### To Investigate effective ways to improve hospital/care-home nurse coordination with the use of a web application.

### Final Year General Computing Project

***A Report submitted in partial fulfilment of the regulations governing the award of Degree of BSc (Honours) Computer Science with Web Development at the University of Northumbria at Newcastle.***

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1. Declaration of Authorship
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HCI definition in relation to my project

What is HCI Heuristics

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1. Introduction

**Project Background**

By examining the aims and objectives of this project a more complete understanding of the project can be achieved.

**Aims of the project**

*“Investigate if hospital/care home alert systems could be improved with the use of a web application in line with smartphone adoption trends.”* This aim addresses the investigative portion of this project, making it necessary to discover how or if the goals of the project could be realised. This will be addressed with the use of extensive research into the target area, as well as a thoroughly designed web-based application.

*“Develop an advanced web service/app to help staff prioritise patient requests in unique hospital and care home settings.”* The project will not only investigate potential solutions, it will aim to design, develop and test a system that addresses the potential problems (see *Potential problems chapter 2.1*).

**Objectives of the project**

*“Perform a literature review of HCI and accessibility for the elderly and disabled, to determine the unique considerations for each group.”* The research conducted will provide the basis for the design of the web application, so it is very important for the project. Key areas will be tackled, such as: HCI methodologies, Heuristic evaluation schemes, the target demographics and their specific needs, e-mental health and medical assistive technology will also be covered.

*“To research relevant information on both staff and patient users to ensure that the application is fit for purpose.“* Research into hospital and care home staff will address this objective. Its importance will be realised in the designing of the functionality within the system. Understanding both may give insight into potential functionality or goals for the project that were overlooked before research began.

*“Gather information from people with experience in care home or hospital environments using a questionnaire. And ask questions about their workflow and current systems in place for patients to alert a member of staff.“* A method for gathering data on the functioning of a hospital or care home will be to ask nurses or staff that have experience within a care home or hospital environment to fill in a questionnaire. This data will determine the necessity of potential application functionality and yield a more accurate representation of the problems associated.

*“Produce high quality design documentation to aid the development of my application. Including wireframes and photoshop mock-ups, as well as technical diagrams to show the movement of data and relationships in the database.”* Aided by the research into staff and patient users and HCI considerations the design documentation will group the concepts and data into a logical plan going forward. Some of the deliverables include: wireframing, use case diagrams, data flow and heuristic evaluation of the GUI designs.

*“Develop an accessible patient call system application interface that is fit for my user demographic. I will use latest trends in design to achieve a visually appealing look.”* The interface design will be of great importance as it will be the only way a user will interact with the system. For many of the user demographics this stage has vital importance for usability and accessibility.

*“Implement a MSQL database for storing data needed by the application.”* The database will be at the core of the development as all data will have to be secure and accessible to the rest of the system, great care will be taken to assure this.

*“Securely connect the front end and database to display relevant information from the database in real time.“* Again this will be realised through meticulous design of components and acknowledgement of security concerns throughout development. AJAX will be utilized with PHP to populate the information to the page in real time.

*“Generate a list of tasks for volunteer test users to perform, testing normal and abnormal use of the application, to ensure it is fit for purpose.”* User testing is in important task in the development of a functioning system. The creation of a comprehensive list of tasks will improve the testing and ensure all of the features are working as intended and bug free.

*“To produce a test plan when performing meticulous product testing, and user testing of my application.”* The user testing will reveal how effective the design of the application for specific demographics has been. By recording the average time to complete tasks and the comprehension when using the application insightful data into how the application can be improved will be attained.

*“Evaluate the final application to determine how it meets my brief, taking into consideration all research and requirements.”* A number of other objectives will be helpful in the evaluation process, for example the user testing will provide a more impartial analysis of how the application meets its brief.

**Project Stages**

1. Analysis

The analysis will comprise of three chapters: identifying the problem, which will address the issues concerns that will arise throughout the project and the problems the software solution will have to address. A literature review will be performed to understand necessary aspects of the scope of the project. Finally the software implementation section will cover research into scalability specific to the software implementation and justification for the project.

* 1. The Problem

The project as covered in the aims section of the introduction will have to overcome a number of issues, ranging from universal usability, technology and consideration of concerns with current healthcare. This section will provide a clear perspective of how the project will strive to overcome the problems.

**Universal Usability**

There are a number of demographics to consider. The vast majority will need no further accommodation to use the application, such as young healthy adults. However there are many that may need additional or specialised help when the problem is investigated. In particular: Elderly, disabled and non-Native speakers will likely require additional consideration.

Disabled users may require additional assistance. A disability is described as a physical or mental problem which interferes with the function of an individual’s participation in an activity. Disability can affect the experiences of an individual greatly. The experiences often depend on a number of aspects: Health conditions as well as personal and environmental Factors. Disability can be analysed in a number of ways; however the purpose of analysis disability will be separated into four categories: Visual, Auditory, Motor impairment and Cognitive impairment. (World Health Organization, 2011) These have been selected as the primary considerations.

**Visual disabilities**

Blindness concerns the loss or partial loss of sight. Screen readers are the only means of allowing a blind person to see what is on the screen. However, this brings limitations such as comprehension of images used. To combat this issue alternate text should be provided allowing comprehension of the page to the user.

Low vision describes the partial loss or reduced capabilities of eyesight. Often affecting reading and colour differentiation. To accommodate for this large text should be used in combination with highly contrasting colours.

Colour blindness can cause problems distinguishing or seeing colours. The most popular being red-green colour blindness, preventing people from differentiating between them. To adapt for this high contrast modes or black and white modes can be used in applications, although not widely considered.

**Auditory disabilities**

Deafness can affect people in a number of ways. From minor such as tinnitus, to full deafness whereby the ear is not functional. Speech can be hard to distinguish therefore visual aids are essential. Such as text on screen or subtitles.

**Motor impairment**

Can be from the mild, slowing the behaviour of a person, to severe. Potentially an Inability to move at all. Many aids exist to make activities more accessible, for instance voice recognition can allow the control of a system by means of the voice alone. Text entry aids also work to make keystrokes more concise for the writing of words or sentences with a single key press.

**Cognitive impairment**

Affecting the memory concentrating and learning. The symptoms include reasoning skills, perception, judgement and memory. People with dementia for example may struggle to concentrate on tasks and show significant loss in short/long-term memory. To aid users with minimal cognitive impairment image aids such as icons can be used, as well as clear on-screen instructions that serve to remind the user.

The elderly, although not exclusively considered disabled, suffer a range of degenerative impacts associated with aging. Eyesight and hearing can be affected greatly. Colour processing tends to decline with age, at 60-70 colour discrimination drops to 76 percent and between 80-90 it further drops to 56 percent (Congdon, N, 2004). Vision degeneration also affects the ability to focus on static and moving objects of varying distances. This can become a huge challenge for the elderly particularly when paired with hearing loss. As people age the range of frequencies that can be heard diminish, making it much harder to perceive sounds and speech effectively. A number of aids are available for the degenerative effects of aging; hearing aids to amplify the sounds, glasses to help with focusing of distant or close objects. However the reduction of colour vision cannot be improved with personal aids, therefore consideration must be made to use highly contrasting colours for improved readability.

Non-native English speakers …

Although not all issues can be addressed throughout this project select issues can be aided (see design section). Any attempt to combat issues within public environments must recognise these considerations as the demographics discussed make up a large quantity of hospital and care home patients. Failure to consider these groups could be viewed as discriminating against these groups.

**Problems with HCI Heuristic evaluation**

Developing applications with HCI in mind there is a huge number of differing ‘rules’ to follow to generate inclusive and usable software. However HCI literature often struggles to bridge the gap between research and practice effectively. This problem occurs as the researchers are not aware of the context that the literature will be used. For example it may be used in sales, or marketing or for use in hospital software. This can make it difficult to present guidelines for a specific project, and successfully find guidance on specific HCI needs. These issues will be further addressed in the literature review (section 2.2) to try and discover the best rules to follow in the development of the project.

Data Visualization

**Concerns with current healthcare**

Understaffing, Funding, Patient wait times, Staff availability

Staff Harassment

* 1. Literature Review

This literature review will look into the current research into general HCI considerations and methodologies as well as more specialised HCI aspects in relation to target demographics of the application. Each of the HCI concepts will be explored and the value for use in the app considered.

**HCI Methodologies**

Many HCI researchers have proposed rules to follow when building a system with human interaction, such as: prevention of errors, Universal usability and simplistic design of interaction. These principles are based on HCI research and give system designers an array of useful heuristics to prevent user interface errors and usability problems. Many heuristic tables exist with varying rules/attributes mirroring human psychology and intuition (Dix, 2003); *Nielsen’s ten usability heuristics* (Nielsen, 1994) is a common methodology and *Schneiderman’s golden rules* (Shneiderman, 1998) are often cited. However each of the tables have shortcomings and advantages associated, discussed below.

Nielsen’s ten usability heuristics is particularly useful due to its high-level approach. It particularly stands out as it reinforces the significance of using documentation and help for the user as they navigate the system. Help guides and documentation can be particularly useful for elderly users, elderly users that have access to visual training can even result in better or comparable results to young users (Mykityshyn, Fisk and Rogers, 2002) This should not be neglected when considering this approach.

Schneiderman’s golden rules present a shorter list of underlying design principles than other heuristic evaluation methods, making it more concise. This approach is considered to have an advantage over many methods as it considers the use of ‘dialogs’ to guide the user through the system. Schneiderman provides guidance in utilizing dialogs in the system design providing designers with the tools to make more useable systems. (Shneiderman, 1998) Where this differs from documentation or help is the use of the dialogs. Dialogs do not serve to supplement the content; it is the content of the system. For example a button with a concise description of its function.

In *First Principles of Interface Design* (Tognazzini, 2003), Tognazzini Indicates 16 principles and claims they are “fundamental” in the design and implementations of systems. Tognazzini particularly addresses colour-blindness stating that secondary cues to convey the information are important when using colour to covey a message. An example of this would be a UK pedestrian crossing, the green man is also in a walking position as a fallback to those that may not perceive the green colour. However the 16 principles are lacking in description when it comes to implementation of these principles in a system.

To benefit from the many differing heuristic evaluation schemes a multiple heuristics evaluation table (MHET) has been created (Wheeler Atkinson, Bennett, Bahr and Walwanis Nelson, 2007). This combined approach takes the most common elements and creates a more inclusive list (see *figure 1 below*).

*Figure 1* – MHET Heuristic Scheme

|  |  |
| --- | --- |
| **MHET Heuristic** | **Description of Heuristic** |
| Software User Interaction | Providing the user with necessary information for interaction. Combining overlapping concepts: “Visibility of system status” (Nielsen, 1994), “Offer informative feedback and Design dialogs to yield closure” (Shneiderman, 1998). |
| Learnability | Training tools and learning aids within the system. Making the system easy and intuitive to learn. |
| Cognition Facilitation | Reducing the cognitive load on the user, combining multiple heuristics such as: “Recognition rather than recall” (Nielsen, 1994) and “reduce short term memory load“ (Shneiderman, 1998). |
| User Control & Flexibility | Creating software that responds flexibly to user actions. “flexibility and efficiency of use” (Nielsen, 1994). Shortcut keys, toolbar icons and other interaction controls. |
| System Real-World Match | Matching the system with the real world, elements such as shopping carts/baskets in a store for example. “match between system and the real world” (Nielsen, 1994). |
| Graphic Design | Defining the quality of design in a system through “Graphical integrity, Multifunctioning graphical elements, Colours and Increasing data comprehension, fitts’ law” (Tognazzini, 2003). |
| Navigation & Exiting | Concept of easy navigation within a system and intuitive reversal of accidental actions. “User control and freedom” (Nielsen, 1994) “Permit easy reversal of actions” (Shneiderman, 1998) “Explorable interfaces and visible navigation” (Tognazzini, 2003). |
| Consistency | Consistent terminology, GUI elements throughout the system. “Should not use multiple words to describe the same function” (Nielsen, 1994). |
| Defaults | Referring to placeholder or default content in input fields to prompt the user to set their own information. “Defaults should be easy to change or delete” (Tognazzini, 2003). |
| System-Software Interaction | How effectively the system can use and present the status of the use of resources on the computer. For example: “reasonable  speed of processing” or “Latency reduction” (Tognazzini, 2003) and “Visibility of system status” (Nielsen, 1994) such as loading screens and status of the process. |
| Help & Documentation | The importance of help files and documentation as well as on screen assistance or prompts without straining the user. (Nielsen, 1994) (Tognazzini, 2003). |
| Error Management | The ability to aid users in noticing, understanding and recovering from errors in the system (Nielsen, 1994) (Tognazzini, 2003) (Shneiderman, 1998). |

**Universal Usability in HCI**

Universal usability is a core aspect of medical assistive systems as the demographics that it caters for are often more challenging for some Heuristic evaluation schemes. The 12 MHET design heuristics (*figure 1.0)* provides an encompassing methodology for system HCI design. However it fails to cover universal usability and accessibility inclusively.

Simplistic interaction design is increasingly important for universal usability when the user demographics may be elderly or disabled. Simplicity is often hard to achieve as functionality cannot be compromised within the system, but an overwhelming number of options can lead to confusion. Ed Chi a computer science researcher at Google discovered that users tend to have a bias towards seeing what they want to see for a particular goal (Nielsen Norman Group. 2020). This phenomena is named “information scent”, this can be used to aid users on a simplified path through the system to the goal. By braking up a large list of functions into category pages and allowing navigation led by the information scent the user can more efficiently navigate without indecision or hesitation.

Bigger buttons are better. Fitts' Law included as one of the 16 principles in *First Principles of Interface Design* (Tognazzini, 2003) was published in 1954. Fitts’ law states that the time required to move to a target for example a button depends on the distance to the target. However, inversely relates to the size of the button. This means that larger target areas of interaction will speed up the comprehension and the smaller the target the longer it will take (Fitts, 1954). Although widely accepted in HCI and UI design it is often overlooked. Fitts law is a very important factor for the elderly due to common vision impairments in this demographic, further making it a necessity to use larger buttons.

HCI and e‐mental health

Diabetes blood glucose logging/analysis

Data Visualization

<https://www.researchgate.net/post/How_to_combine_HCI_and_Data_Visualization>

**Potential Solutions**

Medical assistive technology

**Research to read**

Development of Open Platform Based Adaptive HCI Concepts for Elderly Users

<https://link.springer.com/chapter/10.1007/978-3-642-02710-9_76>

Prototyping a Touch-based Communication Application for Social Support of the Elderly focusing on UI Aspects

<https://www.politesi.polimi.it/handle/10589/89925>

Combining e‐mental health intervention development with human computer interaction (HCI) design

<https://onlinelibrary.wiley.com/doi/full/10.1111/inm.12527>

* 1. Software Implementation

Introduction

**Development Rationale**

**Scalability**

**Survey Results**

1. Synthesis

The synthesis will consist of three chapters, Design, Implementation and Testing. And will discuss the work carried out to develop the application from a conceptual idea into a working tested outcome.

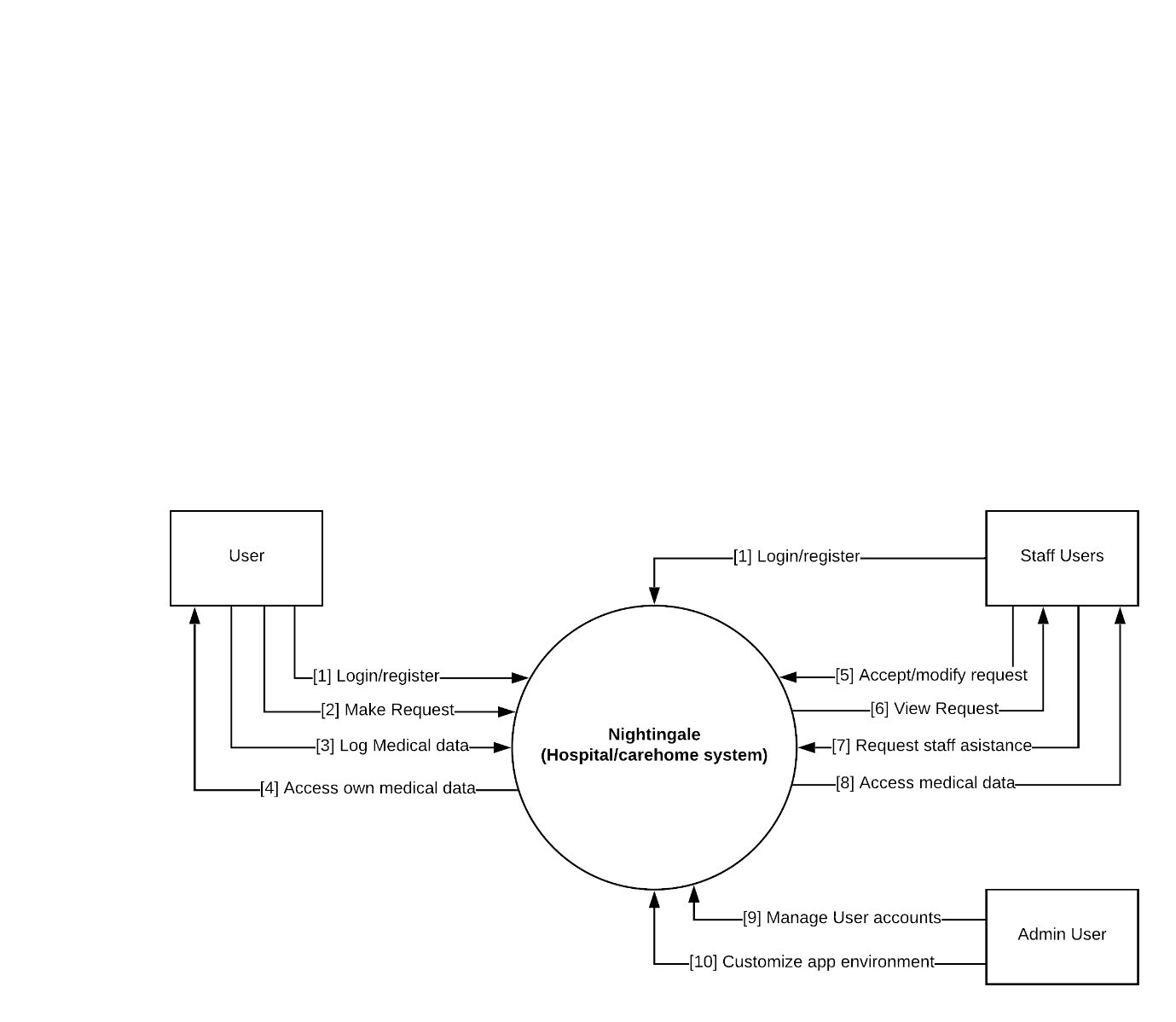
* 1. Design

The process of designing the application was achieved using a variety of methods. Initially the design was simplistic, and research was carried out to understand exactly the goals of the system and its place within the environment it would be used. The research identified the key considerations (see chapter 2.1) and from this a plan and concept of the program could be derived. Three key areas were considered: System design, Interface/user experience design and the vital features and functionality to be included in the application were derived. This chapter will break down the design elements in appendix (section B) and supplement the diagrams and designs.

**Features and functionality**

The chosen features and functionality to be included in the application were considered when researching the problem the application aims to tackle. The features can be broken down into three categories: ‘staff user’ features, ‘user’ features and ‘admin’ features.

*figure 2 – Context Data Flow Diagram*

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The context diagram above shows how the features and functionality will aid the interaction with each of the entities and the system (or Nightingale) as a whole. Each of the numbered subsystems have been broken down and explained, the design of each has been supported with the use of a UML diagram as this is a better representation of user interaction than DFD’s.

1. Login/Register functionality (*figure 2.1 appendix*) will provide a secure login for staff users and users alike. This will be essential for security and individual accounts to differentiate between users.
2. Make request (*figure 2.2 appendix*) will be the main user feature in the application and will allow a user to make a specific request that the staff users can then respond to. The requests will provide data, such as the user concern and urgency of assistance necessary.
3. Log medical data (*figure 2.3 appendix*) is another user feature that will allow the user to log their mood and blood glucose level themselves. This data will be accessible to users and staff users.
4. Access own medical data (*figure 2.4 appendix*) will be used by the user to see the personal data that they logged. A user will only be able to view their own data for security reasons.
5. Accept/Modify request (*figure 2.5 appendix*) is a staff user functionality and will only be available to staff users. It will allow a staff user to handle a user request, by accepting and completing the request via the GUI the staff users can manage patients/residents more effectively.
6. View request (*figure 2.6 appendix*) Staff users must be able to view all non-completed requests in a logical and helpful manner, allowing a staff user to choose specific requests to complete as a priority.
7. Request staff assistance (*figure 2.7 appendix*) Staff users have a feature to safeguard themselves from danger or request assistance from other staff members directly through the app. The staff assistance feature will be in a prominent position in case of emergency.
8. Access medical data (*figure 2.8 appendix*) Staff members will have access to all patients medical data that has been submitted by a user, allowing quick access for diagnostic purposes.
9. Manage user accounts (*figure 2.9 appendix*) This admin functionality is intended for changing of staff users passwords and viewing/deleting user and staff user accounts.
10. Customize app environment (*figure 2.10 appendix*) This will only be available to admin accounts and will allow changes to the user GUI such as, adding and removing types of requests for more customizable functionality. This is important for different types of environments; a care home environment will have very different needs to a hospital or dental practice.

**System Design**

The system needed to be compatible with any mobile device or computer to enable users to have unhindered access, without the need to install third party applications on the device. Updates can be added to a web application without the user having to update through the apple or google store. Additionally no approval from an app store is needed allowing fast deployment. On the other hand native applications have the ability to harness the device capabilities such as camera and access to the photo gallery, which for some projects is a necessity. Considering the specific features planned a web browser-based application is the chosen route of development. The project would use latest methods such as a LAMP stack using apache, MySQL and PHP as the primary languages for development.

Why LAMP …. PHP etc. Systems within the application

AWS scalability

**Interface / HCI design**

The design of the user experience is one of the underpinning considerations throughout the project. Interface design is another important element of the application as it has to assure that it is universally accessible, and anyone can use it intuitively. To achieve these goals consideration of HCI heuristic design was another factor throughout the design process taking elements from a number of popular approaches such as; *Schneiderman’s golden rules* (Shneiderman, 1998), *Nielsen’s ten usability heuristics* (Nielsen, 1994) and utilizing greatly the *Multiple Heuristic Evaluation Table* or MHET (Wheeler Atkinson, Bennett, Bahr and Walwanis Nelson, 2007).

The elderly were considered in the design process extensively

To aid consistency within the web application primarily one font with minimal style variations will be used, this will make the application more cohesive. The primary font chosen is a sans serif, modern and clean font named “Montserrat”. Often boasted on many top 10 lists on the internet as an exceptionally readable font (Medium, 2020). Font readability is a key consideration for the application as users will be of many demographics, meaning people of all ages primarily the elderly cannot be overlooked during design. For this reason font size will be considered throughout to aid people with low vision and to make links easier to click according to fitts’ law (fitts’ 1954). The only variation from the main font is the logo as it needed to stand out as the brand identity. The logo font has a more sophisticated and professional look but is still very readable.

*Calistoga Regular (Logo Font only)*

*Montserrat Bold (Heading and Paragraph text)*

*Montserrat regular (Some Paragraph text)*

The chosen colour styles were selected with universal usability in mind, similar to the use of motorway signs high contrast between the background and the text was utilised. The chosen colour palette is simple

Explain colours

**MHET Considerations**

The 12 MHET elements from the “MHET heuristic scheme” (see section 2.2 *Figure 1*) were used to break the problem into manageable deliverables; allowing each to be considered throughout the design process.

*Software User Interaction:* This is important throughout the system for a number of reasons. Staff users using the system may have to find the relevant patient information quickly, so that they can respond to a request in a timely manner. They may also require easy access to the current status of requests within the system. Users should understand the status of their request e.g. has their request been received or accepted by a staff user. The system should allow both parties to be aware of the system status via clear on-screen dialogs.

*Learnability:* The system should be intuitive to all users at all levels. By taking inspiration from a number of popular applications it will have a familiar feel. A simplified design will ensure that a user can access all information from a low number of pages therefore increasing the learnability of the system.

*Cognition Facilitation:* The system will rely on intuitive labelling of buttons with the use of icons and unique colours so that the users and staff users can easily identify vital information based on “recognition rather than recall” (Nielsen, 1994). For example, the icons on the requests found on the staff dashboard (see *figure 1.7* – high fidelity design) will have identifying colours and icons allowing the information to be recognisable at a glance. Requests that have been accepted will be easily accessible so that the staff user can revisit the information (room numbers, request info etc.), reducing cognitive burden.

Not all information shown some hidden

*User Control & Flexibility:* User control will be considered throughout, therefore minimising the number of onscreen clicks. This will simplify the process, especially for staff users that are working within time restraints. Again the use of icons and descriptive buttons will aid user control effectively.

Navigation

*System Real-World Match:* The system will be handing a real-world problem and must convey the real-world aspects successfully. This will be addressed on the user and staff ends of the system. When a user has requested assistance, they will be reassured that their request is being handled. For the staff user, the location of patients will be included to create a link to the real world that is very tangible, and requests will have semantic meaning cementing the idea of real-world impact.

*Graphic Design:* Quality designs will be created throughout ensuring readability of dialog and clarity of style. Research on elderly and design how I considered in my design. This will ensure that the system is useable for all demographics aforementioned. Colours were another aspect of this heuristic as consideration of colour blindness and low vision were vital for the goals of the system. Research into colour-blindness and how it influenced design. figure 1.3

*Navigation & Exiting:* The visibility of navigation elements is important on the dashboard pages and the active page should be recognised by the user/staff user. Again exiting is an important consideration, back buttons should be logical and visible where necessary. After an operation is confirmed, such as a staff user accepting a request, the operation should be reversible in case of human error. Undo buttons will be present after actions to ensure reversibility.

*Consistency:* Graphical user interfaces (GUI’s) will be designed to have consistency with not only general system trends but will have its own conventions. A house style for fonts, icons, logos, colours and dialog will be coherent throughout providing an experience that will flow more fluidly for end users. Research why consistency Is important!

*Defaults:* Default content will be used for the login and registering of a user account. Utilising placeholder text in forms to instruct the user what information is necessary in each input field. E.g. a name input field may say “first name” and when the user clicks into the field, they can type the first name without deleting the placeholder text. Checkboxes may also be used with default presets that the user can change if required. This will be considered within the login/register system. The forms will have default values to aid the user (see *figure 1.4* high fidelity design).

Validation

*System-Software Interaction:* The system status should always be visible to a user. A user waiting for a request to be handled, entering blood glucose data or completing an evaluation should be aware of the current system state. When a user is waiting for a request they must know with the use of dialogs and onscreen aids that it is occurring (e.g. a message that their request has been accepted and that they should wait for a member of staff). When blood glucose data is being viewed by a user it may take time to plot the data to a graph. Therefore loading times should be apparent to the end user. Finally when the user is completing a patient evaluation it is useful for them to understand their progress through the forms and pages involved. Research advantages of progress bars/ loading screens.

*Help & Documentation:* Will be implemented into the system throughout by providing end users with adequate support in using the application effectively. The user will be guided through a tutorial section on account creation, showing the most basic functionality. Tooltips and dialogs will be provided throughout using the application to ensure that users that may need more help can gain an understanding. This will be achieved using non-technical text and graphics.

*Error Management:* Will be used throughout. If a fatal error occurs in the system, the user must be prompted with an error message. Error messages must be polite and logical to the average user. For example a message such as “I’m sorry something went wrong there” will be presented, accompanied by a button to retry or go back to the previous screen. Each error must be helpful to the current operation within the system and allow the user to return to the application.

**Database Design**

Diagram and Data Dictionary

* 1. Implementation

The system being developed will be a web-based system, comprised of three main components: web-based database, front end or graphical interface and a back end to handle requests and communicate with the database. The system will run on a cloud computing instance to provide adequate security, reliability and future scalability.

**Language/Technology Choice**

*Database:* For the database MySQL will be utilized effectively to create the construct that data will be stored within. Used in the tech stacks of Uber, Airbnb and Amazon shows its impressive scalability (Mysql.com). MySQL will be used as it can handle Data security successfully combined with its high performance and flexibility it was the clear choice for a web application. Additionally it can be used to naturally with PHP to develop the functionality of the application.

How the database is configured – database setup SQL and adding sample information

*GUI/Front end:* This will be developed using HTML and JavaScript to supplement the front-end functionality and usability. The front-end languages will be used in compliance with the w3 standards and will aim to be written semantically making use of HTML5 tags. CSS will be used to style the webpage and provide CSS based transitions/animations.

Use of frameworks/ plugins for front-end

*Back end:*

*Cloud Server Implementation:*

**Coding Standards**

**Code Concepts**

**Database and Security**

* 1. Testing

**Development Testing**

Error handling within the application (table)

**User Testing**

**Evaluation**

1. Evaluations and Conclusions

**Achievements**

**How survey results impacted my design**

**Future Direction**

AI and mathematics for glucose level prediction

<https://link.springer.com/article/10.1007/s41666-019-00059-y>

<https://www.hindawi.com/journals/jhe/2019/8605206/>

**Considerations**

**Conclusions**

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1. Appendices 
   1. Terms of Reference

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KV6003 : Individual Computing Project

### Project Terms of Reference

Jake Southward : w15024065 Computer Science with Web

Supervisor: Yilun Shang

Second marker: Kamlesh Mistry

General Computing Project

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1. Project Title

***Investigate the effective ways to improve hospital/ care-home nurse coordination with the use of a web application.***

1. Background to Project

I have chosen to investigate how medical / care home settings can use modern technology to aid the elderly and hospital patients. Primarily looking at call systems for staff to respond in a timely manner to an incident. A study across 36 hospitals identified three key targets for improving the efficiency of nursing time management: “documentation, medication administration, and care coordination.” (Hendrich, 2008). For my project I will be undertaking the development of a web-based system that will attempt to combat the issue of care coordination in a suitable way.

Nurses spend an average of only 31% of their time with patients and some studies suggest greater use of computers may reduce time spent on non-essential nursing functions. (Hendrickson, Doddato and Kovner, 1990) Undoubtably the use of technology has improved since 1990, however a more recent study (Bagheri Lankarani, 2019) focusing on care coordination and wasted time outlined the need for hospital information systems that can analyse the workload. One of the study’s reason for wasted time was the hospital information systems, showing this trend towards better use of technology is still relevant.

The proposed project is of interest as in the UK there is severe strain on the National Health Service and its resources. Since 1997 the number of nurses leaving the profession has outstripped the number of entrants (B Finlayson, 2002). Leaving less nurses to handle more patients, resulting in less time spent with patients.

This project aims to research and develop a web-based application that could combat the strain on health services by taking advantage of the devices most people already own. Throughout the project it will push me to use everything I know and to learn new things to develop a working product that can be accessible and easy to use for my target audience (staff and people in care). I additionally will explore how my solution could be scaled and configured to a larger user base and used in multiple settings.

The requirement for design is even more specific when creating a system for less traditional or diverse users. The natural process of aging comes with an array of degenerative ability concerns, including visual problems, hearing loss, motor skills may be impaired, and the retention of memory may affect the operation of a new application. Despite these concerns the statistics seem to show an unexpected trend. From 2012 to 2015 elderly (65+) smartphone users have almost doubled in the UK (A Berenguer, 2017). This indicates that as we move into a more technology driven world, more and more elderly people and patients in hospitals will have access smartphones / tablets.

The design of applications for diverse users, such as the elderly or impaired is very important, however the method of training to use the application could be just as vital for specific users. A study (Mykityshyn, Fisk and Rogers, 2002) showed that older participants struggled to retain the training for a home medical device when compared to a younger age group. Additionally when the elderly users were given video training rather than a manual they performed almost as well as the younger age group at retaining the ability to use the device. This shows how a visual tutorial has a greater impact for specific user demographics than plain text manuals.

1. Proposed Work

I will perform necessary research and develop a web-based application/ service that would allow a user to request assistance from a member of staff expanding the existing call system in care homes and hospitals. Where my idea improves on current systems is the request would be made using an application on a smartphone/ tablet and the staff using the same application would be able to see any current requests. This would allow staff with the use of the app to prioritise care and easily see all current requests and how they are being handled in the palm of their hand. Additional optional information could also be sent with the request, for example one patient may be experiencing extreme pain whereas another may have a question for a member of staff, with the system I plan to develop brief information will be available for the staff allowing specific prioritisation as each request happens.

One of the first tasks will involve a questionnaire that will aid the design process. The questionnaire will be targeted at the staff that will be using the web application. This will be crucial in determining the specific functionality of the application as it will be an insight into how the nurses work, but crucially how they can work better with my application.

My literature review will address necessary aspects of the workflow of a nurse to ensure the application is fit for purpose. Furthermore I will need to research the potential issues that may arise when developing an application for the elderly and disabled, for example accessibility and user experience design.

I will generate extensive design documentation that will guide me through the development of the application, giving me specific requirements when programming the front end. During the development of my web-based application I will be using the most relevant methods to achieve my goals. I will be developing the front end of my application using HTML, JavaScript and CSS as I would like to consider multiple browsers and compatibility with devices. My application must be accessible on all screen sizes to encourage easy use for my target demographics.

I will make use of a MySQL web-based database to securely store and access relevant data. In conjunction with the database PHP will be used to deliver the content to the user and encrypt sensitive information to and from the database. Security will be a key aspect of the system as it will be dealing with potentially sensitive data; I will need to overcome this throughout the project.

When the application is at a level where functionality is useable, testing will be very important. Regular testing will help guide any changes as I approach the end of development, this should eradicate any problems that have been overlooked during the design phase. User testing will tie all of the testing together giving a more real world look at how people use my application with very little instruction. My application should be intuitive enough for people to make requests and respond to requests without formal training. So as I develop, I will be thinking of tasks that could be user tested.

1. Aims of Project
   1. Investigate if hospital/care home alert systems could be improved with the use of a web application in line with smartphone adoption trends.
   2. Develop an advanced web service/app to help staff prioritise patient requests in unique hospital and care home settings.
2. Objectives
3. Perform a literature review of HCI and accessibility for the elderly and disabled, to determine the unique considerations for each group.
4. To research relevant information on both staff and patient users to ensure that the application is fit for purpose.
5. Gather information from people with experience in care home or hospital environments using a questionnaire. And ask questions about their workflow and current systems in place for patients to alert a member of staff.
6. Produce high quality design documentation to aid the development of my application. Including wireframes and photoshop mock-ups, as well as technical diagrams to show the movement of data and relationships in the database.
7. Develop an accessible patient call system application interface that is fit for my user demographic. I will use latest trends in design to achieve a visually appealing look.
8. Implement a MSQL database for storing data needed by the application.
9. Securely connect the front end and database to display relevant information from the database in real time.
10. Generate a list of tasks for volunteer test users to perform, testing normal and abnormal use of the application, to ensure it is fit for purpose.
11. To produce a test plan when performing meticulous product testing, and user testing of my application.
12. Evaluate the final application to determine how it meets my brief, taking into consideration all research and requirements.
13. Skills

Throughout the project I will need to rely on many of my skills, many that I have gained from university study and personal development outside of study. Also I may have to build on my skills. Below is a table of the expected skills in this project.

|  |  |
| --- | --- |
| **Skill** | **Acquired / Will Acquire by** |
| Web Programming (HTML, PHP, SQL) | Relational Databases Module (KC4000), Web Programming Modules (KF5002, KF4009), Personal Web Development for Clients. |
| Web Design (Photoshop, CSS) | Personal Web Development for Clients, Web programming module. (KF4009) |
| Research Skills | Most University Modules have included Report/ essay writing. |
| Interpersonal Skills | Effective communication with participants of user testing/ questionnaire. Attained from pervious group tasks and client communication outside of university. |
| Organizational Skills | Previous assignment deadlines have taught me the importance of this skill. |
| Testing code | Testing and profiling Programming throughout University projects. (KF5012, KF5008) |
| User Testing | I will improve my skills in this area by reading relevant books from Northumbria library. |
| Web Security (SSL) | It may be beneficial to learn about the use of SSL to further defend my application. |

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1. Resources – Statement of hardware / software required

**Microsoft Office**

I will use Microsoft Word for the bulk of the report and appendices, this software is available on university machines and my personal laptop. Microsoft excel will be used for the Gantt chart and any results gathered throughout the project.

**GitHub**

This will be used for version control when producing the web application, this will be beneficial as it will make a backup that is available on any machine and all changes will be logged showing a detailed update log through the project.

**Adobe Photoshop**

This will be vital for producing low and high-fidelity designs of the application I wish to develop. Licensed access to Photoshop is available in the university labs and library.

**Personal laptop**

A personal laptop with access to required software will be necessary as it will give me the freedom to work at home or university on the project.

1. Structure and contents of project report

**Title Page**

Any necessary identifying elements of the report, title, author, module etc.

**Declaration of Authorship**

This is a signed declaration that all of the contents of the report and the work described in it are your own work. It also states ethical guidelines and a description of how the work will be used.

**Acknowledgements**

This section will describe any sources that may be acknowledged in the making of the report, for example companies, my project supervisor or university staff.

**Abstract**

The purpose of an abstract is to provide the reader with essential information relating to the report. It will also briefly summarise the basis of the report, so that a reader can easily determine the contents.

**List of Contents**

A page numbered list of the content within the report, for easier reading and navigation.

1. Introduction

The introduction will provide more information, expanding on the abstract. It will also overview the objectives and give a reason for including them in the report. I will introduce the web application I aim to develop. The aims of the project will be introduced here with a breakdown of how it will be achieved.

1. Analysis

The analysis section will comprise of three chapters, problem identified, Literature review and Software Implementation.

* 1. **The Problem**

First, I will identify the problem area of my project and explore the potential problems associated with the demographics (elderly and disabled) that I will be developing the application for.

* 1. **Literature Review**

In this section I will critically analyse existing research and literature related to the problems explored in the previous section. I will also research potential solutions to the problems in the project area that will allow the application development to take shape. I will use mostly online journals and books available in Northumbria Library for my research.

* 1. **Software Implementation**

This section of the analysis I will explain the choices when developing the web application such as tools and techniques and the rationale when choosing specific languages for development.

1. Synthesis

The Synthesis will consist of three chapters, Design, Implementation and Testing. And will discuss the work carried out to develop my application from an idea to a working tested outcome.

3.1. **Design**

Section will explain the design process in terms of how each aspect of the application relates to my initial brief. Interface Design as well as system design, as it needs to be useable and also fit for purpose (having necessary features).

3.2. **Implementation**

The process of developing the nurse call application including all technical aspects. Such as language choice, coding standards, code concepts as well as the database and security.

3.3 **Testing**

This section will involve the testing of the application throughout development and at the end when test users use my application to ensure it is fit for purpose. Throughout this process I will document any testing.

1. Evaluation and Conclusions

This section will be a summary of all that was achieved throughout the project including specific research and a detailed analysis of the final web application after testing and amendments. It is important to discuss any future direction or considerations attained from the project. Additionally I will relate to the literature that I reviewed earlier in the report using my own results and conclusions.

1. References

A list of references used to validate facts when composing my report using Harvard referencing standard.

1. Appendices
2. Terms of Reference
3. Design Documentation
4. UML Diagrams
5. Code Snippets
6. Test plan and Results
7. Gannt Chart
8. Meeting Documentation / eLogbook
9. Marking Scheme: General Computing Project

**Report: 60%**

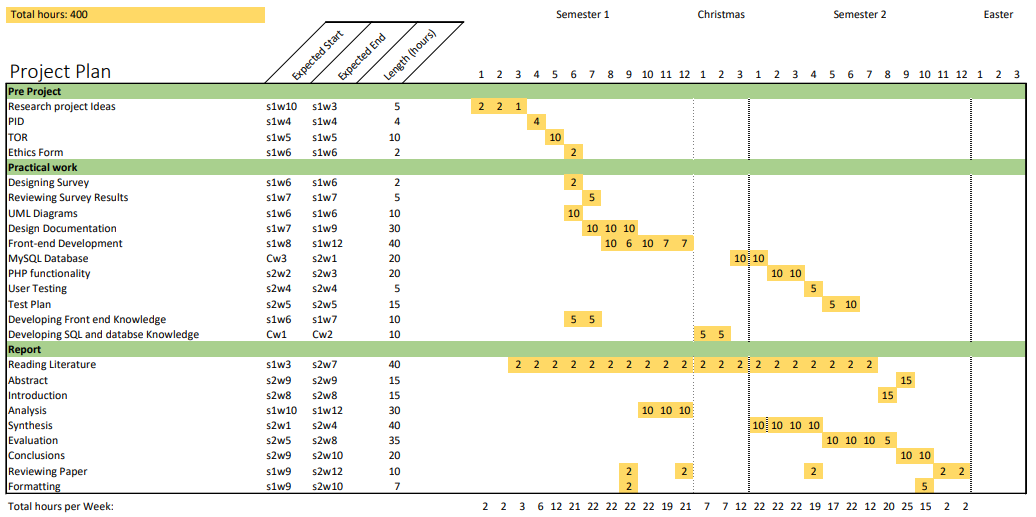
|  |  |
| --- | --- |
| **Section** | **Weight** |
| Abstract & Introduction | 5% |
| Analysis | 30% |
| Synthesis | 30% |
| Evaluation & Conclusions | 30% |
| Presentation | 5% |

**Product: 30%**

|  |  |
| --- | --- |
| **Section** | **Weight** |
| **Fitness for Purpose**   * Accessibility & Language * Suitability of implemented functionality * Cross device compatibility | 70%  **Breakdown**  0 – 15  0 – 40  0 – 15 |
| **Build Quality**   * Code Quality * Quality of design * Quality of testing | 30%  **Breakdown**  0 – 10  0 – 10  0 – 10 |

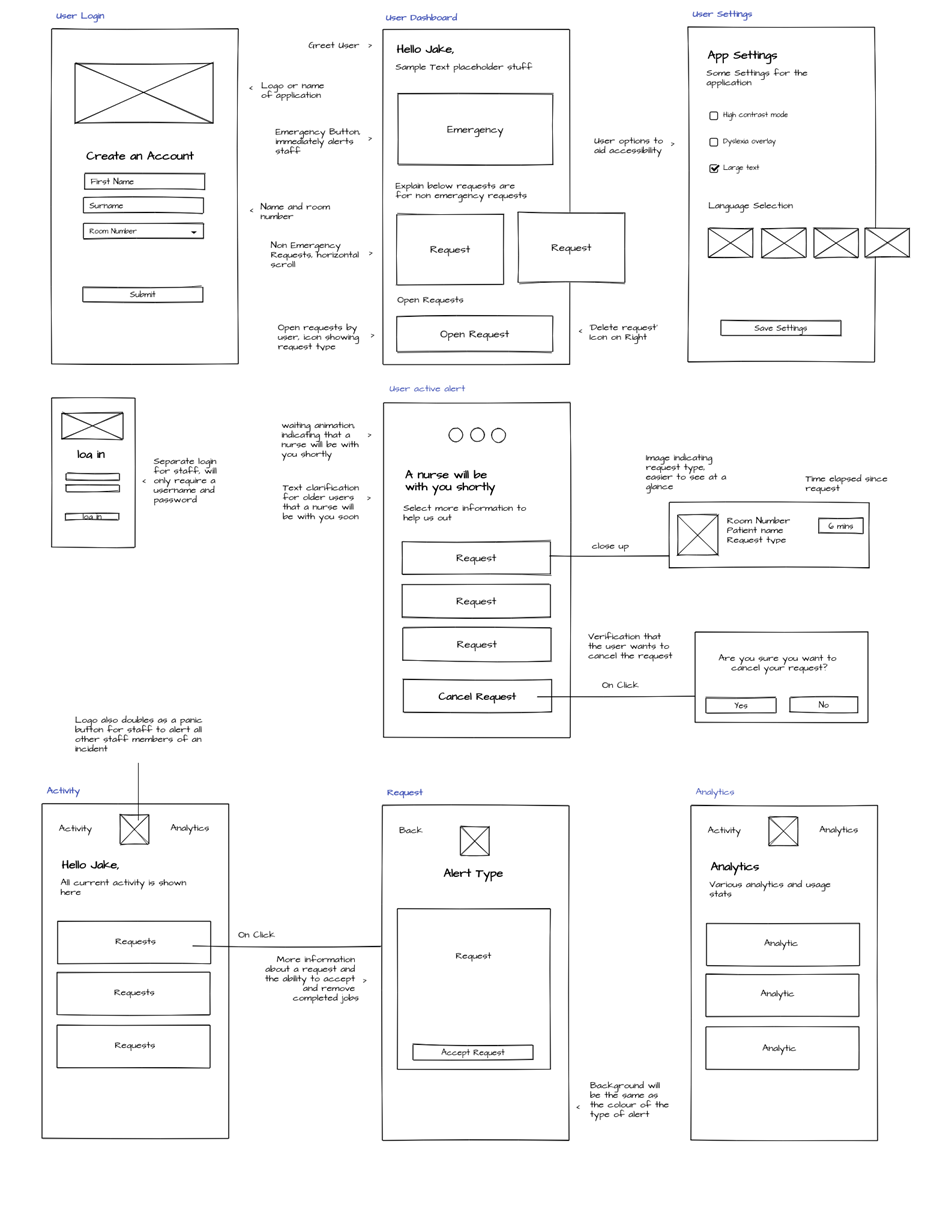
**Viva: 10%**

1. Project Plan – Schedule of activities



* 1. Design Documentation

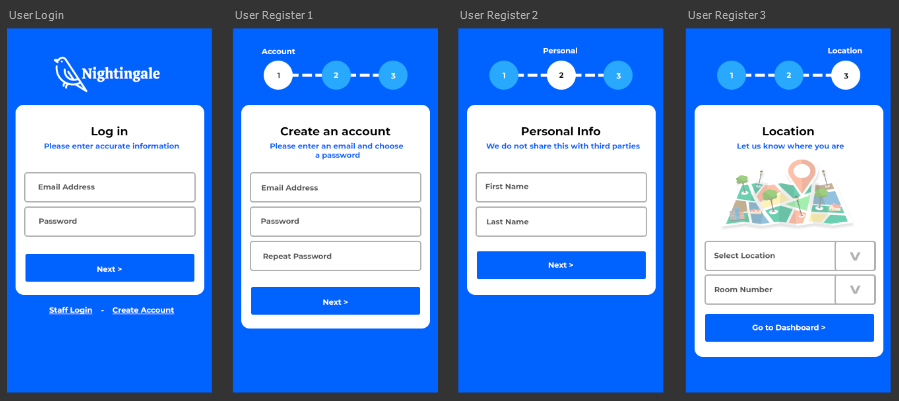
**Table of Heuristic consideration within the system**

*figure 1.2 – Wireframe design of dashboards*

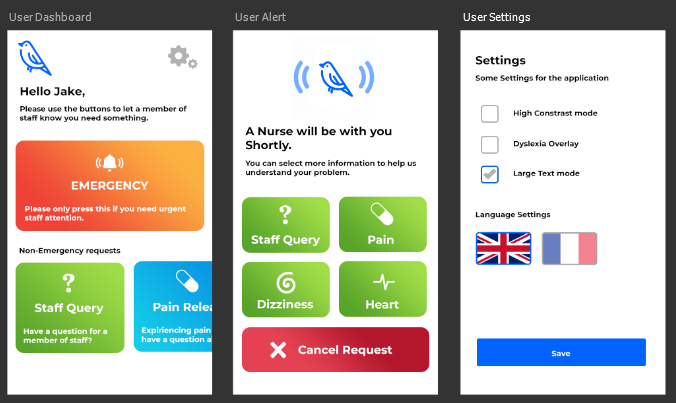
*figure 1.3 – Colour Scheme*



*figure 1.4 – High fidelity designs, Login/Register*

**

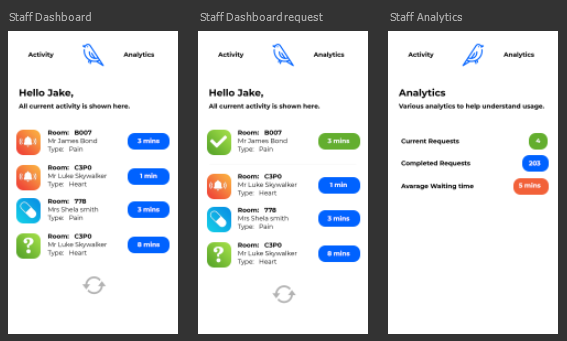
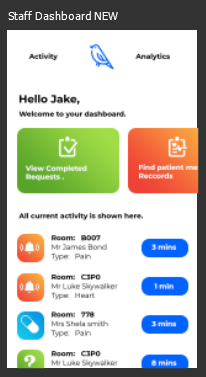
*figure 1.5 – High fidelity designs, User dashboard*

**

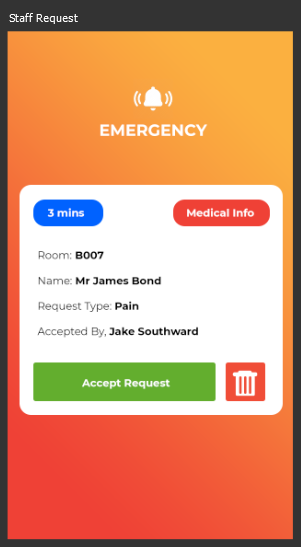
*figure 1.6 – High fidelity designs, User medical data*

Process of inputting medical data

*figure 1.7 – High fidelity designs, Staff user dashboard*

**** ****

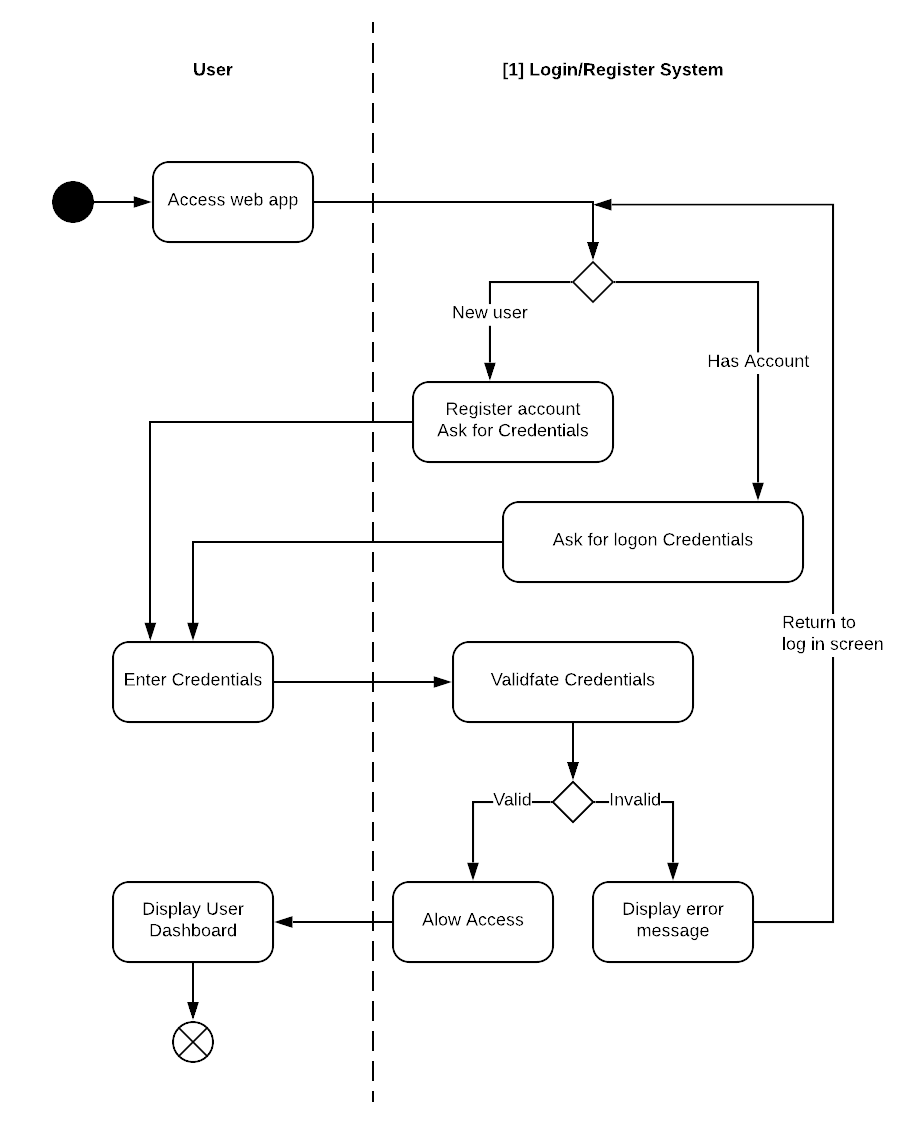
*figure 1.8 – High fidelity designs, Staff user request & medical data*

****

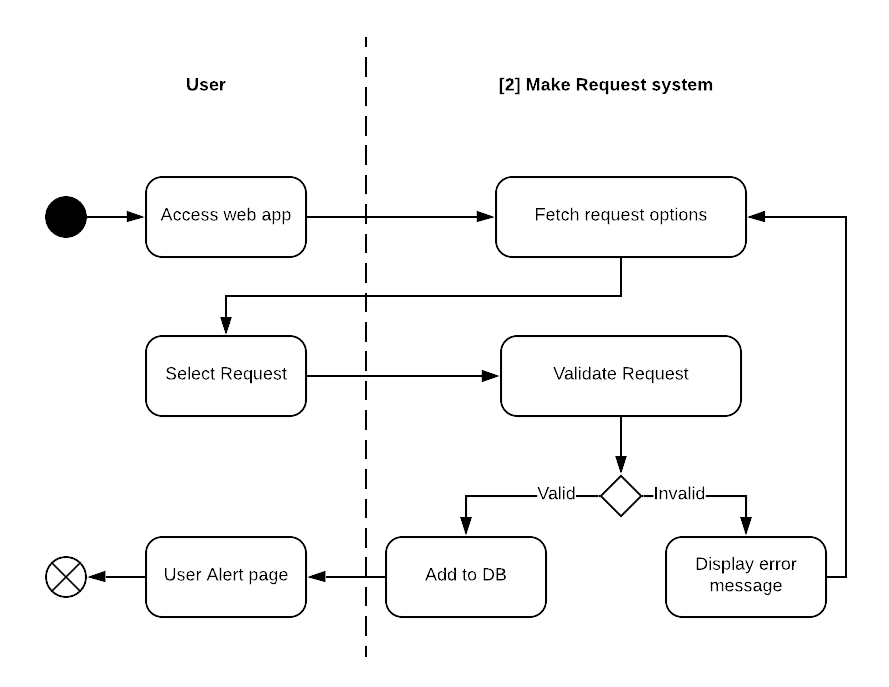
Process of viewing patient medical data

* 1. Diagrams

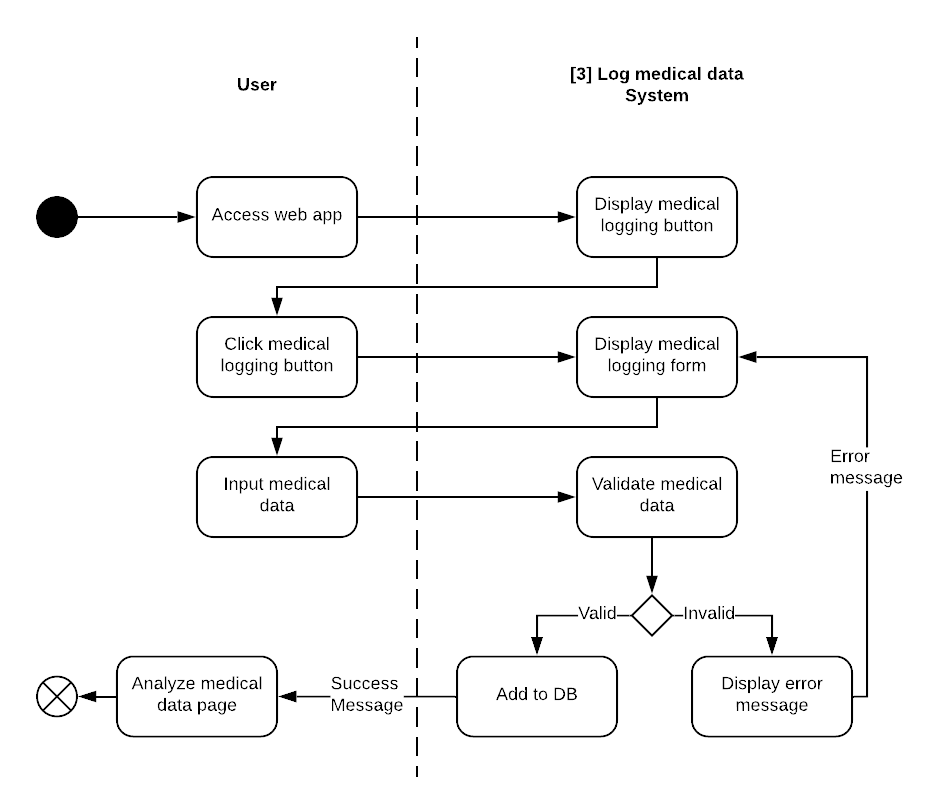
*figure 2.1 – login/register UML*



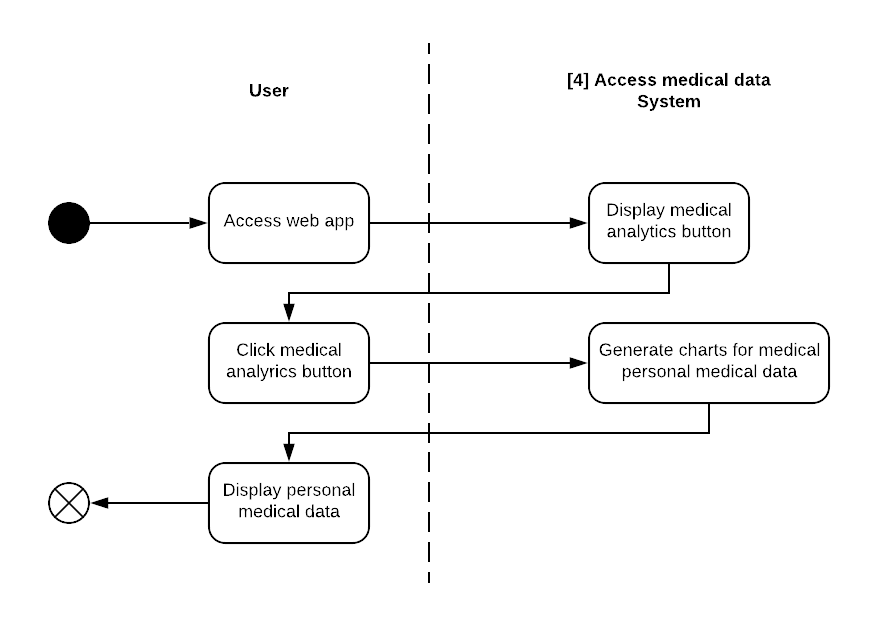
*figure 2.2 – Make Request UML*

**

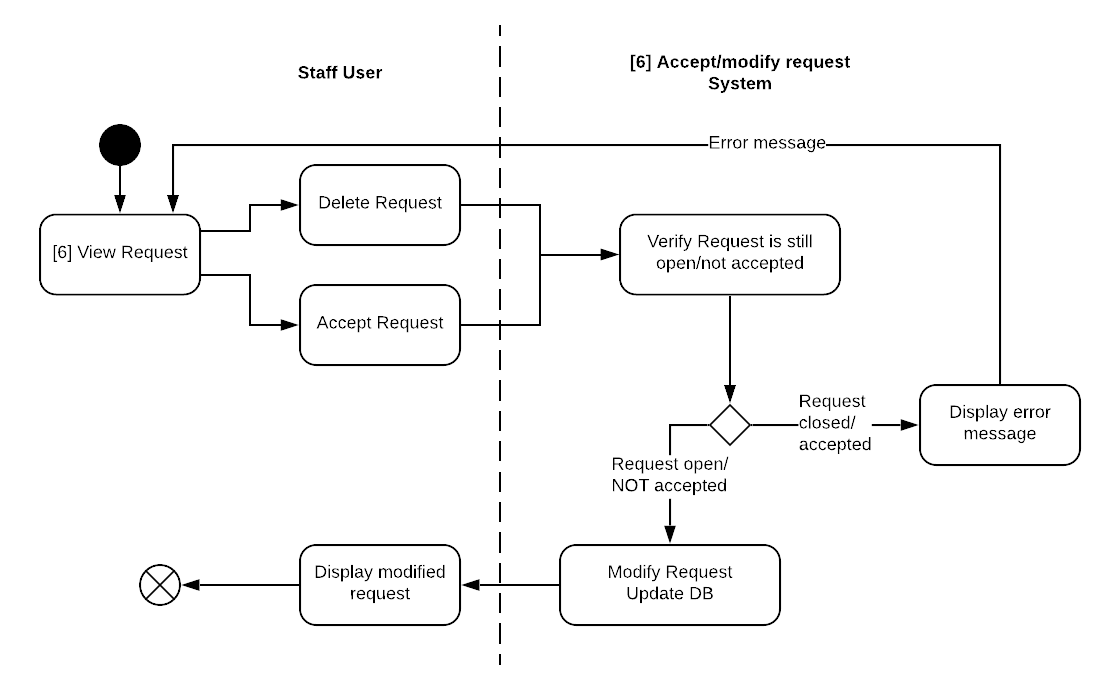
*figure 2.3 – log medical data UML*

**

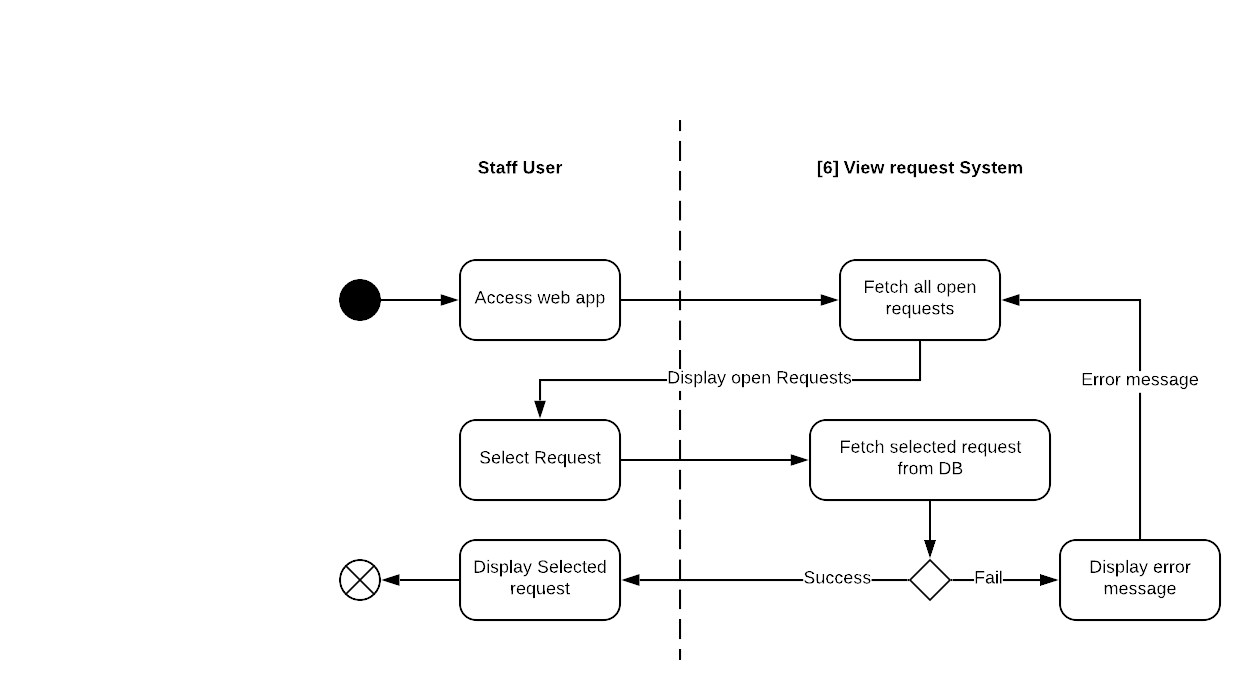
*figure 2.4 – Access own medical data UML*

**

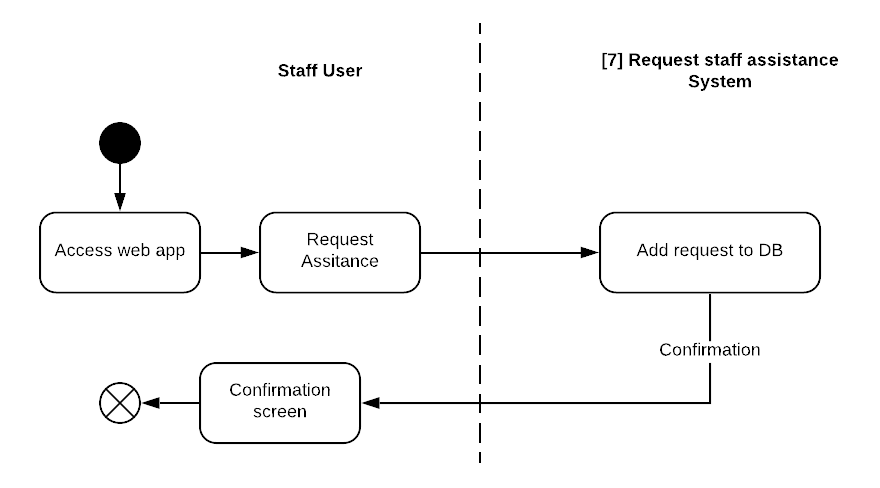
*figure 2.5 – Accept/Modify request UML*

**

*figure 2.6 – View request UML*

**

*figure 2.7 – Request staff assistance UML*

**

*figure 2.8 –*

*figure 2.9 –*

*figure 2.10 –*

* 1. Code snippets
  2. Test Plan and Results
  3. Gannt Charts
  4. Meeting Documentation / eLogbook