. It is important to consider the reputation of the business. Although unlikely in this case, it could hurt the business if unfavourable information was published. it’s imperative to clear with the business the data wishing to be published, to avoid legal ramifications. This this of course isn’t likely to happen as naming the business isn’t required to complete this project. Names of staff and their work schedules will need to be used, both in the database and on the surveys. This being the case, the gathering, use and storage of this information must strictly abide by the data protection act. (See Appendix **15.6**) more Information found online

To abide by strict ethical guidelines, all information must be obtained from willing participant that are aware of how the data will be used (Voluntary Informed Consent). “Consent is the main rule in research on individuals or on information and material that can be linked to individuals. This consent should be informed, explicit, voluntary and documentable”. No prejudice can be made on who will be picked to do surveys and interviews and data should be collected anonymously where possible to keep data impartial.” Impartiality means avoidance of confusing roles and relationships in a way that may give rise to reasonable doubt concerning conflicts of interest.” (THE NORWEGIAN NATIONAL COMMITTEES FOR RESEARCH ETHICS, 2014)

# 8 Design

The website’s design needs to satisfy certain required functions that were decided on based upon research of current enterprise resource planners and the requirements of interviewees.

## 8.1 Database

The first thing that needs to be designed is the schematic of the relational database that the website will use to hold and display the information to the user when required. From interviews with employees of the subject business, it is clear that a minimal database is required to run the website suitably. The first table will hold user information, on all of the employees that need access to the site. This table will hold the full names of an employee, username/password, their supervisor status, the status of their administrator privileges and most importantly a unique user ID that will be used in other tables to enable the sites functionality. The next table will hold information on the individual shifts. The shifts table will need fields for the precise date and time the shift will take place, the user ID of the accepting user (If applicable), a unique shift ID, the supervisor requirement and a final column representing the current availability of the shift in binary. The final table in the database will be for housing all sent messages, it will have a simple layout of; a unique message ID, time/date, sender ID and receiver ID that will coincide with the information from the users table. Table schema found in appendix 15.5.1.

## 8.2 Website

### 8.2.1 Required Pages

Many pages need to be created to allow full functionality of this site. These will be;

* PHP & HTML Pages
  + Index – Login Form
  + Navigation page
  + View Accepted Shifts
  + View Available Shifts
  + View Messages
  + View All Shifts
  + Add Shifts
* Other – JavaScript and CSS files

### 8.2.2 Layout and Design

The website’s core functionality requires a login system for it to be viable, this being the case, the index page for the site will be the login form. Once a user has logged in, a navigation page will be displayed. If this page and/or subsequent pages are accessed prior to log in, the user should be warned to login and be redirected to the index page to login correctly.

The navigation page will display up to six links to further pages, depending on the individual users’ admin credentials. The standard user will see four links; Available shifts, Accepted/Current shifts, send a message and view received messages. Should the user have admin status, two more links will be shown with the aforementioned; Add shifts and All shifts.

With the exception of Add shifts and Send a message, the pages will display the information delivered from the database in tables, in a clear format. The other two pages will be simple forms that will contain all the relevant fields for submitting information to the database.

## 8.3 Design Principles

There are many schools of thought on what constitutes good design. When designing the individual layouts of each page, basic design principles need to be observed for good practice of web design, to ensure the site is simple and easy to use.

### 8.3.1 Don Norman

“Design is concerned with how things work, how they are controlled, and the nature of the interaction between people and technology. When done well, the results are brilliant, pleasurable products. When done badly, the products are unusable, leading to great frustration and irritation. Or they might be usable, but force us to behave the way the product wishes rather than as we wish.” (NORMAN, D.A., 2013)

Don Norman talks about the phycology of everyday things. This is no less poignant when talking about web design. Not following a defined set of universal rules of design can break a site, making it awful and nigh impossible to use. He goes on to mention multiple principles when constructing this site.

#### 8.3.1.1 Feedback

“Feedback—communicating the results of an action—is a well-known concept from the science of control and information theory.”…” Even as simple a task as picking up a glass with the hand requires feedback to aim the hand properly, to grasp the glass, and to lift it. A misplaced hand will spill the contents, too hard a grip will break the glass, and too weak a grip will allow it to fall.”…” Given the importance of feedback, it is amazing how many products ignore it.”( NORMAN, D.A., 2013)

When applied to web design, this can be as simple as communicating errors to the user in a clear fashion. In this case, any time an error occurs a relevant message will be displayed directly in the users eyeline, centre page, in bold text and colour that helps it stand out from the rest of the page. Also, it’s important relevant feedback is returned to the user when they upload to the database. This can be easily achieved by converting the server’s HTTP response codes into user friendly messages. Another way feedback can be correctly implemented in this site will be the simple highlighting of input fields when typing, when a particular field is focused, it has a blue ring surrounding it so the user knows exactly when their input is directed.

#### 8.3.1.2 Mapping

“Mapping is a technical term, borrowed from mathematics, meaning the relationship between the elements of two sets of things.”( NORMAN, D.A., 2013)

This concept is quite commonsensical, yet often overlooked when designing a website. Here it refers to the layout of items on the page. Multiple pages will employ a search function to narrow results. This search area will of course need to be places centrally above the results, making the function of the search input clearer.

#### 8.3.1.3 Affordance

Affordance is a term used to describe usage. Norman offers a simple explanation “A chair affords (“is for”) support and, therefore, affords sitting.”( NORMAN, D.A., 2013) This translates into web design in a similar way, when a link is used on the site, it will use web standards i.e. blue text and underlining. This helps the user understand that they will be redirected to a new page as described in the link text. Also, buttons will be used on forms so the button will need to be distinguished from the surrounding elements and will be slightly raised from the surface, to imply it ‘affords’ pressing.

### 8.3.2 Gestalt Principles

“The Gestalt Principles are a set of laws arising from 1920s’ psychology, describing how humans typically see objects by grouping similar elements, recognizing patterns and simplifying complex images. Designers use these to engage users via powerful -yet natural- “tricks” of perspective and best practice design standards.”( INTERACTION-DESIGN.ORG, 2017)

Principles can include but are not limited to;

* “Common Region: We group elements that are in the same closed region.
* Continuation: We follow and “flow with” lines.
* Figure/Ground (Multi-stability): Disliking uncertainty, we look for solid, stable items. Unless an image is truly ambiguous, its foreground catches the eye first.
* Proximity (Emergence): We group closer-together elements, separating them from those farther apart.
* Symmetry: We seek balance and order in designs, struggling to do so if they aren’t readily apparent.”(INTERACTION-DESIGN.ORG, 2017)

As this is a website, we know that the preferred view is portrait. The user of a website does not expect to scroll horizontally when full screen, as information is traditionally displayed vertically. Continuation comes into effect here. knowing that the user’s eyes will follow a line down the page from the top, it becomes clear that elements on the site should be vertical. They should also go top to bottom in terms of the order they need to be used to function. For example, the page heading should be top of the main section followed by the search form (where appropriate) and then the results of the above search. Proximity is easy, table data will automatically be grouped, and all search related input will be grouped with a submit button, slightly apart from result data. All element on the page will also be as symmetrical as possible as can be seen in wire from designs in appendix 15.2.

# 9 Implementation

as with the design phase, the first area with which to start, is the construction of the database. A database program will be installed on the server prior to developing the site.

As the site will be mostly AJAX based, only the basic outline of the page needs to be written in HTML; the logo, banner, website title, page title etc and importantly – a DIV to contain data returned by the database searches. The majority of the site will need to be written in PHP as the websites core functionality requires constant communication between the client and the server to be viable. All of this completed with security and usability in mind.

## 9.1 Security and Good Practice

When writing PHP certain things need to be considered to ensure the site is safe and secure for its users. Although this particular site does not contain sensitive data such as financial information, it will contain the work schedules and full names of employees. This information could potential be use nefariously, so access to the website and database must be strictly restricted.

### 9.1.1 Form Data

When entering data into a form, the password field should of course, not be visible. This is an obvious step in basic safety, but sometimes overlooked is the importance of the methods used to obtain the data from the forms. Communication is enabled using HTTP (Hypertext Transfer Protocol) “A client (browser) submits an HTTP request to the server; then the server returns a response to the client. The response contains status information about the request and may also contain the requested content.”(W3SCHOOLS, 2019). HTTP has a number of methods, the most common of these being POST and GET. Correct use of these methods can have a big impact on security.

When using the GET method to send information, the names and values of the form data, will be visibly displayed in the query string of the URL. To avoid this issue, any time sensitive information is transmitted, the POST should be used implicitly. The get method should only be used for returning information all other requests that alter data or use private inputs will use POST. This method also stops the storage of links in the browser’s history, to avoid the possibility of another user of the same computer accessing the information.

### 9.1.2 Cross-Site Scripting

“A cross-site scripting attack is one of the top 5 security attacks carried out on a daily basis across the Internet, and your PHP scripts may not be immune. Also known as XSS, the attack is basically a type of code injection attack which is made possible by incorrectly validating user data, which usually gets inserted into the page through a web form or using an altered hyperlink. The code injected can be any malicious client-side code, such as JavaScript, VBScript, HTML, CSS, Flash, and others. The code is used to save harmful data on the server or perform a malicious action within the user’s browser.”(SITEPOINT, 2018)

Though it is unlikely that this site will be the target of an XSS attack, it is still very important to implement basic protection against it. Simple protection on the site will include the use of html entities. This process will convert harmful characters when reading in from input forms.

For example:

<script> harmfulFunc() </script>

Becomes

&#x3C;script&#x3E; harmfulFunc() &#x3C;/script&#x3E;

And therefore, is not interpreted by the browser as XML.

### 9.1.3 SQL injection

“SQL injection is one of the most common web hacking techniques. SQL injection is the placement of malicious code in SQL statements, via web page input.”(W3SCHOOLS, 2019) with this site, this attack is incredibly dangerous, as the core functionality revolves around SQL style databases.

A standard SQL statement here could be

SELECT \* FROM user WHERE UserID = $INPUT

If the input contained code that the server interpreted as SQL, it could be very detrimental. Should the user enter, for instance;

1001 OR 0=0

The statement would then read;

SELECT \* FROM user WHERE UserID = 1001 OR 0=0

As zero will always equal zero, the hacker will be immediately logged into the site. Using this method, any other SQL statement can be added on. This means any data can be accessed or deleted without permission if adequate steps aren’t taken, for instance a hacker could add the term DROP TABLE and irrecoverably remove the table from the database, causing massive damage.

This can be easily guarded against by using prepared statements. “Prepared statements are very useful against SQL injections, because parameter values, which are transmitted later using a different protocol, need not be correctly escaped. If the original statement template is not derived from external input, SQL injection cannot occur.”(W3SCHOOLS, 2019)

For example;

$login = $conn -> prepare

("SELECT \* FROM USERS WHERE Username = $u AND Password= $p");

Becomes;

$login = $conn -> prepare("SELECT \* FROM USERS WHERE Username=:username AND Password=:password");

$login -> bindParam(":username", $un);

$login -> bindParam(":password", $pw);

$login -> execute();

## 9.2 Database

the server has an SQL database set up, this can be achieved either using the inbuilt GUI of the PHPmyAdmin system or using SQL format code to construct the tables. For the purposes of this project, raw SQL will be used, though there isn’t a major difference in terms of the end result. An important requirement of columns in their creation is their nullability status. Should a column be able to be null (be created blank) a number of error could arise and the site could not function. As seen in the appendix, all columns but one are “Not NULL” meaning data will not be able to be added to the table is these fields are missing. The one field that is nullable is the “userID” field in the “SHIFTS” table – this is so that the shift can be created as an available shift, with no current user, and therefore can be accepted post creation. Another import note is that the tables must be linked with foreign keys in order maintain functionality. Both the SHIFTS and the MESSAGES tables must have a field for User ID to be able to form the relationships between them. SQL code for table creation can be found in appendix 15.5.2**.**

## 9.3 Server-Side Scripting

Ove half of the sites code will be PHP, a Server-Side Scripting language. “Server-side scripting is a method of designing websites so that the process or user request is run on the originating server. Server-side scripts provide an interface to the user and are used to limit access to proprietary data and help keep control of the script source code.” (Computerhop,2017)

This code will provide the bridge between the user and the server. A php script is made to connect to the required database and then Appropriate SQL statements are made to request the desired information. This information is then encoded in JSON and returned to the client. A big problem encountered when making PHP scripts is that the errors are not communicated with the user automatically. To overcome this logic will be implemented to handle errors and communicate them with the user – for instance; a 404 HTTP error will be set to the client if no result are found in the database, the client side script will then use this information to display relevant messages to the user.

session\_start();

$userID = $\_SESSION["userID"];

include 'snippets/conn.php'; //Connect to Database

$userQ = $conn->prepare("SELECT \* FROM USERS WHERE userID =:uID");

$userQ -> bindParam(":uID", $userID);

$userQ->execute();

$cUser = $userQ->fetch();

if($cUser)

{

$msgsQ = $conn->query("SELECT \* FROM MESSAGES WHERE ReceiverID =$userID");

$msgs = $msgsQ -> fetchAll(PDO::FETCH\_ASSOC);

if($msgs)

{

echo json\_encode($msgs);

}

else

{

header("HTTP/1.1 404 Not Found");

}

}

else

{

header("HTTP/1.1 401 Unauthorized");

}

This example shows the process. IF logic determines if the user is logged in by checking the value of the session variable. If the variable is false (not set) a header is sent back to the client and is then handled by JavaScript to communicate to the user. A similar process also checks if any data is in the table and responds accordingly. Below is the function that handles HTTP error codes from JavaScript.

function handleError(error)

{

var Err = document.getElementById("error");

var message = "";

var p = document.createElement("P");

p.setAttribute("id", "ErrorMsg");

if(error == 400)

{

message = "Error - Check if shift is still available";

}

if(error == 404)

{

message = "No Results Found";

}

if(error == 414)

{

message = "Error (Length Exceeded) - Edit Search Term and Try Again";

}

if(error == 405)

{

message = "Error (Wrong Method) - Search Using GET Method Only";

}

As this site requires a login system to function, it was important to ascertain the best way to achieve this in PHP. Common practice on basic web pages seemed to use session variables. “A session creates a file in a temporary directory on the server where registered session variables and their values are stored. This data will be available to all pages on the site during that visit.”(Tutorialpoint,2018) on login, these variables can be uniquely named and will be used to store the users ID number and admin status. To make these variables accessible across multiple pages, session\_start must be called. “session\_start() creates a session or resumes the current one based on a session identifier passed via a GET or POST request, or passed via a cookie.” (PHPNET, 2017). These values are then easily checked on each page and if not set, the user will be denied access to the page contents.

## 9.4 Client-side scripting

JavaScript will be used to display information returned from the server and allow functionality. Without this the site would not be able to display the data in a coherent form, only raw JSON.

The site will use an AJAX () front end that employs promises. “A Promise is an object representing the eventual completion or failure of an asynchronous operation”( MOZILLA, 2018) in this application, there will be a string of promises, if a promise is successful it will move on to the next promise, otherwise it will ignore all other promises and move to the catch function.

HTTP\_GET("https://edward2.solent.ac.uk/~agrant/Pr/wsShifts.php?SU=1").then(JSON.parse).then(displayCurShifts).catch(handleError);

function HTTP\_GET(url)

{

var p = new Promise((resolve,reject)=>

{

var XHR = new XMLHttpRequest();

XHR.open('GET', url);

XHR.addEventListener("load", (e)=>

{

if(e.target.status>=400 && e.target.status<=599)

{

reject(e.target.status);

console.log("no");

}

else

{

resolve(e.target.responseText);

console.log("yes");

}

});

XHR.send();

});

return p;

}

Here, the first promise is to make a HTTP request to the desired web service. If the service sends back a code between 400 and 599 (indicating and error) the error function will be called. Otherwise the promise will resolve, and the next promise will initiate. Next the JSON is parsed (an inbuilt function of JS) then the display function is called. This function will take the parsed JSON object as a parameter and use a loop to go through each returned result, then using the DOM creation feature, a table will be created, one row for each result.

shifts.forEach( curShift =>

{

var tr2 = document.createElement("TR");

tr2.setAttribute("id", "rw");

tr2.setAttribute("class", curShift.id);

var varSID = curShift.ShiftID;

var varDate = curShift.Date;

var varStart = curShift.Start;

var varEnd = curShift.End;

var varUID = curShift.Firstname + " " + curShift.Surname;

var varS = "No";

if(curShift.Supervisor == 1)

{

varS = "Yes"

}……

Within this loop, once a row has been created, it will be fitted with a click event listener so that the shift is able to be deleted/accepted/edited/swapped.

tr2.addEventListener("click",()=>{ ………..}

as the implementation of this project has used in excess of 24 files and 1000 lines of code, it would be unwise to detail fully the complete functionality of the site, due to concerns of exceeding a sensible dissertation length. Therefore, flow charts are included to help visualise the main functionalities of the site as they have been implemented and can be found in appendix 15.3. the website login can be found in appendix 15.7.

# 10 Results

## 10.1 What has been implemented

The first feature of the website that the user is presented when they access it is a log in page. For this to work there is a fully working database table that is live on the server. This database table has test entries in it with fields that relate to user log in information. The login page has two fields one for username and one for password. This page successfully links to the main navigation page, with the user being logged in as either a regular user or as an admin. If the user is logged in as an admin then they are presented with six buttons on the navigation page. if the user logs in as a regular user then they are presented with four buttons. The four buttons available to a regular user on the navigation page are: view available shits, view accepted shifts, view messages, and view all shifts. These links all work correctly and are presented nicely. If the user logs in as admin they can also see a link for all shifts for all users and add / delete shifts.

The shift features and functionality rely on a working database table to be live on the server. This database table has been fully implemented. The view available shifts page displays details of all available shifts that are in the shifts database. This information is gathered from the database. This page displays the shifts in a clean look and is as planned in the design section of the report. If a logged in user clicks a shift on this page, then it is assigned to that user. The view accepted shifts page will display all the shifts a user has assigned to them clearly, if the user then clicks an accepted shift, then the shift is moved back to the available shifts page. This is done by altering the ‘available’ field in the database. If the user double clicks an accepted shift then this shift becomes invisible to users, with it having no assigned user and also not being available. It does still exist on the server. This is all the planned functionality of the available / accepted shifts pages, and it all works correctly with no errors. The database also works correctly with no errors.

There is an implemented database for the messaging function. This works through having a new database table. This database table has fields for message, sender ID, and receiver ID. These messages can be viewed on the implemented messages pages. There is a send messages page. This uses JavaScript to send a message through the database, adding a new entry to the table. There is also a view messages page, this will search the database for entries with the currently logged in user’s ID in the receivers ID field, and then display all results.

If the user logs in as an admin then two more options are shown to the user. These are view all shits, and create shift. On the all shifts page the admin is able to edit and delete shifts that are assigned or available for any user. And the create shift page uses an insert statement to add a new shift to the database.

## 10.2 Aims and objectives completion:

The first objective of the project was to research current competitor enterprise resource planner. The literature review outlines lots of this research. Research on current competitors was done to find features and components that could influence the design of the new enterprise resource planner. Further research was done, on the tools and systems that will be used for the design and implementation of the new system, such as coding programs. Research was done on the server that should be used for the website to be hosted on, and also for the database. Research was also done on what type of database should be used. The next objective was to design the new system itself. Using information learnt from the literature review this design was created to attempt to improve upon what current systems had to offer, hoping to provide a more fully featured experience to it’s users, and give more admin options. UX design was kept in mind throughout this section and a clean look was planned throughout.

The next objective was to actually create the website pages and database tables themselves. These tables and website pages were all created using the languages appropriate, relating to the function they would perform, as set out in the design section. These were all uploaded to the sever and it is all live and usable. A tool called Filezilla was used to upload these to the server. There were no features that are not currently working on the live server.

The final objective was to evaluate the final result and analyse the working features. This was done through analysis of what features were implemented. And evaluation was done by seeing how the objectives of the project were completed. There is then a usability lab test that was done on a university student to get opinions and feedback on the functionality of the website, and then also a survey was completed to find out the general opinion of the market. This information gives a good insight into how well the objectives of the project were achieved. The results were positive with great information on how to improve it. This completes the aim which was to create a web-based application enterprise resource planner with the intent of improving the system of a current business.

## 10.3 Survey and Usability test

Survey:

A survey was created and five people from the workplace that has been interviewed for this project have been asked to do it. The results have been shown below.

What they thought was good:

They felt that the design was clean and looked nice. They thought that the features chosen for the website were suitable, and they found they all worked correctly. The front page contains all the links you would expect, and the fact that the two admin links are only shown if the person logs in as admin is great.

What they thought could be better:

They felt that the visual design could be improved, with the buttons being placed with better grouping between buttons that relate to each other, and gaps between those that do not relate. They thought that the function to make a shift available again after it’s been chosen by someone could be made clearer. There is also a function if you were to click an accepted shift twice then it gets removed entirely, this is not clearly explained.

Usability test:

A member of the workplace that was interviewed for the research section of this project was asked to complete a usability test. This person was told to attempt to use certain functions of the website and then feedback was acquired based upon ease of use of the function, design, and problems they had.

Assign a new shift to yourself from the available shifts section.

“The available shifts section was easily visible on the front page. I clicked the button and was presented with a page filled with available shifts. Each shift was displayed clearly with their details shown to me. All the details I wanted to know where shown to me, and when I clicked a shift it would be outlined. When I went back to the home page and then to the accepted shifts page, the new shift was shown on the page clearly.”

Put a shift back on the available shifts section from accepted shifts.

“I opened the accepted shifts page easily through the button on the front page. I was not sure at first how to make the shift available again, however when I clicked the shift I wanted to change it was highlighted. When I went back to the available shifts page it was there again. I think it would be good if you were told how to make a shift available again.”

As an admin, add a new shift.

“I logged in as an admin this time, and then two new buttons were shown to me on the homepage, this was good design. I clicked the add a shift button and was presented a page with fields for all the shift information. I inserted information and then clicked submit. I was presented with a page that told me the shift was added, which was nice. I went back to the homepage and then the available shifts page, and the shift was there, giving me confirmation.

# 11 Conclusion

The aims and objectives for this report were decided on in the literature review. The aim is to create a web-based application enterprise resource planner with the intent of improving the system of a current business. This was completed through a few objectives. Firstly, research of current online enterprise resource planners. This was done through the literature review, comparisons against other websites, and a survey and questionnaire. Secondly there is the objective of designing the new system. The pages required were planned out one by one based on required features, and the visual design of each was planned. The required database tables were planned, and the server choice was decided. The third objective was to actually make the website, implementing the design. Each page was hand coded in the languages required for each, and each database table was created, and all this was uploaded to the server. The results and evaluation were then the final objective, with each feature and issue being outlined, and a usability lab test, survey, and comparison with other websites completing the evaluation. In completion of these objectives, the aim of the project has surely been met. A new enterprise resource planner has been created, and feedback has been received. Notes have been made on how someone could improve this further if they were to do this project again.

# 12 Recommendation for Further Work

There are recommendations that could be made if someone were to do this project or if it were to be completed again. A new feature that could be added that would improve the functionality would be a replicate shift function. This would allow a user or admin to make a shift repeat for the next week, with the same information as the shift but just one week later, this would add this as a new entry to the database.

A recommendation that would make implementation of the messaging system easier would be to use a google API such as firebase. This solution would allow for sending of pictures over messages, and would utilise googles servers, which is more reliable and secure in comparison to the university server. The server would also be faster. Using a paid dedicated server to host the website would also improve page load times and also improve reliability in comparison to the university server.

Another important feature that could be included to improve the site would be a combination of the businesses current clock in system and the site. The site would have its own clock in page that keeps track of staff attendance. This addition could also include automatic notifications to management when staff are late for instance and could automatically calculate staffs monthly earning for use by employees and management.

If there was more time to complete this project, it would have been beneficial to create an accompanying mobile phone app that would show data when offline.

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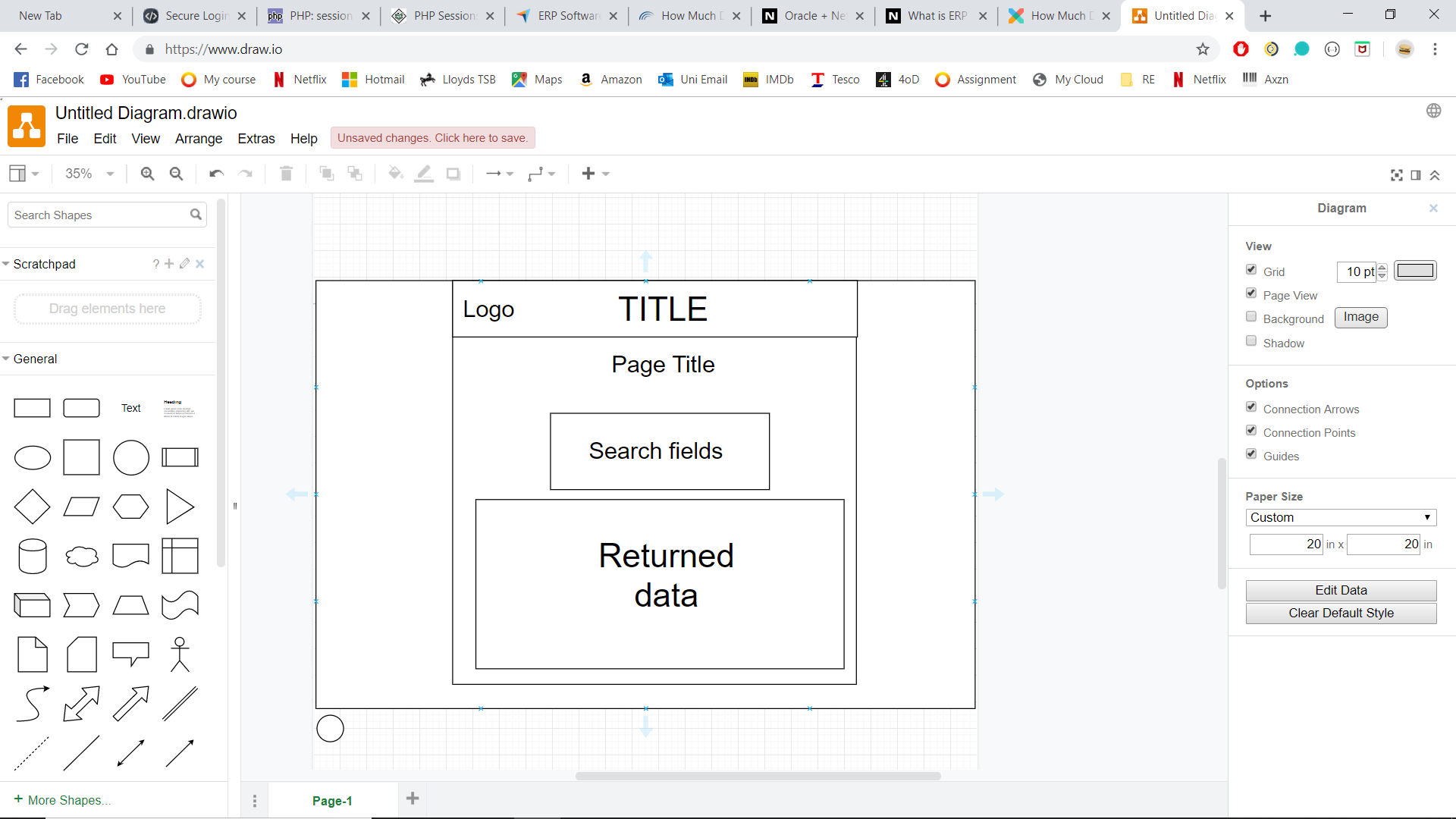
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# 15 Appendices

## 15.1 Gantt Chart

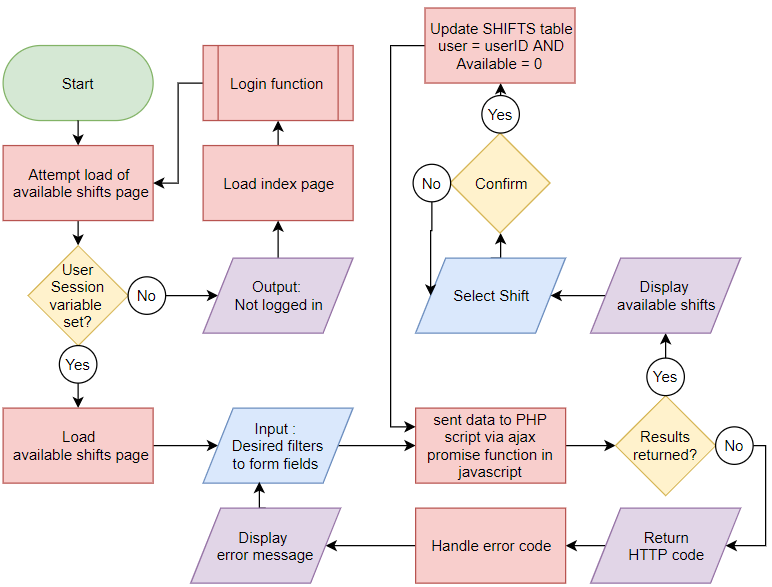
## 15.2 Wire Frame



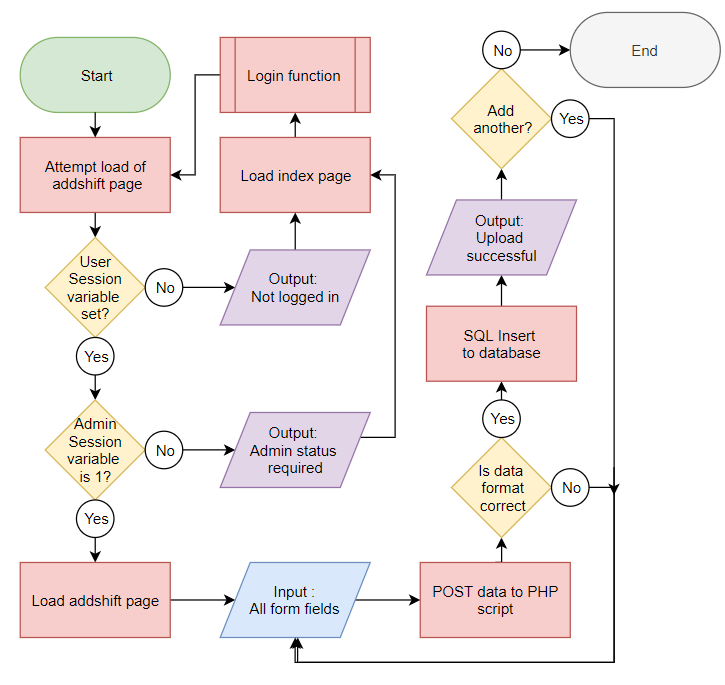
## 15.3 Flow Charts

### 15.3.1 Login

### 15.3.2 Accept a shift

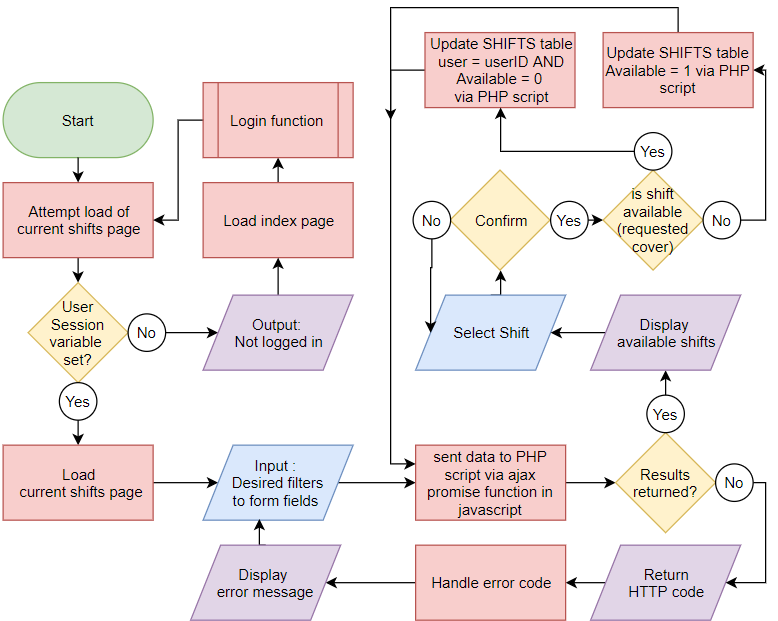


### 15.3.3 Add a shift



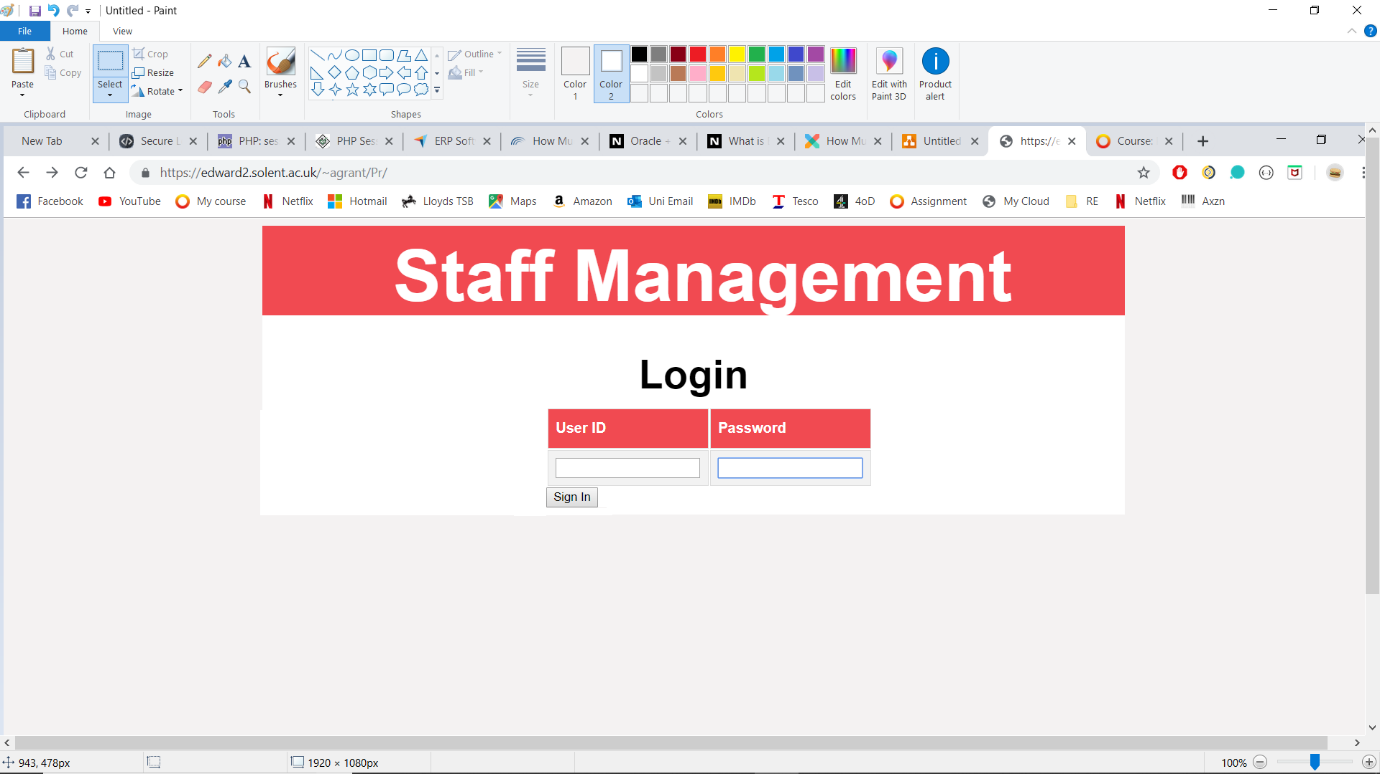
### 15.3.4 All shifts

### 15.3.5 display current shifts

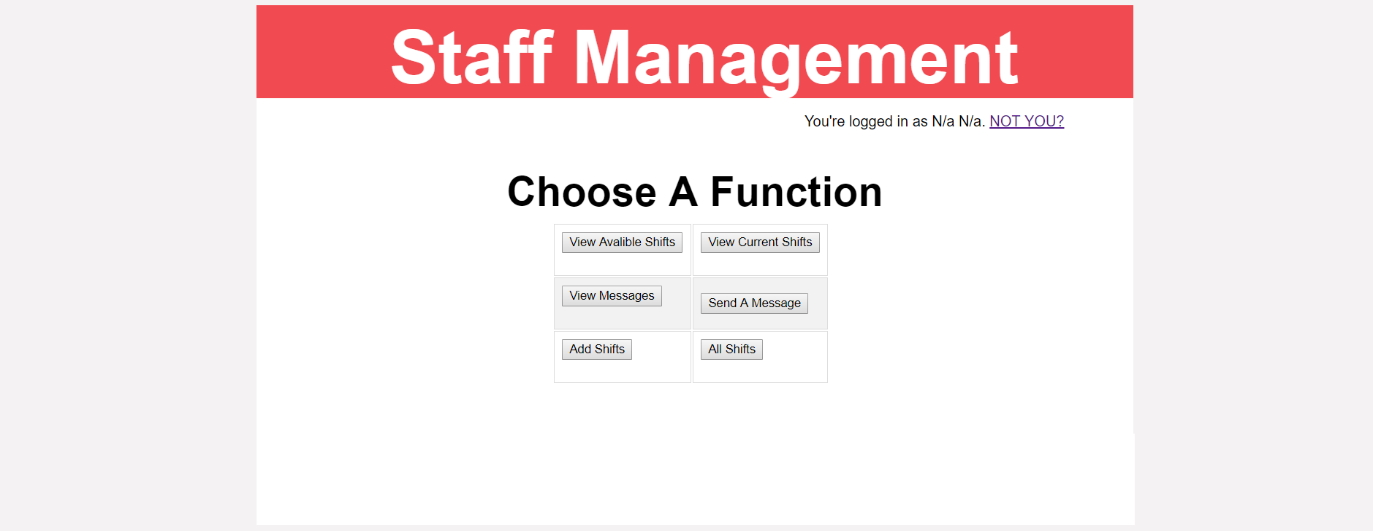


## 15.4 Design Screens

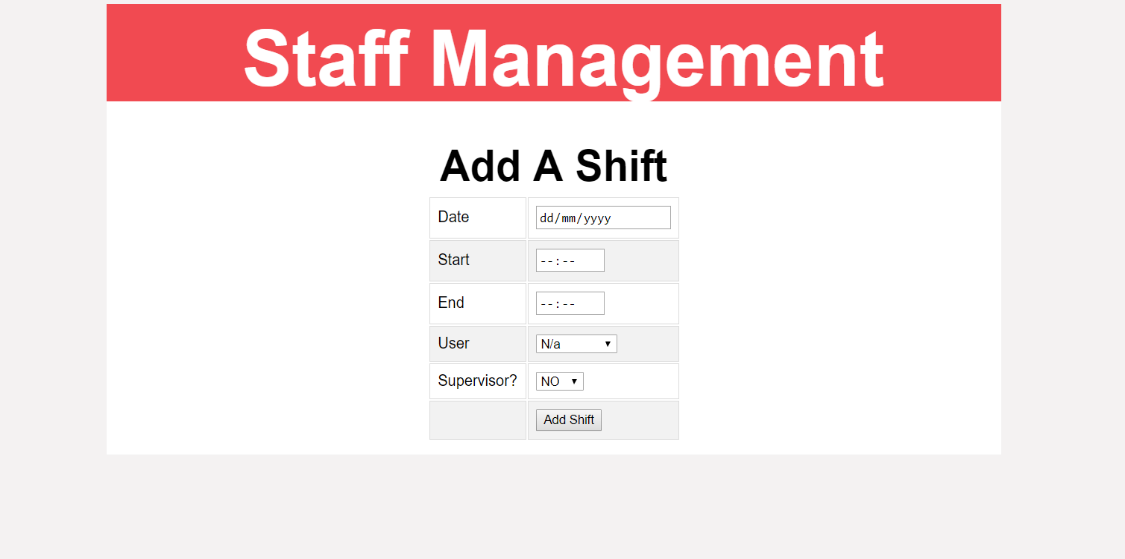
### 15.4.1 Login



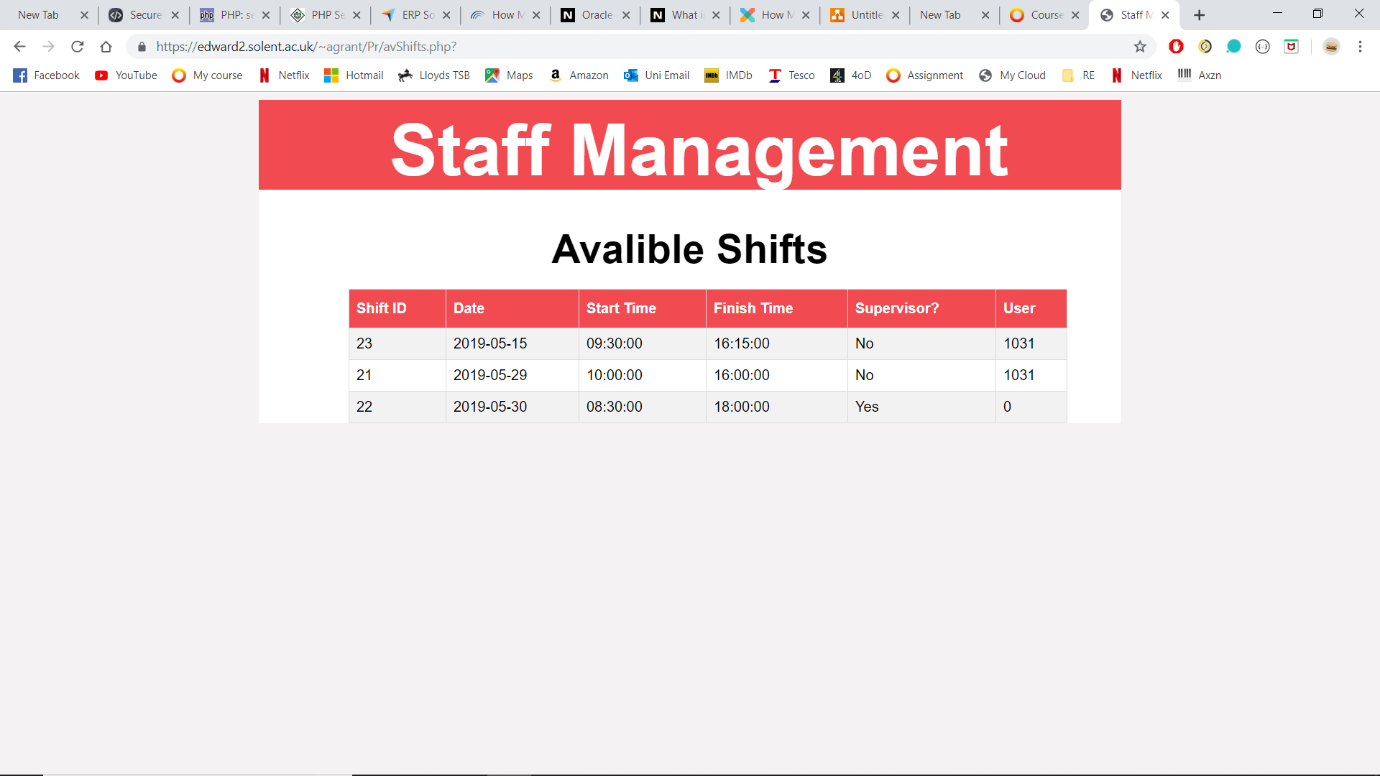
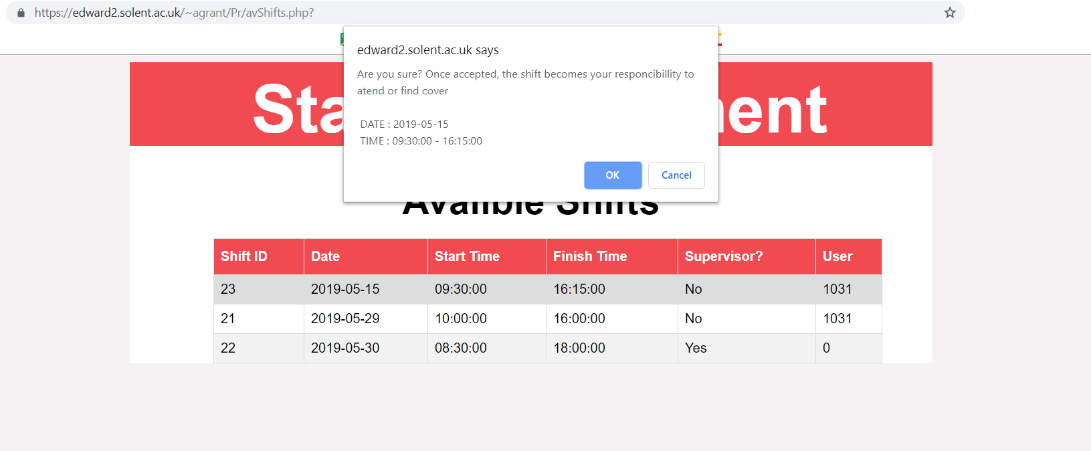
### 15.4.2 Navigation



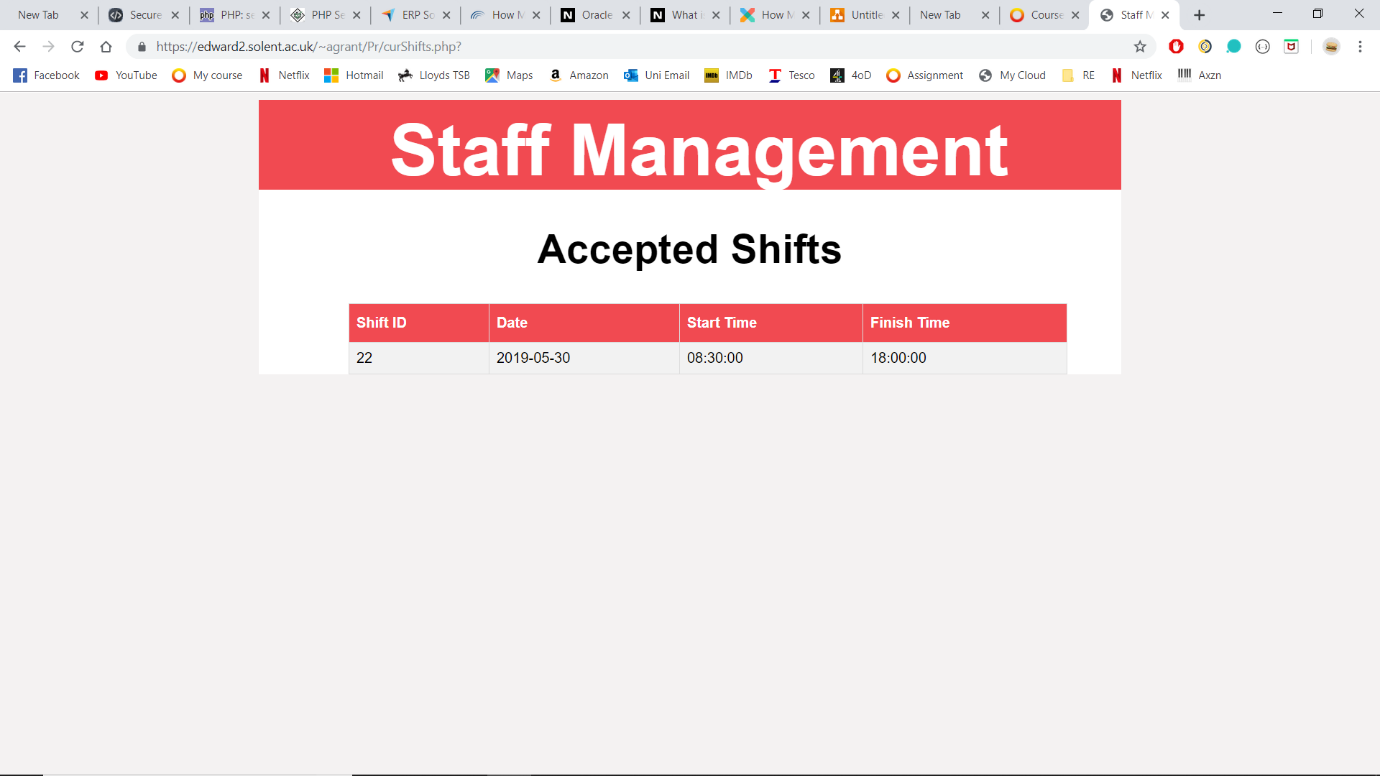
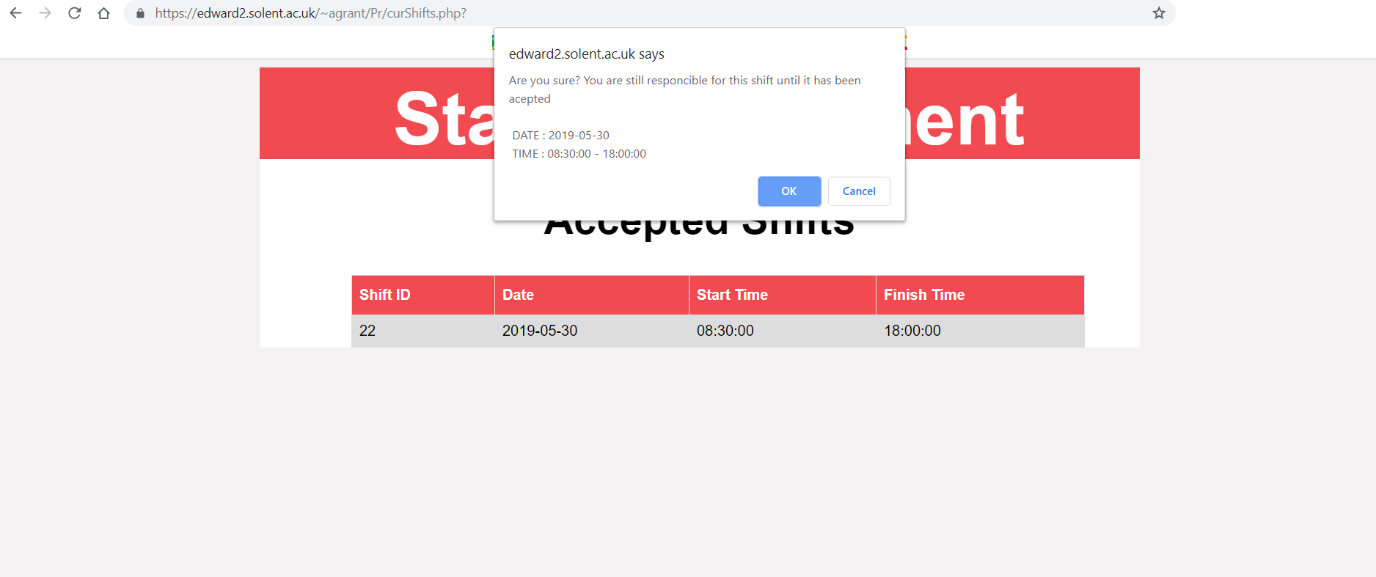
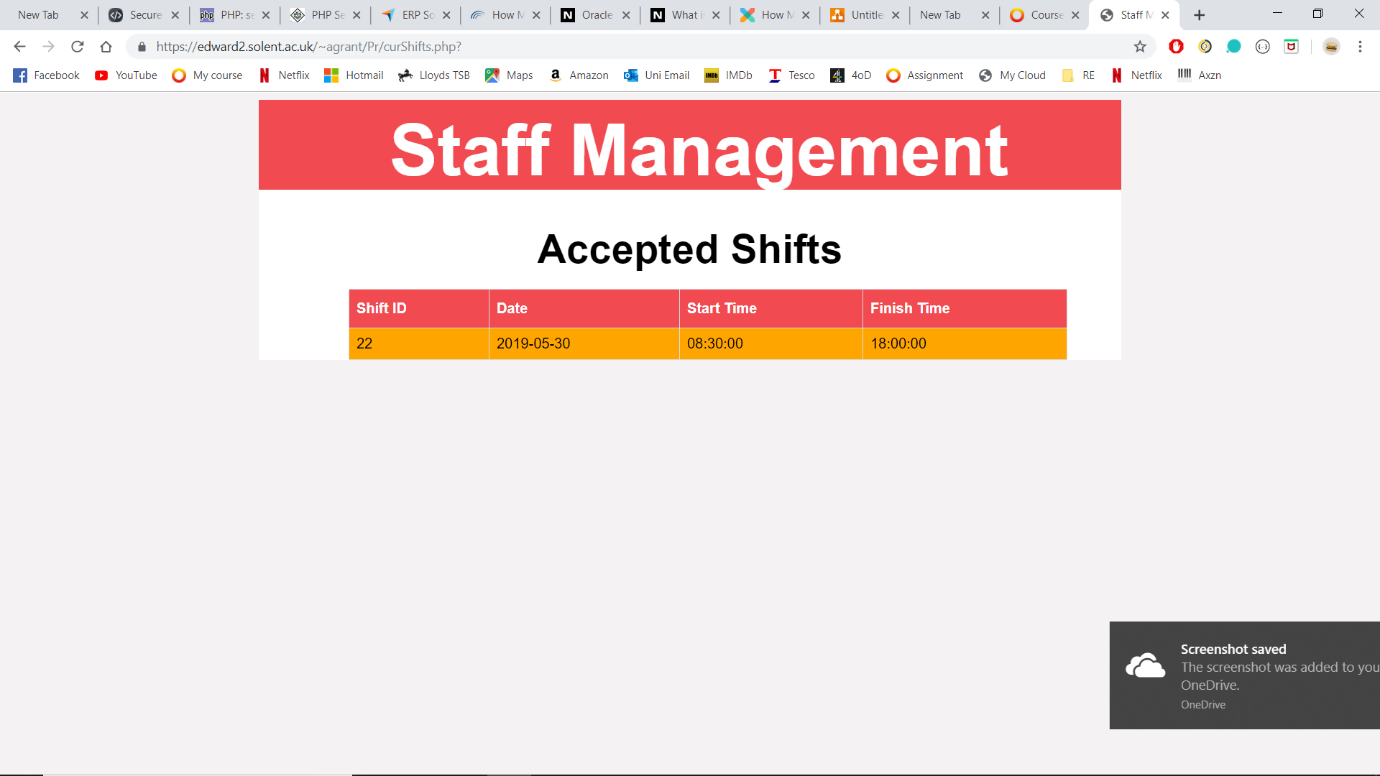
### 15.4.3 Add Shift



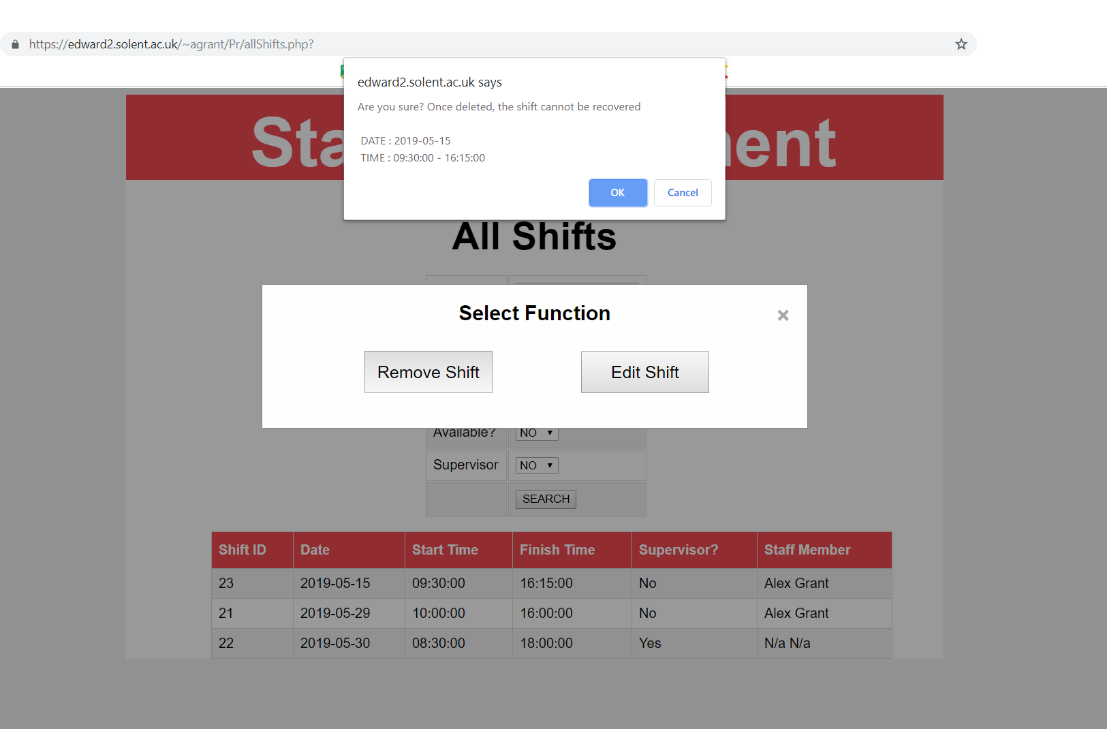
### 15.4.4 Available shifts



### 15.4.5 Accepted Shifts

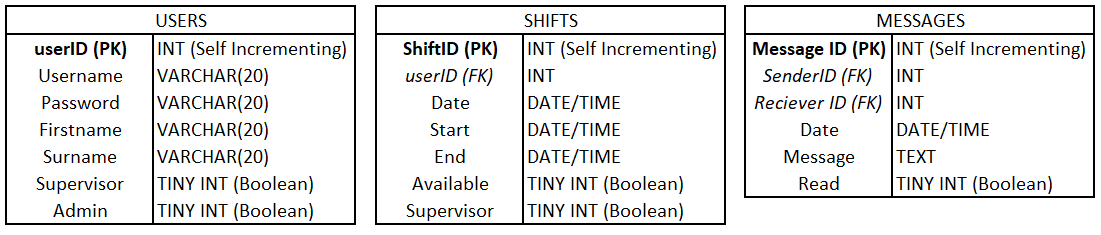


### 15.4.6 All shifts



## 15.5 Database Construction

### 15.5.1 Schema

****

### 15.5.2 SQL

### 15.6. Data Protection

“Everyone responsible for using personal data has to follow strict rules called ‘data protection principles. They must make sure the information is:

* used fairly, lawfully and transparently
* used for specified, explicit purposes
* used in a way that is adequate, relevant and limited to only what is necessary
* accurate and, where necessary, kept up to date
* kept for no longer than is necessary
* handled in a way that ensures appropriate security, including protection against unlawful or unauthorised processing, access, loss, destruction or damage “

(UK GOV,2018)

## 15.7 Site Access and Login

<http://edward2.solent.ac.uk/~agrant/Pr/index.php>

server pass – Username : 2grana91 / PW : 290991

site pass – admin - Username : admin / PW : admin

standard user - Username : emp / PW : emp