Appointment and Workload Management System

by

CS 18-11

Department of Computer Science
School of Computing & Informatics Technology

A Project Report Submitted to the
School of Computing and Informatics Technology for the Study Leading to
a Project Report in Partial Fulfilment of the requirements for the
Award of the Degree of Bachelor of Science in
Computer Science of Makerere University

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Declaration

We, Group CS 18-11 do hereby declare that this Project Report is original and has not been published and/or submitted for any other degree award to any other University before.

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Approval

This Project Report has been submitted for examination with the approval of the following supervisor.

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Dedication

We dedicate this report to the Almighty God who gave us the knowledge and ability to continue with our project successfully. We further dedicate it to our parents and guardians for their unceasing and selfless support throughout our stay in this university.
Acknowledgement

We are deeply indebted to our project supervisor Dr. Ngubiri John whose unlimited steadfast support, guidance and inspirations have made this project a great success. In a very special way, we thank him for all the knowledge and support he rendered unto us to see that we succeed in this challenging study.

Special thanks goes to our friends and families who bared with us during the hectic moments and stress we went through during the course of our Final Year Project.

We thank the school for giving us the grand opportunity to work as a team which has indeed promoted our team work spirit, interpersonal and communication skills. We also thank the individual group members for the unending team spirit, will and solidarity that was exhibited during the course of the project.
Abstract

The health sector is among the most important sectors in the Republic of Uganda. The rate at which health facilities such as hospitals, pharmacies and medical laboratories are established and/or revamped increases annually. These facilities must provide spot-on services for their clients, as well as acceptable working conditions for their medical personnel. This report describes the development of an appointment and workload management system designed to provide support to health facilities in terms of service delivery for clients coupled with creation of equally favorable conditions for all personnel. It describes the problem being addressed, objectives intended for the project, and a review on the functionality of existing related systems. The report also provides a full description of the development cycle (design and implementation) of the system.
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declaration</td>
<td>i</td>
</tr>
<tr>
<td>Approval</td>
<td>ii</td>
</tr>
<tr>
<td>Dedication</td>
<td>iii</td>
</tr>
<tr>
<td>Acknowledgement</td>
<td>iv</td>
</tr>
<tr>
<td>Abstract</td>
<td>v</td>
</tr>
<tr>
<td>Abbreviations/Acronyms</td>
<td>xi</td>
</tr>
<tr>
<td>1 Introduction</td>
<td></td>
</tr>
<tr>
<td>1.1 Background</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Problem Statement</td>
<td>2</td>
</tr>
<tr>
<td>1.3 Main Objective</td>
<td>3</td>
</tr>
<tr>
<td>1.3.1 Specific objectives</td>
<td>3</td>
</tr>
<tr>
<td>1.4 Scope of the Project</td>
<td>3</td>
</tr>
<tr>
<td>1.5 Significance of the Project</td>
<td>3</td>
</tr>
<tr>
<td>2 Literature Review</td>
<td></td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>5</td>
</tr>
<tr>
<td>2.2 Related Systems</td>
<td></td>
</tr>
<tr>
<td>2.2.1 Eclipse</td>
<td>5</td>
</tr>
<tr>
<td>2.2.1.1 Strengths</td>
<td>5</td>
</tr>
<tr>
<td>2.2.1.2 Weaknesses</td>
<td>6</td>
</tr>
<tr>
<td>2.2.2 AppointMate</td>
<td>6</td>
</tr>
<tr>
<td>2.2.2.1 Strengths</td>
<td>6</td>
</tr>
<tr>
<td>2.2.2.2 Weaknesses</td>
<td>6</td>
</tr>
<tr>
<td>2.2.3 Jituzu</td>
<td>7</td>
</tr>
<tr>
<td>2.2.3.1 Strengths</td>
<td>7</td>
</tr>
<tr>
<td>2.2.3.2 Weaknesses</td>
<td>7</td>
</tr>
</tbody>
</table>
7 Appendices

7.1 Appendix A: Sample code ........................................ 35
7.2 Appendix B: Interview questions ............................... 37
7.3 Appendix C: Work plan ............................................ 38
List of Figures

2.1 A comparison of the system features. 8
4.1 A pie chart showing the percentage of patients with smart devices. 13
4.2 A pie chart rating appointment scheduling methods. 14
4.3 A bar graph showing doctors’ contentment towards workload distribution. 15
4.4 Use case diagram/blueprint of the system. 18
4.5 Context diagram of the system. 19
4.6 Data flow diagram of the system. 20
4.7 Entity relationship diagram of the system. 21
5.1 Interface for registering and creating doctor accounts. 24
5.2 Account creation interface for patients. 24
5.3 User login interface. 25
5.4 Appointment scheduling interface. 25
5.5 Location of the health facility. 26
5.6 View of the doctors available and their time for an appointment. 26
5.7 Appointment request viewed by a doctor. 27
5.8 Viewed appointment marked as seen. 27
5.9 Error message displayed by the system. 28
7.1 Sample code for displaying error messages. 35
7.2 Code for testing the user type. 36
7.3 Code for redirecting a user to their specific interface. 36
List of Tables

3.1 Main tools used during data collection. ....................... 11
4.1 System hardware requirements. ......................... 16
4.2 System software specifications. ......................... 17
7.1 Work plan. ................................................. 38
Abbreviations/Acronyms

**App**  Application

**AWMS**  Appointment and Workload Management System

**CSS**  Cascading Style Sheets

**DBMS**  Database Management System

**ERD**  Entity Relationship Diagram

**HTML**  Hypertext Markup Language

**IT**  Information Technology

**MySQL**  Structured Query Language

**OS**  Operating System
Chapter 1

Introduction

Several University students in Uganda prefer hostels to halls of residence. Students in hostels often rely on their smartphones to keep abreast of what is happening on campus.

1.1 Background

Over the years, numerous health facilities such as hospitals and clinics have been established in different locations of the country due to the enormously high demand for their services.

For any patient or client of the health facility to access these services, an appointment must be scheduled with a doctor at an agreed day and time to improve on service delivery. Some situations however, such as emergency cases where immediate attention is required do not need appointments to be scheduled. A patient must be attended to by an immediate doctor because such cases do not provide room for wasted time. In some health facilities, patients do not schedule appointments at all. Once one goes to the facility, he is given any doctor available to work on him at that time, and if none is available the patient is advised to either wait for some hours or come back the next day.

With these services, many complaints arise from various patients when it comes to lining up in long queues to be able to schedule appointments with health specialists. Patients are told to first fill appointment forms after which they have to wait for hours to get a response on whether their appointments have been successfully scheduled or not. For cases of unsuccessful scheduling, patients have to wait for days to be able to get their appointments confirmed.
This means that a lot of time is wasted on patients’ side in making unnecessary movements to and from the facility to the final day of when they are worked on. With such delays and disorganization with appointment schedules, it raises a question of what would happen if an emergency occurred and all doctors are occupied by other patients. Would a doctor have to turn off from his patient to attend to the emergency cases or would the patient with an emergency have to wait for a doctor to be available?

When it comes to workload distribution among doctors, it has been noted that some doctors have been overwhelmed by the number of patients they are supposed to work on whereas others are left free. This is because health facilities do not specify shifts for each doctor and how many patients one must attend to per shift. This increases the possibility of one doctor being loaded with many patients while there’s one that is completely free. Also relating to the doctors’ workability, if prior appointments are not made, a doctor is not given the ability to properly prepare the tools and equipment needed for his meeting with a patient. This is time consuming because the doctor organizes the equipment while a patient sits and waits for the doctor to be ready.

1.2 Problem Statement

The current process of queuing and filling of appointment forms used by most health facilities within the country has proven to be tedious and time consuming. Considering a big health facility (such as Mulago hospital) which works on a large number of patients on a daily basis, one can spend almost half a day just trying to set an appointment with a health specialist because of the long queues.

In some hospitals, appointments are not even scheduled. Once a patient walks in, he is assigned to any doctor available at that time. This however can be risky in some situations such as emergency cases if all the doctors are occupied. It can lead to disorganization in terms of choosing who to work on the emergency patient which can lead to a stand-still on hospital operations.

Existing patient appointment scheduling system allow patients to select a personally known doctor they want to schedule an appointment with. This means that there are high chances of one doctor being selected by many patients depending on their level of preference for that particular doctor, leaving most of the other doctors in the facility less occupied during their allocated shifts. This leads to the uneven distribution of workload among doctors bas-
ing on the number of appointment requests received per day. The problem this system addresses is the uneven distribution of workload among doctors which always occurs during appointment scheduling.

1.3 Main Objective

To develop a system that allows patients to schedule appointments with doctors, and provides even/uniform distribution of workload for doctors within a particular health facility.

1.3.1 Specific objectives

The specific objectives of the study were:

i. To carry out a study on the literature of related and/or existing medical appointment scheduling systems to identify the necessary requirements for the system.

ii. To design the prototype that illustrates the main functionalities of the system.

iii. To implement the designed system prototype.

iv. Finally, to carry out testing and validation of the implemented system.

1.4 Scope of the Project

The system aims at eliminating uneven distribution of workload among doctors of the same specialty in a health facility during the process of scheduling appointments by patients. The system ensures that each doctor receives one appointment at a time depending on the workload of other doctors (with the same specialty) in the system. This means that on a normal working day for example, each doctor can have at most four patients attended to at the end of a shift rather than one doctor having three while another has only one

The system supplements the automation of even workload distribution as part of appointment scheduling in a health facility.

1.5 Significance of the Project

The Appointment and Workload Management System is significant in the following ways:
i. Once completed and fully functional, the system will greatly reduce on the overall amount of time taken by patients to see health specialists by providing on-line appointment scheduling. This is archived by eliminating the long queues and appointment forms that are currently used by most health facilities.

ii. The system improves the effectiveness and workability of doctors in a health facility through the uniform distribution of work-load. This is attained by ensuring that all doctors are given an equal number of patients to work on during their allocated shifts.

iii. The system also provides room for further study within this area by creating a source of reference literature for students that would wish to develop similar/related systems.
Chapter 2

Literature Review

2.1 Introduction

The main purpose of this chapter is to present a review of some of the re-
lated/existing appointment scheduling systems currently used by health fa-
cilities, together with their strengths and weaknesses.

2.2 Related Systems

2.2.1 Eclipse

This is a practice management software that was developed by the MPN
software systems company in the United States. It has been in daily use at
thousands of locations for over 20 years. Eclipse includes medical scheduling
features such as patient appointment scheduling and management, storage
and access for patients’ records.

2.2.1.1 Strengths

(i) Eclipse provides billing estimates for medical services required by pa-
tients as they request for appointment schedules. The software allows
processing of payments on-line and also provides patients with their
payment history for those that use the system more than once.

(ii) Eclipse also provides patient management features such as location
tracking which allows the medical facility to identify the location of
its patients when required. This can be used to investigate the state of
a patient for cases of ‘no-shows’ on the day an appointment was set.
2.2.1.2 Weaknesses

(i) The software does not cater for workload distribution among doctors registered in the system. A patient can schedule an appointment with any doctor displayed by the system during any time of their convenience.

(ii) Eclipse does not have a functionality that considers cases of emergency patients.

2.2.2 AppointMate

This is a medical appointment scheduling software that was developed by Delta Health Technologies company in the United States. It provides patient scheduling and record management features.

2.2.2.1 Strengths

(i) The software provides billing and invoicing information required by patients while scheduling appointments, allowing them to be informed about their pricing capabilities and affordability of the services to be used.

(ii) AppointMate provides alerts for over-due appointments to doctors for cases of patient ‘no-shows’ providing room to perform follow-ups on patients.

(iii) It records the shift availability of doctors in a health facility.

(iv) It also provides patients with a map and turn-by-turn directions of a health facility for cases where the location is not known.

2.2.2.2 Weaknesses

(i) AppointMate does not support the even distribution of workload, regardless of the fact that it provides records for the shift availability of the different doctors in a facility.

(ii) It also has no functionality that provides support for emergencies.
2.2.3 Jituzu

This is a mobile phone application that enables service provider professionals to better engage with their clients. Jituzu is used to allow easy communication between patients and health workers at all times.

2.2.3.1 Strengths

(i) Jituzu is similar to Eclipse in that it also provides on-line billing and payment processing features which are used by patients to approximate the charges required for medical services.

(ii) The App allows both patients and doctors to set appointment reminders. These are set before the appointment’s date to allow one easily remember and prepare for the appointment.

(iii) The App has a no-show tracking functionality which allows a doctor to identify which patient did not appear for an appointment, and whether there is a reason given by that patient.

(iv) The App also provides on-call scheduling whereby patients log in to the system, select a doctor to schedule an appointment with, and then make a direct phone call to set a date. This is archived through a fast response time which is suitable for real-time communication between patients and health workers.

2.2.3.2 Weaknesses

(i) Similar to Eclipse, Jituzu does not support even/uniform workload distribution among similar doctors registered in the system.

(ii) The calendar used by the App for scheduling appointments does not provide separability between valid and invalid dates for a patient to set an appointment. This affects the level of visibility and clarity for users. Patients also have trouble when tracking across from left where hours are marked to select a day for setting the appointment.

2.3 Comparison of the Systems

The figure below shows a comparison of the three systems identified above in terms of the key functionalities they provide for their users, together with the key functions they do not implement.
2.4 Conclusion

Current systems used by health facilities for patients to schedule appointments with doctors, as identified above, do not cater for the even distribution of workload during the scheduling process. It is only AppointMate that puts into consideration records concerning the shift allocation for each doctor registered in the system but it does not use this information to ensure uniformity in workload distribution.

The other main weakness that was identified with these existing systems is that they do not consider emergency cases. A situation can occur whereby a patient needs to be attended to urgently but when all doctors are occupied by other patients. This can cause major alterations in operations.

The other procedure used in scheduling appointments by queuing and filling appointment forms is very time consuming and exhausting according to the comments given by a number of patients in different health facilities.

The proposed system will address these challenges/weaknesses by making sure that workload is evenly distributed among doctors. This provides support for emergency situations whereby a minimal number of doctors is always made available whenever an emergency occurs.
Chapter 3

Methodology

3.1 Introduction

This chapter highlights the different techniques that were used to successfully complete the project. It provides a description of the development cycle, data collection and analysis methods, system design and implementation methods, together with the system testing and validation techniques that were applied to make sure that the system satisfies and meets user requirements.

3.2 Data Collection

Below are the methods that we used to gather relevant data that was used to identify the core user needs and/or requirements for proper implementation of the system.

3.2.1 Oral interviews

Interviews were conducted to gather information about the current setting as far as how appointments are scheduled and how the workload of doctors is managed and distributed within a health facility. These interviews were conducted on a few patients and medical workers we interacted with. We also had interactions with fellow students regarding their visits to various health facilities in the country.

Reasons for using this method:

(i) We found it much easier to start conversations with our subjects, which then became our interview sessions without them feeling subjected to random questions. This made it easy for us to gather as much information as we needed for our developed system’s requirements.
(ii) Oral interviews provide room for collecting more information through use of open-end questions, and not limiting the answers/responses that can be given by an interviewee.

(iii) Last but not least, oral interviews are also considered as one of the cheapest method of data collection when looking at a minimal study set. In this case we looked at the major health facilities in Kampala such as Mulago and Nsambya hospital.

### 3.2.2 Internet research

Internet research was conducted to gather information on existing appointment scheduling systems currently in use. More research was carried out to analyze how workload of doctors is managed, and whether there are any systems already developed. Through Internet research we highlighted the main challenges users find with the existing systems by looking at different user reviews posted on-line.

**Reasons for using this method:**

(i) Internet research allows the collection of data for systems not only in Uganda but in different parts of the world.

(ii) More information could be obtained in a very short period of time through looking at different on-line resources such as websites and blogs with system reviews on various applications.

### 3.3 Tools Used

The table below shows the tools that were used during the two data collection methods/techniques mentioned above.
3.4 Data Analysis

The collected data was analyzed to be able to attain consistency and reliability for proper modeling and implementation of the system. The data was studied to identify key user and system requirements. These were classified under functional and non-functional requirements.

3.5 System Design and Implementation

The functionalities of the system were implemented using C-Sharp for the back-end code. User interfaces were designed using HTML, CSS and JavaScript, while MySQL was used for creating and manipulating the required databases.

3.6 Testing and Validation

Once implementation of the system was completed, we performed testing and validation of its functionalities by using sample data to evaluate how fast user input is processed, and if the output is provided in the required form by our target users. We were also able to identify the response time of the system and whether all the system requirements are met.

| Oral interviews          | - Pens  
|                         | - Paper  
|                         | - Mobile phones (when audio recording was required)  
| Internet research       | - Internet enable mobile phones  
|                         | - Laptops with WiFi connection  

Table 3.1: Main tools used during data collection.
Chapter 4

System Analysis and Design

This chapter describes the system study, analysis and design of the system. It highlights the identified requirements and architectural design of the system.

4.1 System Study

This was carried out on some hospitals in Kampala, that is Mulago and Nsambya hospital where the main purpose was to find out how appointments are scheduled and how workload is distributed according to the number of doctors available in the hospital per day. We were able to identify that the system currently used in these health facilities is entirely manual. When a patient wants to schedule an appointment, he is supposed to go to the facility and physically contact the responsible personnel to schedule the appointment. In these hospitals, workload is hardly put into consideration. As a result, any number of patients can be assigned to only one specific doctor without considering the current workload of other doctors. We realized that this greatly affects the workability of most doctors in the hospital.

4.2 System Analysis

4.2.1 Data analysis

During the oral interviews we conducted, 60% of patients owned smart phones and hence would be able to easily access the system to schedule appointments on-line with much ease. 27% owned smart phones but also believed that accessing the system using a laptop would be more efficient for them as they already owned personal laptops/computers. The remaining portion (13%) did not own smart phones, but they were open
to being helped by the personnel at a health facility with the on-line process. This is why we recommend the facility to ensure that a support team is available to help such patients that are not well versed with the on-line system. The pie chart below shows the above analysis.

![Pie Chart](image)

**Figure 4.1**: A pie chart showing the percentage of patients with smart devices.

We asked patients to rate the currently used appointment scheduling methods, i.e. queuing and filling of appointment forms. 29% agreed that forms were more efficient and easier to follow up on compared to making long queues. 14% were fine with queuing and said they had gotten used to the whole process. 57% of our interviewees agreed that having an on-line system would make the whole appointment process much faster, easier and less time consuming. This analysis is also described by the pie chart below.
Looking at the workload of doctors in hospitals, over 69% of the doctors we talked to had complaints on how uneven workload was distributed on a daily basis. Some of them even complained that regardless of whether shifts were allocated, they would find themselves working beyond the hours of their shifts. 24% were however contented with the current workload evaluation methods used in their hospitals and had no major complaints. The remaining 7% was not really sure if workload distribution was an issue to them but were interested in the idea of having workload management system in place. The graph below illustrates the above analysis when doctors were asked if they were contented with their current workload distribution, or not.
4.2.2 Requirements specifications

The requirements of AWMS were classified into user and system requirements.

4.2.2.1 User requirements

During data collection, we analyzed how current systems operate by looking at their functionalities and associated weaknesses. We categorized user requirements into functional and non-functional requirements.

**Functional requirements** specify what the system is expected to do. These include:

(i) AWMS must accept submission of information for patients and medical personnel.

(ii) The system should be able to assign patients to appropriate doctors according to the current state of workload distribution at the time a patient schedules an appointment.
(iii) The system must provide user authentication for its different user types.

iv. It should also be able to identify authorization levels for users.

**Non-functional requirements** describe the behavior of the system, and these include:

(i) The system must verify and validate all user input. Error messages must be displayed immediately once any invalid input is detected.

(ii) Any modifications that are made to the system’s database should be updated to all users accessing the system within a maximum of one minute.

(iii) The system must also provide data security and integrity for the information of its users.

(iv) The system should be able to recover from any complications as quickly as possible in order to avoid interruptions of operations at the health facility.

### 4.2.2.2 System requirements

These describe the hardware and software requirements needed for effective and efficient running of the system.

**Hardware requirements:**
The table below shows the hardware components that a computer must have for proper functioning of the system.

<table>
<thead>
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<th>Minimum requirement</th>
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<tr>
<td>Processor</td>
<td>2.4 Ghz processor speed</td>
</tr>
<tr>
<td>Memory</td>
<td>2 GB Ram</td>
</tr>
<tr>
<td>Disk space</td>
<td>500 GB including 20 GB for the DBMS</td>
</tr>
<tr>
<td>Display</td>
<td>800 by 600 color, 1024 by 768 high color - 16 bit recommended</td>
</tr>
</tbody>
</table>

Table 4.1: System hardware requirements.

**Software requirements:**
The table below shows the software specifications that a computer must have for proper functioning of the system.
<table>
<thead>
<tr>
<th>Software component</th>
<th>Minimum requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>Windows 7 or later</td>
</tr>
<tr>
<td>DBMS</td>
<td>MySQL server</td>
</tr>
<tr>
<td>Runtime environment</td>
<td>WampServer</td>
</tr>
</tbody>
</table>

Table 4.2: System software specifications.

4.3 System Design

This section includes a detailed description of the system’s architecture. It describes the design and development process of the application using a use case diagram to explain how the actors will interact with the system and data flow diagrams to show the flow of data in the system.

4.3.1 Use case diagram

This describes the different types of users of the system, and how they independently interact with the system. The use case diagram is a blueprint of the system, providing a simplified graphical representation of the system’s functionalities. The diagram shows the three key users (actors) of the system, that is: the patients in the health facility, doctors that are part of the personnel team, and members of the top management/administration of the health facility such as human resource managers.
4.3.2 Context diagram

This is a diagram that illustrates AWMS as a single process, showing how external entities interact with the system together with an overview of its main functionalities. The diagram shows a patient, doctor and administration personnel as external entities.
4.3.3 Data flow diagram

The DFD illustrated in figure 4.7 below shows the graphical representation of the flow of data in the system. It describes the different processes involved in the system and data that flows in and out of each process depending on
the interactions from the external entities.

Figure 4.6: Data flow diagram of the system.

Key:

- External entity
- Process
- Data store
- Data flow
4.3.4 Database design

The entity relationship diagram below illustrates the interrelationship between the different entities that are used in the system database. The DBMS that was used is MySQL server.

Figure 4.7: Entity relationship diagram of the system.
4.3.5 Design methodology

The methodology that we used is the agile development method. This is a creative process that provides room for flexibility and applies a high level of organization into the delivery of the final system. We were able to focus on maintaining simple and organized code by performing regular testing, and obtaining system functionalities as soon as they were ready. This enabled us to eliminate risks such as code errors/bugs.
Chapter 5

System Implementation, Testing and Validation

5.1 Introduction

This chapter describes how the system was implemented. The purpose of implementation and validation was to make sure that the system meets its set objectives and requirement specifications that were identified.

5.2 System Implementation

This section defines the user interfaces and activities that allow users to interact with the system.

5.2.1 User interface design

(i) Account Creation:
For any patient or hospital personnel to use the system and/or access its information and services, he/she is required to have a user account. Figure 5.1 shows the interface that allows a member of the administration to create accounts and register doctors and other personnel in the hospital. Figure 5.2 shows the interface for patients to register their details (personal information) into the system used to create their user accounts.
(ii) Login activity:
Once a user creates an account, the login interface is used to sign into the system and access his/her information. This activity is shown in figure 5.3.
(iii) Appointment scheduling:
When a patient signs into the system, he/she can be able to schedule an appointment by selecting a valid date and adding a brief description or message for his appointment request, as seen in figure 5.4. The patient can also view the location of the hospital while scheduling his appointment (as seen in figure 5.5).
Once the appointment details are entered, the patient can then view and select the preferred time for his appointment. This is shown in figure 5.6.

(iv) Appointment requests:
Once patients request to schedule an appointment with a doctor, he can be able to view all these requests which show the name and a brief description as input by the patient. The appointments viewed are also marked as seen. Figures 5.7 and 5.8 illustrate this system feature.
(v) **Error messages:**
Error messages are displayed by the system whenever an invalid input is detected. Figure 5.9 shows an error message that is displayed when a patient selects an invalid date while scheduling an appointment. The message is displayed as red text.
5.3 System Testing and Validation

Regular testing and validation of a system is required to ensure that the quality and integrity of the system model is maintained throughout the development process. Testing and validation was conducted to ensure that the AWMS meets its specifications and fulfills its intended objectives.

5.3.1 System testing

Testing was performed throughout the development process to ensure that we were developing the desired system in the right way. This was done in two ways, that is: unit testing and integration testing.

Test Plan: The system was designed to prescribe the scope, approach, resources, and schedule all testing activities. The plan identifies the items and features tested, the types of testing that were performed, the personnel responsible for testing, the resources and schedule required to complete the testing process.

The purposes of a software test plan include:

(i) To achieve the correct code and ensure that all functional and design requirements are implemented as specified in the systems documentation.
To provide a procedure for unit and system testing.

To identify the test methods to be used.

Process of Test Plan:

(i) Identify the requirements to be tested. All test cases were derived using the existing design specifications.

(ii) Specify the particular tests to use for each module.

(iii) Identify the expected results for each test.

(iv) Perform the test.

5.3.1.1 Unit testing

Unit testing was carried out on individual modules of the system to ensure that they are fully functional units. We did this by examining each unit. Looking at the appointment module, it was tested to ensure that it functions as required and that it captures data and other details as input. We had to ensure that all this data is stored within the systems database appropriately. The success of each individual unit gave us the go ahead to carry-out integration testing. Any error conditions that were identified were handled as well.

5.3.1.2 Integration testing

We carried out integration testing after different modules had been put together to make a complete system. Integration testing was aimed at ensuring that modules are compatible and they can be integrated to form a complete working system. For example we tested to ensure that when a user is logged in, he/she is redirected to the appropriate page.

5.3.2 Validation

System validation was performed to ensure that the system meets its requirements. A combination of checks were evaluated to identify, fix and eliminate any run-time errors users would encounter while using the system. Some of the validation checks that were conducted include:

(i) Does the system only allow users to login with valid user-names and passwords?
(ii) Does the system maintain its authorization levels for the different user types?

(iii) Are doctors able to view all appointment requests sent in by patients?

(iv) Does the system display required error messages for any invalid input detected?
Chapter 6

Recommendations, Conclusion and Future Works

This chapter describes our recommendations for the different users of the system, conclusions as well as future works/enhancements for the system.

6.1 Recommendations

Training of staff members/medical personnel in the hospital with how the system works is a major priority. Making sure that all doctors are able to use the system with ease and confidence would increase their effectiveness during work shifts. We therefore recommend that the hospital’s management ensures that all doctors responsible are trained and given all the basic information on how to use the system.

The AWMS being a new system (with added technology) some members of staff are most likely to get threaten that the computerized system will replace their jobs. We recommend that the management of the hospital educates their staff on how the system will operate and how it will supplement their efforts, instead of replacing their job positions (because the system would not operate itself without the personnel).

For efficiency of the hospital, all users of the system need to be thoroughly informed about the personal information/credentials that they use to create their accounts. Users are advised to record their passwords and email addresses safely for easy remembrance while logging in to the system. We also recommend that the email addresses used are existing addresses allowing users to receive notifications through email where possible.
The system has authorization levels for the different user types, whereby patients and medical personnel can only view information made accessible for them and a member of management has the right to access all information of the system. We therefore recommend that the management must be keen on whoever is to be identified as part of the management/admin team.

It is also known that some patients would be illiterate when it comes to working with components of the system. We strongly recommend that the hospital should be able to provide such patients with assistance as much as possible.

6.2 Conclusion

The core reason for the development of a computerized system of scheduling appointments and managing workload is to improve on how operations run within the hospital on a daily basis. Therefore the I.T. used should support the core objective of the system if it is to remain relevant to the hospital.

A lot still needs to be done in the I.T. department in order to make the available technology effective. This may involve training of staff on how to operate the system and the management to keep updating hardware and software requirements of the system. I.T. and computer systems must be upgraded as more technology is introduced now and then.

6.3 Future Works

Certain elements in this project leave scope for further development. With almost any project which includes a software component, a list of future enhancements could be endless.

For purposes of further development, AWMS can be expanded or supplemented by adding a functionality of monitoring the use of medical logistics (such as drugs) and hospital equipment. This would be used by a health facility to have an estimated period of using a specified amount of its logistics.

The system can also be implemented to support real-time interactions or conversations between medical personnel and patients. This can help patients make any inquiries about any medical situation and also send suggestions
without the need to be directly at the hospital. A hospital’s personnel can also be able to send feedback and support more efficiently.
References


Chapter 7

Appendices

7.1 Appendix A: Sample code

Figure 7.1 shows the sample code for displaying the error messages for invalid input.

```java
public class HtmlElements {
    public enum MessageType (SUCCESS, INFO, ERROR);
    public enum UserType (PATIENT, DOCTOR, MANAGEMENT, ALL);
    public string GetMessage(string message, MessageType type, UserType userType) {
        var type_ = string.Empty;
        switch (type) {
            case MessageType.SUCCESS: type_ = "success"; break;
            case MessageType.INFO: break;
            switch (userType) {
                case UserType.PATIENT: type_ = "primary"; break;
                case UserType.DOCTOR: type_ = "royal"; break;
                case UserType.MANAGEMENT: type_ = "warning"; break;
                default: type_ = "info"; break;
            }
        }
        var d = string.Empty;
        d = $"";
        <div class="alert alert-"{type_}" alert-light alert-dismissible" role="alert"><button type="button" class="close data-dismiss="alert" aria-label="Close"
          <i class="mdi mdi-close"></i></button>
        <strong>{message}</strong></div>
        return d;
    }
}
```

Figure 7.1: Sample code for displaying error messages.

Figure 7.2 shows the sample code that checks for the user type (whether one is a patient, doctor or management member) when one logs in.
When the user type is identified, the system redirects the identified user to their assigned interface view. Figure 7.3 shows the sample code for redirecting a member of the management team to the management page/interface view.

```java
region Management
    public string Dashboard => "~/management/dashboard";
    public string ManNewDoctor => "~/management/doctor/new";
    public string ManNewDoctorDetails => "~/management/doctor/new/details";
    public string ManPassword => "~/management/password";
    public string ManUsername => "~/management/username";
    public string ManPicture => "~/management/picture";
    public string ManNewUser => "~/management/admin/new";
@endregion

--------*user login status check*
private void Check()
{
    if (!SV.IsLoggedin)
    {
        Response.Redirect(nav.Logout);
    }
    else
    {
        if (SV.Status.ToLower() != "management")
        {
            Response.Redirect(nav.Logout);
        }
    }
}
```

Figure 7.3: Code for redirecting a user to their specific interface.
7.2 Appendix B: Interview questions

We were able to interact with a few people while conducting our oral interviews. Below are a few interview questions we asked the patients we encountered:

a. How often do you make an appointment with a doctor?

b. How long does it take for you to receive a response after requesting for an appointment?

c. What services do you think should be improved by this health facility?

Below are some interview questions we asked the health workers:

a. What procedure do patients follow to make an appointment with a health specialist?

b. Is there a way or method currently used to distribute the workload among doctors within the facility? If yes, please tell us about it.
7.3 Appendix C: Work plan

The anticipated time frame for implementing the Appointment and Workload Management System was approximately six months, and this was followed subject to our academic calendar for the year. Below was the anticipated plan that we followed during the implementation process:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data collection through interviews and Internet research</td>
<td>Two weeks</td>
</tr>
<tr>
<td>Data analysis</td>
<td>One week</td>
</tr>
<tr>
<td>System design and implementation</td>
<td>Twenty weeks</td>
</tr>
<tr>
<td>System testing and validation</td>
<td>One week</td>
</tr>
</tbody>
</table>

Table 7.1: Work plan.