

BCS HEQ PGD Professional Project Documentation

E-Health Care System

For Jayarathna Consultation Services (Pvt) Ltd

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Abstract

This E-Healthcare system was developed as per the requirement of the Jayarathna Consultation Services (PVT) Ltd. who can be considered as one of the major healthcare service providers in Sri Lanka. Their key objective in developing this system was to enhance their customer base and increase their profit by surpassing the geographical barrier. One of the major problems faced by the patients who are suffering from certain illnesses is that it may be difficult for them to travel to a consultation center to consult a doctor. In the recent event of the COVID 19 pandemic the patients were not able to go to a consultation center to consult a doctor even at an emergency. Furthermore some of the patients do not remember to bring the prescriptions which were given to them for certain other illnesses when they consult a doctor. This will lead to several allergies when using different medications and drugs together. And also it is difficult for the patients to manage their test reports and prescriptions as they are paperwork and hardly manageable.

An online web based E- Healthcare system was developed by the candidate as a solution for the above mentioned problems. In this system both the doctors and patients can register to the system and login. The registered patients can request appointments if they know the doctor to be consulted and if not they can use the help option to find the most suitable doctor to be consulted. The patient's profile is updated with the medical histories, test results and the previously given prescriptions so that there won't be any complications when using several medications together. This project has a mobile medical testing facility as well for the patients who are living nearby. As the concept of time is considered as one of the most valuable aspects in the daily routine of the public, this system can help the patients to save their precious time. This e – healthcare system improves the user friendliness and maximizes the convenience of the patients by managing their medication and test results on behalf of them.

This system has been developed with the choice of object oriented design methodology. PHP was used as the server side language. JavaScript, HTML, CSS was used as client side languages. Apache web server was used as the web server and MySQL was used for database transactions.

Acknowledgement

The success of this project lies on the contribution of many individuals.

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List of acronyms

BCS – British Computer Society

HEQ – Higher Education Qualification

PGD – Professional Graduate Diploma

MBCS – Member of the British Computer Society

CT- Computed Tomography

MRI – Magnetic Resonance Imaging

ECG – Electrocardiogram

EEG – Electroencephalogram

EMG – Electromyography

SDLC – Software Development Life Cycle

RAD – Rapid Application Development

ER – Entity Relationship

HTML – Hypertext Markup Language

CSS – Cascading styling sheet

PHP – Hypertext preprocessor

SQL – Structured query language

DBMS – Database management system

IIS – Internet information services

AJAX – Asynchronous JavaScript and XML

XML – Extensible markup language

CD-ROM – Compact Disk Read only memory

SWOT – Strengths, weaknesses, opportunities and threats

Chapter 1

Introduction

1.1 Introduction

1.1.1 Purpose of the project

The British Computer Society which is the Chartered Institute for the IT professionals provides numerous opportunities for the IT enthusiasts to become IT professionals by providing internationally recognized IT qualifications for a career in Information Technology. Successful completion of the BCS- HEQ is equivalent to a UK honours degree and is also accepted as an entry qualification for a Master's degree in both local and foreign universities.

BCS PGD Project is a mandatory prerequisite to become a professional member of the British computer Society (MBCS). Hence in order to accomplish this course requirement a web-based E- Health Care System for the “Jayarathna Consultation Services (PVT) LTD” has been developed. Thereby I here present the system and its documentation for the project I developed.

1.1.2 Company Background

Jayarathna Consultation Services (PVT) LTD is a medical channeling centre located in the city of Kandy in Sri Lanka. This company was established in 2005 under the chairmanship of a retired medical practitioner Professor A. M. K. Jayarathna. This company offers various healthcare facilities to the customers such as Channeled consultations, Counseling sessions and also Laboratory facilities. They provide highest values of clinical services across a wide range of specialties with leading specialist doctors and surgeons. Driven by the vision of providing healthcare excellence through patient-centered care, Jayarathna Consultation Services (PVT) LTD has become one of the pioneers in channeled consulting services in Sri Lanka.

The customers have the opportunity of consulting leading specialist doctors in the fields of Cardiology, Pediatrics, Gynecology, Psychology, Dermatology, Endocrinology, Nephrology, Neurology, Urology, Radiology, Oncology etc. In addition they provide diverse laboratory facilities for the customers under the categories of Bio Chemistry, General Pathology, Hematology, Serology etc. and

also medical tests such as CT/ MRI / Ultra Sound scans, ECG, EMG, EEG, Holter Monitoring Test, X- Ray etc.

1.2 Current System

The current system of the Jayarathna Consultations (PVT) LTD. is a fully manual system. All the activities in this system were carried out via human interaction. These manual procedures include,

- Appointment management
- Human resource management
- Laboratory and medical test management
- Payment management
- Report management

The patients can visit the consultation centre or call the receptionist to arrange the appointment. The receptionist should enter the appointment to the appointment list for the respective doctor and should give the patient a number according to which the consultation is carried out. The patients should decide the doctor whom they want to consult. All the consultations are done on site. The payments are done on site after when the patient arrives to the consultation center for the appointment. These payments include the charge of the doctor plus the charge of the consultation center. Payments are accepted as cash or Visa/Master debit and credit cards.

The customers can request for the medical tests only after they appear at the consultation center. Call requests are not accepted. The payment has to be done prior the medical test being carried out. The laboratory staff will call the customers to let them know that the results have arrived.

Human resource management in the current system involves a huge amount of paper work. The doctors should register and should provide the medical practice license when registering. Laboratory technicians, nurses and the other staff members are recruited and managed manually. Monthly and daily reports should be prepared by the managers and the respective staff. Ledgers, log books and paper based media are used to keep track of the accounts. The staff members of the Consultation center have encountered many losses due to the errors occurred during managing these accounts.

However in the current system there is not efficient way of recording and maintaining the patient's medical history records which will be useful for the next

consultation. The staff members of the consultation center found it complicated for them to retrieve information at emergency situations as it is time consuming to go through the recorded data manually. Also the current system of the Jayarathna Consultation Services (PVT) LTD did not have any mobile medical testing facilities for the patients who are having difficulties in travelling. Following is an illustration of the existing system.

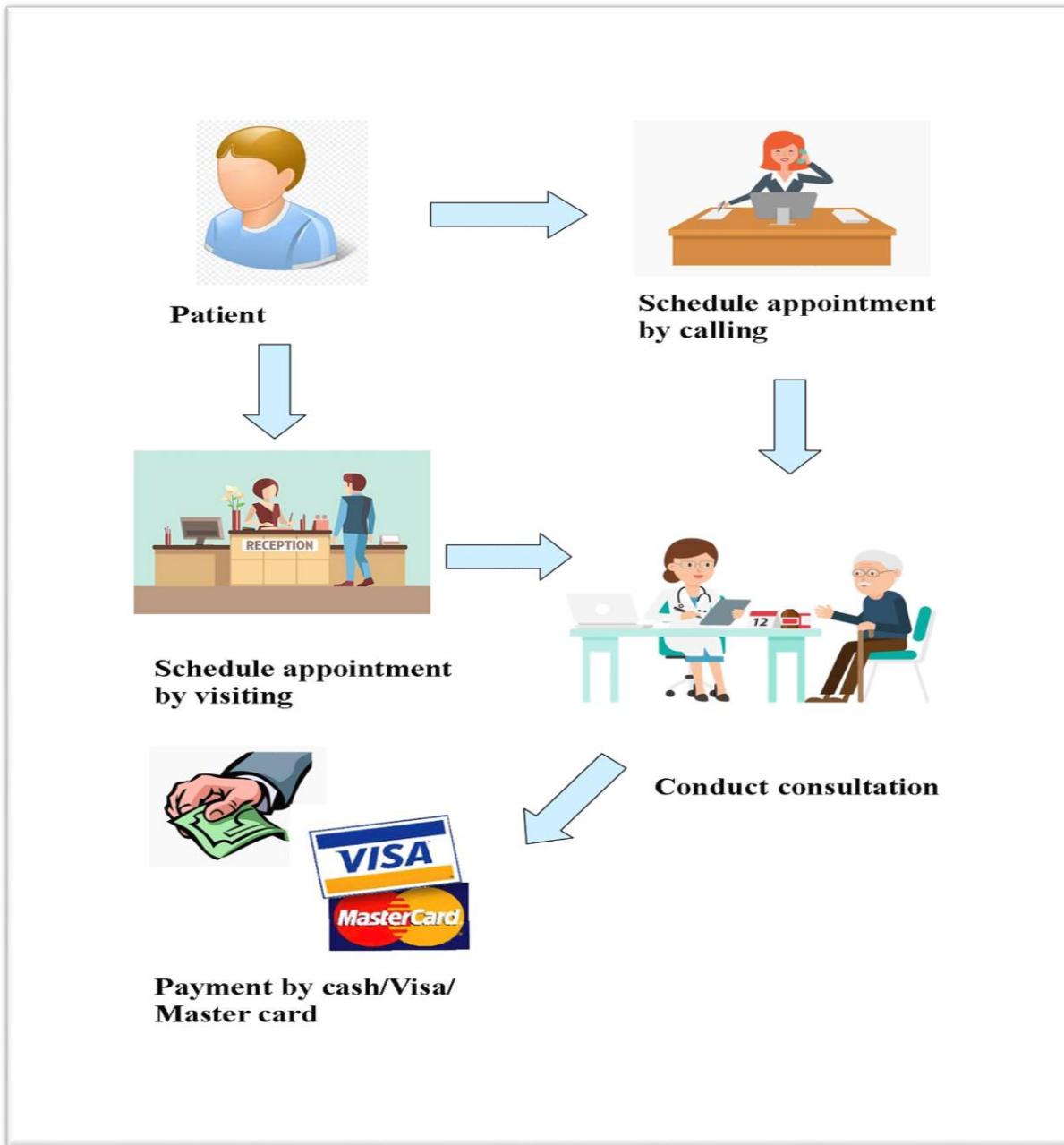


Figure 1.2.1

1.3 Motivation

Due to the recent pandemic situation in the world an E- Health Care system has become a timely need for the people around the globe. Lots of people who are suffering from several illnesses had to face many difficulties recently as there is a high risk of being infected from the viruses when they had to arrive at the consultation centers or hospitals for their necessary consultations. Several deaths due to heart attacks were even reported in many countries as the patients refuse to go to the consultation centers or hospitals since they are exposed to the viruses causing fatal infections.

For most patients who are having severe illnesses are advised not to travel longer distances as it might make their health situation weaker and worse. Therefore it will be very productive for them if the company can offer them with online consultation facilities.

Hence the client has requested to build an E- Health Care system as a solution to this problem identification and also as a new business improvement to expand the system enhancing their business to the global plane.

1.4 Project Scope

The users who intend to use the proposed web based E- Healthcare system is,

- Patients
- Doctors
- Administrators
- Laboratory Technicians

A summary of the main modules of the proposed web-based E-Healthcare system is illustrated using the following diagram.

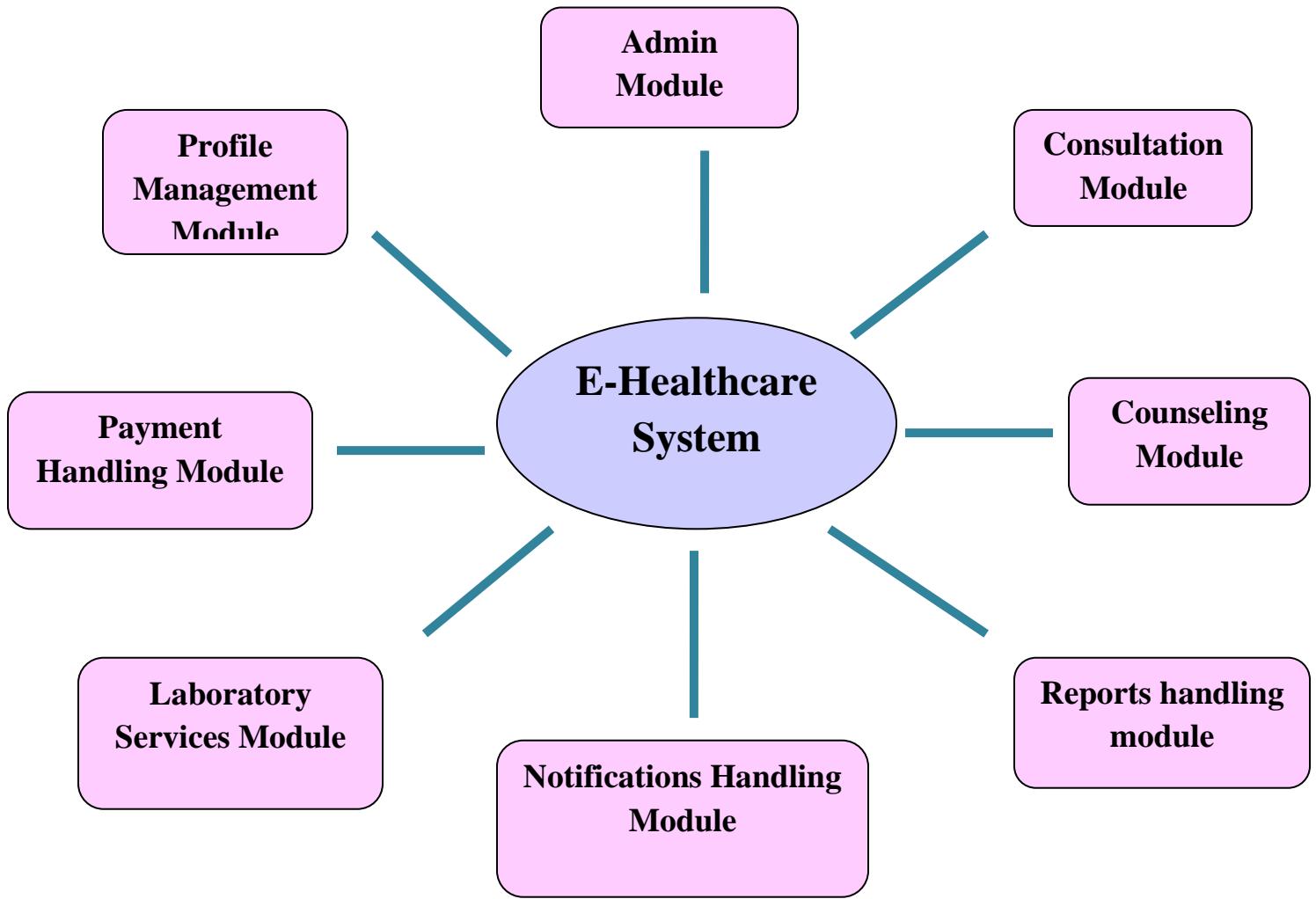


Figure 1.4.1

- **Profile management module**

The users can get registered in the system by submitting the registration form with the required information. The doctors when registering should upload a scanned copy of their medical practice license which will be reviewed and accepted by the administrators. Secure login and logout options are available with encrypted passwords. The users have the ability of resetting the password if they need or forget their old password.

- **Admin module**

The administrator is capable of managing the doctors, patients, appointments, profiles and medical laboratory tests through the admin panel conveniently. All the notifications will be visible to the administrator once logged in to the system.

- **Consultation module**

The registered users once logged in to the system can schedule an appointment by entering their symptoms or the disease to the relevant form. Then the system will analyze the entered data and find the best suited doctors for the user. From the filtered set of doctors the patients can select their desired doctor and check their availability and can schedule the appointment. The appointments could be scheduled either online or onsite. After the consultation is carried out the prescriptions are sent via email for the online consultations. The doctor should update the medical history of the patients after each consultation. The patient can also cancel their appointments within a given period of time.

- **Payment module**

The registered users after scheduling their appointment must pay their consultation fees. If the consultation is an onsite consultation the fee must be paid via cash/credit/debit cards. In case of an online consultation the payment must be done online. Online payments must be verified from the bank. This module generates payment receipts for the online and onsite payments. The receipts for the online payments are sent via email.

- **Counseling module**

The registered users once logged into the system can schedule a counseling session by selecting their desired consultant after checking the available time slots. The sessions could be scheduled either online or onsite. After the session is over the necessary prescriptions are sent via email for the online sessions. The doctor should update the medical history of the patients after each session. The patient can also cancel their appointments within a given period of time.

- **Laboratory services module**

The medical tests could be done either onsite or the users can request for the mobile medical test facilities. The registered users once logged in can request for mobile medical tests by selecting the required medical test. The mobile medical

testing facilities are only available under the categories of Bio chemistry, General pathology, hematology and Serology. If the user requests for the mobile medical test facility the laboratory team will go to the patients residence and collect the sample to be tested and the test is conducted at the laboratory. The results are sent to the user via email. A hard copy of the test results will be mailed only if the user requests.

- **Notifications handling module**

When the user schedules an appointment, counseling session or a medical test both the patient and the doctor will receive a confirmation email. Notifications are also sent to the users in order to confirm the transactions and changes made in their profiles. The administrator receives notifications about managing appointments, profiles, medical test requests, patients and doctors.

- **Report handling module**

Generate planned and ad hoc reports. Furthermore this module has the ability of report customization and auto emailing the generated reports to the administrators.

1.5 Project Objectives

The objective of this system is to offer a platform to the customers in order to satisfy their healthcare needs online as well as to automate most of the internal functions of the Jayarathna Consultation Services (PVT) LTD.

- Increase the profit of the organization by surpassing the geographical barrier by an initial percentage of 30%
- Maximize the customer satisfaction by enhancing the efficiency by a percentage of 60%
- Increase reliability and efficiency by a percentage of 70%
- Manage appointments easily
- Gain competitive advantage over the other competitors
- Satisfy administrator needs in decision making through report generation
- Manage doctors, patients and medical tests conveniently
- Offer an efficient service to the patients through updating their medical history in their profiles

1.6 Document Arrangement

This section of the documentation will present a brief overview about the content of the remaining chapters.

Chapter 2 – Requirement analysis

The chapter illustrates the enigmas found in the existing manual system and how the proposed system solves them using the new functionalities introduced. The similar systems were evaluated in the literature review and further the requirements were analyzed and documented under the categories of functional, non-functional and domain requirements for better understanding.

Chapter 3– System design

This chapter illustrates the feasible solutions which can be used to develop the system. Different alternative development strategies, system software and process models were discussed and the most suitable was selected among them. The system design was presented by including design diagrams such as use case, sequence diagram, class diagram, activity diagram and entity relationship diagram. The major user interfaces of the proposed system were also included in the end of this chapter.

Chapter 4- System Development

This chapter illustrates the implementation environment of the proposed web system and has described the tools and technologies which were used in the development process. Platform dependency of the system was described in this chapter and interactions of the main modules are presented using a diagram. Main code segments and the database table structures were also included in the end of this chapter.

Chapter 5 – Evaluation

In this chapter the testing strategies which were used in the verification and validation process was discussed. The developed project has used black box testing, white box testing and system testing as the testing strategies. The test cases of the core modules of the system such as login, registration, appointment reservation were presented in this chapter. At the end of this section the user evaluation form which was filled by the client was presented. The segment also contains screen shots of the results obtained by executing the test cases.

Chapter 6 – System implementation and maintenance

This chapter illustrates different implementation strategies used. However the phased implementation method was used to implement the developed web system. The pre implementation plan was presented followed by the user training techniques. At the end of this chapter some of the significant topics related to the maintenance of the system were discussed such as the data backups, application support and maintenance plan, change request handling and version controlling.

Chapter 7 – Critical Appraisal

This chapter illustrates the difficulties, challenges faced by the developer and how they were resolved. Also the constraints and assumptions made were also mentioned within this chapter. The future enhancements that could be done to the developed system were suggested and the overall achievement of the project was discussed. The project was scheduled to monitor the progress of the project and the actual Gantt chart used for the actual project time frame was presented at the end of the chapter.

1.7 Summary

This is the dissertation of the “E- Healthcare system” done as a partial fulfillment of the requirements of BCS Professional Graduate Diploma examinations which is a mandatory requirement to complete the BCS- HEQ.

This chapter contains a brief overview of the company and the existing manual system of the organization. The motivation, scope of the proposed project and its objectives are mainly discussed in this episode. Furthermore this section contains a brief summary about all the chapters that have been encountered.

Chapter 2

Analysis

2.1 Introduction

Analysis is the practice of determining what the system should do in order to solve the problem. This process is concerned about gathering information about the existing system as well as establishing the requirements of the new system. Through analysis it is possible to get an unambiguous, consistent and a comprehensive image of the required system. Analysis is also used in system modeling. This practice is also known as “Requirements Engineering”.

2.2 Requirement gathering techniques

Understanding and documenting the requirements of the clients plays a critical role in the software development process. For a successful system to be built the user and system requirements must be unambiguous, consistent and complete. This process is a complicated practice due to numerous reasons.

- Stakeholders don't know what they really want
- Stakeholders express the requirements in their own terms
- Different stakeholders may have conflicting requirements
- Organizational and political influence
- Requirements change during the analysis phase [1]

Hence selecting the most effective requirement gathering technique is essential in order to get a comprehensive understanding about the client's expectations. The requirement gathering techniques are also known as “Fact finding techniques”.

Three requirement gathering techniques were used in this project.

- Interviews
- Observations
- Document inspection

2.2.1 Interviews

An interview is a formal discussion between two individuals. The one asking questions is known as the interviewer and the one who responds to the questions is known as the interviewee. The responses given by the interviewee is recorded during the interview itself. Generally, the interviewees are the current users of the existing system and the potential users of the proposed system.

The reason for choosing interviews as a fact-finding technique in the proposed project is that it is easy to clarify the doubts found in the previously gathered information by asking extra questions from the stakeholders. It is vital to elucidate the doubts as the proposed system is dealing with the public health.

One-on-one interviews were used to gather requirements from the employees, managers and customers of the Jayarathna Consultation Services (PVT) LTD. The interviewers sit together with the key stakeholders of the organization and discuss with them about their needs and about the current working environment. The discussion started with an unstructured interview. At the latter part of the interview the interviewer asked a prepared set of questions to gather information from the stakeholders. The interviews lasted for about 20-30 minutes. The key stakeholders who were selected for the interviewing process are managers, doctors, patients and staff members. The interview was pre planned and asked both close and open end questions from each interviewee. After the interview the recorded results were given back to the interviewees in order to verify the content.

2.2.2 Observations

Formal visits were made to the Jayarathna Consultation Services (PVT) LTD. in order to observe the interactions of the users with the current manual system and to understand the ordinary flow of activities within the organization. This method was helpful in identifying problems, bottlenecks and misunderstandings caused by the other fact-finding techniques about the current working processes. However, though this technique is highly time-consuming, it was extremely reliable and inexpensive than the other requirement gathering techniques. Furthermore, through observation it was possible to gather data about the physical environment of the workplace.

The reason for selecting observations as a fact-finding technique for the proposed system is that it is possible to observe the genuine process of the existing manual system through direct and indirect observation techniques.

2.2.3 Document inspection

This technique involves in reading through historic documents such as annual reports, financial reports, consultation details, doctor and patient details, salary reports of the workers, invoices, tax files etc. to obtain information about existing systems. The gathered data during this technique was later used to prepare questions for the interviews.

The reason behind selecting document inspection as a fact-finding technique in the proposed system is that it could be considered as a reliable method to examine the existing manual system.

2.3 Enigmas found in the existing system

After gathering the requirements following were identified as the drawbacks of the current system.

- Time consuming**

The patients most of the time should have to try calling many times to schedule their appointment by phone as most of the telephone lines are busy all the time. The office staff on the other hand must spend some time to manage appointments as they are done manually.

- Less efficient data retrieving process**

In the existing system all the appointments were recorded in log books. Hence retrieving those data is very difficult.

- Difficult to maintain the medical history records of the patients**

There is no method in the current system to facilitate the patients to maintain their personal medical records. Hence they have to maintain them by themselves. It is very complicated and risky for the doctors to assign prescriptions for the patients who has not maintained their medical history records properly.

- Storage issues**

A manual file system consists of a huge amount of paper based media to store information related to the organization. This requires a large and a separate storage space. Furthermore there is a high risk of losing these records as they could be exposed to disasters such as floods, fires, pest attacks etc.

- **Data redundancy and inconsistency**

Repeated records are found in consultation management, counseling management and in medical test management sections of the organization. Manual data records consists of inconsistencies as human tend to do mistakes often.

2.4 Advantages of the envisioned system

The proposed system is designed as to address all the enigmas found in the existing system. It consists of several new functionalities which will increase user satisfaction hence increasing the competitive advantage of the organization.

- **Less time consuming**

There is no need for the patients to call the consultation center or visit to make an appointment. They can easily schedule their appointment online without any difficulties.

- **Efficient data retrieving process**

As the system is automated in the proposed system there will be very less paper based media to deal with. Hence the data retrieving process will be much easier.

- **Maintaining medical history of the patients**

After the consultation is over both the diagnose report and the prescriptions are uploaded in to the patients profile for the use of future consultations.

- **Less storage**

Since the system is automated there will be very less amount of paper work being involved. Most of the data will be stored digitally and will be stored in hard disks as softcopies. It is easier to protect the digital data than the paper based data as it is much simpler to make backups of digital data and store it elsewhere.

- **Less data redundancy and inconsistency**

Since databases are used to store the information in the proposed system there will be minimal redundancy and inconsistency being involved. As the human involvement in the data management process is less the accuracy of the information could be guaranteed as well.

- **Enhanced user friendliness**

The office staff members will gain the opportunity of interacting with an interesting graphical user interface without being limited to the pen and the paper.

- **Convenient for the patients who have difficulties in travelling**

The online consultation facility and the mobile medical testing facility offered by the proposed system will make the consultation process convenient for those who have difficulties in travelling.

- **Helps out the patients to find a suitable doctor**

The proposed system offers a new functionality to help out the patients who doesn't know which doctor to consult. The patients can enter the symptoms of their illnesses and the system will automatically filter out the best doctors suitable to treat the particular illness.

2.5 Literature Review

Different organizations offer diverse types of online healthcare systems. Currently many organizations use web-based systems in order to enhance the efficiency and increase the competitive advantage. Some of these comparable systems were analyzed and described below.

Website Features	www.doctorondemand.com	mydoctor.lk	www.plushcare.com	www.jcc.lk (Proposed system)
User account	Yes	Yes	Yes	Yes
Online appointment scheduling	Yes	Yes	Yes	Yes
Online consultations	Yes	No	Yes	Yes
Suggest suitable doctors	No	No	No	Yes
Counseling module	Yes	Yes	No	Yes
Maintaining medical history records	Yes	Yes	No	Yes
Mobile medical tests	No	No	No	Yes

Table 2.5.1

With the rapid development of the technology and the improvement of the concept of globalization at present people tend to use online facilities to full fill their daily requirements. That trend is now slowly moving towards the health sector as well. Recently due to the COVID-19 pandemic the attention of the people was drawn towards using online facilities to full fill their consultation and testing requirements. From the systems which provide such online facilities some of the major systems were reviewed and analyzed.

Doctor on demand is one of the major systems which offer online healthcare facilities. This is also a web-based system where the patients can create an account and request appointments with the doctor of his or her choice. Facilities such as appointment scheduling, counselling facilities, online consultation facilities are offered by Doctor on Demand. This system updates the patient's profile after each consultation. However, they do not provide any facilities for mobile medical tests. One of the key problems found in this system is that the user must have at least a slight understanding about the illness he or she is suffering from in order to choose a suitable doctor. If the patient chooses an unsuitable doctor for that particular sickness the patient's consultation fee is wasted and the sickness might get worse over time.[3]

My Doctor is another key web based online healthcare system. In this system the patients can create a profile and request appointments with a doctor of his or her choice. Facilities such as appointment scheduling and scheduling counselling sessions are offered by My Doctor. This system allows the user to update their profile including their medical history. However, they do not provide any facilities for mobile medical tests. The main problems found in this system are,

- the suitable doctors are not suggested to the patients
- there is no facility for online consultations
- the medical history of the patient is not updated automatically hence this method is inefficient as the users tend to forget to update their profiles.[4]

Plushcare is another major web-based healthcare system. In this system the patients can create a profile and get registered to the system and request appointments with a doctor of his or her choice. Facilities such as online appointment scheduling, online consultation facilities are offered by plushcare. However, this system does not provide any facilities for mobile medical tests. Plushcare does not have any ability to manage the patient's profiles with their medical history. Furthermore, it does not

facilitate online counseling sessions and does not have any capacity to suggest the suitable doctors to the users.[5]

2.6 Analysis of requirements

2.6.1 Functional requirements

Services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations are illustrated using functional requirements.[2] Here the system services are described in detail. Functional requirements depend on the type of software, expected users and the type of system where the software is used.

- Profile management module**

Both the patients and doctors must login to the system after registration using their email and password in order to use the facilities offered by the system. The password must be hidden while the user types it in the relevant field. The system must verify the data given by the users and allow them to login. The doctors when registering must submit a scanned copy of their medical practice license. The administrators will then review the doctor's account and allow them to register to the system. All the passwords in the system are encrypted to ensure a secure login. The users can reset their passwords when needed. Both the doctors and patients can chat with the administrator to resolve the issues they have regarding the system.

- Admin module**

The system must have the ability to identify the administrator login precisely so that administrator account will be more secure and only the authorized users will have the access to the administrator account. Securing the administrator account is crucial in a system which is dealing with the public health. The administrator once logged in is capable of managing doctors, patients, appointments, profiles and medical laboratory tests easily through the administrator panel. The administrator can add and remove patients and doctors from the system. The administrator also has the capability to cancel and change appointments and medical tests.

- Consultation module**

The registered patients once logged in can schedule their appointments online. The patients can either select their desired doctor or for the patients who don't know the

field of the doctor to be consulted, can enter their symptoms to the system and the system will filter out the best suited doctors for the patient. The system after checking the availability of the doctor selected by the patient, schedules the appointment. The patients have the choice of cancelling the scheduled appointments within a 24 hours prior to the time of the appointment. The doctors after conducting the consultation must send the prescriptions to the patient via email for the online consultations and must update the medical history of the patients as well.

- **Payment module**

The patients once reserved an appointment or a medical test will receive the payment details together with the confirmation message of the scheduled appointment or the medical test. The patients can click on the provided link to continue with the payment process. The users must make their payment online. The online payments must be verified from the bank. Once the payment is verified the system must generate an invoice and send to the patient via email.

- **Counseling module**

The registered users once logged in to the system can schedule their counseling appointments online. The system after checking the availability of the doctors selected by the patient, schedules the appointment. The patients have the choice of cancelling the appointments 24 hours prior to the scheduled time. The doctors after conducting the counseling session must send the prescriptions to the patient via email for the online counseling sessions and also must update the medical history of the patient.

- **Laboratory services module**

The registered users once logged in to the system can request for mobile medical tests by selecting the type of the test required. The user must fill in the required details in the form provided in order to schedule the mobile medical test. The results are sent to the user via email and will be updated in the patient's profile.

- **Notifications handling module**

When a patient schedules an appointment, counseling session or a medical test both the patients and doctors must receive a confirmation email. Notifications are also sent to the users in order to confirm the transactions and changes made in their

profiles. The administrator receives notifications about managing appointments, profiles, medical test requests, patients and doctors.

- **Report handling module**

This module must have the ability of generating planned and ad hoc reports, customizing them and emailing them to the administrators when needed. The daily, monthly or annual income reports could be requested by the administrator from the report handling module. This module can also generate maintenance reports and sales reports about the appointments and medical tests performed daily, monthly or annually.

2.6.2 Non-functional requirements

Non- functional requirements are the constraints on the functions offered by the system such as timing constraints, constraints on the development process, standards, etc [2]. These requirements are not directly concerned with a specific function and may relate to several functions of the system. Non- functional requirements deal with the performance and the technical aspects of a system.

- **Security**

Security requirements are essential in order to prevent unauthorized access to the user data. Passwords were encrypted in the system to ensure the secure login facility. The security requirement assures that all the data within the system are protected against malware attacks and unauthorized access.

- **Usability**

User friendliness is an essential requirement for a system. The proposed system should have interesting user interfaces with suitable colors and also should have online help facilities, navigation links, contact information of the management and the necessary documentation in order to improve the user friendliness.

- **Availability**

Availability ensures that a system is always available and ready to satisfy the client requests. Hence it is essential to ensure that the downtime of the database servers is extremely low.

- **Concurrency control**

In an online system it is vital to avoid concurrency related problems as lots of users will be using the system at the same time.

- **Robustness**

The software must have the ability to cope up with the errors occurring in the system. Meaningful error messages must be displayed to the users in case of an error.

- **Reliability**

As the proposed system is E- Healthcare system reliability plays a critical role. The system should be able to perform all the functions accurately and produce reliable outputs.

- **Performance**

The system should provide quick and accurate responses. The performance of the proposed system is increased by using query optimization.

2.6.3 Domain requirements

Domain requirements are the requirements that come from the application domain of the system. In the proposed system when the patient enters the symptoms of the disease the system should be able to analyze the symptoms and suggest the user the best suited doctors for the consultation.

2.7 Summary

At the start of the chapter the requirement gathering techniques used in the proposed system were discussed. Further the drawbacks of the manual system and the advantages of the proposed system were reviewed. At the middle part of the chapter a literature review was conducted by examining and evaluating the similar systems. Finally the requirements were further analyzed under the categories of functional, non-functional and domain requirements.

Chapter 3

System Design

3.1 Introduction

Software design could be considered as the most significant step of developing a software system. It defines how software should be implemented by developers. Software design maps software requirement specification elements in to design elements. The components of the system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system are designed during this phase.

3.2 Alternative solutions

Strategy selection

- **Developing from the scratch**

When developing from the scratch the development environment needs to be created from the beginning and also must be concerned about the platform dependency and programming languages. This approach is complicated as there will be a lot of bugs in the code since there is no previous code to reuse. Due to the changing requirements of the users this strategy is practically complex. As the Jayarathna Consultation Services (PVT) LTD. didn't have a web system previously developing from scratch is a feasible option for the proposed system. However the client did not like this option since it is time consuming and costly.

- **Using open source software**

In open source software the source code could be reviewed, modified and enhanced by anyone. This technique is not as time consuming as developing from scratch. Since the code is already developed only some of the modifications have to be done in order to develop a new system. Prior using these components, the user must agree to the terms and agreements of the code provider. However, the new system may need some new modules to be added to the source code. Hence the new components have to be integrated to the existing source code. This process of integrating the new components is costly and will make the system more complex. Therefore, this

strategy was not used to develop the web system of Jayarathna Consultation Services (PVT) LTD.

- **Using templates**

This approach is less time consuming and also less costly. The structure of the system in this strategy is already created hence it only has to be modified in order to develop the new system. The developing stress is less in this methodology as it is less exhausting to modify an existing code rather than generating it from scratch. This strategy was used to develop the web system of Jayarathna Consultation Services (PVT) LTD. as this is the most suitable and the feasible strategy to develop the proposed system according to the budget and time limitations.

- **Component reuse**

Commercial off the shelf software components, developed by vendors who offer them as products, provide targeted functionality with well-defined interfaces.[4] These existing software artifacts could be reused to develop the novel system. This strategy has various benefits such as improved reliability and risk reduction since these components were well tested prior releasing them. Also, this strategy is less time consuming. However, there are some drawbacks of software reuse. The maintenance cost is high since some of the features required to implement the new system may not be available for reuse. Another problem of software reuse is that the tools may become obsolete over time. The reusable components have to be managed by maintaining a component library which will lead to a large overhead. Therefore, this strategy was not used to develop the web system of Jayarathna Consultation Services (PVT) LTD.

Development Strategy Selection

- **Stand-alone application**

Stand-alone applications are traditional applications that are installed on each client system. These applications do not get pooled with extra applications. The stand-alone applications can run without the help of any other computer process or the internet. All the tasks and functions associated are no accessible from anywhere else but the installed computer. This is not effective in the proposed system as this is an online system and also quite a few parts of the system are linked to the central

system. Therefore, this strategy was not used to develop the proposed web system of Jayarathna Consultation Services (PVT) LTD.

- **Mobile system**

A mobile system is a system which is centered on mobile devices for computing and information needs. At present mobile systems are admired by the users as they provide an efficient service to the customers. The mobile systems are movable and easy to carry. However they require additional devices and may cost more than expected. Also the instability and poor battery quality could be stated as the drawbacks of mobile systems. In order to implement a mobile system the company should have a skilled and a well trained staff. This strategy was not used to develop the web system of Jayarathna Consultation Services (PVT) LTD. since the company does not intend to recruit a new staff and also as the mobile systems are exclusively built for the mobile devices it is not suitable to build the proposed system as it should also be accessible through the other computers as well.

- **Cloud based system**

A cloud based system is a system which is running on the internet with its components stored online. These systems facilitate to save a substantial cost as it does not need any hardware investments. Cloud systems allow the users to deploy their services quickly. These systems have additional advantages such as reliability, mobility and collaboration. However cloud based systems have various bandwidth issues accompanied with it. Also most of the cloud service providers tend to enable the major features only. Hence it is not promising to receive every required feature or to customize them. As cloud systems are entirely dependent on the internet connections there can be a downtime due to connection troubles. This could also be considered as an obstacle of using cloud based systems in the proposed system. Security issues are as well prominent in cloud based systems as the sensitive data are being exposed to the cloud service provider. As the proposed system is a health care system the cloud based systems are not an appropriate approach to be used in the system of Jayarathna Consultation Services (PVT) LTD.

- **Web based system**

With the emergence of web 2.0 technology the web based systems are now evolving in to sophisticated computing environments that not only provide stand-alone features, computing functions to the end user, but also integrated with cooperate

databases and business applications. [4] The web based approach is the most suitable strategy to develop the proposed system as reaching the global community is one of the major objectives of the client organization. The web based systems could be accessed from anywhere as long as the user has an internet connection and a web browser and also the development cost is less compared to the other strategies which were discussed. As the web systems are installed on web servers the security of these systems are enhanced due to centralized security. Unlike the traditional systems the web based systems does not have to be installed in to local machines hence the installation and maintenance is much convenient. Considering all these factors the web based system was preferred as the most appropriate strategy to develop the proposed web system of Jayarathna Consultation Services (PVT) LTD.

System software selection

- **Windows**

Microsoft Windows is an operating system which manages the computer hardware and software resources. Users are extremely familiar with the windows operating system as it is one of the widely used operating systems which are popular among majority of users. Hence most of the hardware vendors make drivers for windows. Windows operating system is equipped with a range of applications. Hence there is a vast selection of available software. Windows is also compatible with the Microsoft driven websites. Therefore, this system software was used in the proposed web system of Jayarathna Consultation Services (PVT) LTD.

- **Android**

Android is a key mobile operating system. Since the proposed system is not a mobile system this system software was not used in the proposed web system of Jayarathna Consultation Services (PVT) LTD.

- **Cross platform**

Cross platform software is system software that is implemented on multiple computer platforms. This system software has key integration challenges with their target operating systems. Cross platform software also has a extremely low code performance and limited user experience. Therefore, this system software was not used in the proposed web system of Jayarathna Consultation Services (PVT) LTD.

3.2 Process models

A software process is a set of ordered tasks involving activities, constraints and resources that produce a software system. A process usually involves a set of tools and techniques. The structure of the process guides the actions of the developers by allowing them to examine, understand, control and improve the activities that comprise the process.

The generic activities which are found in all software processes are as follows.

- Specification – What the system should do and its development constraints
- Development – Production of the software system
- Validation – Checking whether the software is what the customer wants
- Evolution – Changing the software in response to changing demands[5]

Rapid Application Development

Rapid application development (RAD) is an incremental software process model which is focusing on short development cycles. This process model is most suitable for the projects where the requirements and the project scope are well established. Hence by using the Rapid application development a ‘fully functional system’ could be developed within a very short time period. As in rapid application development there is no detailed pre planning involved it is easier to incorporate changes within the development process.

Following are the different phases of the rapid application development.

- Business modeling -The information flow in a business system considering functionality
- Data modeling-The information flow defined in the business modeling is refined into a set of data objects that are needed to support the business
- Process modeling-The data objects defined in data modeling is transformed to achieve the information flow necessary to implement business objectives
- Application generation-Rapid application development assumes the use of 4th Generation language features such as database management systems, form designers, code generators, report generators, application programming generators etc. or visual tools to generate the system using reusable components

- Testing and turnover-New components must be tested and all interfaces must be fully exercised

The traditional SDLC follows a rigid process model with high emphasis on requirement analysis and gathering before coding starts. In this approach the customer is not able to see a working version of the system for a long time. After the client sees the system, they might need some changes to be incorporated to the system. However, in the traditional SDLC a rigid process has to be followed in order to make changes. Occasionally it might not be feasible to make changes as well. RAD method should only be used when a system can be modularized to be delivered in an incremental manner.

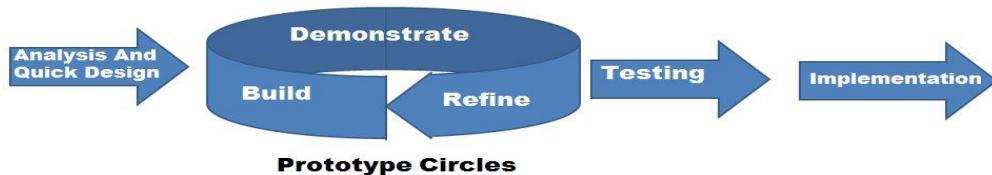


Figure 3.2.1

There are numerous benefits of using RAD model. They are,

- Changing requirements could be accommodated
- Progress can be measured
- Reduced development time
- Increases reusability of components
- Quick initial reviews occur
- Encourages customer feedback

However, there are few drawbacks of using RAD model as well. They are,

- Management complexity is more
- Suitable for systems that are scalable
- Requires user involvement throughout the life cycle [6]

As the proposed project of Jayarathna Consultation Services (PVT) LTD. is a healthcare system it might require frequent customer feedbacks as well as to make changes often as it involves the wellbeing of the public. Also, the researcher was

given a limited time period hence the development has to be rapid as possible while safe guarding the quality of the project. Due to the above factors Rapid application development model was selected as the process model which is used to develop the proposed e-healthcare system of the Jayarathna Consultation Services (PVT) LTD.

3.3 System Design

System design sits at the technical kernel of software engineering and is applied regardless of the software process model that is used. System design is an iterative process through which requirements are translated in to a “blueprint” for constructing the software. [4] The purpose of system design is to generate a technical solution that satisfies the functional requirements of the system. The system design should be clear, simple and easily understandable. This design should overcome the limitations of the existing system and help the client to achieve their objectives. The completed design also should facilitate maintenance.

The proposed e-healthcare system of Jayarathna Consultation Services (PVT) LTD. used the object-oriented methodology as the selected design technique and the software tool Microsoft Visio was used to generate the design diagrams.

3.3.1 Use Case Diagrams

A use case diagram provides a big picture of the functionalities of the system hence it is a helpful aid for ensuring that the designers have covered the entire functionality of the system. [4] A use case diagram shows the system functions from a user perspective. A use case is a typical interaction between the user/actor and the system. A use case achieves a discreet objective for the user. This diagram concentrates on what the system does rather than how. Use case diagrams therefore show the people or actors who initiate the use cases and also illustrates that an actor receives information from a use case. Hence additionally a use case diagram can illustrate the requirements of the system.

Use case diagram for the proposed system

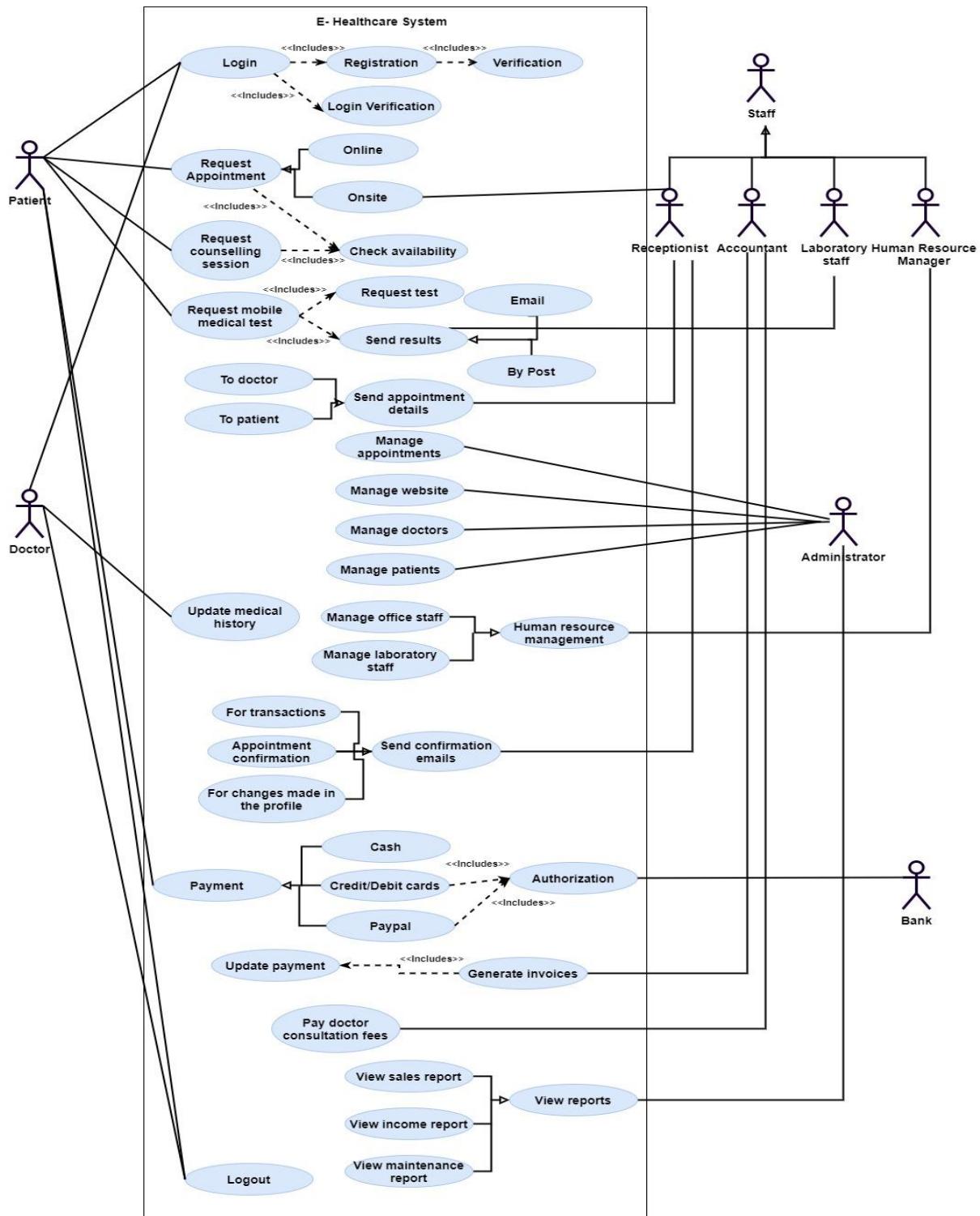


Figure 3.3.1.1

Use case diagram – Login

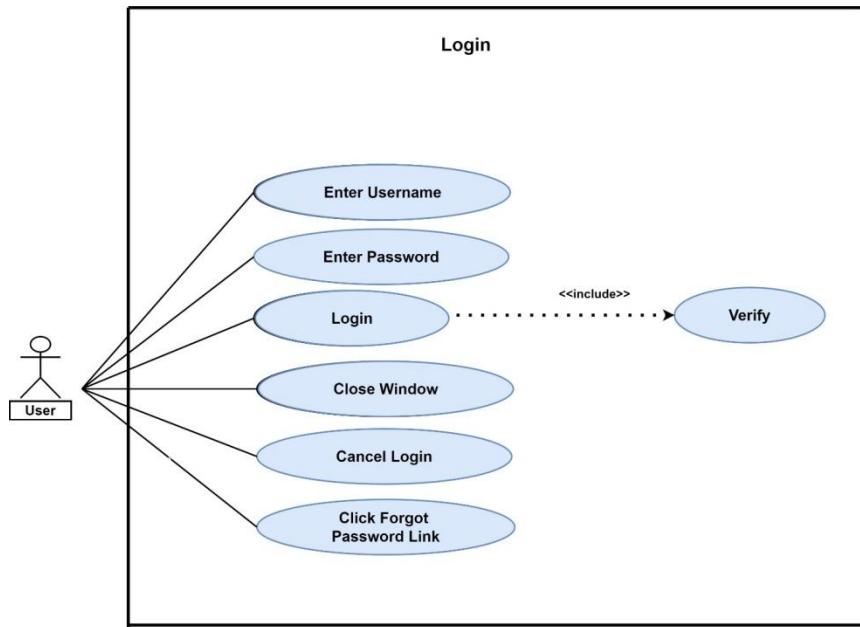


Figure 3.3.1.2

Use case number

UC-001

Use case name	Login
Overview	This use case allows users to log in to the system
Actors	Patient Doctor Admin
Conditions	<p>Pre-Condition: Patient and doctor is registered as a system user and the privileges are set by the system administrator</p> <p>Post-Condition:</p> <ol style="list-style-type: none"> 1. Login Successful – User is granted access to the system with additional privileges and system main screen is presented according to his or her role 2. Login Aborted – User cancels the login by clicking on the cancel button 3. System denies access – User is not a registered user

Business rules	System should not allow unauthorized access Users should be able to access the system by local or remote location
Main flow of event	<ol style="list-style-type: none"> 1. User clicks the login icon 2. System displays the login screen 3. User enters the email and the password and hits the login button 4. Use case terminates with post condition 1
Exceptions	<ol style="list-style-type: none"> 1. User clicks on the cancel button after deciding to cancel the login request 2. Use case terminates with post condition 2 3. User is not registered in the system 4. System displays an error message indicating unmatched email and the password 5. Use case terminates with post condition 3

Table 3.3.1.1

Use case diagram – Request appointment

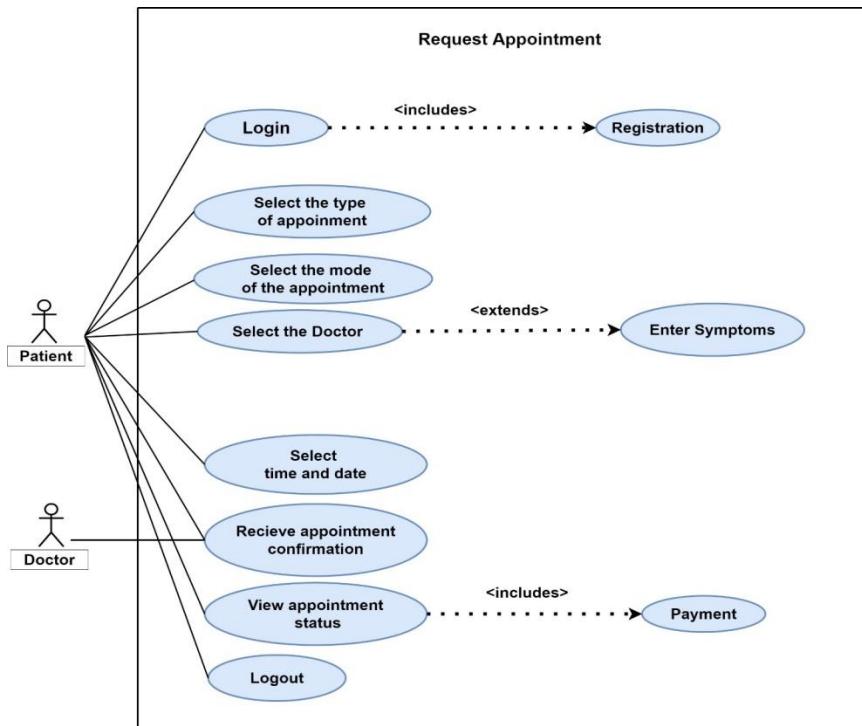


Figure 3.3.1.3

Use case number

UC-002

Use case name	Request Appointment
Overview	This use case allows patients to request an appointment
Actors	Patient Doctor
Conditions	<p>Pre-Condition: Patient must be a registered patient</p> <p>Post-Condition:</p> <ol style="list-style-type: none"> 1. Send an appointment confirmation email to the patient 2. Update the appointment schedule of the doctor 3. Successful appointment booking will redirect to payment interface
Business rules	System should not allow appointment booking for unregistered patients
Main flow of event	<ol style="list-style-type: none"> 1. Login or register to the system 2. Fill in the appointment request form indicating the particular doctor to be consulted 3. Use case terminates with post conditions 1, 2 and 3
Alternative flow of event	<ol style="list-style-type: none"> 1. Login or register to the system 2. Fill in the appointment request form and enter the symptoms to get suggestions on the most suitable doctor to be consulted 3. Use case terminates with post conditions 1, 2 and 3
Exceptions	<ol style="list-style-type: none"> 1. No appointments are available in the selected date and the selected doctor 2. Error message is displayed to the user

Table 3.3.1.2

The other use case scenarios are available in the Appendix A

3.3.2 Class Diagrams

A class diagram is a static/structural model of a system that shows all classes required to provide the functionality documented in use case diagrams. For each class it shows the attributes, operations, associations etc. The class diagrams show the interactions between the classes of the system as well. A class on a class diagram is created for each type of object in a sequence or collaboration diagram. Following is the class diagram for the proposed system.

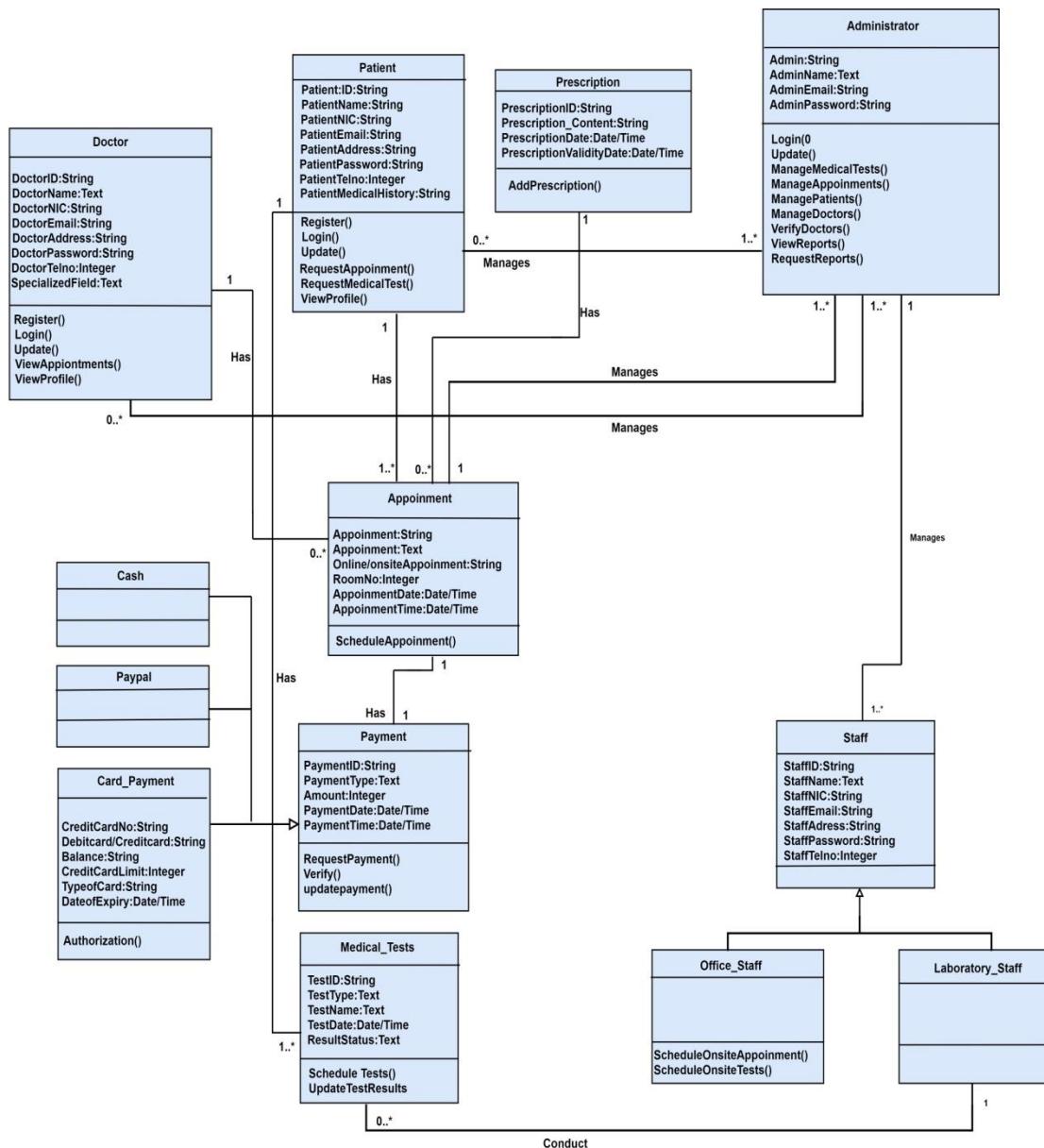


Figure 3.3.2.1

3.3.3 Sequence Diagrams

A sequence diagram shows objects and their interactions in time order. The time progresses as going down the page. It also illustrates the messages that are passed from one object to another. The sequence diagram is an interaction diagram which is considered as a dynamic diagram. The sequence diagrams are also used to show the flow functionality through a use case.

Sequence diagram – Consultation

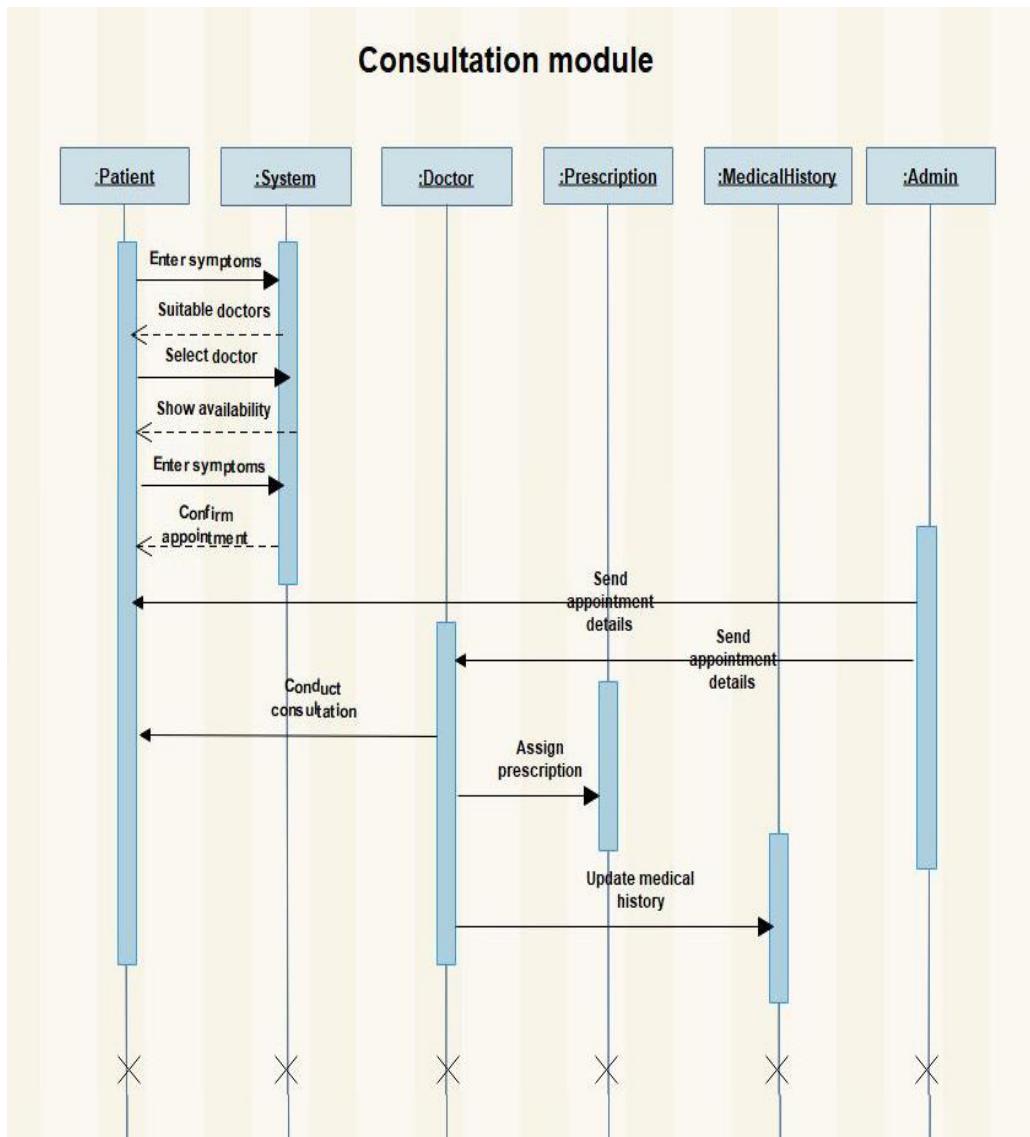


Figure 3.3.3.1

Sequence diagram – Login

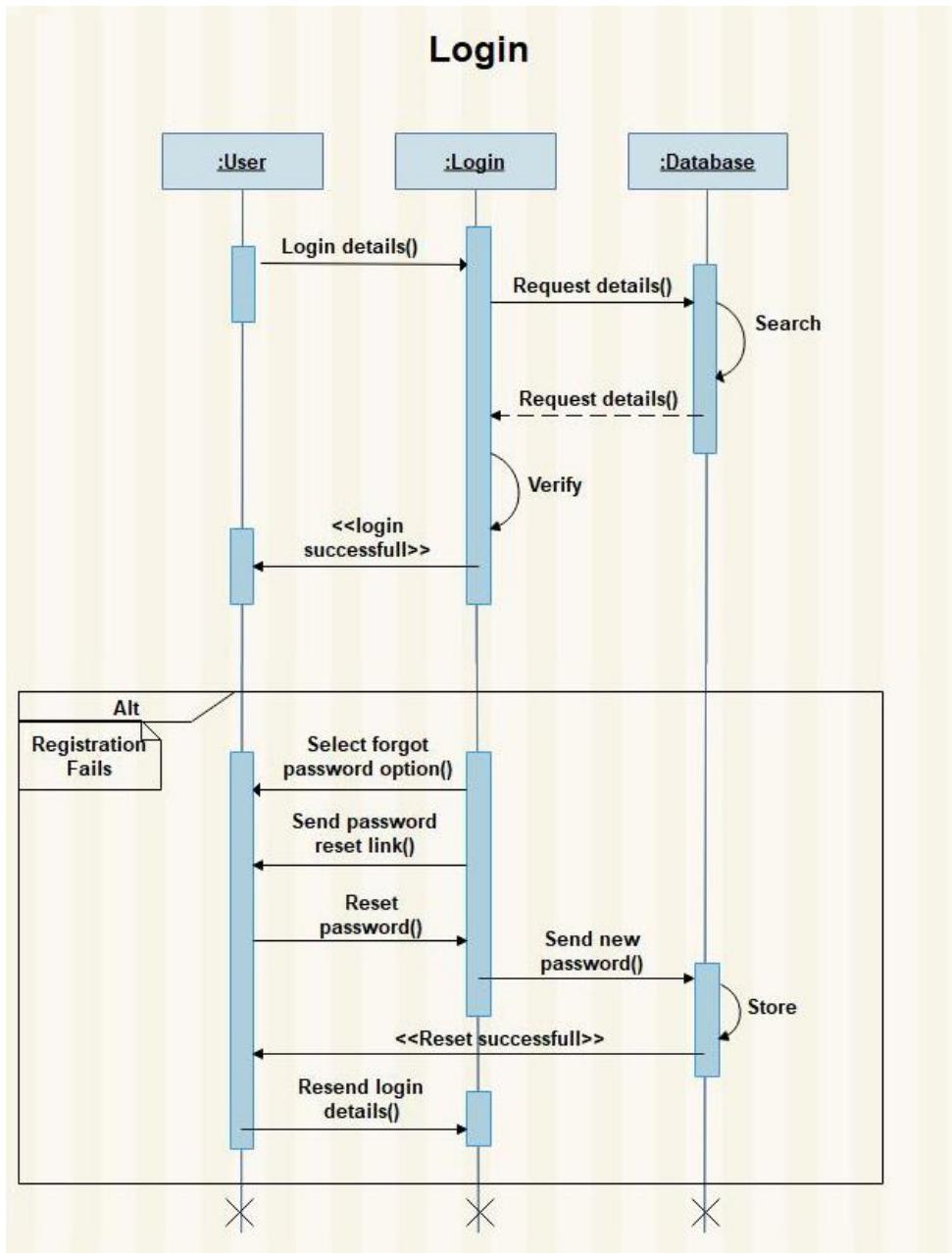


Figure 3.3.3.2

The other sequence diagrams are available in the Appendix A.

3.3.4 Activity Diagram

Activity diagrams illustrate the flow of functionality in a system. It may be used in business modeling as well. They may also be used in the requirement gathering phase to illustrate the flow of events through the use case. These diagrams define where the workflow starts, ends and what activities occur during that workflow. An activity is considered as a task which is performed during the work flow. [7] Activity diagrams can illustrate activities that are done conditionally or parallelly. They are also useful to analyze the use cases by describing what actions need to take place at which time.

Activity diagram – Login

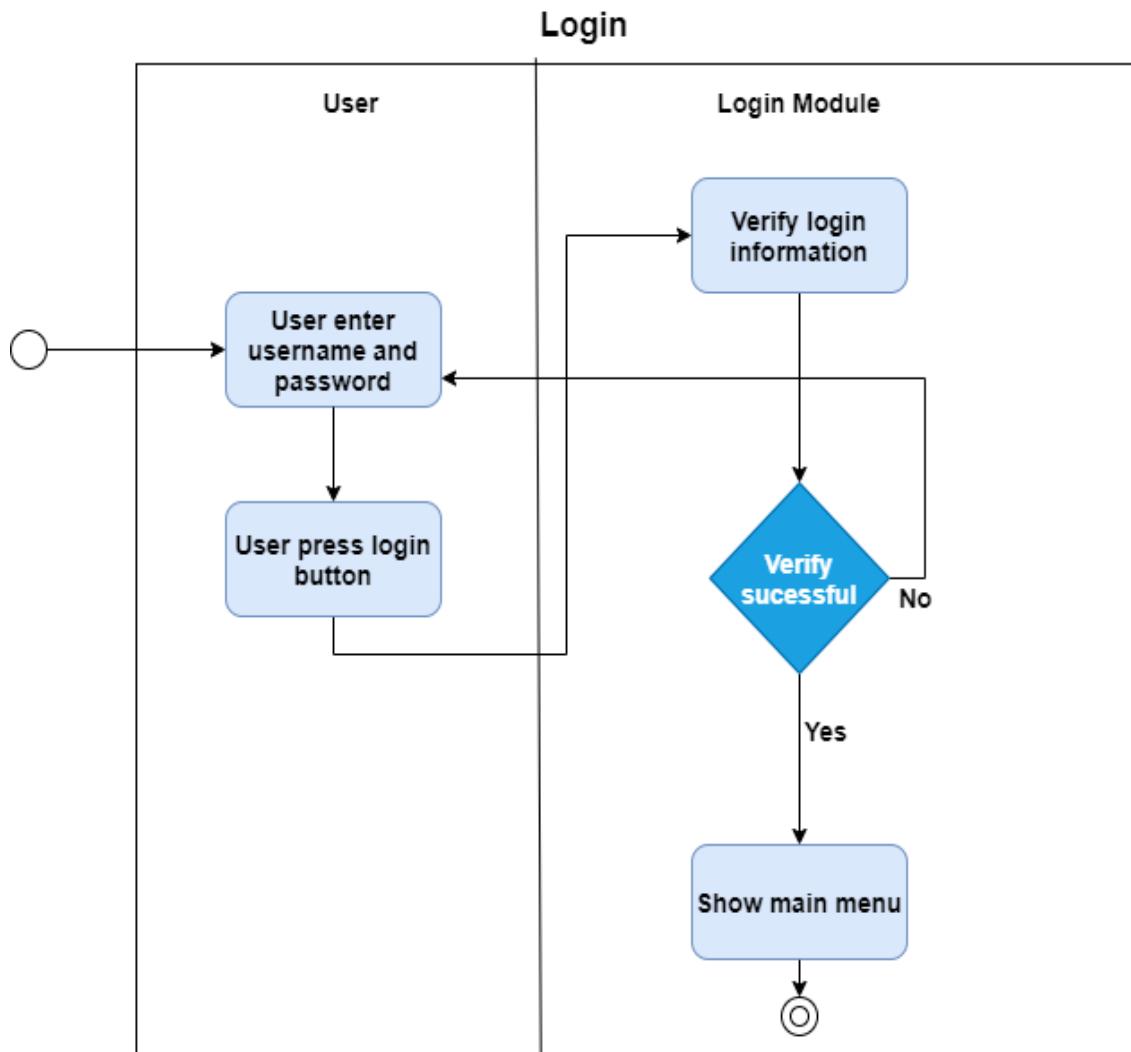


Figure 3.3.4.1

Activity diagram – Consultation

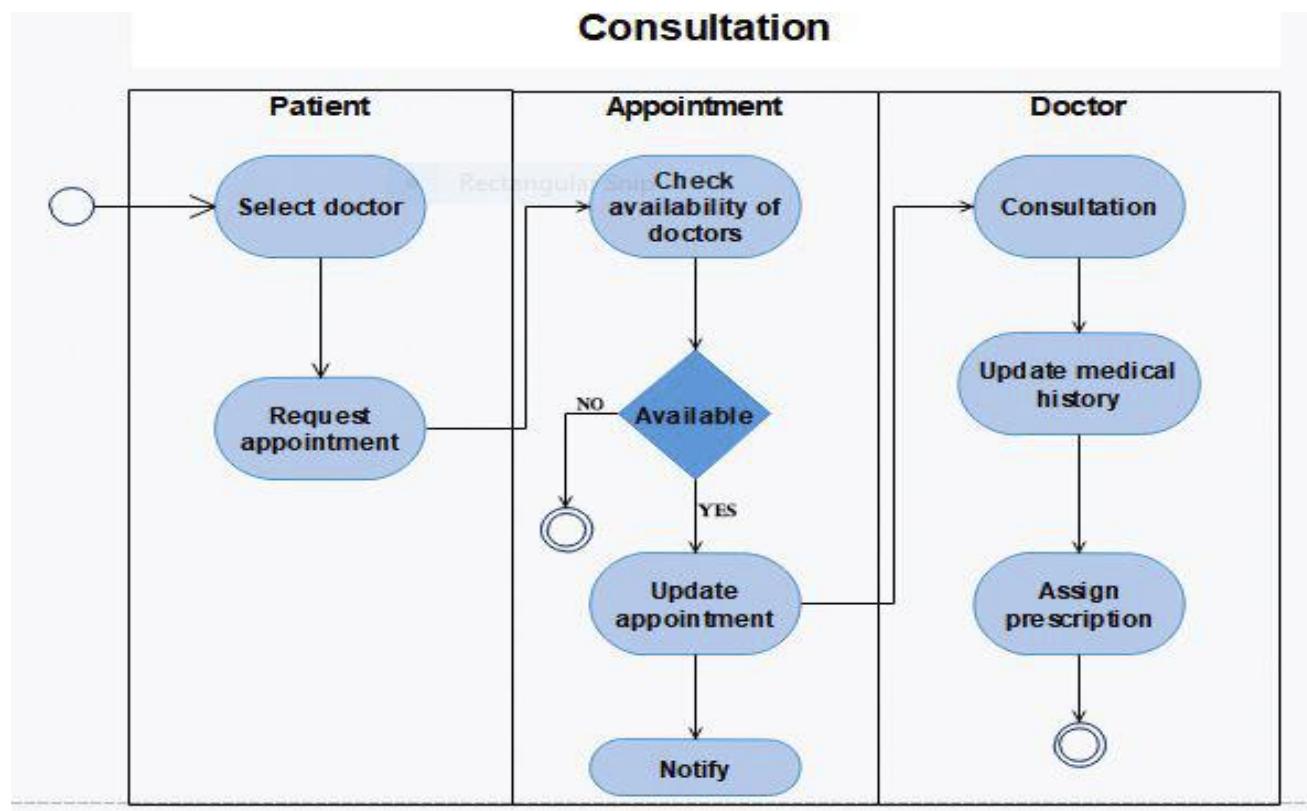


Figure 3.3.4.2

The other activity diagrams are available in the Appendix A.

3.3.5 Entity Relationship Diagram

Entity relationship model is a detailed, conceptual representation of the data for an organization or for a business area. The E-R model is expressed in terms of entities in the business environment, the relationships among them and the attributes of both entities and their relationships. The design of a database is illustrated as an E-R diagram. Once it is completed it could be easily mapped in to an actual table structure. Following is the class diagram for the proposed system.



Figure 3.3.5.1

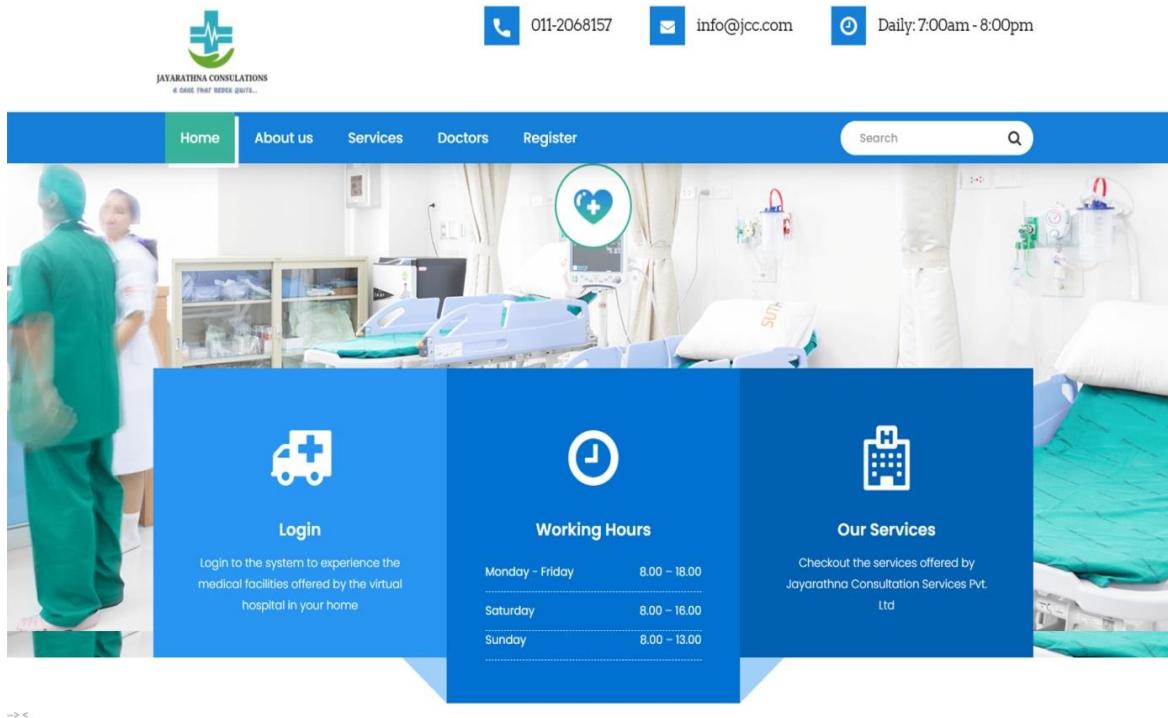
3.3.6 User interfaces

The design of the user interface defines how the user will interact within the system. In most commercial systems the interface is a graphical user interface with windows, dialog boxes and mouse interactions. Each user interacts with the system in different ways. Different approaches might be needed for the different parts of the system as well to enhance the user friendliness. The user interfaces must be more interactive and accessible.

A good user interface design is critical to the success of a system. An interface that is difficult to use will result in a high rate of user errors. Occasionally the users may even refuse to use the software system irrespective of their functionality.

Home Page

The home page of the e – healthcare system of Jayarathna Consultation Services (PVT) LTD. directs the users to the main functionalities of the system which are, login, registration, consultation, view doctors, offered services etc. Once a user visits the website the home page is the page that will be displayed to them first.



"The art of medicine consists of amusing the patient while nature cures the disease."

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Figure 3.3.6.1

Patient Login and Registration

In order to reserve an appointment for a consultation or to experience any of the services offered by the e – healthcare system of Jayarathna Consultation Services (PVT) LTD. the patient must have an account. A new patient can create an account by filling and submitting the registration form and the existing users can login to the system by entering the email address and the password.

Patient SignUp Form

Patient Name

Patient Address

Patient NIC/SS Number

Patient Phone Number

Email

Password

The password should consist of atleast 8 characters with atleast one Uppercase letter and a symbol

Confirm Password

I Agree To The Terms & Conditions

SIGN UP

Already have an Account? Login Now!



Figure 3.3.6.2

Patient Login



Email

Password

LOGIN

Don't have an Account? Register Now!

Figure 3.3.6.3

Request Appointment

The registered and logged in patients can request an appointment by filling and submitting the Appointment Reservation form. The patients can either select their preferred doctor or can enter the symptoms of their illness so that the system will suggest the most suitable doctors to be consulted.



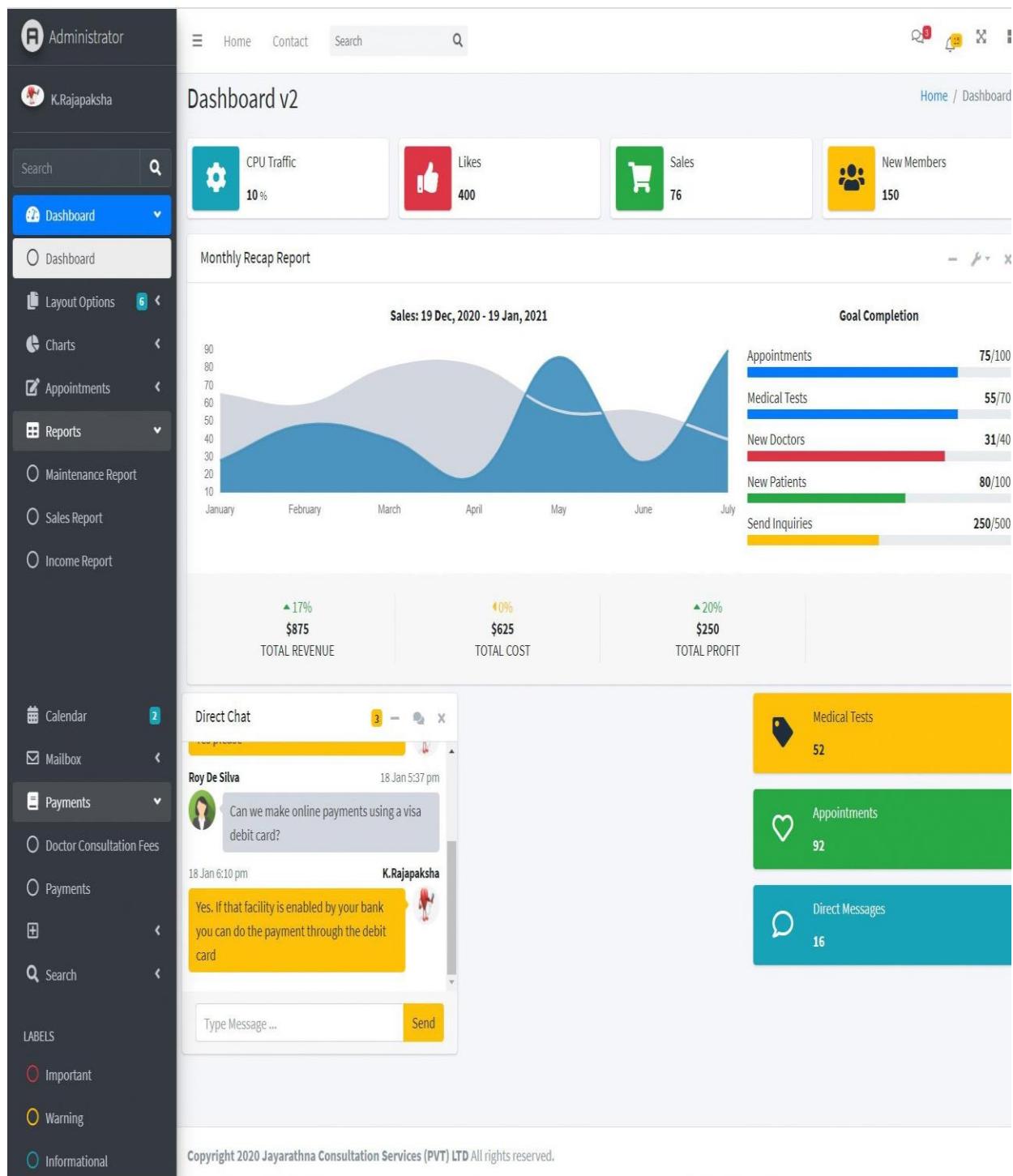
A screenshot of a web-based appointment booking interface. At the top, there's a blue header bar with a blurred background image of a stethoscope resting on a laptop keyboard. Below the header, the page title "Request Appointment" is centered. The main form area contains several input fields and buttons:

- "Appointment Type" dropdown menu
- "Doctor Name" text input field
- "Appointment Date" text input field with a calendar icon
- A green "Check Availability" button
- "Available Sessions" dropdown menu
- Two green buttons: "Find doctor by field" and "Let us find you the best doctor"
- A large green "Submit" button at the bottom center

Figure 3.3.6.4

Admin Dashboard

When the admin logs in to the system the admin dashboard will be displayed with all the updated information regarding daily income, performed medical tests, appointments etc. The statistics of this information are also presented as charts in the admin dashboard.



The screenshot displays the E-Health Care System's dashboard. At the top, there is a navigation bar with links for Home, Contact, Search, and a user icon. Below the navigation is a header bar with icons for search, notifications, and other system functions.

The main area is titled "Dashboard v2". It features several key performance indicators (KPIs) in cards:

- CPU Traffic: 10 %
- Likes: 400
- Sales: 76
- New Members: 150

Below these cards is a section titled "Monthly Recap Report" with a chart titled "Sales: 19 Dec, 2020 - 19 Jan, 2021". The chart shows sales trends from January to July. To the right of the chart is a "Goal Completion" section with the following data:

Goal	Status
Appointments	75/100
Medical Tests	55/70
New Doctors	31/40
New Patients	80/100
Send Inquiries	250/500

Below the chart are three summary statistics:

- TOTAL REVENUE:** ▲ 17% \$875
- TOTAL COST:** ▯ 0% \$625
- TOTAL PROFIT:** ▲ 20% \$250

On the left side, there is a sidebar with a dark background containing the following menu items:

- Administrator
- K.Rajapaksha
- Search
- Dashboard** (highlighted)
- Layout Options
- Charts
- Appointments
- Reports** (highlighted)
- Maintenance Report
- Sales Report
- Income Report
- Calendar
- Mailbox
- Payments** (highlighted)
- Doctor Consultation Fees
- Payments
- Search
- LABELS
- Important
- Warning
- Informational

In the bottom right corner of the dashboard, there is a "Direct Chat" window. The window shows a conversation between "Roy De Silva" and "K.Rajapaksha". Roy asks if online payments using a visa debit card are possible. K.Rajapaksha responds that if the facility is enabled by the bank, it can be done through a debit card. The chat interface includes a message input field and a "Send" button.

On the far right, there are three summary boxes:

- Medical Tests:** 52
- Appointments:** 92
- Direct Messages:** 16

At the bottom of the dashboard, there is a copyright notice: "Copyright 2020 Jayarathna Consultation Services (PVT) LTD All rights reserved."

Figure 3.3.6.5

The other interfaces are available at the Appendix C (User Documentation)

3.4 Summary

Among the many feasible alternative solutions web applications using templates was selected as the most suitable development strategy while having windows as the chosen system software. Rapid application development was selected as the most appropriate process model among the other major process models such as waterfall, spiral model, agile etc.

System design is a significant part in the SDLC. In this stage the requirements must be well understood and must be documented in design diagrams such as use case diagrams, class diagrams, sequence diagrams and activity diagrams before starting the development phase. These diagrams should be simple, clear and also complete. Having a better design is a vital component of the SDLC as the complete implementation of the system fully depends on the design. However, if the system design consists of numerous errors it might lead to a faulty system.

Chapter 4

System Development

4.1 Introduction

System development is a significant stage in the development of a software system. System development involves taking all the detailed design documents from the designing stage and transforming them into the actual system. This phase signifies the start of the production. Selection of the most appropriate development tools and the programming language plays a vital role in this phase. Prior starting this phase, the development methodology, the coding skills of the developer on the selected programming language, and the client requirements should be determined.

4.2 Implementation Environment

4.2.1 Hardware

- Model Name: Acer Aspire
- Model: Aspire A515-54G
- Processor Name: Intel Core i7
- Processor Speed: 2.0 GHz
- Number of Processors: 1
- Total Number of Cores: 4
- Memory: 8 GB
- System Type: 64-bit operating system
- Internet Connection: ADSL line

4.2.2 Software

- Microsoft Windows 10 Operating system
- XAMPP 3.2.2
- Notepad ++ editor
- PhpMyAdmin
- Microsoft Office 2016

4.2.3 Tools and Technologies

- HTML (Hypertext markup language)

HTML is a standard markup language which is used to create web pages. It is a simple scripting language. An html document is a plain text file that contains nothing but text. They are used to describe the structure of a web page. Html elements are the building blocks of html pages and are represented using tags. Browsers do not display the html tags, but uses them to render the content of the page.

- CSS (Cascading styling sheet)

CSS defines how to display HTML elements. Styles are normally stored in Style sheets. By using CSS multiple style definitions will cascade in to one. The external style sheets are stored in CSS files and they describe the presentation of the documents written in mark-up languages.

- JavaScript

JavaScript is also one of the most significant technologies used in WWW. It is an essential part of web applications as it enables interactive web pages. Most websites use JavaScript for client-side validations and almost all the major web browsers have a dedicated JavaScript engine to execute the JavaScript code on the end devices. The scripts are embedded in or included from HTML documents.

- PHP (Hypertext preprocessor)

PHP is a widely used server-side open source scripting language which is used for the development of dynamic webpages. It runs on various platforms such as Windows, Linux, Unix, Mac OS etc. and is compatible with almost all servers used today such as Apache, IIS etc. PHP supports a wide range of databases and is supported by many providers of web hosting. PHP is capable of creating, opening, reading, writing, deleting and closing files on the server and also can collect form data, send and receive cookies and encrypt data.

- MySQL

MySQL is a very popular, open source relational Database management system. It can manage and handle very large databases and is compatible with the standard

SQL. MySQL is a reliable technology and possess a faster performance. SQL is the most popular language which allows the users to access and manipulate data in a DBMS.

- jQuery

jQuery is an open sourced JavaScript library that helps to simplify the creation and navigation of web applications. jQuery simplifies the Document Object model manipulation of HTML by allowing users to find, select and change the elements with specific properties. Further, it incorporates JavaScript functionalities by manipulating CSS properties. jQuery is supported by many user-created plugins.

- AJAX (Asynchronous JavaScript and XML)

AJAX is not a programming language. It is a new technique for creating faster and more interactive web applications with the help of XML, HTML, CSS and JavaScript. AJAX allows web pages to be updated asynchronously by exchanging data with a web server. AJAX is a web browser technology independent of web server software. With AJAX a user can continue to use the application while program requests information from the server in the background.

- Bootstrap

Bootstrap is a free, open source CSS framework directed at responsive, front-end web development. The Bootstrap framework is built on the technologies such as HTML, CSS and JavaScript. It includes user interface components, layouts and JavaScript tools along with the framework of implementation. Responsive design makes it possible for a web page to detect the screen size of the visitor and automatically adopt the display accordingly.

4.2.4 Platform Dependency

The e – healthcare system of Jayarathna Consultation Services (PVT) LTD. was developed using platform independent software such as Apache, MySQL and PHP. This software is free and open source and enhances the portability of the system as well. Hence the system could be accessed from any place at any time.

4.3 Interactions Between the Main Modules of the System

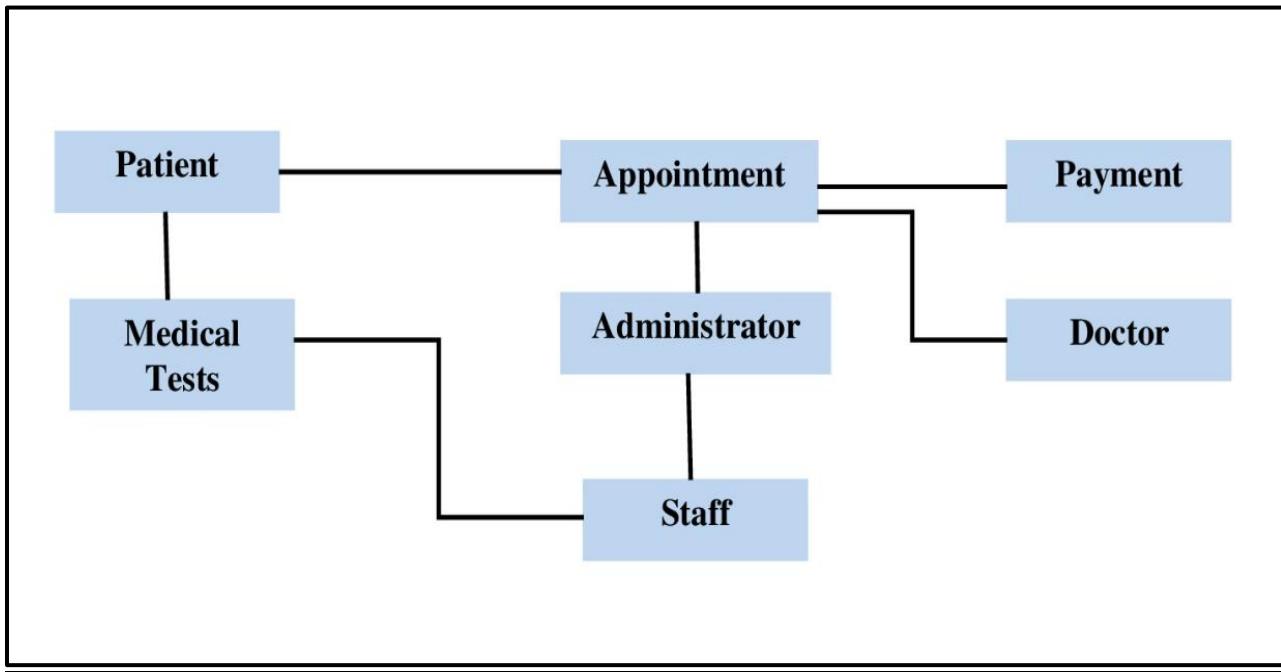


Figure 4.3.1

4.4 Major Code Segments

4.4.1 Database Connectivity

Connecting and gaining access to the database is one of the most significant functions which have to be satisfied by the system. The following code was used to access and connect the database to the system.

```
<?php
session_start();
$host = "localhost"; /* Host name */
$user = "root"; /* User */
$password = ""; /* Password */
$dbname = "ehs_db";

$con = mysqli_connect($host, $user, $password, $dbname);
// Check connection
if (!$con) {
    die("Connection failed: " . mysqli_connect_error());
}
```

Figure 4.4.1.1

4.4.2 Login Handling

Login handling is used to verify the username and the password entered by the user in the login form. If the user has entered the necessary credentials correctly then the system will allow the user to enter in to the system and otherwise it won't. The following code is used to implement login handling in the e – healthcare system of Jayarathna Consultation Services (PVT) LTD.

```
<?php
include "config.php";

if(isset($_POST['but_submit'])){

    $uname = mysqli_real_escape_string($con,$_POST['user']);
    $password = mysqli_real_escape_string($con,$_POST['pass']);

    if ($uname != "" && $password != ""){

        $sql_query = "select count(*) as cntUser from patient where username='".$uname."' and password='".$password."'";
        $result = mysqli_query($con,$sql_query);
        $row = mysqli_fetch_array($result);

        $count = $row['cntUser'];

        if($count > 0){
            $_SESSION['uname'] = $uname;
            header('Location: home.php');
        }else{
            echo "Invalid username and password";
        }
    }
}
```

Figure 4.4.2.1

4.4.3 Registration Handling

Registration handling is used to register the patients and doctors when they enter their details to the system. If the new user has entered all the required information correctly the system will store the information in the database and the user will be

registered. The following code is used to implement registration handling in the e – healthcare system of Jayarathna Consultation Services (PVT) LTD.

```
<?php
require('db.php');
// If form submitted, insert values into the database.
if (isset($_REQUEST['username'])){
    // removes backslashes
    $username = stripslashes($_REQUEST['username']);
    //escapes special characters in a string
    $username = mysqli_real_escape_string($con,$username);
    $PatientName= stripslashes($_REQUEST['PatientName']);
    $PatientName = mysqli_real_escape_string($con,$PatientName);
    $PatientAddress= stripslashes($_REQUEST['PatientAddress']);

    $PatientAddress = mysqli_real_escape_string($con,$PatientAddress);
    $PatientNICno= stripslashes($_REQUEST['PatientNICno']);
    $PatientNICno = mysqli_real_escape_string($con,$PatientNICno);
    $PatientTelno= stripslashes($_REQUEST['PatientTelno']);
    $PatientTelno = mysqli_real_escape_string($con,$PatientTelno);
    $password = stripslashes($_REQUEST['password']);
    $password = mysqli_real_escape_string($con,$password);
    $rpassword = stripslashes($_REQUEST['rpassword']);
    $rpassword = mysqli_real_escape_string($con,$rpassword);
    $trn_date = date("Y-m-d H:i:s");

    $query = "INSERT into `patient` (username,PatientName,PatientAddress,PatientNICno,PatientTelno, password,rpassword, trn_date)
VALUES ('$username','$PatientName','$PatientAddress','$PatientNICno','$PatientTelno', '".md5($password)."', '".md5($password)."', '$trn_date')";
    $result = mysqli_query($con,$query);
    if($result){
        echo "</div>
<div class='alertcontent'>
    <h4>Success!</h4>
    Registration Successfull!
</div>";
    }

} else{
    echo "</div>
<div class='alertcontent'>
    <h4>Unsuccessful!</h4>
    Registration Unsuccessfull!
</div>";
}
?>
```

Figure 4.4.3.1

4.4.4 Appointment Reservation Handling

Appointment reservation handling is used to request a medical appointment. The registered and logged in patient can enter the required details and request an

appointment. If the user has entered the information correctly the system will store the entered information in the database and the reserved appointment will be confirmed via an email. The following code is used to implement appointment reservation handling in the e – healthcare system of Jayarathna Consultation Services (PVT) LTD.

```
<body>
<?php
require('db.php');
// If form submitted, insert values into the database.
if (isset($_REQUEST['eaddress'])){
    // removes backslashes
$eaddress = stripslashes($_REQUEST['eaddress']);
    //escapes special characters in a string
$eaddress = mysqli_real_escape_string($con,$eaddress);
$fname= stripslashes($_REQUEST['fname']);
$fname = mysqli_real_escape_string($con,$fname);
$lname= stripslashes($_REQUEST['lname']);

$lname = mysqli_real_escape_string($con,$lname);
$phone= stripslashes($_REQUEST['phone']);
$phone= mysqli_real_escape_string($con,$phone);
$dname= stripslashes($_REQUEST['dname']);
$dname= mysqli_real_escape_string($con,$dname);
$appdate= stripslashes($_REQUEST['appdate']);
$appdate = date("Y-m-d");

$query = "INSERT into `apptemp` (eaddress, fname, lname, phone, dname, appdate)
VALUES ('$eaddress', '$fname', '$lname', '$phone', '$dname', '$appdate')";
$result = mysqli_query($con,$query);
if($result){
    echo "</div>
        <div class='alertcontent'>
            <h4>Success!</h4>
            Appointment Reservation Successfull!
        </div>";
}
else{
echo "</div>
        <div class='alertcontent'>
            <h4>Unsuccessful!</h4>
            Appointment Reservation Unsuccessfull!
        </div>";
}
?>
```

Figure 4.4.4.1

Other code segments are available in the Appendix E

4.5 Database Structures

Database Name: ehs_db

1) Patient table structure

Once a patient is registered to the system, the information obtained from the patient registration form is stored in this table.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	PatientID	int(11)			No	None		AUTO_INCREMENT	Change Drop ▾ More
2	PatientName	varchar(100)	utf8_general_ci		No	None			Change Drop ▾ More
3	username	varchar(100)	utf8_general_ci		No	None			Change Drop ▾ More
4	PatientAddress	varchar(200)	utf8_general_ci		No	None			Change Drop ▾ More
5	password	varchar(50)	utf8_general_ci		No	None			Change Drop ▾ More
6	PatientTelno	int(20)			No	None			Change Drop ▾ More
7	PatientNICno	varchar(20)	utf8mb4_general_ci		No	None			Change Drop ▾ More
8	PatientMedicalHistory	varchar(300)	utf8mb4_general_ci		No	None			Change Drop ▾ More

Figure 4.5.1

2) Patient Login table structure

Once a patient is logged in to the system, the login information is stored in this table.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	PatientID	int(11)			No	None			Change Drop ▾ More
2	PatientName	varchar(100)	utf8_general_ci		No	None			Change Drop ▾ More
3	PatientEmail	varchar(100)	utf8_general_ci		No	None			Change Drop ▾ More
4	PatienPassword	varchar(50)	utf8_general_ci		No	None			Change Drop ▾ More
5	LoginTime	datetime			Yes	current_timestamp()			Change Drop ▾ More

Figure 4.5.2

3) Appointment table structure

Once a patient reserves an appointment, the appointment details are stored in this table.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action	
1	AppointmentID	int(11)			No	None			Change	Drop
2	AppointmentType	varchar(20)	utf8_general_ci		No	None			Change	Drop
3	AppointmentDate	date			No	None			Change	Drop
4	AppointmentTime	time			No	None			Change	Drop
5	RoomNo	int(11)			No	None			Change	Drop
6	PatientID	varchar(300)	utf8mb4_general_ci		No	None			Change	Drop
7	DoctorID	varchar(300)	utf8mb4_general_ci		No	None			Change	Drop

Figure 4.5.3

4) Medical Test table structure

Once a patient schedules a medical test, the test details are stored in this table.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action	
1	TestID	int(11)			No	None		AUTO_INCREMENT	Change	Drop
2	TestName	varchar(100)	utf8_general_ci		No	None			Change	Drop
3	TestType	varchar(100)	utf8_general_ci		No	None			Change	Drop
4	TestDateTime	datetime			No	current_timestamp()			Change	Drop
5	ResultStatus	varchar(50)	utf8_general_ci		No	Pending			Change	Drop
6	PatientEmail	varchar(300)	utf8mb4_general_ci		No	None			Change	Drop
7	StaffID	varchar(100)	utf8mb4_general_ci		No	None			Change	Drop

Figure 4.5.4

5) Doctor table structure

Once a doctor is registered to the system, the information obtained from the Doctor registration form are stored in this table.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
□ 1	DoctorID 📃	int(11)			No	None		AUTO_INCREMENT	📝 Change 🗑 Drop ⏺ More
□ 2	DoctorNICno	varchar(20)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 3	DoctorName	varchar(100)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 4	DoctorAddress	varchar(200)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 5	DoctorEmail	varchar(100)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 6	MedicalPracticeLicenceNo	varchar(100)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 7	DoctorPassword	varchar(50)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 8	DoctorTelno	varchar(15)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 9	SpecializedField	varchar(100)	utf8_general_ci		No	None			📝 Change 🗑 Drop ⏺ More

Figure 4.5.5

6) Payments table

The consultation payments done by the patients are stored in the payments table.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
□ 1	PaymentID 📃	int(100)			No	None		AUTO_INCREMENT	📝 Change 🗑 Drop ⏺ More
□ 2	PaymentDate	datetime			No	current_timestamp()			📝 Change 🗑 Drop ⏺ More
□ 3	PaymentType	varchar(100)	utf8mb4_general_ci		No	None			📝 Change 🗑 Drop ⏺ More
□ 4	Amount	double			No	None			📝 Change 🗑 Drop ⏺ More
□ 5	AppointmentID	varchar(100)	utf8mb4_general_ci		No	None			📝 Change 🗑 Drop ⏺ More

Figure 4.5.6

4.6 Summary

This chapter concentrates on how the blueprint obtained from the designing phase is converted in to functioning modules in the development phase. The development phase is one of the key phases in the SDLC as the actual product is developed in this stage. The major code segments used in the process of development and the table structures created in the database was presented in this chapter.

The web-based system of Jayarathna Consultation Services (PVT) LTD. use technologies such as HTML, CSS to run the client side. Client-side validations are applied using JavaScript. PHP is used to run the server side and to implement the logical functions and business logic to the system. The database programming is handled via MySQL.

Chapter 5

Evaluation

5.1 Introduction

Testing is the process which is used to detect the correctness, completeness and quality of the developed software. During this stage the system is checked for errors or bugs. The purpose of testing is not to demonstrate that there are no errors in the program but to detect any bugs that may still exist. The testing process has two distinct goals.

- Verification - Software correctly implements the specified functions (Are we building the product right?)
- Validation - The software should do what the user really wants (Are we building the right product?)

The ultimate goal of the verification and validation process is to establish confidence that the software system is fit for purpose. The level of required confidence depends on the system's purpose, the expectations of the system users and the current marketing environment of the system. [8]

5.2 Test Strategies

- Black box testing

Functional or black box testing is a testing methodology where the tests are delivered from the program. The system is a black box whose behavior can only be determined by studying its inputs and outputs. [8] In black box testing there is no attempt given to understand how the codes work. In this methodology test data are derived from the specification and carefully selected to test every possible combinations of the output.

Finally the actual results from specified test data are compared with the expected results. If the actual results agree with the expected results it can be concluded that the program works as specified.

The advantages of black box testing are,

- The tester need not understand the code
- Faster

However there are some disadvantages of black box testing as well. They are,

- The program might have undetected hidden errors.

The web based e- healthcare system of Jayarathna Consultation Services (PVT) LTD have chosen black box testing as a testing methodology as the functionalities of the system could be verified through this testing methodology.

- **White box testing**

White box testing is used for relatively small programs such as subroutines or operations associated with various objects. This testing methodology requires a detailed knowledge of the codes to be tested since the emphasis of this test is codes, the test data may be illogical when compared with the program specification. Tester is concerned with the internal logic of the system. This testing methodology ensures that every statement in the program is executed at least once. White box testing attempts to uncover hidden logical errors by testing every logical path.

However, white box testing is considered as a time consuming approach as it involves understanding the code first.

The web based e- healthcare system of Jayarathna Consultation Services (PVT) LTD have chosen white box testing as a testing methodology as the logical paths of the separate modules could be tested individually to identify the hidden logical errors of the program.

- **System testing**

The purpose of system testing is to check whether the system meets the agreed user requirements and works in the target environment. System testing covers both functional and nonfunctional requirements.

- System testing includes the following sub testing methodologies.
- Recovery testing – Testing the ability of an application to be restarted after a failure
- Security testing – Tests the security features of the system
- Performance testing – Checking the speed of the system

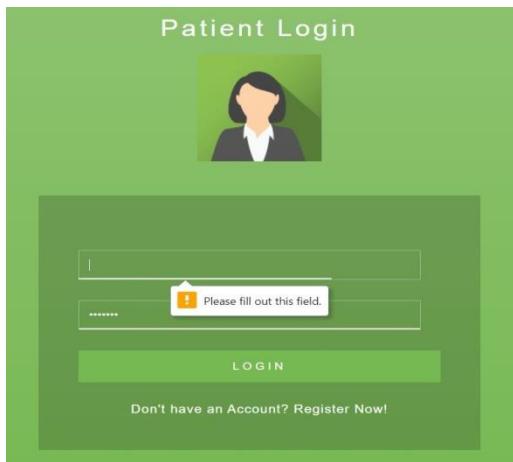
The web based e- healthcare system of Jayarathna Consultation Services (PVT) LTD have chosen system testing as a testing methodology as the functional as well as nonfunctional requirements could be tested through system testing.

5.3 Test Case Designing

A test case is a documented set of preconditions, procedures and post conditions which a tester uses to determine whether a system under test satisfies the defined requirements or not. [10] Test cases are defined at the planning phase of the testing stage and these test cases should be specific and detailed when a detailed explanation is expected.

Test Case 01					
No					
Objective	Verify Patient login module				
Steps	Action	Test data	Expected result	Actual result	Result status
1	Enter correct username and correct password	Username-abc Password-246	User login to the system by redirecting to the patient profile page	User logged in to the system by redirecting to the patient profile page	Pass
2	Enter incorrect username and password	Username-pqr Password-123	Display login error message	Login error message displayed	Pass
3	Enter correct username and incorrect password	Username-abc Password-123	Display login error message	Login error message displayed	Pass
4	Enter incorrect username and correct password	Username-pqr Password-246	Display login error message	Login error message displayed	Pass
5	Click login button without entering either username or password	Keep username and password fields empty and click login	Display error message indicating “Please fill out this field”	Error message displayed indicating “Please fill out this field”	Pass

Table 5.3.1



The Patient Login form has a green header with the title "Patient Login". It features a placeholder image of a woman in a suit. Below the header is a login input field with a placeholder "Email" and a password input field with a placeholder ".....". A yellow warning icon with the text "Please fill out this field." is positioned above the password field. A green "LOGIN" button is at the bottom, followed by a link "Don't have an Account? Register Now!".

Figure 5.3.1



Figure 5.3.2

Test Case No 02					
Objective	Verify patient registration module				
Steps	Action	Test data	Expected results	Actual result	Result status
1	All the required fields are filled correctly	All the fields filled with correct data	User should register to the system with a message displaying "Registration Successful"	User registered successfully with a message displaying "Registration Successful"	Pass
2	All the required fields are not filled	Leave the Address field empty	Display error message indicating "Please fill out this field" in the field which is left empty	Error message displayed indicating "Please fill out this field" near the address field	Pass
3	Validate input data	Email-john123	Display error message indicating "The email address is not in the correct format"	Error message displayed indicating "The email is not in the correct format"	Pass
4	Clicking Register button leaving every field empty	Leave every field empty	Display error message indicating "Please fill out this field" in the first field	Error message displayed indicating "Please fill out this field" near the first field	Pass

Table 5.3.2

Patient SignUp Form

N.M.Dias	
Patient Address	
942385867v	! Please fill out this field.
0812345678	
nmdiaz@gmail.com	

The password should consist of atleast 8 characters with atleast one Uppercase letter and a symbol.

<input type="checkbox"/> I Agree To The Terms & Conditions

<input checked="" type="checkbox"/> I Agree To The Terms & Conditions

SIGN UP

Already have an Account? [Login Now!](#)

Figure 5.3.3

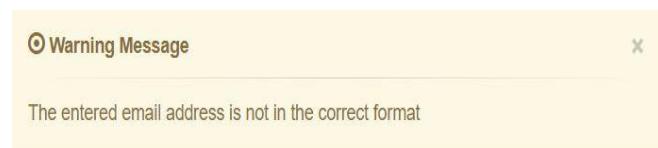


Figure 5.3.4



Figure 5.3.5

Test Case No 03

Objective	Verify request appointment module				
Steps	Action	Test data	Expected results	Actual result	Result status
1	All the required fields are filled correctly	All the fields filled with correct data	User should reserve the appointment with a message displaying “Appointment reservation Successful”	User successfully reserved the appointment with a message displaying “Appointment reservation Successful”	Pass
2	All the required fields are not filled	Leave the Patient name field empty	Display error message indicating “Please fill out this field” in the field which is left empty	Error message displayed indicating “Please fill out this field” near the Patient name field	Pass
3	Entered doctor is not available in the system	Doctor name- John Mark	Display error message indicating “Doctor not found”	An error message was displayed indicating “Doctor not found”	Pass

4	Selected doctor does not have any appointments left to be reserved on a particular day	Request an appointment for a doctor on a date which is fully occupied with scheduled appointments	Display error message indicating "Sorry there are no appointments available for this date"	Error message displayed indicating "Sorry there are no appointments available for this date"	Pass
5	Clicking Submit button leaving every field empty	Leave every field empty	Display error message indicating "Please fill out this field" in the first field	Error message displayed indicating "Please fill out this field" in near the first field	Pass

Table 5.3.3

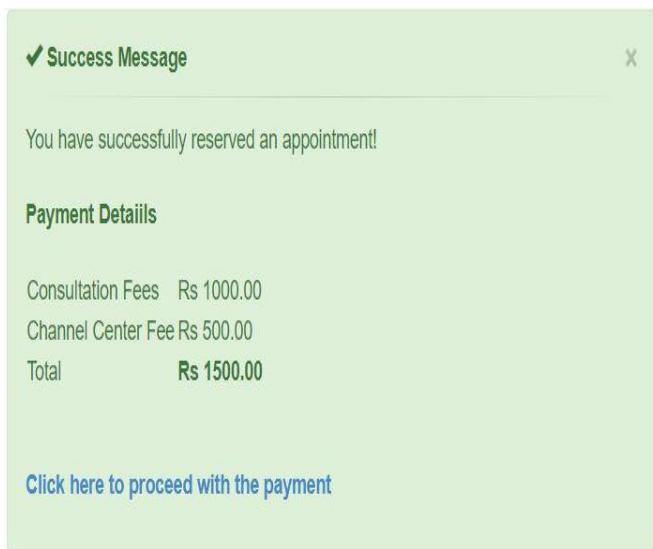
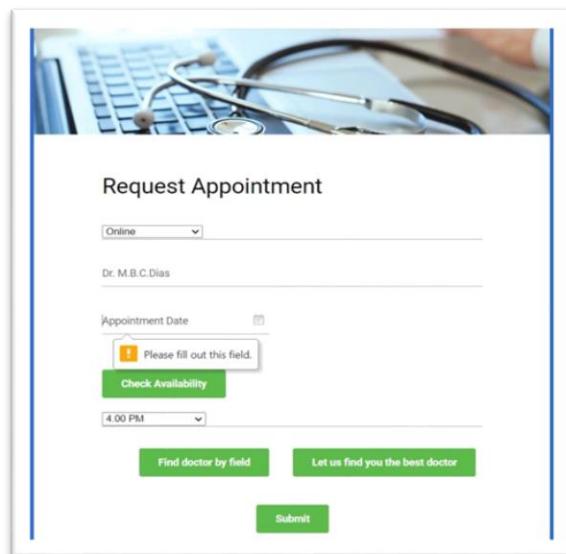


Figure 5.3.6



The screenshot shows a web page titled 'Request Appointment'. It has a dropdown menu set to 'Online'. A text input field contains 'Dr. M.B.C.Dias'. Below it, an 'Appointment Date' field has a red error message: 'Please fill out this field'. A green 'Check Availability' button is next to it. A dropdown menu below shows '4:00 PM'. At the bottom, there are three buttons: 'Find doctor by field', 'Let us find you the best doctor', and a large green 'Submit' button.

Figure 5.3.7

The other test cases are available in the Appendix D.

5.4 User Evaluation

Acceptance testing is carried out with the client's attendance. The purpose of the acceptance testing is to make the client evident that the software indeed works.

The web based e- healthcare system of Jayarathna Consultation Services (PVT) LTD have chosen user acceptance testing as a testing methodology as the satisfaction of the client is a key factor towards the success of a project and that could be verified through user acceptance testing. Here the user evaluation is done by obtaining the individual feedback from the IT manager of the organization through a questionnaire with closed ended and open ended questions. The web system was presented and the client was allowed to experience the system in order to get the user reviews.

Sample User feedback form is given below [11] followed by the Feedback form which was completed by the client.

User Feedback Statement of the E- Healthcare System of Jayarathna Consultation Services (PVT) LTD.

Please answer all the questions

Functions	Very poor	Poor	Neutral	Good	Very Good
The user friendliness of the system					
Reliability of the software					
Security of the software					
Responsiveness of the overall system					
Level of satisfaction about the overall functionalities of the system					
First impression of the system					
Overall system performance					
General Feedback					

Name

Date

Figure 5.4.1

**User Feedback Statement of the E- Healthcare System of Jayarathna
Consultation Services (PVT) LTD.**

Please answer all the questions

Functions	Very poor	Poor	Neutral	Good	Very Good
The user friendliness of the system				✓	
Reliability of the software					✓
Security of the software					✓
Responsiveness of the overall system					✓
Level of satisfaction about the overall functionalities of the system					✓
First impression of the system				✓	
Overall system performance					✓

General Feedback

I am more than satisfied about the functionalities and the security offered by the system and was impressed about the user friendliness of the system.

Mr. K.D. Perera

03.02.2021

Name

Date

Figure 5.4.2

The following pie chart depicts the ease of use of the system.

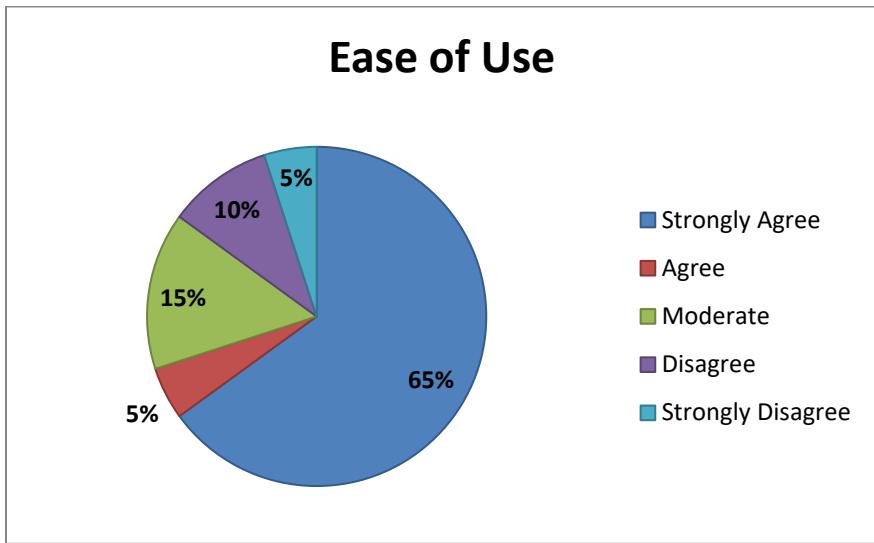


Figure 5.4.3

5.5 Summary

Testing is considered as one of the most significant stages of the SDLC. In this stage the developer verifies and validates the developed system whether it has been built right and whether the right product has been built.

In this chapter the testing strategies which were used in the verification and validation process was discussed. The developed project has used black box testing, white box testing and system testing as the testing strategies. The test cases of the core modules of the system such as login, registration, appointment reservation were presented in this chapter. At the end of this section the user evaluation form which was filled by the client was presented. The segment also contains screen shots of the results obtained by executing the test cases.

Chapter 6

System Implementation and Maintenance

6.1 Introduction

System implementation and maintenance is the concluding stage of the SDLC. In this segment the formerly designed, developed and tested software will be implemented in the client organization. During the course of implementation, the end users of the system also gets involved as they should be suitably trained on how to use the system to obtain an optimum efficiency.

System implementation includes hardware acquisition, software acquisition, user preparation, hiring and training end users, site and data preparation and installation etc. Hardware acquisition is defined as obtaining hardware components required to operate the developed system. The organization can purchase, lease or rent the required hardware from vendors. Third party software can be acquired by purchasing from external developers or could be developed in-house.

6.2 Implementation Strategy

- **Direct implementation**

In direct implementation the old system is discarded completely and the new system is initiated immediately. This method is less expensive than parallel implementation and is less time consuming than the other implementation methods. However, if there was a problem in the system the entire organization will be affected by that and will in turn result in the loss of productivity of the organization which will adversely affect the routine business processes of the institution.

This implementation method was not used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as this method is much riskier to be used since the staff members are used to a manual system and it will take some time and practice for them to get familiar with the recently implemented automated system.

- **Parallel implementation**

In parallel implementation both the new and the old systems are run simultaneously until it is evident that the new system performs correctly. Both systems are maintained and kept up to date in case of a failure in the new system. This method is less risky than the other implementation methods as in case of a failure the organization can instantly move back to the previous system. However, this implementation method is more expensive to be used as both old and new systems are running parallel hence increasing the cost of operation. This method is also highly labor intensive as there should be sufficient number of staff members to operate old and new systems simultaneously.

This implementation method was not used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as this method is much more expensive to be used and also the client organization doesn't have a sufficient labor force to work simultaneously in both the new and old systems.

- **Pilot implementation**

In this implementation method the system is used by only a small group of people until it is evident that the new system performs correctly. Thereafter the system is introduced to the remaining staff members. In this method the system errors could be recognized before implementing the system to the entire institution. This method is also comparatively more expensive as both the systems are running simultaneously.

This implementation method was not used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as this method is much more expensive to be used.

- **Phased implementation**

In this implementation method the new system is implemented in phases until it is evident that the new system performs correctly and thereafter implementing the remaining phases of the new system. In the phased implementation the staff could be gradually trained to the new system as they only need to be trained to operate the part of the system that is currently being phased in. However, in this method each phase should be tested separately before moving in to the next phase.

This implementation method was used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as in this method there is no instant change and the staff members could be gradually trained to use the new system step by step. The appointment reservation module will be implemented as the first phase where the staff should be trained on appointment reservation, payment and handling the notifications sent to the patients and the doctors. After it is evident that the end users are familiar with appointment reservation course the other processes will be implemented to the institution gradually.

6.3 Pre-Implementation Plan

Throughout the development process the APACHE server was used to fulfill the server requirements of the system. The main purpose of using the APACHE server in the development process was to test whether the developed modules are working fine. However, when the system is implemented in the implementation environment a separate server will be purchased to carry out the operations of the developed system.

PHPMYADMIN was used to initially develop the database. However, when implementing the system in the implementation environment the SQL scripts which were created in the PHPMYADMIN will be exported to the hosting environment.

The internet facility which is required to operate the system will be facilitated through upgrading the existing ADSL connection.

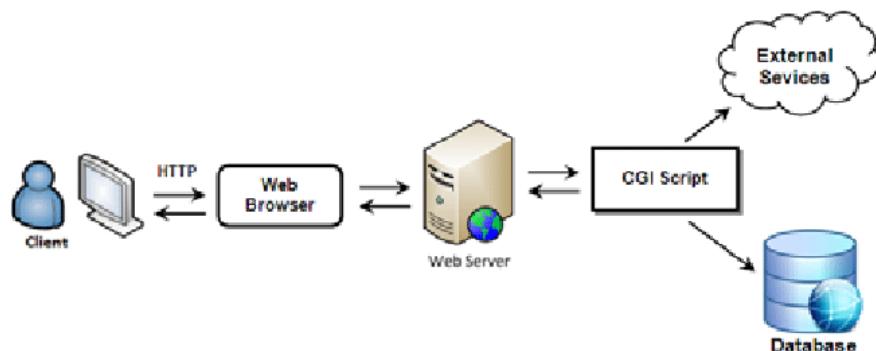


Figure 6.3.1

6.4 User Training

Providing quality training to the end users of the system is an essential part of the implementation process. In order to obtain the maximum efficiency from the developed web-based solution the end users should be familiar with the new system and should have a sufficient knowledge about the functionalities of the system. User training not only involves learning about the operations and functions of the system but also about how to troubleshoot the system problems. Several types of user training techniques are mentioned below.

- Instructor led virtual classroom training**

In this mode of training all the trainees must be present at the same time but they don't have to be in the same place in order to conduct the training. The training is done in a virtual classroom through methods such as video conferencing or virtual reality packages.

This training method was not used in used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as it requires all the trainees to be present at the same time for the training program. This will impede the routine business processes of the organization.

- Instructor led normal classroom training**

In this mode of training the trainees has to be present at the same time and also, must be present at the same place. The instructor lead normal class room training is done by conducting a lecture series in a classroom using the primary tools such as the blackboard, overhead projector etc.

This training method was not used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as it requires all the trainees to be present at the same time and same place in order to participate in the training program. This will obstruct the routine business processes of the organization.

- Self-paced web-based training**

In this mode of training the trainees doesn't have to be present at the same time or at the same place. The training could be done in a self-pace according to the convenience of the trainee and the organization. The self-paced web-based training offers the lectures in the format of hypermedia which is supported by the internet.

The trainees can access the lectures and training sessions through the internet at any time.

This training method was not used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as there will be an excessive use of the internet facilities within the organization which may cause internet connection problems within the organization which might impede the routine business processes.

- **Self-paced multimedia training**

In this mode the trainees don't have to be present at the same time or at the same place. The training could be done in a self-pace according to the convenience of the trainee and the organization. The self-paced multimedia training offers the lectures in the format of multimedia and is stored in a CD-ROM. The copies of these CD-ROMs are distributed among the trainees and they can access the resources at their convenience. This method also minimizes the cost of developing an in-house training course.

This training method was used in the web-based e-healthcare system of Jayarathna Consultation Services (PVT) Ltd. as this method is an efficient and a convenient method to conduct the user training without any obstruction to the routine business processes of the organization and also by practicing this training methodthe cost of user training could be minimized. [9]

6.5 Data Backups

System data backup is the process of storing and archiving a copy of system data so that in case of a system failure the data could be recovered effortlessly. The system data of the developed web-based e -healthcare system will be copied and stored at the end of each day in a remote location by the administrator. Since the data is backed up frequently the risk of losing the system data due to natural disasters or system failures will be less as the data is backed up in a safe place which is easy to access at any time.

6.6 Application Support and Maintenance Plan

Software maintenance is the overall process of changing the system after it has been implemented. The change may be a simple coding error or could be a complex system design change to accommodate new requirements. The client is given a free maintenance period of one year and when a maintenance has to be done the client can make a request and the request is then analyzed to investigate the validity and feasibility of that change. Since the developed system is a web-based solution the maintenance could be carried out at any location.

6.7 Change Request Handling and Version Control

Every system should undergo some changes as it operates for some time due to the changing requirements, system faults etc. Change requests are the formal requests made by the system users, customers or management for system changes. All the requested changes should be carefully analyzed before implementing. However, some change requests such as fault repair must be implemented urgently. Hence there are two procedures to be followed when considering a change request. They are change implementation and emergency repair. The processes followed when handling a change implementation is shown below shown below.

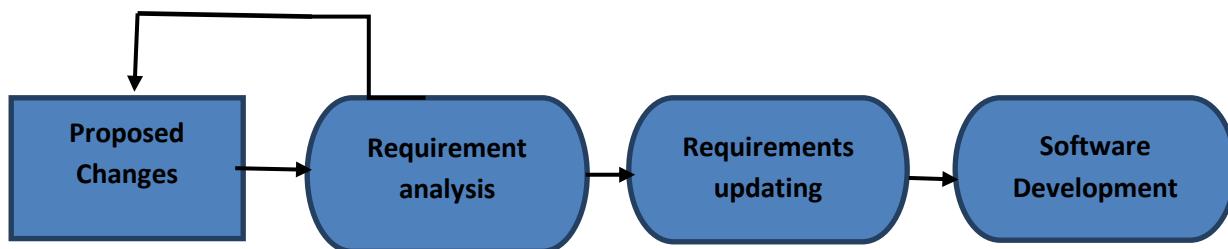


Figure 6.7.1

The processes followed when handling an emergency repair is shown below shown below.

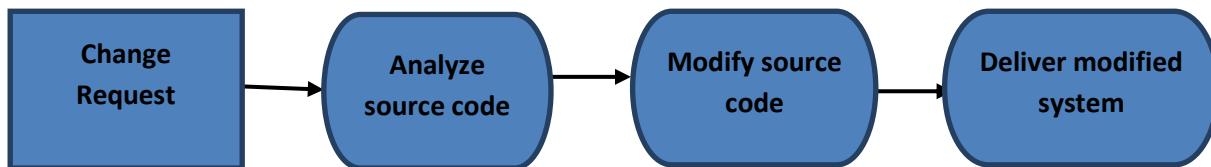


Figure 6.7.2

Version control is the practice of tracking and managing changes done to the software code. Version control systems are software systems that facilitate managing the changes done to the source code over time. Version control is a significant requirement when there is a change in the development environment. It is facilitated in the developed web solution through a third-party open-source platform known as GitHub.

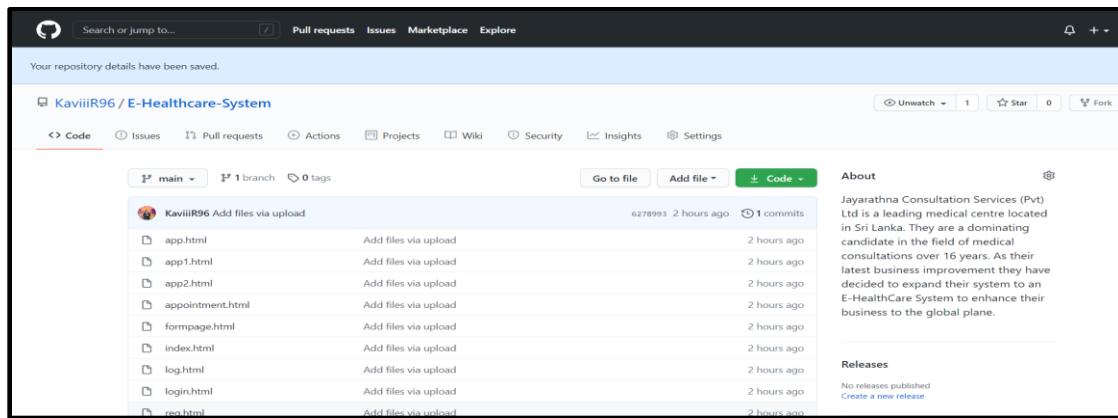


Figure 6.7.3

6.8 Summary

Implementation is one of the key stages in the SDLC and also is the final stage of the development process. The system is being installed in this stage in the client's organization and the end users were given a proper training on how to operate the software effectively.

The phased implementation was used to implement the system in the client's organization and the end users were given a proper training through self-paced multimedia training. Though this stage was a challenging phase the candidate was able to overcome the difficulties faced and the system was implemented successfully.

Chapter 7

Critical Appraisal

7.1 Introduction

This web-based E-Healthcare solution for the Jayarathna Consultation Services (PVT) LTD was developed to accomplish one of the BCS-HEQ PGD level course requirements. This e-healthcare system was developed in order to minimize the complications within the existing system and to improve the productivity of the organization by surpassing the geographical barrier. The developed project introduces a platform for online appointment reservation, online counselling sessions, and conduct mobile medical tests for the patients who are living within the Kandy city limits and also will provide a platform to facilitate the patients to find the most appropriate doctor for their sickness. This web-based solution also provides a patient management facility where the system maintains a user profile in which all the previous diagnosis reports, prescriptions and the test reports are available so that the complications occurring due to different types of drugs could be minimized.

This chapter evaluates the e- healthcare system which was developed by the candidate by discussing the challenges faced, overall achievements, assumptions made and an analysis of the overall development process.

7.2 Difficulties Faced

One of the major challenges faced in this phase was that the client didn't supply the required information correctly. The client didn't have a proper understanding about the main functions of the system. However the candidate was able to overcome that challenge by asking extra questions in the interview from the director of the company within the requirement gathering stage, and by indirectly observing the process of the existing system via cameras installed within the organization and analyzing the video recordings obtained as a result of the observation process.

Another challenge the candidate had to face was the staff members of the Jayarathna Consultation Services (PVT) LTD. had a lower computer literacy. Hence it was a difficulty faced during the implementation process. Malfunctioning of the routine business operations can impede the productivity and efficiency of the organization.

However the candidate was able to resolve that difficulty by discussing with the director and agreeing to recruit four new staff members with a considerable computer literacy to carry out the major and critical operations of the system such as payment handling, appointment management etc. And the rest of the staff members were given a self paced multimedia training to enhance their computer skills.

Assumptions

- The documents gathered during the data gathering phase were assumed to be up to date.
- The codes written to develop the system was assumed to be compatible with all the web browsers
- The system was assumed to be working without failure when there are large number of simultaneous requests made on the web server

Constraints

- Since the time allocated for the interviewing process was limited and the requirements stated by the client were unclear the candidate had to arrange an extra interview session to ask some extra questions from the client to clarify the doubts regarding the requirements of the system.

7.3 Overall Achievement

The main intention of developing this web-based solution for the Jayarathna Consultation Services (PVT) LTD. was to make their business processes more efficient and convenient. Another major objective of the candidate was to enhance the customer base by surpassing the geographical barrier. That objective was well achieved as a large number of patients have been registered throughout Sri Lanka.

The candidate distributed a feedback form a week after the implementation to the director of the company, receptionists, and few patients and was able to receive a positive feedback from them. (Received feedback forms are attached in the appendix F). All the users who have completed the form have stated that the system is very useful and they were able to achieve the goal they were expecting. From the responses received it was evident that there were about 50 consultation sessions scheduled per day before the system was implemented and after it had increased up to 100-150.

Also the director has mentioned that there were positive comments from the patients as well. The patients have stated that this system was a timely need due to the recent Covid 19 pandemic. The patients have also praised the patient management function stating that it is a very efficient and an effective function since when some medicinal drugs were given together certain side effects such as nervous system malfunctioning could occur. And there were also optimistic comments from the consultants who has registered to the system saying that this system was very useful to them since any patient living at any location can consult them hence they can help more people as well can gain more profit through consulting.

The director also stated that the profit of the organization has increased due to the new system and also the profit level and the success rate could be easily monitored from the reports such as daily sales report generated by the report handling module.

Considering the above feedbacks given by the stakeholders of the company it is evident that the developed project is at utmost success.

Presented below is the SWOT analysis conducted for the developed project.

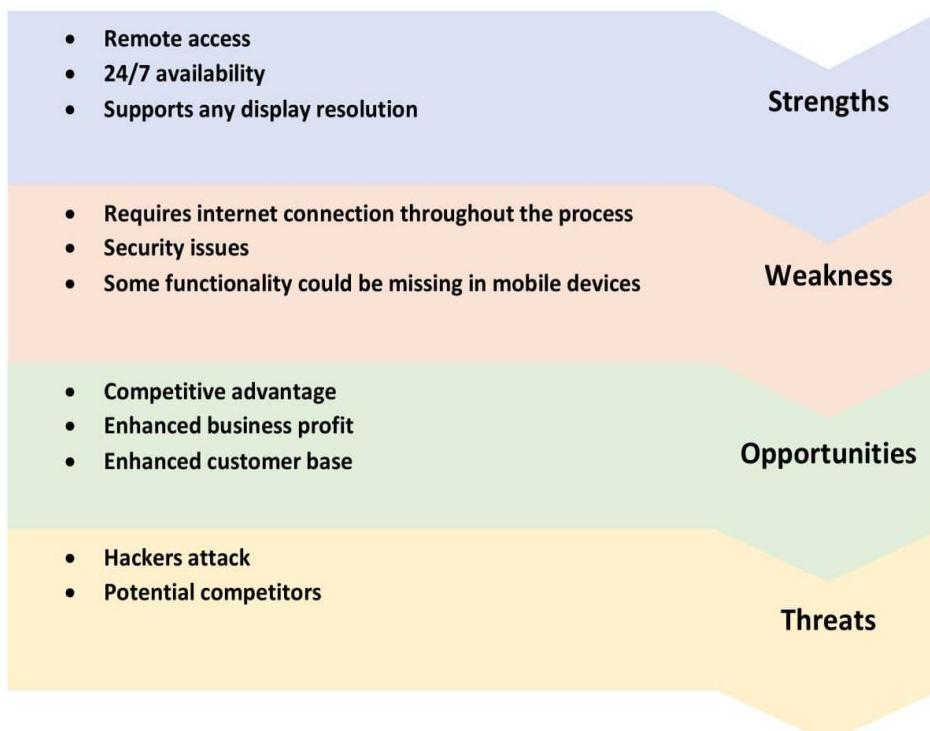


Figure 7.3.1

7.4 Suggestions for Future Enhancements

The candidate was able to implement the proposed web system successfully while developing the objectives mentioned in the documentation. Despite the features that are already present, the web solution could be enhanced further as a new project with all the stages and new agreements. The enhancements that could be done to the developed system are as follows.

- Though the system supports mobile devices as some of the features may not be available in some devices a mobile application can be developed so that the users can use the system conveniently
- The system could be enhanced to include a real time automated chat feature as a help to the users by using a chat bot
- A hardware device could be developed to check the pressure, pulse rate and sugar level of the user and the obtained results will be accessible by the doctor when the device is connected to the system
- GPS functionalities could be introduced to easily find the location of the patient and the recent locations for a patient who has requested a mobile medical test and by implementing GPS functions the doctor can get an extra clue about the sickness of the patient by finding the location of the patient and checking whether there are any pandemics prominent in that particular area. For an example if the patient is having symptoms such as fever, headache etc the patient may have a more severe virus such as dengue virus or a normal viral fever or the doctor could roughly predict whether the patient has been in contact with a patient who has been infected with Covid 19.

7.5 Lessons Learnt

The candidate was able gain a vast knowledge on system development through this project and was able to get a good experience on how to practically apply the theories and concepts which were learnt in the modules such as Software Engineering, Information Systems, Web Engineering, Project Management, Database management Systems etc. the candidate was able to learn how to plan, develop and implement a software project within a limited time frame. However this process was a lot challenging but it was worth all the effort spent to complete the project. The candidate was able to gain the following skills through this project as well.

- Work according to the planned schedule within a limited time frame
- Manage client requirements
- Negotiate with the client
- System design
- System development
- System testing
- Academic writing and documenting
- Interact with stakeholders professionally
- Set the system scope
- Implementing security features

7.6 Gantt chart

Gantt chart is a simple horizontal bar chart that shows project tasks against a calendar. Each bar represents a named project task. It could be used for planning, monitoring and coordinating projects. Using the chart the parallel processes could be easily identified. The following is the Gantt chart for the actual project time frame.



Figure 7.6.1

7.7 Summary

Development of an e – healthcare system was a challenging but a valuable experience. The candidate had to go through several stages throughout the development and each of them was a challenging experience. There were many difficulties throughout the project but the candidate was able to resolve them successfully. This chapter consists of the difficulties, challenges faced by the developer and how they were resolved. Also the constraints and assumptions made were also mentioned within this chapter. The future enhancements that could be done to the developed system were suggested and the overall achievement of the project was discussed.

The project was scheduled to monitor the progress of the project and the actual Gantt chart used for the actual project time frame was presented at the end of the chapter.

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Appendix A – Design Documentation

Use case scenarios

Use case number	UC 003
Use case name	Request Counseling session
Overview	This use case allows patients to request a counseling session
Actors	Patient Doctor
Conditions	<p>Pre-Condition: Patient must be a registered patient</p> <p>Post-Condition:</p> <ol style="list-style-type: none"> 4. Send an counseling session confirmation email to the patient 5. Update the session schedule of the doctor 6. Successful session booking will redirect to payment interface
Business rules	System should not allow session booking for unregistered patients
Main flow of event	<ol style="list-style-type: none"> 4. Login or register to the system 5. Fill in the counseling session request form indicating the particular doctor to be consulted 6. Use case terminates with post conditions 1, 2 and 3

Appendix A Table 1

Use case number	UC 004
Use case name	Request Medical Test
Overview	This use case allows patients to request a medical test
Actors	Patient Laboratory staff
Conditions	<p>Pre-Condition: Patient must be a registered patient</p> <p>Post-Condition:</p> <ol style="list-style-type: none"> 1. Update the test result status to “complete” 2. Send the results to the patient through mail or email

Business rules	System should not allow medical test requesting for unregistered patients
Main flow of event	<ol style="list-style-type: none"> 1. Login or register to the system 2. Fill in the medical test request form indicating the type of the test to be conducted 3. The sample is collected and the test is conducted 4. Use case terminates with post conditions 1 and 2

Appendix A Table 2

Use case number	UC 005
Use case name	Payment
Overview	This use case allows users to make their payments
Actors	Patient Accountant
Conditions	<p>Pre-Condition: Patient must be a registered patient</p> <p>Post-Condition:</p> <ol style="list-style-type: none"> 1. Update the database 2. Generate and send the invoice to the patient
Business rules	System should not allow payments for unregistered patients
Main flow of event	<ol style="list-style-type: none"> 1. Payment is requested by the system 2. The online payment is made 3. System request the bank for the payment authorization 4. Payment is confirmed by the patient 5. Use case terminates with post conditions 1 and 2
Alternative flow of event	<ol style="list-style-type: none"> 1. Payment is requested by the system 2. The payment is done in cash 3. Use case terminate with post conditions 1 and 2

Exceptions

1. The payment is not authorized by the bank
2. Error message is displayed to the patient

Appendix A Table 3

Use case number	UC 006
Use case name	View Reports
Overview	This use case allows the administrator to view the reports
Actors	Administrator
Conditions	Pre-Condition: Administrator must be a registered administrator
Business rules	System should not allow report viewing for unregistered administrators
Main flow of event	<ol style="list-style-type: none"> 1. Login to the system as administrator 2. Select the report generation option in the administrator dashboard 3. Select the type of the report 4. Select the content to be included in the report 5. Generate report 6. Use case terminated

Appendix A Table 4

Use case number	UC 007
Use case name	Manage Website
Overview	This use case allows the administrator to manage the website
Actors	Administrator
Conditions	Pre-Condition: Administrator must be a registered administrator
Business rules	System should not allow website managing for unregistered administrators

Main flow of event

1. Login to the system as administrator
2. Select the manage website option in the administrator dashboard
3. Update website
4. Use case terminated

Appendix A Table 5

Use case number	UC 008
Use case name	Manage Patients
Overview	This use case allows the administrator to manage the Patients
Actors	Administrator
Conditions	Pre-Condition: Administrator must be a registered administrator
Business rules	System should not allow patient managing for unregistered administrators
Main flow of event	<ol style="list-style-type: none"> 1. Login to the system as administrator 2. Select the manage patient option in the administrator dashboard 3. Remove patients 4. Send notification to the patient 5. Use case terminated

Appendix A Table 6

Use case number	UC 009
Use case name	Manage Appointments
Overview	This use case allows the administrator to manage the appointments
Actors	Administrator
Conditions	Pre-Condition: Administrator must be a registered administrator
Business rules	System should not allow appointment managing for unregistered administrators

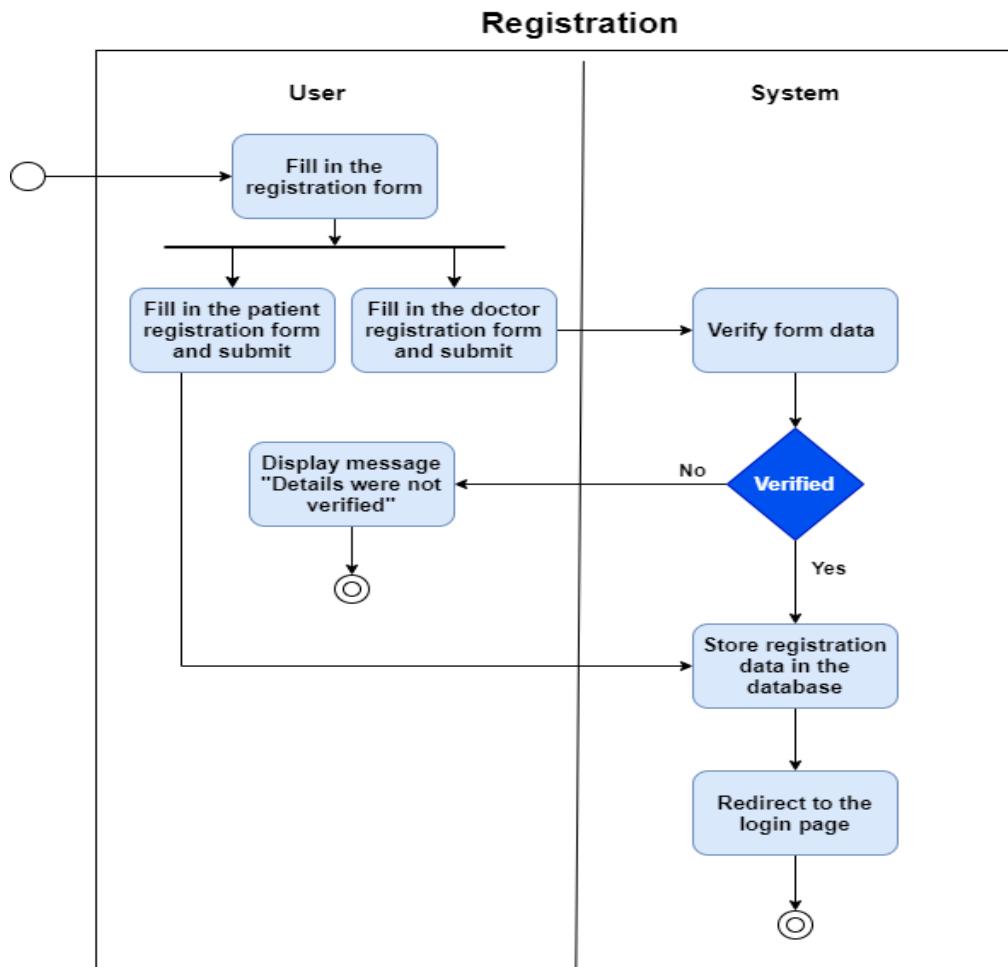
Main flow of event

1. Login to the system as administrator
2. Select the manage appointment option in the administrator dashboard
3. Update appointments
4. Send update confirmation to doctors and patients
5. Use case terminated

Appendix A Table 7

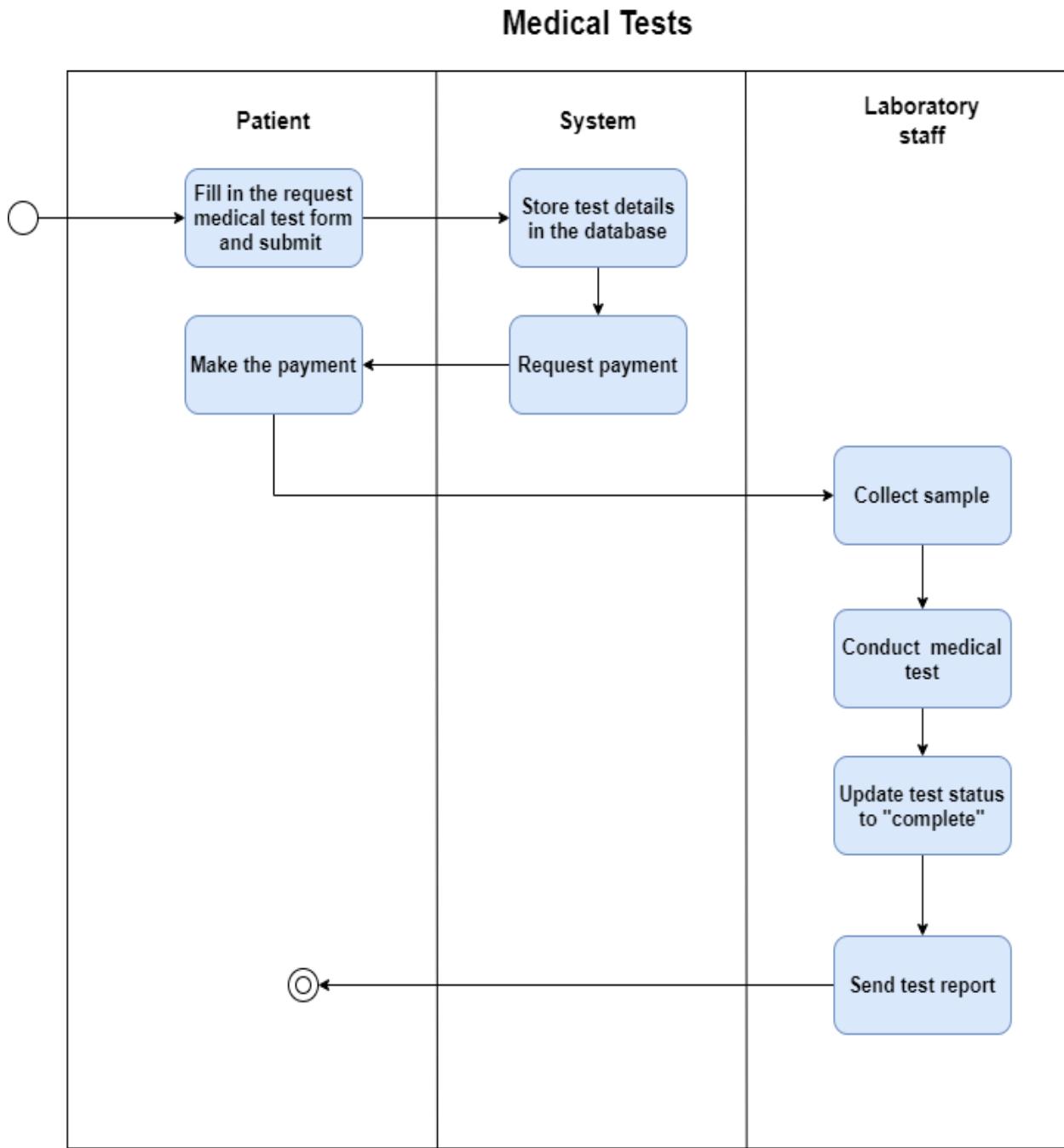
Activity Diagrams

- **Registration**



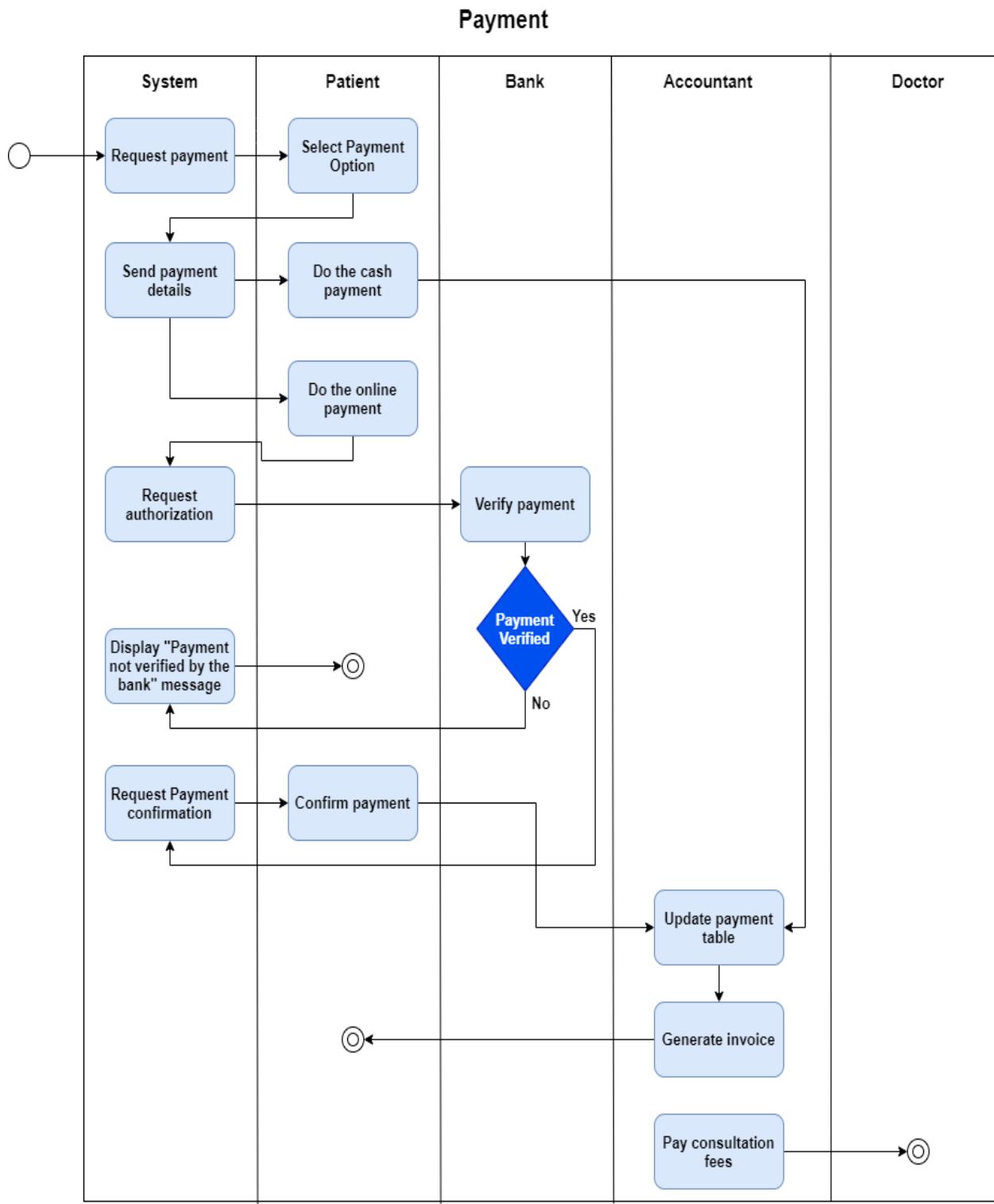
Appendix A Figure 1

- Request medical tests



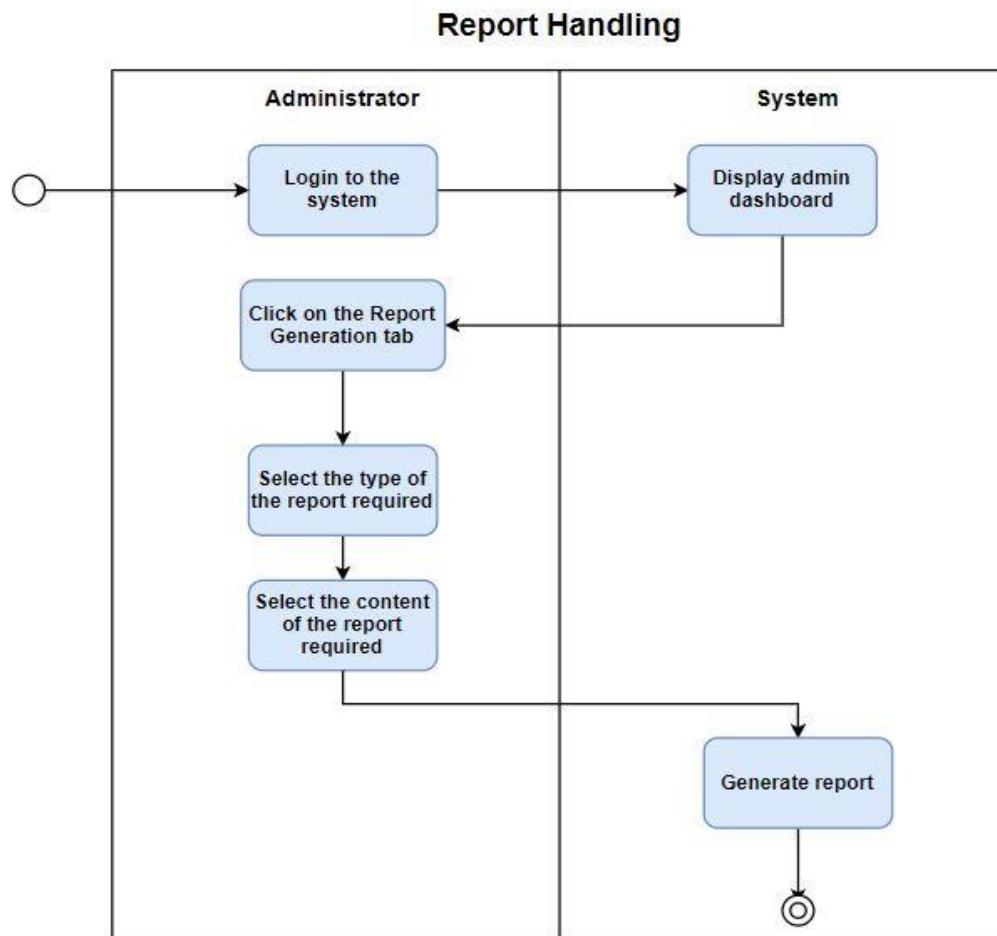
Appendix A Figure 2

- Payment



Appendix A Figure 3

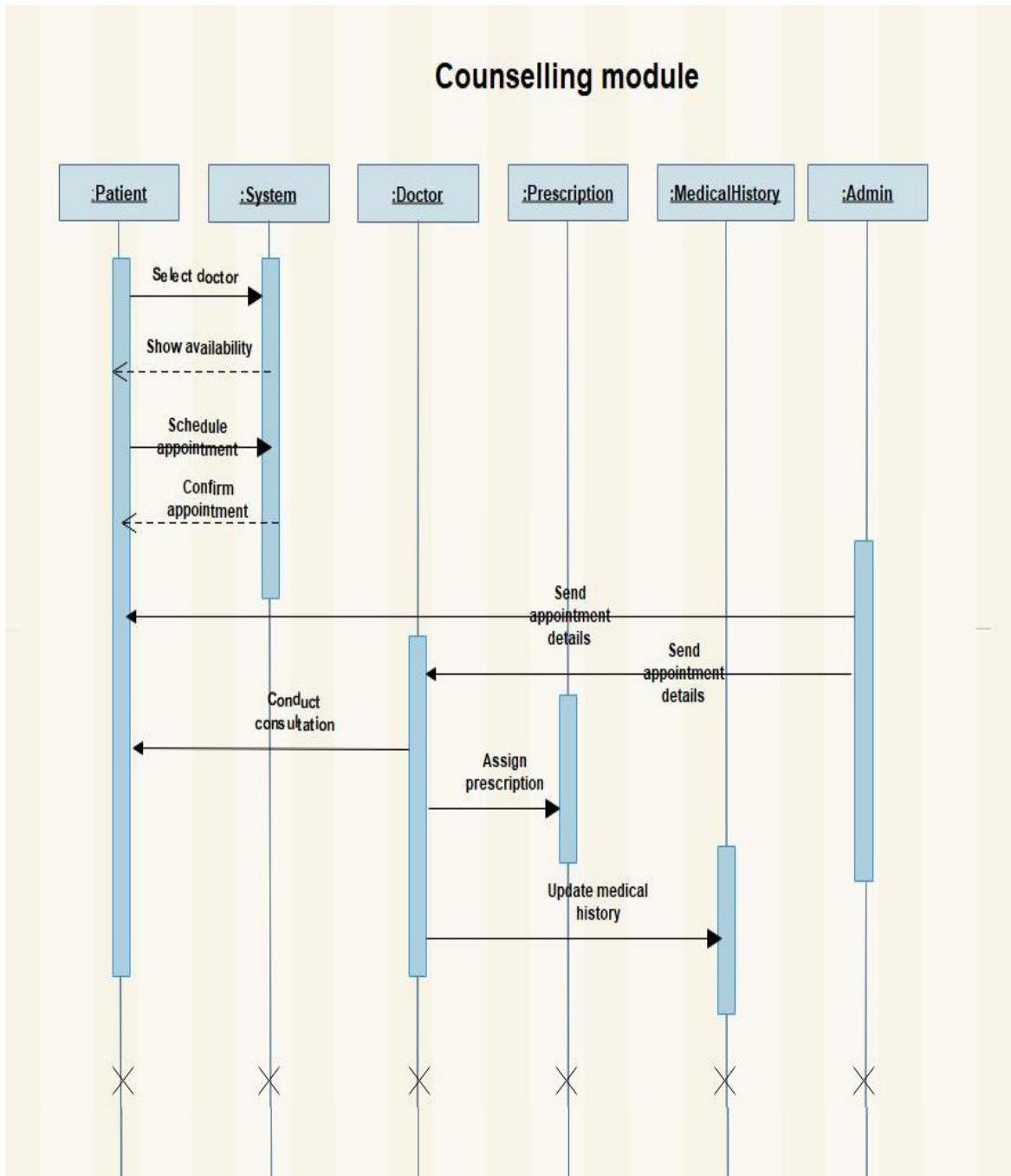
- Report handling



Appendix A Figure 4

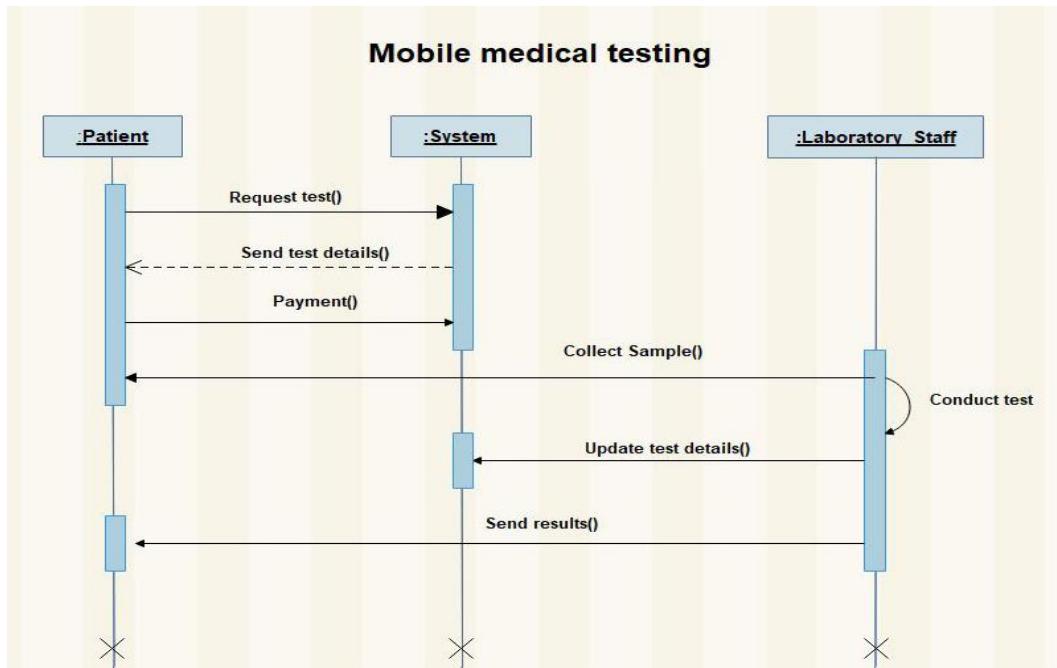
Sequence Diagrams

- Request counseling session



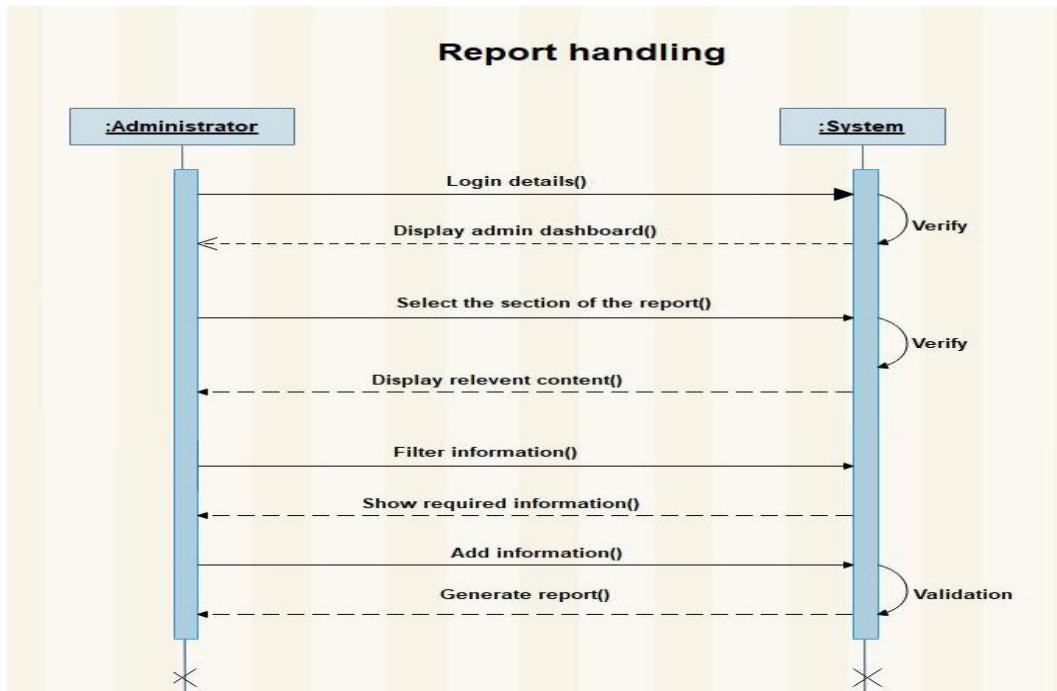
Appendix A Figure 5

- Request medical tests



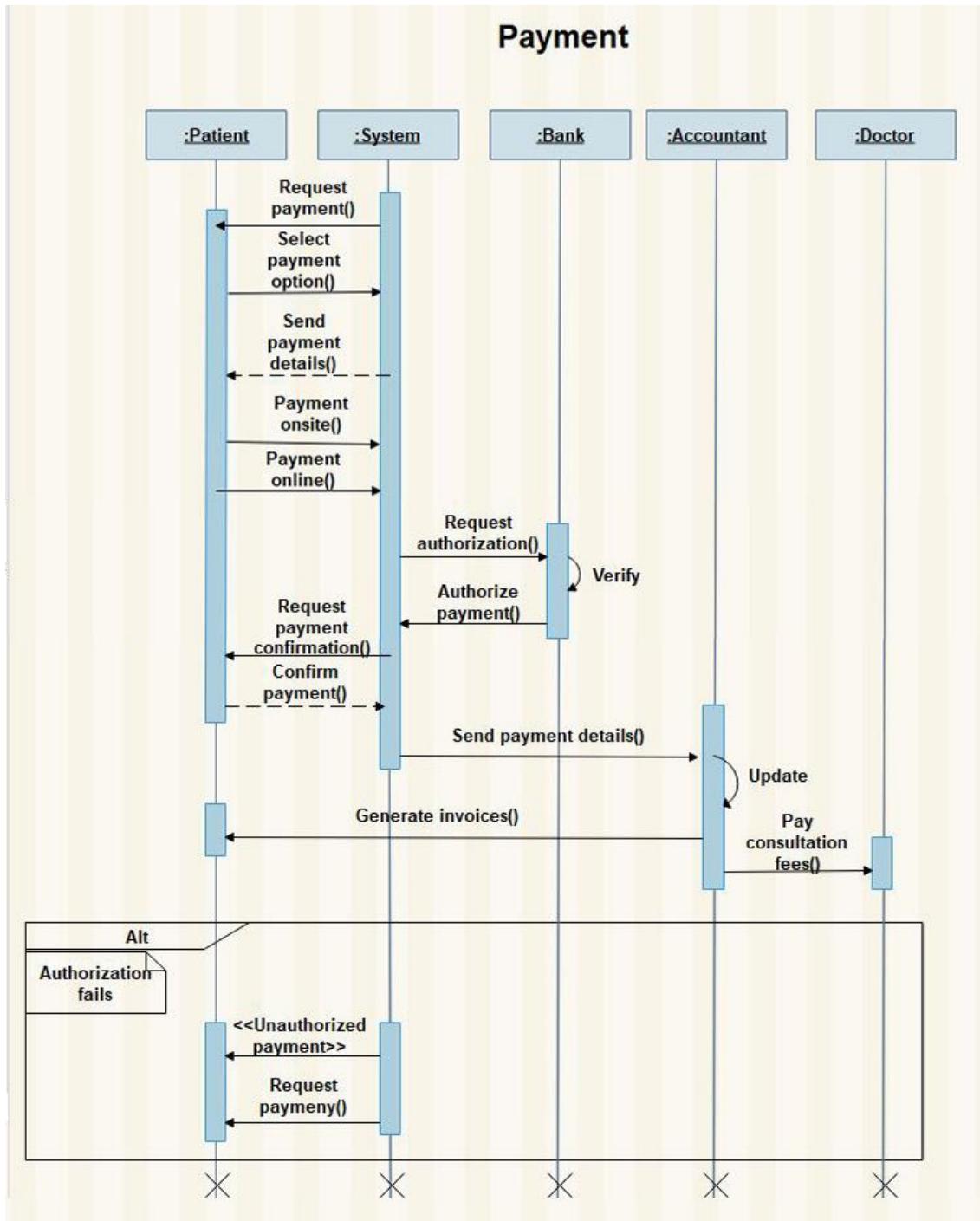
Appendix A Figure 6

- Report handling



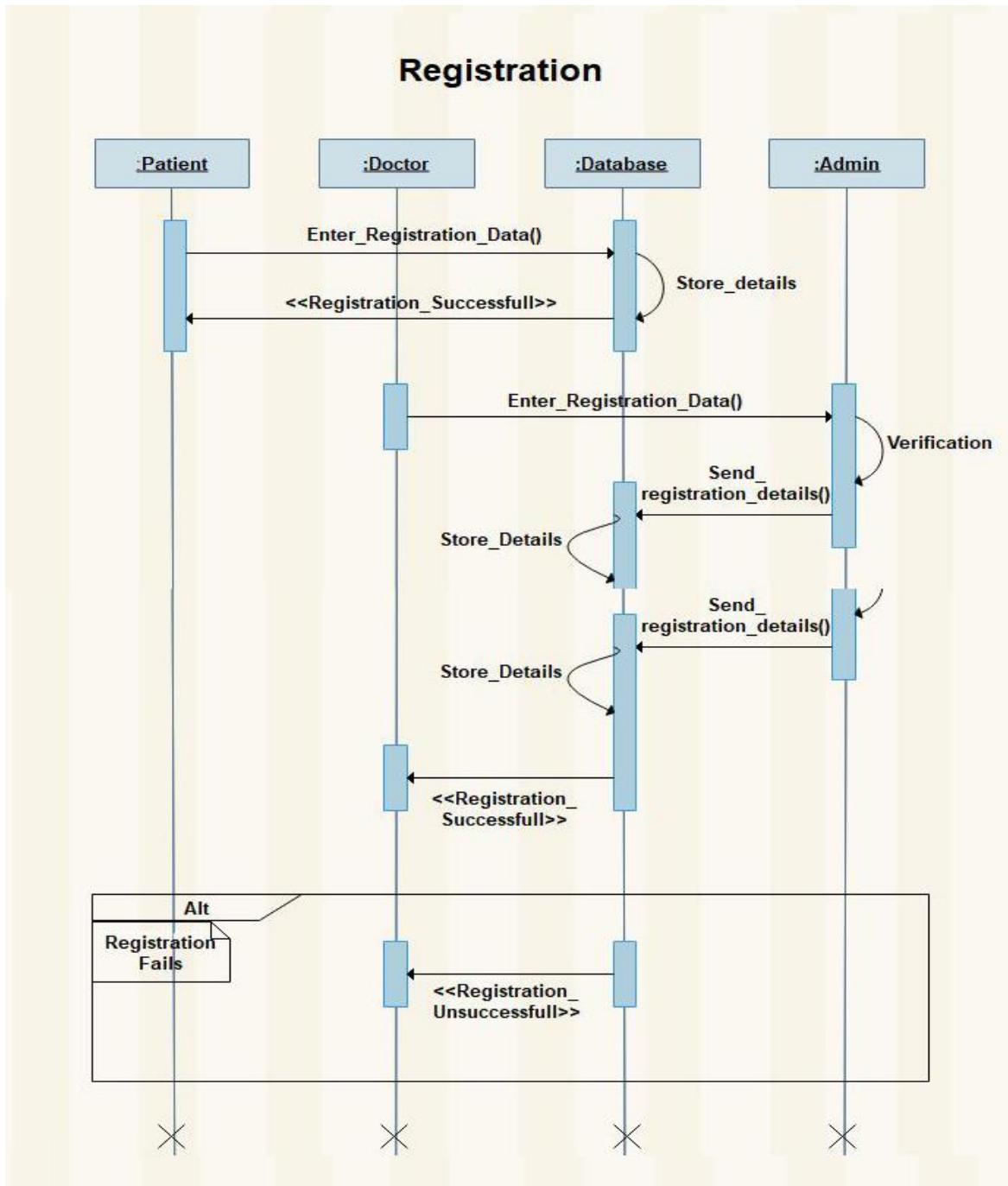
Appendix A Figure 7

- Payment



Appendix A Figure 8

- Registration



Appendix A Figure 9

Appendix B – System Documentation

The system documentation covers the technical aspects of the system. It describes how the system was built. This document is used by the technical people such as programmers and analysts when carrying out system upgrading and bug removals. The following is the technical documentation of the E-healthcare system of Jayarathna Consultation Services (PVT) LTD. which can be used by the administrators and other users to continue upgrading the system.

1. System Requirements

Hardware	Minimum Requirement
Processor	Intel Pentium IV or higher
System Type	64 bit Operating System
Memory	8GB RAM
Hard Disk	60GB HDD or Higher
Internet Connection	ADSL connection of a minimum 1 Mbps
Graphics	On-board VGA

Appendix B Table 1

2. Software Requirements

Software	Minimum Requirement
Server	XAMPP 3.2.2 server
Operating System	Windows 7 or higher
Web Browser	Google Chrome is recommended
Database	MySQL

Appendix B Table 2

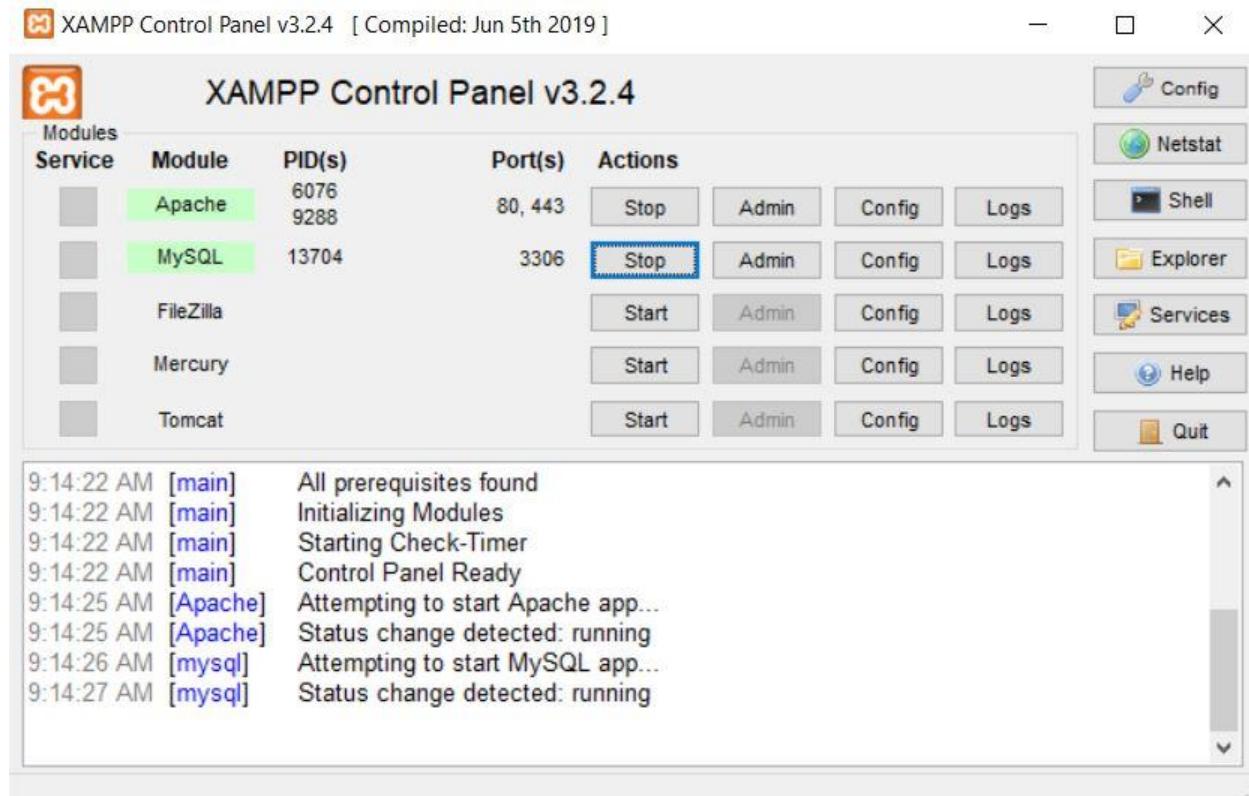
3. Software Installation

Step 1 – Download the XAMPP server from the official site and install it in the system. (www.apachefriends.org/download.html)

Step 2 – Install a web browser to access the server and the database. (Google chrome is recommended)

Step 3 – Copy the system files to the htdocs folder (C:\xampp\htdocs\E-Healthcare_System)

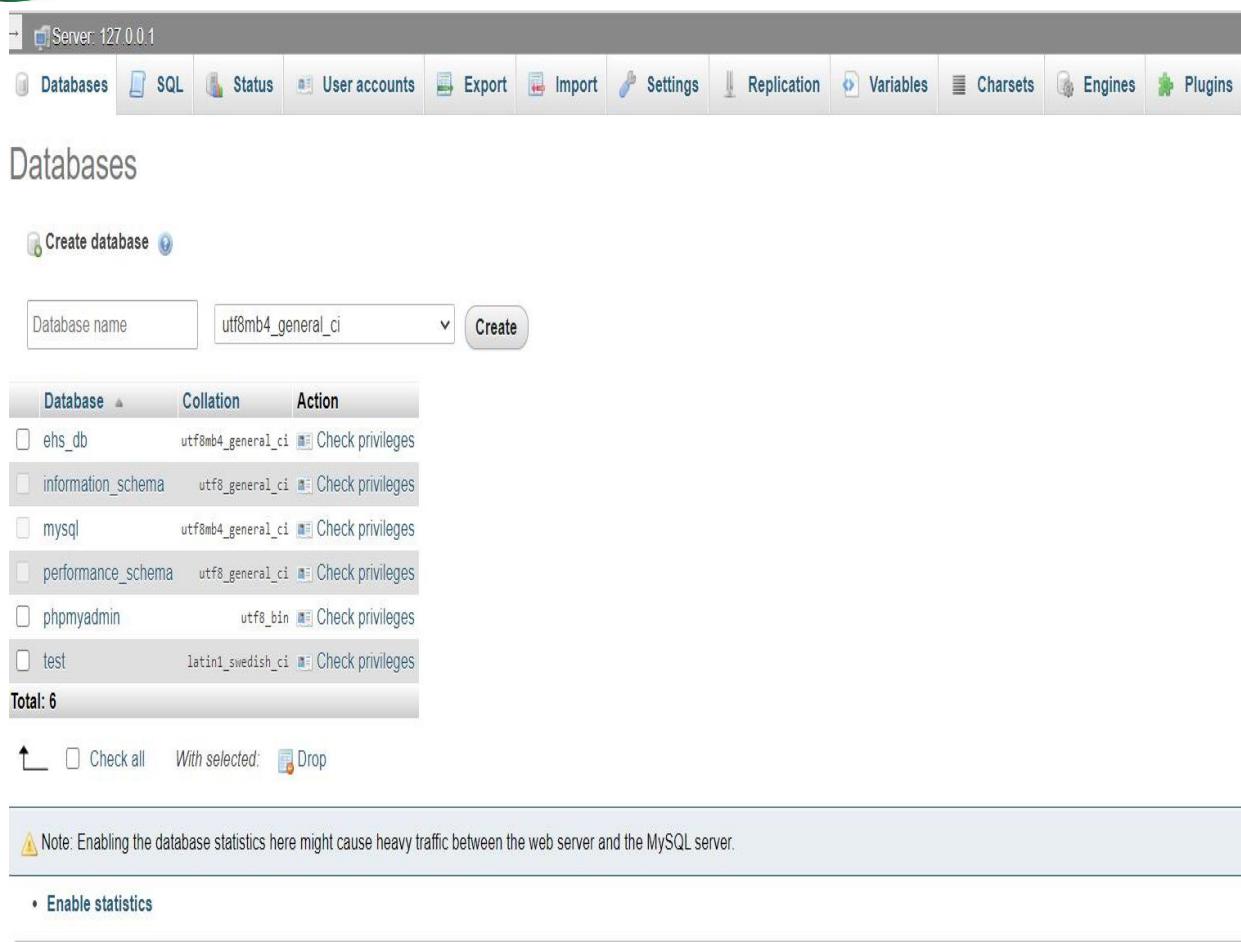
Step 4 – Launch the XAMPP control panel and start the Apache server and MySQL.



Appendix B Figure 1

Step 5 – Type http://localhost/E-Healthcare_System/index.html in the address bar to access the system.

Step 6 – Open the phpMyAdmin to access the database by typing <http://localhost/phpmyadmin> in the address bar.



→ Server: 127.0.0.1

Databases SQL Status User accounts Export Import Settings Replication VariablesCharsets Engines Plugins

Databases

Create database

Database name: utf8mb4_general_ci Create

Database	Collation	Action
ebs_db	utf8mb4_general_ci	<input type="button" value="Check privileges"/>
information_schema	utf8_general_ci	<input type="button" value="Check privileges"/>
mysql	utf8mb4_general_ci	<input type="button" value="Check privileges"/>
performance_schema	utf8_general_ci	<input type="button" value="Check privileges"/>
phpmyadmin	utf8_bin	<input type="button" value="Check privileges"/>
test	latin1_swedish_ci	<input type="button" value="Check privileges"/>

Total: 6

Check all With selected: Drop

Note: Enabling the database statistics here might cause heavy traffic between the web server and the MySQL server.

- Enable statistics

Appendix B Figure 2

The HTML, CSS, JavaScript and PHP codes can be edited using any test editor including Notepad ++.

Appendix C- User Documentation

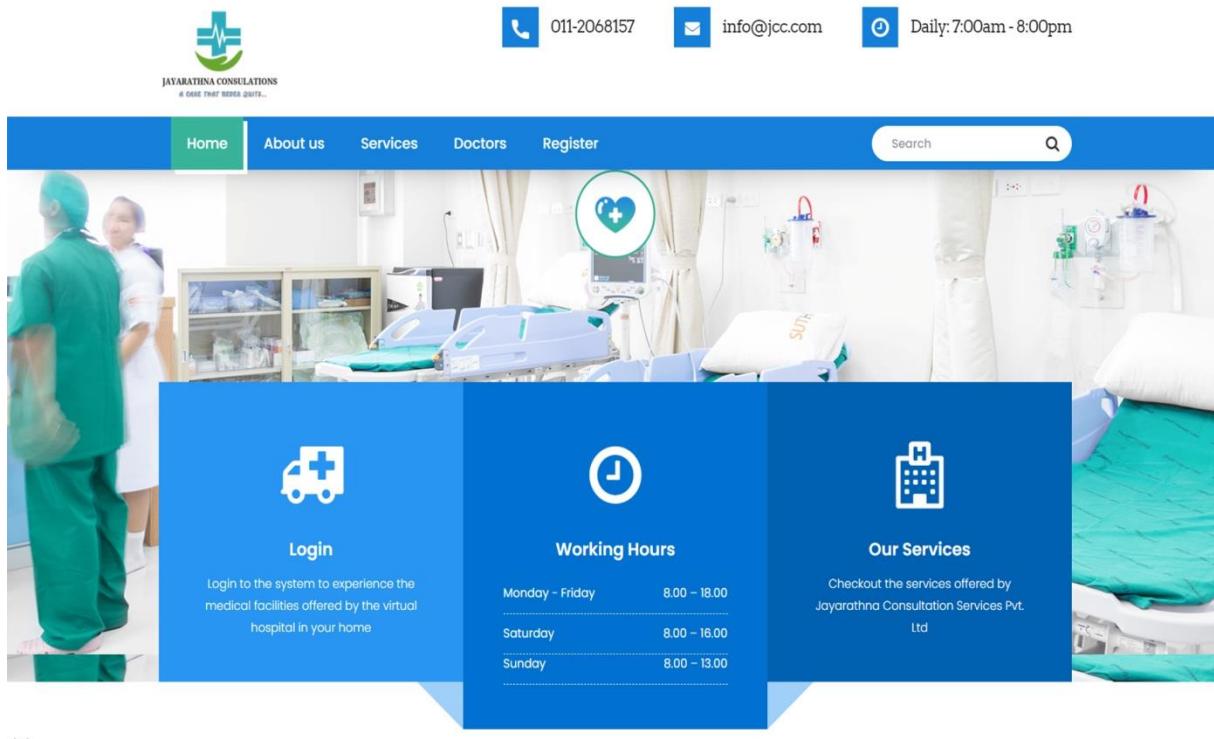
The user documentation is the manual that supports the user to work with the program. This is a non technical document that tells what the system does and how to use it. A complete, quality and a simple user manual can enhance the customer satisfaction, customer productivity, customer experience etc. Following is the user documentation of the developed web-based E-healthcare system of Jayarathna Consultation Services (PVT) LTD.

Introduction

Jayarathna Consultation Services (PVT) LTD. is one of the pioneering healthcare service providers in Sri Lanka. This company offers various healthcare facilities to the customers such as Channeled consultations, Counseling sessions and also Laboratory facilities. The system has two external users namely doctor and patient. The administrator, receptionist and the accountant are internal users of the organization.

Home Page

This web page is the introductory and the default startup page of the developed web based solution. This page contains all the navigational links to access and experience the services offered by the e-healthcare system of Jayarathna Consultation Services (PVT) LTD. Any visitor can access this page merely by typing <http://localhost/E-Healthcare System/index.html> in the address bar of the web browser. Following is a screen shot of the Home page of the developed e-healthcare system.



The screenshot shows the homepage of Jayarathna Consultations. At the top, there's a navigation bar with links for Home, About us, Services, Doctors, and Register. Below the navigation is a search bar. The main content area features a large image of medical staff in an operating room. Overlaid on this image are three blue service cards:

- Login**: An icon of a medical cross inside a white van. Text: "Login to the system to experience the medical facilities offered by the virtual hospital in your home".
- Working Hours**: An icon of a clock. Text: "Monday - Friday 8.00 - 18.00", "Saturday 8.00 - 16.00", and "Sunday 8.00 - 13.00".
- Our Services**: An icon of a hospital building. Text: "Checkout the services offered by Jayarathna Consultation Services Pvt. Ltd".

--> <



"The art of medicine consists of amusing the patient while nature cures the disease."

CONTACT US

-  No 147 Baseline Road Colombo 07
-  info@jcc.com
-  (+94)11 206 8157

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Email address



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Appendix C Figure 1

About Us

Any visitor can access the about us page by just clicking on the About Us navigational tab in the home page. This page consists of a brief description about the background and the history of Jayarathna Consultation Services (PVT) LTD. and the vision and the mission of the organization. Following is a screen shot of the About us page of the developed e-healthcare system.



We established Jayarathna Consultations Services pvt. ltd in 2005 and are one of the pioneers in channel consulting service in Sri Lanka. Our institution is the largest, most reputed, state of the art channelled consultation centre in the central province serving the public with consultation facilities for over 100 consultants belonging to almost all the specialties. We have over 100 health care workers on our staff to assist the consultants and to serve our patients with concern, care and compassion. CCC Kandy is committed to the highest quality of patient care and has earned a reputation as a leader in the field of channel practice. We are dedicated to provide you with the best healthcare. Care is at the heart of our business and we thrive to provide the best possible level of service to our patients. Recently we have refurbished both new services and buildings with extensions, modern equipment and additional facilities with wheel chair access to all floors and adequate parking for doctors and patients.



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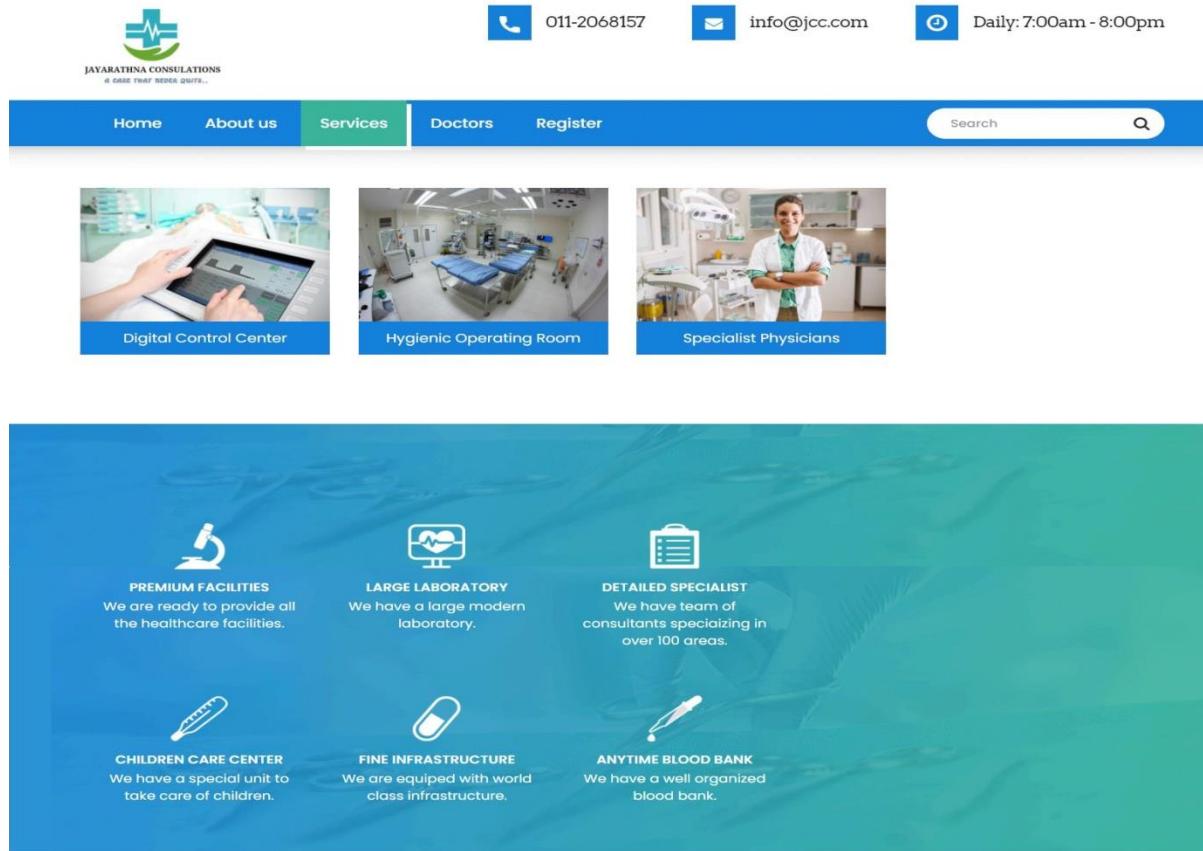
Get healthy news, tip and solutions to your problems from our experts.



Appendix C Figure 2

Services

The services page consists of a brief introduction about the services offered by the Jayarathna Consultation Centre. Any visitor can visit this page by simply clicking on the Services navigation tab.



The screenshot shows the services page of the Jayarathna Consultations website. At the top, there is a header with the logo, contact information (phone 011-2068157, email info@jcc.com, and operating hours Daily: 7:00am - 8:00pm), and a search bar. Below the header, there is a navigation menu with links to Home, About us, Services (which is highlighted in green), Doctors, and Register. The main content area features three service cards: 'Digital Control Center' (showing a person using a tablet), 'Hygienic Operating Room' (showing an operating room), and 'Specialist Physicians' (showing a doctor). Below this, there is a section with six icons and descriptions: 'PREMIUM FACILITIES' (laboratory glassware icon), 'LARGE LABORATORY' (monitor with heart rate icon), 'DETAILED SPECIALIST' (doctor's clipboard icon), 'CHILDREN CARE CENTER' (stethoscope icon), 'FINE INFRASTRUCTURE' (pill icon), and 'ANYTIME BLOOD BANK' (blood drop icon).



"The art of medicine consists of amusing the patient while nature cures the disease."

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Email address



Appendix C Figure 3

Doctors

The doctor page allows any visitor to find the doctors who are available for consultation through our system. This page can be accessed by merely clicking on the doctor navigation tab. Once the find doctor window appears the visitor can select the field of expertise of the doctor by clicking on the small arrow in the corner of the form element and select the desired field from the list and hit submit. The users can even schedule an appointment with the desired doctor by clicking on the name of doctor. However appointment requesting is only permitted by the registered users. Hence once a name of a doctor is selected the user will be redirected to the login page.



A screenshot of a web page titled "View Doctors". At the top, there is a circular icon containing a stylized illustration of a female doctor with brown hair and a stethoscope around her neck. Below the title, the text "Choose the field:" is followed by a dropdown menu set to "Urology" and a "Submit" button.

Appendix C Figure 4

Register

The register page consists of two links. They are the links to the patient registration form and the doctor registration form. The visitor can click on the link according to the expected role to be played in the system. Any visitor can simply access the register page by clicking on the register tab in the navigation bar on the home page.



JAYARATHNA CONSULTATIONS
A CARE THAT NEVER QUITS...

011-2068157 info@jcc.com Daily: 7:00Am - 8:00pm

Home

About us

Services

Doctors

Register

Search



Registration



Patient Registration



Doctor Registration



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Appendix C Figure 5

Patient Registration Form

This form could be accessed by any visitor. If the visitor is planning to play the role of the patient within this system this registration form has to be filled and submitted. All the fields in this system are mandatory to be filled. As this is a healthcare system the profiles could contain the sensitive information hence it is recommended to create a strong password. The password that is created here should at least be 8 characters long and should contain at least one uppercase letter and a symbol. Finally as the last steps of the registration process the user must give their consent to the terms and conditions of the system. After completing the signup form the user should click on the submit button. If the registration is successful the registered user will be redirected to the login page.

Patient SignUp Form

Patient Name

Patient Address

Patient NIC/SS Number

Patient Phone Number

Email

Password

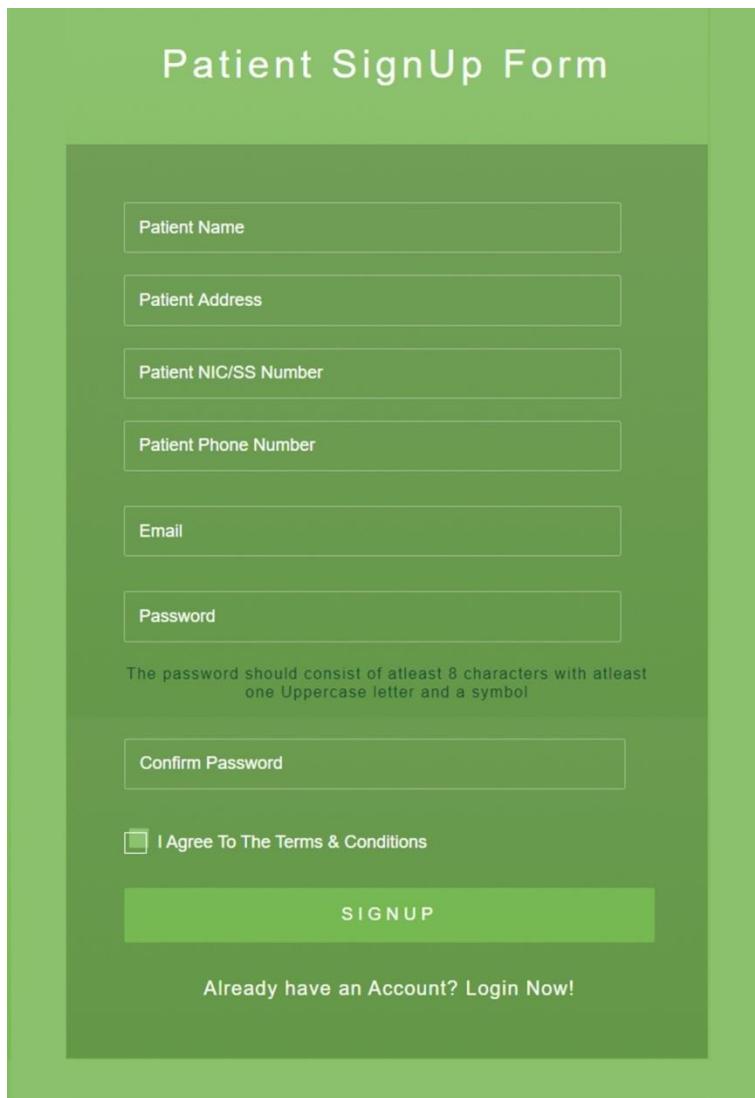
The password should consist of atleast 8 characters with atleast one Uppercase letter and a symbol

Confirm Password

I Agree To The Terms & Conditions

SIGN UP

Already have an Account? [Login Now!](#)



This figure shows a Patient SignUp Form. It consists of several input fields: Patient Name, Patient Address, Patient NIC/SS Number, Patient Phone Number, Email, and Password. A note below the Password field specifies that it should be at least 8 characters long, containing at least one uppercase letter and one symbol. There is also a Confirm Password field. A checkbox for agreeing to terms and conditions is present. At the bottom, there is a large green 'SIGN UP' button and a link for users who already have an account to log in.

Appendix C Figure 6

Doctor Registration Form

This form could be accessed by any visitor. If the visitor is planning to play the role of the doctor within this system this registration form has to be filled and submitted. All the fields in this system are mandatory to be filled. The doctors should produce the medical practice license and upload it to the system by clicking on the choose file button. After completing this form the doctors can hit the submit button. Thereafter the license is being verified by the administrators and an email will be

sent to the doctors upon successful registration. A link to the login form will be included in that email as well.

Doctor SignUp Form

Choose the field:

The password should consist of atleast 8 characters with atleast one Uppercase letter and a symbol

Please upload the medical practice licence:

No file chosen

I Agree To The Terms & Conditions

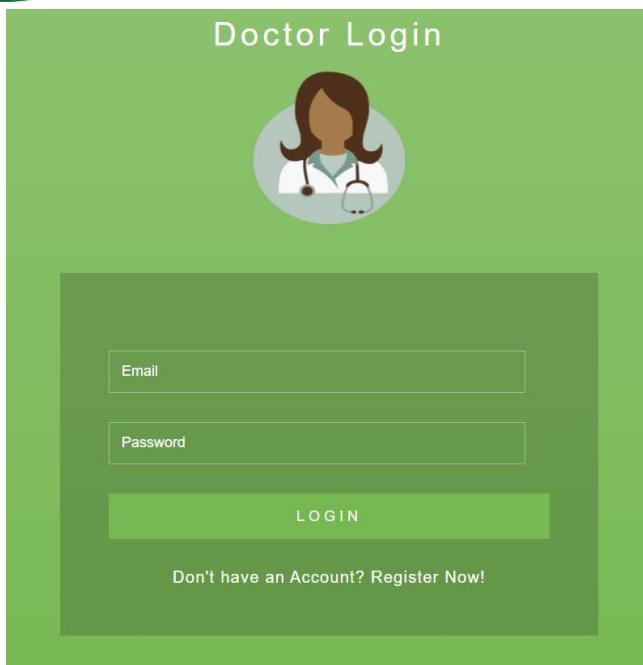
SIGN UP

Already have an Account? [Login Now!](#)

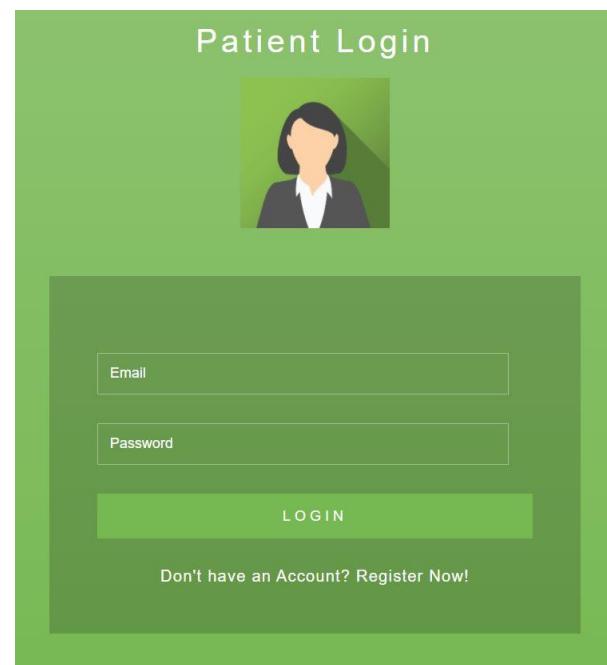
Appendix C Figure 7

Doctor and Patient Login

Once the users are successfully registered they are redirected to the login page. The users can either access the login page by clicking on the “Login now” option at the bottom of the registration form. They can simply log in to the system by entering their email and the password that they have entered in their registration process.



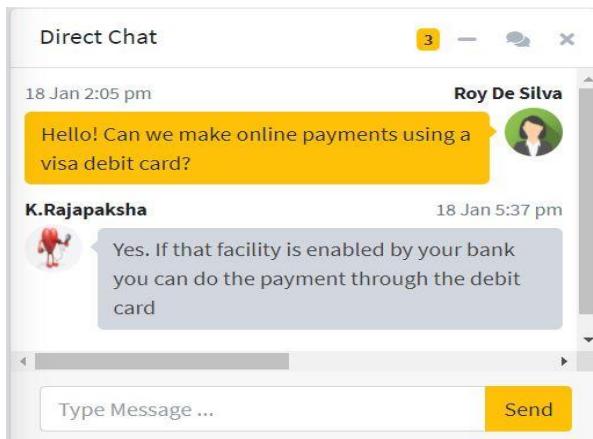
Appendix C Figure 8



Appendix C Figure 9

Patient Profile

Once the registered patients successfully login to the system they will be redirected to their profile page. The patients can view upcoming appointments, medical history, current health status and the weight graph in their profile pages. They can also chat with the administrators and make inquiries using the chat tab in the navigation bar.



Appendix C Figure 10

[Account Settings](#) [Chat](#) [Test Reports](#) [Notifications 1](#) [Medical History](#)

MENU BOX

[Update Medical History](#)

[Request Medical Test](#)

[Request Appointment](#)

[Update Health Attributes](#)



Welcome Roy De Silva

Blood Type : B Positive
Age : 61 Years
Gender: Male

"It is health that is the real wealth, and not pieces of gold and silver."

Click here to

[View Test Status](#)

[View Doctors](#)

WEDNESDAY

19

[ADD EVENT](#)

Upcoming Appointments

Dr. Manjula Bandara - General Consultant
[View Details](#)
11th January 2021

Dr. M.B.C.Dias - Gastrologist
[View Details](#)
22th January 2021

Current Health Status



120/80

Systolic	Diastolic	Pulse	Sugar
135	90	79	147

JANUARY 2021

S	M	T	W	R	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						



400 300 300



2020 November 30	82 Kg
2020 December 12	78 Kg
2020 December 29	80 Kg

Appendix C Figure 11

Update Medical History

This page consists of the details of the diagnosis of the previous appointments and their prescriptions. The patient can access this page by clicking on the update medical history menu in the menu box of the profile page or the medical history tab in the navigation bar. The medical history can be updated by the patient as well as a doctor with whom the patient had an appointment with.



The screenshot shows a 'Medical History' interface. At the top right is a green circular button with a white plus sign. Below it are two cards representing medical records:

- Dr. Fransis Perera - General Consultant**
 - Date 12.12.2020
 - Diagnosis High blood pressure, cholesterol and blood sugar level
 - Prescription
 - Metric 500mg
 - MISAR 40 mg
 - Losartan 50 mg
 - Atorvastatin 50 mg
- Dr. M.B.C.Dias - Gastrologist**
 - Date 20.12.2020
 - Diagnosis Mild Chronic Gastritis
 - Prescription
 - Omeprazole 50 mg
 - Lansoprazole 50 mg
 - Clarithromycin 50 mg
 - Amoxicillin 50 mg

Appendix C Figure 12

Request Medical Test

A registered and logged in patient can request for a medical test. The patient can merely click on the Request medical test menu on the menu box in the profile page to access the Request medical test form. They should fill the form and hit submit.



Request Medical Test

Patient Email

Test Type ▾

Current Address

Share Current Location

Medical Test Name ▾

Submit

View Instructions

Appendix C Figure 13

Request Appointment

A logged in patient can request for a medical appointment. The patient can click on the Request medical appointment menu on the menu box in the profile page to access the Request medical appointment form. The patient should fill the form and hit submit. The patient should enter the type of the appointment (whether it is an online or an onsite appointment) from the list provided and the name of the doctor to be consulted. If the patient doesn't know the doctor to be consulted there are two options the patient can use. They are, if the patient knows the field of expertise of the doctor to be consulted they can click on the find doctor by field option or the patient can click on the let us find you the best doctor button.



A screenshot of a web-based appointment booking form. At the top, it says "Request Appointment". Below that is a dropdown menu labeled "Appointment Type". The next field is "Doctor Name", followed by "Appointment Date" with a calendar icon. A green button labeled "Check Availability" is positioned between the date and session selection fields. Below the date field is a dropdown menu labeled "Available Sessions". At the bottom of the form are two green buttons: "Find doctor by field" and "Let us find you the best doctor". A final green "Submit" button is located at the very bottom center.

Appendix C Figure 14

Let us find you the best doctor option

Once the logged in patient clicks on the let us find you the best doctor option in the request appointment form the system will redirect them to a page where the patients should mark their symptoms of their illness and the system will predict the field of expertise and the best doctor and to be consulted. Once the patient clicks on a name of a doctor out of the filtered list provided by the system the patient will be redirected to the request appointment form again to proceed with the appointment reservation process.

Find Doctors



Symptom List

<input type="checkbox"/> Fever	<input type="checkbox"/> Headache	<input type="checkbox"/> Muscle Pain	<input type="checkbox"/> Neck Pain
<input type="checkbox"/> Fatigue	<input type="checkbox"/> Heart burn	<input type="checkbox"/> Cough	<input type="checkbox"/> Throat Pain
<input type="checkbox"/> Rash	<input type="checkbox"/> Chest Pain	<input type="checkbox"/> Dry Skin	<input type="checkbox"/> Nosebleed
<input type="checkbox"/> Dizziness	<input type="checkbox"/> Sweating	<input type="checkbox"/> Insomnia	<input type="checkbox"/> Irregular Heartbeat
<input type="checkbox"/> Constipation	<input type="checkbox"/> Anxiety	<input type="checkbox"/> Jaw pain	<input type="checkbox"/> Indigestion
			<input type="checkbox"/> Snoring
			<input type="checkbox"/> Vomiting
			<input type="checkbox"/> Bleeding
			<input type="checkbox"/> Pain through the Left arm
			<input type="checkbox"/> Pain through the Right arm

Submit Symptoms

Appendix C Figure 15

Update Health Attributes

A logged in patient can access this page by clicking on the update health attributes menu on the menu box of the profile page of the patient. Once the patient has done a random blood sugar level test or checked the pressure and the weight they can update it in this page. In onsite appointments the doctor is updating the health attributes in the patient's profile. These attributes are being displayed in the current health status section of the patients profile page.

Update Health Attributes

Blood Pressure

Systolic 135 Hg mm
Diastolic 90 Hg mm

UPDATE

Blood Sugar

Blood Sugar Level 147 mg/dL

UPDATE

Pulse Rate

Pulse Rate 79

UPDATE

Weight

Body Weight 80 Kg
Height 5 Feet 2 Inches

UPDATE

Appendix C Figure 16

View Test Status

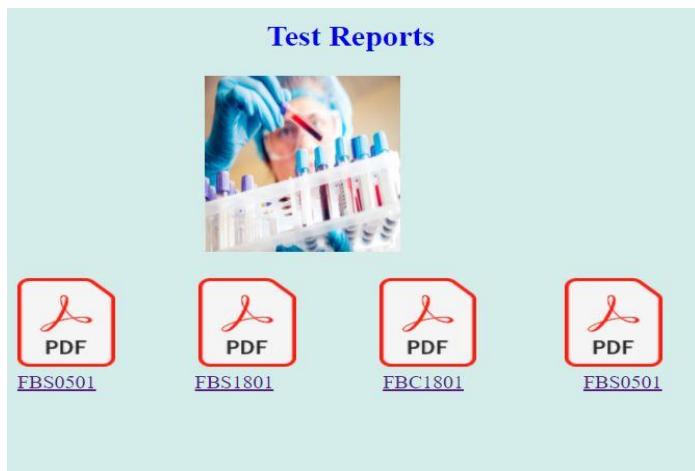
The logged in patient can view the result status of the medical tests conducted on them in this page. The patients can access this page by clicking on the view test status menu on the “click here to” section in the patient profile page. If the test report is ready the patient can download it from the link provided.

Test Results				
Test Report ID	Test Name	Test Date	Result due Date	Result Status
FBS1801	Fasting Blood Sugar	18.01.2021 15:45	19.01.2021 15:45	Ready Download
FBC1801	Full Blood Count	18.01.2021 15:50	19.01.2021 15:50	Ready Download
SE1901	Serum Electrolyte	19.01.2021 12:25	20.01.2021 12:25	Processing

Appendix C Figure 17

Test Reports

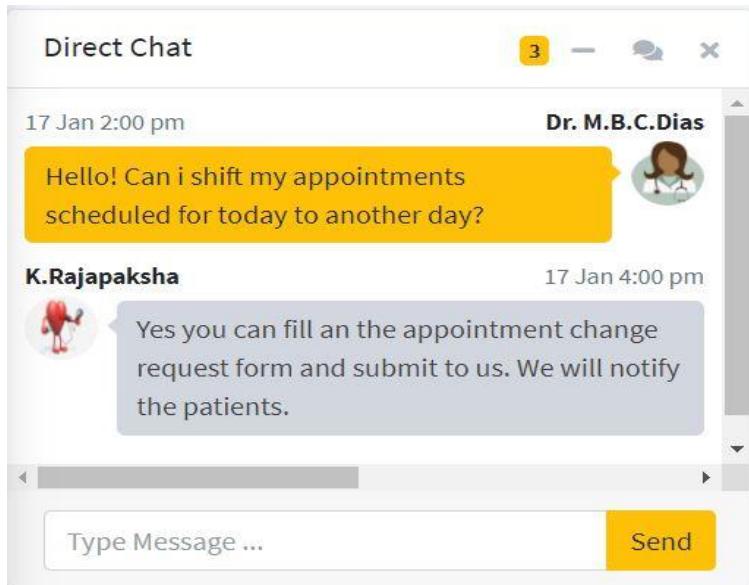
The logged in patients can access the previously downloaded medical test reports from this section by clicking on the test reports tab in the navigation bar of the patient profile page. The doctors can also access this page during an appointment through the patient’s profile.



Appendix C Figure 18

Doctor Profile

Once the doctors successfully login to the system they will be redirected to their profile page. The doctors can view upcoming appointments and the respective patient profiles, payment details and appointment status in their profile pages. They can also chat with the administrators and make inquiries using the chat tab in the navigation bar.



Appendix C Figure 19

[Account Settings](#) [Chat](#) [Appointments](#) [Notifications 1](#)

MENU BOX

- [Appointments](#)
- [Payments](#)
- [Update Appointment Schedules](#)

WEDNESDAY

19

[ADD EVENT](#)

JANUARY 2021

S	M	T	W	R	F	S
			1			
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						



Welcome Dr. M.B.C.Dias

Consultant Gastroenterologist and Hepatologist
Teaching hospital Kandy, Sri Lanka
Department of Gastroenterology

MBBS, MD

Upcoming Appointments

Mr. A.N.M. Perera
[View Patient Profile](#)
[View Details](#)
5.00 PM

Mr. M.G.D. Dias
[View Patient Profile](#)
[View Details](#)
5.30 PM

Click here to

[View Profile](#)

Appointment Status



22	23	24
25	26	27
28	29	30

Yesterday	Completed	Tomorrow	Upcoming
10	4	6	8





400
300
300

Appendix C Figure 20

123 | Page | E-Health Care System

Appointments

A logged in doctor can access the appointments page which contain information about all the appointments completed or upcoming by clicking on the appointments menu in the menu box or appointments tab in the navigation bar.

Appointments				
Patient ID	Patient Name	Appointment Date	Appointment Time	Appointment Status
PAT023	Kamal De Silva	19.01.2021	02.00 PM	Completed
PAT019	J.K.Perera	19.01.2021	02.30 PM	Completed
PAT035	P.L.Fernando	19.01.2021	03.00 PM	Completed
PAT020	N.M.Grace	19.01.2021	03.30 PM	Completed
PAT018	R.K.Green	19.01.2021	04.00 PM	Completed
PAT016	I.P.Silva	19.01.2021	04.30 PM	Completed
PAT013	A.N.M.Perera	19.01.2021	05.00 PM	Upcoming
PAT001	M.G.D.Dias	19.01.2021	05.30 PM	Upcoming
PAT005	M.P.Francis	19.01.2021	06.00 PM	Upcoming
PAT002	John Robinson	19.01.2021	06.30 PM	Upcoming

Appendix C Figure 21

Doctor Payments

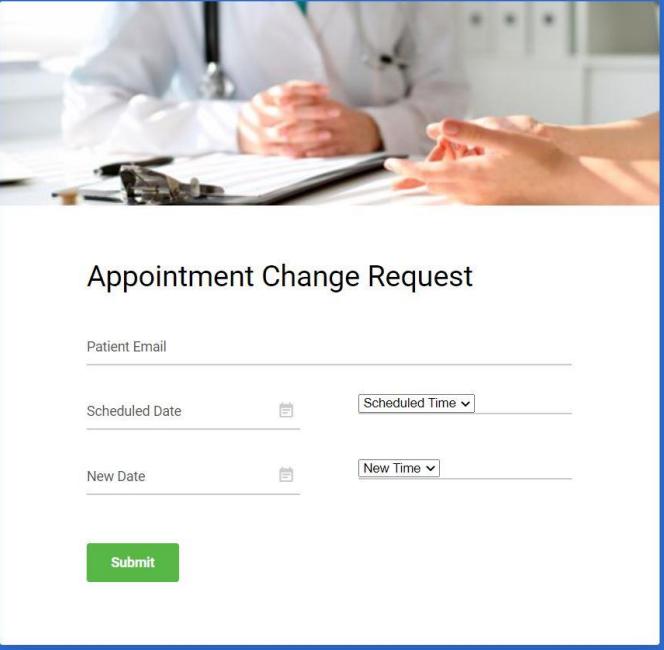
A logged in doctor can access the payment page which contain information about the payments for the completed appointments by clicking on the payments menu in the menu box.

Payments			
Date	Number of Appointments	Total Amount	Payment Status
01.01.2021	3	Rs 3000.00	Completed
04.01.2021	7	Rs 7000.00	Completed
05.01.2021	6	Rs 6000.00	Completed
06.01.2021	3	Rs 3000.00	Completed
07.01.2021	5	Rs 5000.00	Completed
08.01.2021	8	Rs 8000.00	Completed
11.01.2021	4	Rs 4000.00	Completed
12.01.2021	11	Rs 11000.00	In Process
13.01.2021	10	Rs 10000.00	In Process
17.01.2021	8	Rs 8000.00	In Process
18.01.2021	10	Rs 10000.00	In Process

Appendix C Figure 22

Update Appointment Details

If the doctor wants to change an appointment they can click on the update appointment details menu in the menu box and request for an appointment change by filling the provided form and submit. The form will be reviewed by the administrator and will notify the patients.



Appointment Change Request

Patient Email _____

Scheduled Date _____

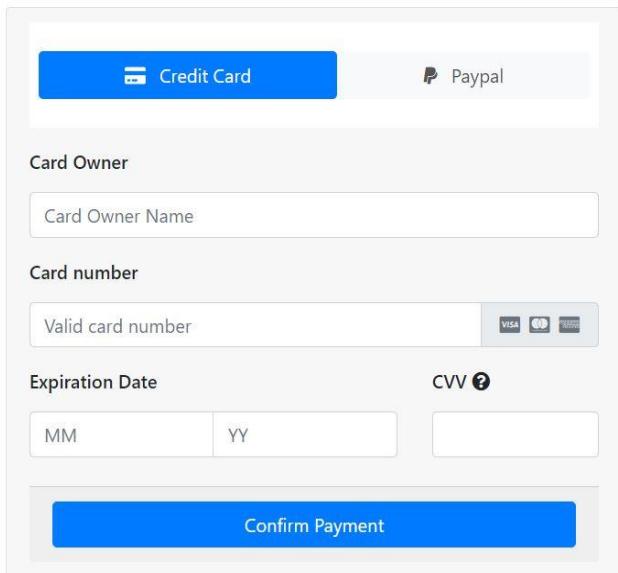
New Date _____

Appendix C Figure 23

Consultation payments

Once the patient has successfully reserved an appointment they will be directed to a page containing the payment details and a link to proceed with the payment. The patient can click on the link and fill the payment form. The patient can choose between the two payment methods card payment and PayPal by switching between the two tabs.

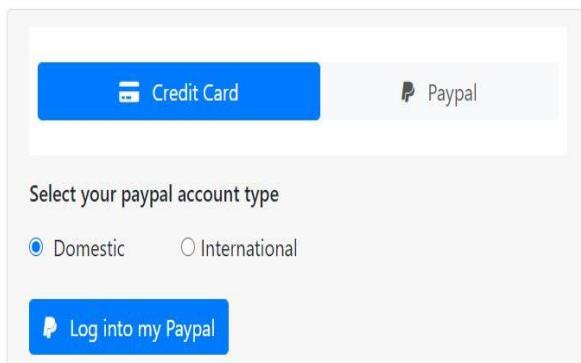
Payment



The screenshot shows a payment interface with two main buttons at the top: "Credit Card" (highlighted in blue) and "Paypal". Below these are fields for "Card Owner Name" and "Card number". Under "Card number", there is a placeholder "Valid card number" and a small icon showing VISA, MC, and AMEX. To the right of these fields are dropdown menus for "Expiration Date" (MM and YY) and "CVV" (with a question mark icon). At the bottom is a large blue "Confirm Payment" button.

Appendix C Figure 24

Payment

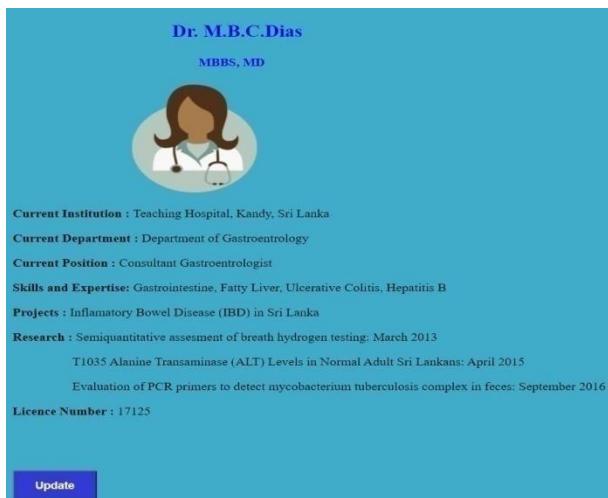


The screenshot shows a payment interface with two main buttons at the top: "Credit Card" (highlighted in blue) and "Paypal". Below these is a section titled "Select your paypal account type" with two radio buttons: "Domestic" (selected) and "International". At the bottom is a blue "Log into my Paypal" button.

Appendix C Figure 25

Account Settings

Both the patients and doctors can change their account details by clicking on the account settings tab in the navigation bar in their profile pages. For the doctors this can be done by clicking on the view profile menu in the “click here to” section as well.



The screenshot shows a doctor's profile page for "Dr. M.B.C.Dias". It includes the title "MBBS, MD", a circular profile picture of a female doctor, and a list of professional details:

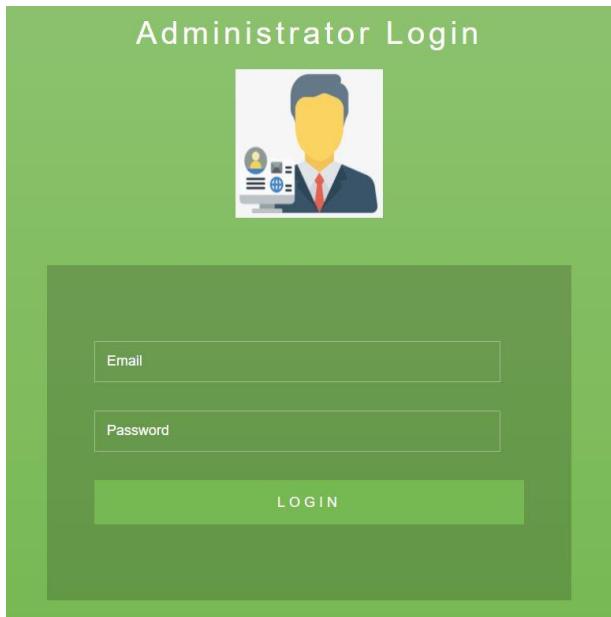
- Current Institution : Teaching Hospital, Kandy, Sri Lanka
- Current Department : Department of Gastroenterology
- Current Position : Consultant Gastroenterologist
- Skills and Expertise: Gastrointestine, Fatty Liver, Ulcerative Colitis, Hepatitis B
- Projects : Inflammatory Bowel Disease (IBD) in Sri Lanka
- Research : Semiquantitative assessment of breath hydrogen testing: March 2013
T1035 Alanine Transaminase (ALT) Levels in Normal Adult Sri Lankans: April 2015
Evaluation of PCR primers to detect mycobacterium tuberculosis complex in feces: September 2016
- Licence Number : 17125

At the bottom is a blue "Update" button.

Appendix C Figure 26

Administrator and staff login

Only the organization can access the administrator and staff login page. The administrator and the staff members should fill the login form and hit login.



Appendix C Figure 27

Administrator Panel

This page consists of different sales and goal charts and navigational links for all the company side processes. The administrators can chat and reply to the inquiries made by the patients and doctors in the direct message section of the admin panel. The logged in administrator can generate reports by clicking on the type of the required report from the navigational bar on the left side of the administrator panel. Thereafter the admin should select the section of the required report and hit generate report.

A Administrator

K K.Rajapaksha

S Search

M Home Contact Search

Q C X

Dashboard v2

Home / Dashboard



CPU Traffic
10 %



Likes
400



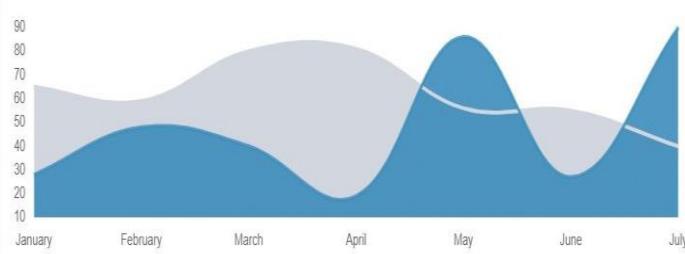
Sales
76



New Members
150

Monthly Recap Report

Sales: 19 Dec, 2020 - 19 Jan, 2021



Goal Completion

Category	Value
Appointments	75/100
Medical Tests	55/70
New Doctors	31/40
New Patients	80/100
Send Inquiries	250/500

TOTAL REVENUE
▲ 17%
\$875

TOTAL COST
◀ 0%
\$625

TOTAL PROFIT
▲ 20%
\$250

Direct Chat

Roy De Silva 18 Jan 5:37 pm

 Can we make online payments using a visa debit card?

18 Jan 6:10 pm K.Rajapaksha

 Yes. If that facility is enabled by your bank you can do the payment through the debit card

3

-

X

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Appendix C Figure 28

128 | Page | E-Health Care System

Manage Doctors and Patients

The logged in administrator can access this page by clicking on the doctors tab and the patients tab in the administrator panel. The administrator can remove or give warnings to the patients or doctors from this page.

Manage Doctors				
Doctor ID	Doctor Name	Specialization	Action	
DT00001	Dr.K.F.D.Perera	Gastroenterologist	Remove	Send email
DT00002	Dr.N.H.Silva	Urologist	Remove	Send email
DT00003	Dr.A.W Jayarathna	Cardiologist	Remove	Send email
DT00004	Dr.N.M.Herath	Gastroenterologist	Remove	Send email
DT00005	Prof.M.D.Dias	General Consultant	Remove	Send email
DT00006	Dr.G.I.Bandara	Neurologist	Remove	Send email
DT00007	Dr.G.T.S.Perera	Pathologist	Remove	Send email
DT00008	Dr.P.T.Mendis	Orthodontist	Remove	Send email
DT00009	Dr.H.M.De Alwis	Neurologist	Remove	Send email
DT00010	Dr.B.V.Silva	Surgeon	Remove	Send email

Appendix C Figure 29

Send Confirmation Emails

The logged in receptionist can click on the appointments and medical test tabs in the admin panel to access this page. The receptionist can simply click on the provided links to send emails to the doctors and patient.

Appointments				
Patient ID	Appointment Date and Time	Doctor ID	Action	
PT00002	19.01.2021 02.30PM	DT00050	Update	Send Confirmation Email
PT00045	19.01.2021 03.00PM	DT00008	Update	Send Confirmation Email
PT00012	19.01.2021 03.30PM	DT00058	Update	Send Confirmation Email
PT00001	19.01.2021 04.00PM	DT00002	Update	Send Confirmation Email
PT00034	19.01.2021 04.30PM	DT00059	Update	Send Confirmation Email
PT00078	20.01.2021 02.30PM	DT00009	Update	Send Confirmation Email

Appendix C Figure 30

Generate and Send Invoices

The logged in accountant can view the completed transactions by clicking on the payments tab in the administrator panel. Then invoices could be generated for the completed payments and could be sent to the patients. The doctor's consultation fees could also be handled by the accountant in the same way.

Payments			
Patient ID	Appointment Date and Time	Amount Paid	Action
PT00002	19.01.2021 02.30PM	DT00050	Send Invoice
PT00045	19.01.2021 03.00PM	DT00008	Send Invoice
PT00012	19.01.2021 03.30PM	DT00058	Send Invoice
PT00001	19.01.2021 04.00PM	DT00002	Send Invoice
PT00034	19.01.2021 04.30PM	DT00059	Send Invoice
PT00078	20.01.2021 02.30PM	DT00009	Send Invoice

Appendix C Figure 31

Appendix D –Test Cases

Test Case 04					
Objective	Verify doctor registration module				
Steps	Action	Test data	Expected results	Actual result	Result status
1	All the required fields are filled correctly	All the fields filled with correct data	User should register to the system with a message displaying “Registration Successful”	User registered successfully with a message displaying “Registration Successful”	Pass
2	All the required fields are not filled	Leave the Address field empty	Display error message indicating “Please fill out this field” in the field which is left empty	Error message displayed indicating “Please fill out this field” near the address field	Pass
3	Validate input data	Email-jane123	Display error message indicating “The email address is not in the correct format”	Error message displayed indicating “The email is not in the correct format”	Pass
4	Clicking Register button leaving every field empty	Leave every field empty	Display error message indicating “Please fill out this field” in the first field	Error message displayed indicating “Please fill out this field” near the first field	Pass

Appendix D Table 1

✓ Success Message

Congratulations! You have registered successfully

⌚ Warning Message

The entered email address is not in the correct format

Appendix D Figure 1

Appendix D Figure 2

Doctor SignUp Form

B.M.W.Fernando

769845231v  Please fill out this field.

0762345678

bmfernandez@gmail.com

20400

Choose the field: Dermatologist

The password should consist of atleast 8 characters with atleast one Uppercase letter and a symbol

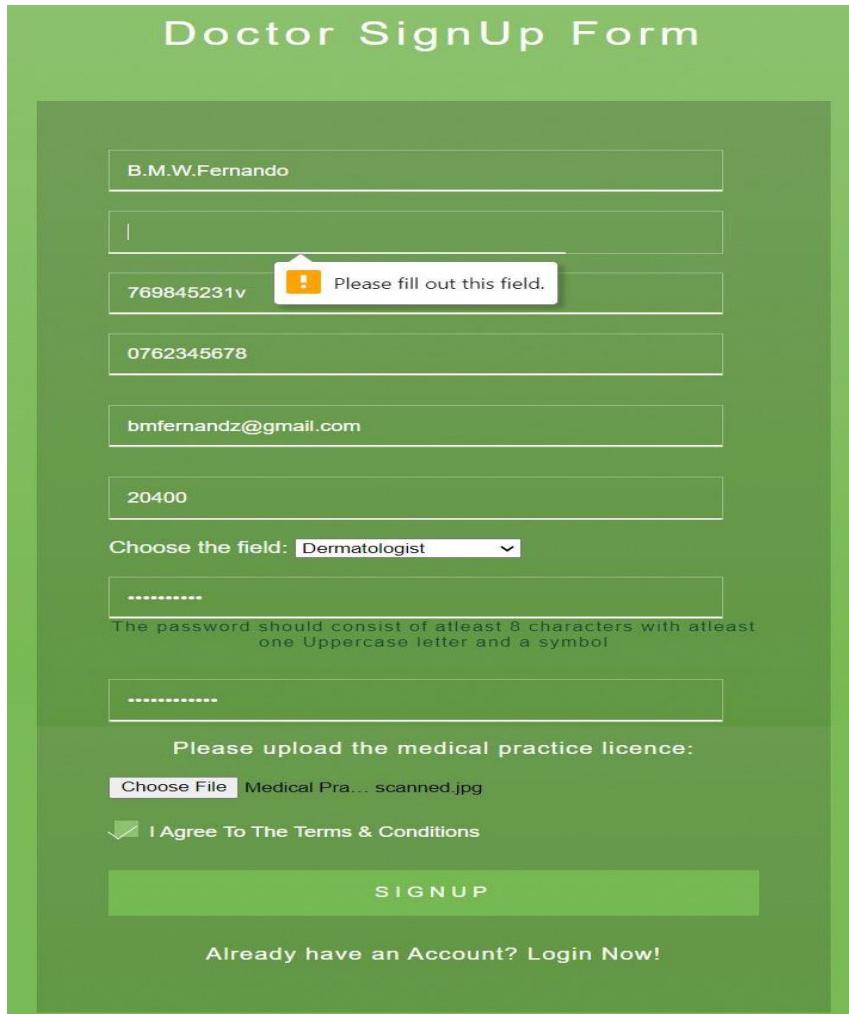
Please upload the medical practice licence:

Choose File Medical Pra... scanned.jpg

I Agree To The Terms & Conditions

SIGN UP

Already have an Account? [Login Now!](#)

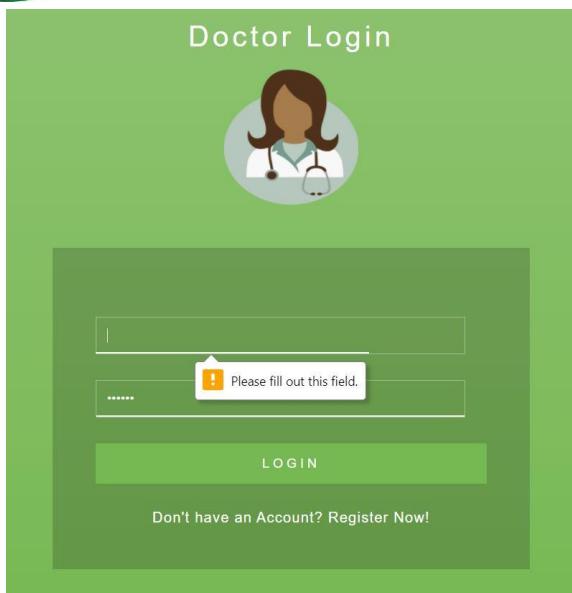


Appendix D Figure 3

Test Case No		05			
Objective	Verify doctor login module				
Steps	Action	Test data	Expected result	Actual result	Result status
1	Enter correct username and correct password	Username-mbc Password-2021	User login to the system by redirecting to the doctor profile page	User logged in to the system by redirecting to the doctor profile page	Pass
2	Enter incorrect username and password	Username-pqr Password-123	Display login error message	Login error message displayed	Pass
3	Enter correct username and incorrect password	Username-mbc Password-123	Display login error message	Login error message displayed	Pass
4	Enter incorrect username and correct password	Username-pqr Password-2021	Display login error message	Login error message displayed	Pass
5	Click login button without entering either username or password	Keep username and password fields empty and click login	Display error message indicating "Please fill out this field"	Error message displayed indicating "Please fill out this field"	Pass

Appendix D Table 2

Doctor Login



The form has a green header and footer. It contains two input fields: one for email and one for password. Below the password field is a red error message: "Please fill out this field." A green "LOGIN" button is at the bottom, and a link "Don't have an Account? Register Now!" is in the footer.



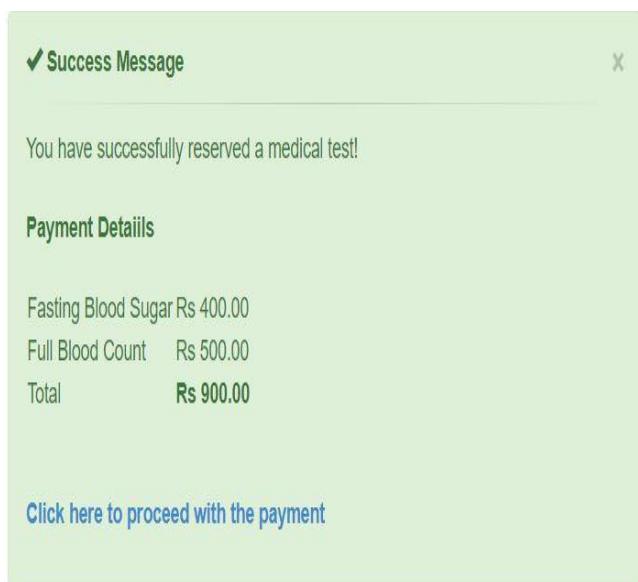
Appendix D Figure 5

Appendix D Figure 4

Test Case No	06				
Objective	Verify request medical test module				
Steps	Action	Test data	Expected results	Actual result	Result status
1	All the required fields are filled correctly	All the fields filled with correct data	User should reserve the test with a message displaying “medical test reservation Successful”	User successfully reserved the appointment with a message displaying “medical test reservation Successful”	Pass
2	All the required fields are not filled	Leave the Patient name field empty	Display error message indicating “Please fill out this field” in the field which is left empty	Error message displayed indicating “Please fill out this field” near the Patient name field	Pass

3	Clicking Submit button leaving every field empty	Leave every field empty	Display error message indicating “Please fill out this field” in the first field	Error message displayed indicating “Please fill out this field” in near the first field	Pass
---	--	-------------------------	--	---	------

Appendix D Table 3



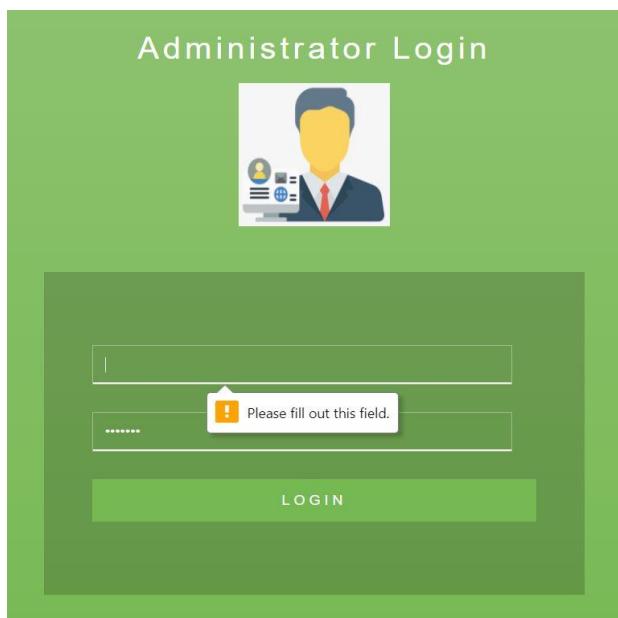
Appendix D Figure 6

Appendix D Figure 7

Test Case No	07				
Objective	Verify admin login module				
Steps	Action	Test data	Expected result	Actual result	Result status
1	Enter correct username and correct password	Username-admin1 Password-nma#12	Admin login to the system by redirecting to the admin panel	Admin logged in to the system by redirecting to the admin panel	Pass

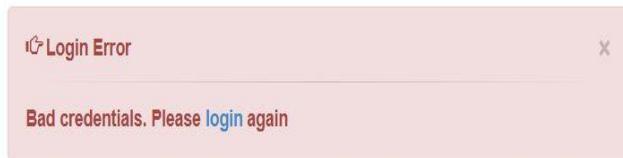
2	Enter incorrect username and password	Username—pqr Password—123	Display login error message	Login error message displayed	Pass
3	Enter correct username and incorrect password	Username—admin1 Password—123	Display login error message	Login error message displayed	Pass
4	Enter incorrect username and correct password	Username—pqr Password—nma#12	Display login error message	Login error message displayed	Pass
5	Click login button without entering either username or password	Keep username and password fields empty and click login	Display error message indicating “Please fill out this field”	Error message displayed indicating “Please fill out this field”	Pass

Appendix D Table 4



The form is titled "Administrator Login" and features a placeholder icon of a person with a computer monitor. It contains two input fields: one for "Username" (with placeholder "username") and one for "Password" (with placeholder "password"). Below the password field is a red validation message: "Please fill out this field." A large green "LOGIN" button is at the bottom.

Appendix D Figure 8

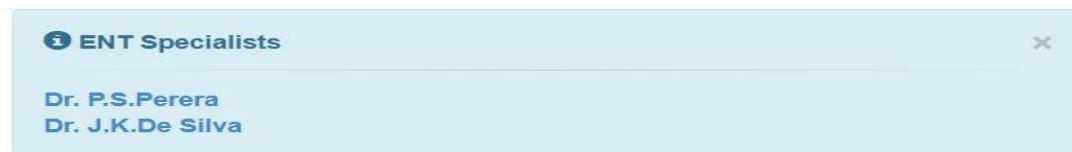


Appendix D Figure 9

Test Case 08
No

Objective	Verify find doctor by specialized field module				
Steps	Action	Test data	Expected result	Actual result	Result status
1	Select a field and click on the submit button	Field-ENT	The names of the doctors P.S. Perera and J.K. De Silva should appear on the screen	The names of the doctors P.S. Perera and J.K. De Silva should appeared on the screen	Pass

Appendix D Table 5



Appendix D Figure 10

Test Case 09
No

Objective	Verify find doctor by entering symptoms module				
Steps	Action	Test data	Expected result	Actual result	Result status
1	Select a correct combination of symptoms	Symptoms – Chest pain, Pain through the left arms And fatigue	The names of the doctors who are cardiologists should display on the screen. Names on the screen should be K.G. Silva and L.H. Fransis	The names of the doctors who are cardiologists displayed on the screen. Names on the screen were K.G. Silva and L.H. Fransis	Pass

2	Select a wrong combination	Symptoms – Neck pain, throat pain, nose bleed, indigestion, snoring	Display error message “Doctor not found. Try selecting the symptoms related for only a single illness”	Error message displayed “Doctor not found. Try selecting the symptoms related for only a single illness”	Pass
---	----------------------------	---	--	--	------

Appendix D Table 6



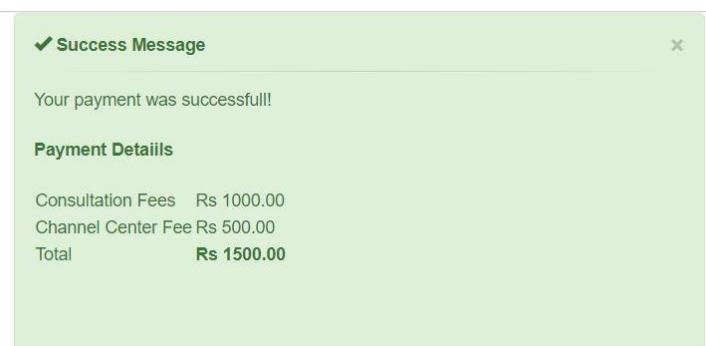
Appendix D Figure 12

Appendix D Figure 11

Test Case 10						
Objective	Verify payment module					
Steps	Action	Test data		Expected result	Actual result	Result status
1	Enter valid credit card details	Enter credit card details Card number- 2345 7654 1234 9876 Expiry date – 09/21 CVV number - 093		Display message “Payment Successful”	Displayed message “Payment Successful”	Pass
2	Enter invalid credit card details	Enter credit card details Card number- 0000 0000 0000 0000 Expiry date – 09/65 CVV number – 000		Display error message “Payment Unsuccessful”	Displayed error message “Payment Unsuccessful”	Pass

3	Enter correct pay pal login details	Email- rdsilva@gmail.com Password – rd#silva3478	Display error message “Payment Successful”	Displayed error message “Payment Successful”	Pass
4	Enter incorrect pay pal login details	Email- 1234@gmail.com Password - 1234	Display error message “Payment Unsuccessful”	Displayed error message “Payment Unsuccessful”	Pass
5	Check invoice generation	Administrator click on the invoice generation link	The invoice should be received through email	The invoice was received through email	Pass

Appendix D Table 7



Appendix D Figure 14

Appendix D Figure 13

Invoice 19/01/2021

Invoice Number: 20210119001

From:

Jayarathna Consultation Services (PVT)LTD.
Colombo 07, Sri Lanka
Email: info@jcc.com.
Phone: +94 11 206 8157

To:

Mr. Roy De Silva
Colombo 03, Sri Lanka
Email: roysilva@gmail.com
Phone: +94 11 457 8345

#	Description	Total
1	Consultation Fees	Rs 1000.00
2	Channel Center Fees	Rs 500.00
Subtotal		Rs 1500.00
Discount		Rs 100.00
Total		Rs 1400.00

Appendix D Figure 15

Test Case No	11				
Objective	Verify report generation module				
Steps	Action	Test data	Expected result	Actual result	Result status
1	Verify daily income report	Select Income report from report type and select daily from the content options	Display daily income report	Daily income report was displayed	Pass

2	Verify monthly income report	Select Income report from report type and select monthly from the content options	Display monthly income report	Monthly income report was displayed	Pass
3	Verify annual income report	Select Income report from report type and select annual from the content options	Display annual income report	Annual income report was displayed	Pass
4	Verify daily sales report	Select Sales report from report type and select daily from the content options	Display sales income report	Daily sales report was displayed	Pass
5	Verify monthly sales report	Select Sales report from report type and select monthly from the content options	Display monthly Sales report	Monthly sales report was displayed	Pass
6	Verify annual sales report	Select sales report from report type and select annual from the content options	Display annual sales report	Annual sales report was displayed	Pass
7	Verify maintenance report	Select maintenance report from the report type	Display maintenance report	Maintenance report was displayed	Pass

Appendix D Table 8

Jayarathna Consultation Services (PVT)LTD.		
Daily Sales Report (Date: 18/01/2021)		
Patient ID	Description	Total Amount
PT00007	Medical Tests	Rs 2500.00
PT00002	Counselling	Rs 1500.00
PT00005	Counselling	Rs 1500.00
PT00003	Consultation	Rs 1500.00
PT00012	Counselling	Rs 1500.00
PT00034	Consultation	Rs 1500.00
PT00014	Medical Tests	Rs 4500.00
PT00032	Consultation	Rs 1500.00
PT00023	Counselling	Rs 1500.00
PT00016	Medical Tests	Rs 500.00
Total		Rs 18 000.00

Appendix D Figure 16

Jayarathna Consultation Services (PVT)LTD.				
Monthly Income Report (Date: December 2020)				
#	Description	Income	Expense	Total
1	Medical Tests	Rs 35 000.00		Rs 35 000.00
2	Counselling	Rs 18 000.00		Rs 18 000.00
3	Consultation	Rs 38 500.00		Rs 38 500.00
4	Doctor Consultation Fees		Rs 25 000.00	- Rs 25 000.00
4	Staff Payments		Rs 15 000.00	- Rs 15 000.00
4	Test Kits		Rs 10 000.00	- Rs 10 000.00
4	Water, Electricity and Telecommunication		Rs 10 000.00	- Rs 10 000.00
Total Income				Rs 31 500.00

Appendix D Figure 17

Appendix E – Source Codes

Home Page

```
<!DOCTYPE html>
<html lang="en">
    <meta charset="utf-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1">
    <meta name="viewport" content="initial-scale=1, maximum-scale=1">
    <title>Jayarathna Consultations Pvt.Ltd</title>
    <meta name="keywords" content="">
    <meta name="description" content="">
    <meta name="author" content="">
    <link rel="shortcut icon" href="images/favicon.ico.png" type="image/x-icon" />
    <link rel="apple-touch-icon" href="images/apple-touch-icon.png">
    <link rel="stylesheet" href="css/bootstrap.min.css">
    <link rel="stylesheet" href="style.css">
    <link rel="stylesheet" href="css/colors.css">
    <link rel="stylesheet" href="css/versions.css">
    <link rel="stylesheet" href="css/responsive.css">
    <link rel="stylesheet" href="css/custom.css">
    <script src="js/modernizer.js"></script>
</head>
<body class="clinic_version">
    <div id="preloader">
        | 
    </div>
    <header>
        <div class="header-top wow fadeIn">
            <div class="container">
                <a href="index.html"></a>
                <div class="right-header">
                    <div class="header-info">
                        <div class="info-inner">
                            <span class="icontop"></span>
                            <span class="iconcont"><a href="tel:800 123 456">011-2068157</a></span>
                        </div>
                        <div class="info-inner">
                            <span class="icontop"><i class="fa fa-envelope" aria-hidden="true"></i></span>
                            <span class="iconcont"><a data-scroll href="mailto:info@yoursite.com">info@jcc.com</a></span>
                        </div>
                    </div>
                </div>
            </div>
        </div>
        <div class="header-bottom wow fadeIn">
            <div class="container">
                <nav class="main-menu">
                    <div class="navbar-header">
                        <button type="button" class="navbar-toggle collapsed" data-toggle="collapse" data-target="#navbar" aria-expanded="false" aria-controls="navbar"><i class="fa fa-bars" aria-hidden="true"></i></button>
                    </div>
                    <div id="navbar" class="navbar-collapse collapse">
                        <ul class="nav navbar-nav">
                            <li><a class="active" href="index.html">Home</a></li>
                            <li><a data-scroll href="aboutus.html">About us</a></li>
                            <li><a data-scroll href="services.html">Services</a></li>
                            <li><a data-scroll href="doctors.html">Doctors</a></li>
                            <li><a data-scroll href="registration.html">Register</a></li>
                        </ul>
                    </div>
                </nav>
                <div class="search-bar">
                    <div id="custom-search-input">
                        <div class="input-group col-md-12">
                            <input type="text" class="form-control input-lg" placeholder="Search" />
                            <span class="input-group-btn">
                                <button class="btn btn-info btn-lg" type="button">
                                    <i class="fa fa-search" aria-hidden="true"></i>
                                </button>
                            </span>
                        </div>
                    </div>
                </div>
            </div>
        </div>
    </header>
```

```
<div class="info-inner">
    <span class="icontop"><i class="fa fa-clock-o" aria-hidden="true"></i></span>
    <span class="iconcont"><a data-scroll href="#">Daily: 7:00am - 8:00pm</a></span>
</div>
</div>
</div>
<div class="header-bottom wow fadeIn">
    <div class="container">
        <nav class="main-menu">
            <div class="navbar-header">
                <button type="button" class="navbar-toggle collapsed" data-toggle="collapse" data-target="#navbar" aria-expanded="false" aria-controls="navbar"><i class="fa fa-bars" aria-hidden="true"></i></button>
            </div>
            <div id="navbar" class="navbar-collapse collapse">
                <ul class="nav navbar-nav">
                    <li><a class="active" href="index.html">Home</a></li>
                    <li><a data-scroll href="aboutus.html">About us</a></li>
                    <li><a data-scroll href="services.html">Services</a></li>
                    <li><a data-scroll href="doctors.html">Doctors</a></li>
                    <li><a data-scroll href="registration.html">Register</a></li>
                </ul>
            </div>
        </nav>
        <div class="search-bar">
            <div id="custom-search-input">
                <div class="input-group col-md-12">
                    <input type="text" class="form-control input-lg" placeholder="Search" />
                    <span class="input-group-btn">
                        <button class="btn btn-info btn-lg" type="button">
                            <i class="fa fa-search" aria-hidden="true"></i>
                        </button>
                    </span>
                </div>
            </div>
        </div>
    </div>
</div>
</div>
```

Appendix E Figure 1

```
<div id="home" class="parallax first-section wow fadeIn" data-stellar-background-ratio="0.4" style="background-image:url('images/slider-bg.png');">
    <div class="container">
        <div class="row">
            <div class="col-md-12 col-sm-12">
                <div class="text-contant">
                    <h2>
                        <span class="center"><span class="icon"></span></span>
                    </h2>
                </div>
            </div>
        </div>
    </div>
<div id="time-table" class="time-table-section">
    <div class="container">
        <div class="col-lg-4 col-md-4 col-sm-12 col-xs-12">
            <div class="row">
                <div class="service-time one" style="background:#2895f1;">
                    <span class="info-icon"><i class="fa fa-ambulance" aria-hidden="true"></i></span>
                    <h3><a href="login.html"><font color="white">Login</font></a></h3>
                    <p>Login to the system to experience the medical facilities offered by the virtual hospital in your home</p>
                </div>
            </div>
        <div class="col-lg-4 col-md-4 col-sm-12 col-xs-12">
            <div class="row">
                <div class="service-time middle" style="background:#0071d1;">
                    <span class="info-icon"><i class="fa fa-clock-o" aria-hidden="true"></i></span>
                    <h3>Working Hours</h3>
                    <div class="time-table-section">
                        <ul>
                            <li><span class="left">Monday - Friday</span><span class="right">8.00 - 18.00</span></li>
                            <li><span class="left">Saturday</span><span class="right">8.00 - 16.00</span></li>
                            <li><span class="left">Sunday</span><span class="right">8.00 - 13.00</span></li>
                        </ul>
                    </div>
                </div>
            </div>
        </div>
    </div>
</div>
```

```
<div class="col-lg-4 col-md-4 col-sm-12 col-xs-12">
    <div class="row">
        <div class="service-time three" style="background:#0060b1;">
            <span class="info-icon"><i class="fa fa-hospital-o" aria-hidden="true"></i></span>
            <h3><a href="login.html"><font color="white">Our Services</font></a></h3>
            <p>Checkout the services offered by Jayarathna Consultation Services Pvt. Ltd </p>
        </div>
    </div>
</div>
</div>

<footer id="footer" class="footer-area wow fadeIn">
    <div class="container">
        <div class="row">
            <div class="col-md-4">
                <div class="logo padding">
                    <a href="#"></a>
                    <p>The art of medicine consists of amusing the patient while nature cures the disease.</p>
                </div>
            </div>
            <div class="col-md-4">
                <div class="footer-info padding">
                    <h3>CONTACT US</h3>
                    <p><i class="fa fa-map-marker" aria-hidden="true"></i> No 147 Baseline Road Colombo 07</p>
                    <p><i class="fa fa-paper-plane" aria-hidden="true"></i> info@jcc.com</p>
                    <p><i class="fa fa-phone" aria-hidden="true"></i> (+94)11 206 8157 </p>
                </div>
            </div>
        </div>
    </div>
</footer>
```

Appendix E Figure 2

```
<footer id="footer" class="footer-area wow fadeIn">
    <div class="container">
        <div class="row">
            <div class="col-md-4">
                <div class="logo padding">
                    <a href=""></a>
                    <p>"The art of medicine consists of amusing the patient while nature cures the disease."</p>
                </div>
            </div>
            <div class="col-md-4">
                <div class="footer-info padding">
                    <h3>CONTACT US</h3>
                    <p><i class="fa fa-map-marker" aria-hidden="true"></i> No 147 Baseline Road Colombo 07</p>
                    <p><i class="fa fa-paper-plane" aria-hidden="true"></i> info@jcc.com</p>
                    <p><i class="fa fa-phone" aria-hidden="true"></i> (+94)11 206 8157 </p>
                </div>
            </div>
            <div class="col-md-4">
                <div class="subscriber-info">
                    <h3>SUBSCRIBE</h3>
                    <p>Get healthy news, tip and solutions to your problems from our experts.</p>
                    <div class="subscriber-box">
                        <form id="mc-form" class="mc-form">
                            <div class="newsletter-form">
                                <input type="email" autocomplete="off" id="mc-email" placeholder="Email address" class="form-control" name="EMAIL">
                                <button class="mc-submit" type="submit"><i class="fa fa-paper-plane"></i></button>
                            <div class="clearfix"></div>
                            <div class="mailchimp-alerts">
                                <div class="mailchimp-submitting"></div>
                                <div class="mailchimp-success"></div>
                                <div class="mailchimp-error"></div>
                            </div>
                        </div>
                    </form>
                </div>
            </div>
        </div>
    </div>
</footer>
```

```
<div class="copyright-area wow fadeIn">
    <div class="container">
        <div class="row">
            <div class="col-md-8">
                <div class="footer-text">
                    <p>© 2020 jcc. All Rights Reserved.</p>
                </div>
            </div>
            <div class="col-md-4">
                <div class="social">
                    <ul class="social-links">
                        <li><a href=""><i class="fa fa-rss"></i></a></li>
                        <li><a href=""><i class="fa fa-facebook"></i></a></li>
                        <li><a href=""><i class="fa fa-twitter"></i></a></li>
                        <li><a href=""><i class="fa fa-google-plus"></i></a></li>
                        <li><a href=""><i class="fa fa-youtube"></i></a></li>
                        <li><a href=""><i class="fa fa-pinterest"></i></a></li>
                    </ul>
                </div>
            </div>
        </div>
    </div>
    <a href="#home" data-scroll class="dmtop global-radius"><i class="fa fa-angle-up"></i></a>
    <script src="js/all.js"></script>
    <script src="js/custom.js"></script>
    <script src="https://maps.googleapis.com/maps/api/js?key=AIzaSyCNUPWkb4Cjd7Wxo-T4uoUldFjojUA1fJc&callback=myMap"></script>
</body>
</html>
```

Appendix E Figure 3

Medical test reservation

```
<?php
require('db.php');
if (isset($_REQUEST['TestName'])) {
    $TestName = stripslashes($_REQUEST['TestName']);
    $TestName = mysqli_real_escape_string($con,$TestName);
    $TestType = stripslashes($_REQUEST['TestType']);
    $TestType = mysqli_real_escape_string($con,$TestType);
    $ResultStatus = stripslashes($_REQUEST['ResultStatus']);
    $ResultStatus = mysqli_real_escape_string($con,$ResultStatus);
    $TestDateTime= date('Y-m-d H:i:s', strtotime($_POST['TestDateTime']));
    $PatientEmail = stripslashes($_REQUEST['PatientEmail']);
    $PatientEmail = mysqli_real_escape_string($con,$PatientEmail);
    $query = "INSERT into `medical_test` (TestName,TestType,ResultStatus,TestDateTime,PatientEmail)
VALUES ('$TestName','$TestType','$ResultStatus','$TestDateTime','$PatientEmail')";
$result = mysqli_query($con,$query);
if($result){
    echo "<div class='alert alert-success">
        <strong>Success Message</strong> You have successfully reserved a medical test <br>
        <strong>Payment Details</strong><br>
    </div>
    $result1 = mysqli_query($con, "SELECT * FROM TestPrice WHERE TestName='$TestName'");
    ?>
    <table>
        <?php
            while($res = mysqli_fetch_array($result1)) {
                echo "<tr>";
                echo "<td>".$res['TestName']."</td>";
                echo "<td>".$res['TestPrice']."</td>";
            }
        ?>
        </table>
    </div>";
}
else{
    ?>
}
```

Appendix E Figure 4

Update medical history

```
<html>
<head>
<meta charset="utf-8">
<title>Update Medical History</title>
<link rel="stylesheet" href="css/style.css" />
</head>
<body>
<?php
require('db.php');

if (isset($_REQUEST['DoctorName'])) {
    // removes backslashes
    $DoctorName = stripslashes($_REQUEST['DoctorName']);
    // escapes special characters in a string
    $DoctorName = mysqli_real_escape_string($con,$DoctorName);
    $Diagnosis = stripslashes($_REQUEST['Diagnosis']);
    $Diagnosis = mysqli_real_escape_string($con,$Diagnosis);
    $Prescription = stripslashes($_REQUEST['Prescription']);
    $Prescription = mysqli_real_escape_string($con,$Prescription);
    $query = "INSERT into `History` (DoctorName,Diagnosis,Prescription)
VALUES ('$DoctorName', '$Diagnosis', '$Prescription')";
    $result = mysqli_query($con,$query);
    if($result){
        echo "<div class='form'>
            <h3>History updated successfully.</h3>
            <br/>Click here to <a href='login.php'>View history section</a></div>";
    }
    else{
        ?>
        <div class="form">
            <h1>Medical History</h1>
            <form name="History" action="" method="post">
                <input type="text" name="DoctorName" placeholder="DoctorName" required />
                <input type="text" name="Diagnosis" placeholder="Diagnosis" required />
                <input type="text" name="Prescription" placeholder="Prescription" required />
                <input type="submit" name="submit" value="Update" />
            </form>
        </div>
    <?php } ?>
</body>
</html>
```

Appendix E Figure 5

Update health attributes

```

<html>
<head>
<meta charset="utf-8">
<title>Update Medical History</title>
<link rel="stylesheet" href="css/style.css" />
</head>
<body>
<?php
require('db.php');

if (isset($_REQUEST['BpressureSys'])){
    $BpressureSys = mysqli_real_escape_string($con,$BpressureSys);
    $BpressureDis = stripslashes($_REQUEST['BpressureDis']);
    $BpressureDis = mysqli_real_escape_string($con,$BpressureDis);
    $BSugar= stripslashes($_REQUEST['BSugar']);
    $BSugar= mysqli_real_escape_string($con,$BSugar);
    $PRate= stripslashes($_REQUEST['PRate']);
    $PRate= mysqli_real_escape_string($con,$PRate);
    $Weight= stripslashes($_REQUEST['Weight']);
    $Weight= mysqli_real_escape_string($con,$Weight);
    $query = "INSERT into `patientattributes` (BpressureSys,BpressureDis,BSugar,PRate,Weight)
VALUES ('$BpressureSys', '$BpressureDis', '$BSugar', '$PRate', '$Weight')";
    $result = mysqli_query($con,$query);
    if($result){
        echo "<div class='form'>
<h3>Attributes updated successfully.</h3>
<br/>Click here to <a href='login.php'>View health attribute section</a></div>";
    }
} else{
?>
<div class="form">
<h1>Update health attributes</h1>
<form name="attributes" action="" method="post">
<input type="text" name="BpressureSys" placeholder="Systolic blood pressure" required />
<input type="text" name="BpressureDis" placeholder="Diastolic blood pressure" required />
<input type="text" name="BSugar" placeholder="Blood sugar level" required />
<input type="text" name="PRate" placeholder="Pulse rate" required />
<input type="text" name="Weight" placeholder="Weight" required />
<input type="submit" name="submit" value="Update" />
</form>
</div>
<?php } ?>
</body>
</html>

```

Appendix E Figure 6

View medical test status

```

<html>
<head>
<meta charset="utf-8">
<title>Update Medical History</title>
<link rel="stylesheet" href="css/style.css" />
</head>
<body>
<?php
require('db.php');

$sql = "SELECT * FROM medicaltest WHERE PatientEmail=$_SESSION['patientemail']";
if($result = mysqli_query($link, $sql)){
if(mysqli_num_rows($result) > 0){
    echo "<table>";
    echo "<tr>";
        echo "<th>Test Report ID</th>";
        echo "<th>Test Name</th>";
        echo "<th>Test Date</th>";
        echo "<th>Results due Date</th>";
        echo "<th>Result status</th>";
    echo "</tr>";
    while($row = mysqli_fetch_array($result)){
        echo "<tr>";
            echo "<td>" . $row['reportid'] . "</td>";
            echo "<td>" . $row['reportname'] . "</td>";
            echo "<td>" . $row['date'] . "</td>";
            echo "<td>" . $row['resultsduedate'] . "</td>";
            echo "<td>" . $row['status'] . "</td>";
        echo "</tr>";
    }
    echo "</table>";
    mysqli_free_result($result);
} else{
    echo "No records matching your query were found.";
}
else{
echo "ERROR: Could not able to execute $sql. " . mysqli_error($link);
}
mysqli_close($link);
?>
</body>
</html>

```

Appendix E Figure 7

Card payment handling

```

<?php
if(!empty($_POST['stripeToken'])){
    $token = $_POST['stripeToken'];
    $name = $_POST['name'];
    $email = $_POST['email'];
    $card_num = $_POST['card_num'];
    $card_cvc = $_POST['cvc'];
    $card_exp_month = $_POST['exp_date'];
    require_once('stripe-php/init.php');
    $stripe = array(
        "secret_key" => "Your API Secret Key",
        "publishable_key" => "Your API Publishable Key"
    );
    \Stripe\Stripe::setApiKey($stripe['secret_key']);
    $patient = \Stripe\patient::create(array(
        'email' => $email,
        'source' => $token
    ));
    $charge = \Stripe\Charge::create(array(
        'patient' => $patient,
        'amount' => $fee,
        'currency' => $currency,
        'doctorname' => $doctorname,
        'metadata' => array(
            'appointment_id' => $appointmentID
        )
    ));
    $chargeJson = $charge->jsonSerialize();
    if($chargeJson['amount_refunded'] == 0 && empty($chargeJson ['failure_code']) && $chargeJson['paid'] == 1 && $chargeJson['captured'] == 1){
        $amount = $chargeJson['amount'];
        $balance_transaction = $chargeJson['balance_transaction'];
        $currency = $chargeJson['currency'];
        $status = $chargeJson['status'];
        $date = date("Y-m-d H:i:s");
        include_once 'dbConfig.php';
        $sql = "INSERT INTO payment( amount, appointmentID,paymentdate) VALUES('".$amount."','".$$appointmentID."','".$$date."')";
        $insert = $db->query($sql);
        $last_insert_id = $db->insert_id;
        if($last_insert_id && $status == 'succeeded'){
            $statusMsg = "<h2>The transaction was successful.</h2>";
        }else{ $statusMsg = "Transaction has been failed"; }
    }else{ $statusMsg = "Transaction has been failed";}}
    echo $statusMsg;
?>

```

Appendix E Figure 8

Appendix F – User Feedback Results

Feedback form from the director

Give us your feedback!			
Did you achieve your goal?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> Partially	<input type="checkbox"/> No
How useful was this system to your organization?	<input checked="" type="checkbox"/> Very useful	<input type="checkbox"/> Useful	<input type="checkbox"/> Not useful
	<input type="checkbox"/> Not useful at all		
Was the report generation facility in this system helpful in the decision making process?	<input checked="" type="checkbox"/> Very useful	<input type="checkbox"/> Useful	<input type="checkbox"/> Not useful
	<input type="checkbox"/> Not useful at all		
The average number of appointments reserved per day before the new system was implemented	<input checked="" type="checkbox"/> 0-50	<input type="checkbox"/> 51-100	<input type="checkbox"/> 101-150
	<input type="checkbox"/> More than 150		
The average number of appointments reserved per day after the new system was implemented	<input type="checkbox"/> 0-50	<input type="checkbox"/> 51-100	<input checked="" type="checkbox"/> 101-150
	<input type="checkbox"/> More than 150		
Any other benefits you gained from this system?	Easier to manage the patients and the doctors than the previous system Success rate can be easily monitored using the reports		
Are there any complaints to be made about the system?	–		

Name: W.D.M. Perera

Date: 02/02/2021

Appendix F Figure 1

Feedback form from the receptionist

Give us your feedback!			
Did you achieve your goal?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> Partially	<input type="checkbox"/> No
How useful was this system to your organization?	<input checked="" type="checkbox"/> Very useful <input type="checkbox"/> Useful <input type="checkbox"/> Not useful <input type="checkbox"/> Not useful at all		
Was the report generation facility in this system helpful in the decision making process?	<input checked="" type="checkbox"/> Very useful <input type="checkbox"/> Useful <input type="checkbox"/> Not useful <input type="checkbox"/> Not useful at all		
The average number of appointments reserved per day before the new system was implemented	<input checked="" type="checkbox"/> 0-50 <input type="checkbox"/> 51-100 <input type="checkbox"/> 101-150 <input type="checkbox"/> More than 150		
The average number of appointments reserved per day after the new system was implemented	<input type="checkbox"/> 0-50 <input type="checkbox"/> 51-100 <input checked="" type="checkbox"/> 101-150 <input type="checkbox"/> More than 150		
Any other benefits you gained from this system?	Easier to manage appointments hence can save time		
Are there any complaints to be made about the system?	—		

Name: S.M. Fernando

Date: 02/02/2021

Appendix F Figure 2

Feedbacks form from patients

Give us your feedback!			
Are you satisfied with the new system?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> Partially	<input type="checkbox"/> No
How useful was this system to you?	<input checked="" type="checkbox"/> Very usefull	<input type="checkbox"/> Useful	<input type="checkbox"/> Not useful
	<input type="checkbox"/> Not useful at all		
Was the patient profile management feature useful for you?	<input checked="" type="checkbox"/> Very usefull	<input type="checkbox"/> Useful	<input type="checkbox"/> Not useful
	<input type="checkbox"/> Not useful at all		
Was the mobile testing facility useful for you?	<input type="checkbox"/> Very usefull	<input type="checkbox"/> Useful	<input checked="" type="checkbox"/> Not useful
	<input type="checkbox"/> Not useful at all		
Was the online consultation sessions useful for you?	<input checked="" type="checkbox"/> Very usefull	<input type="checkbox"/> Useful	<input type="checkbox"/> Not useful
	<input type="checkbox"/> Not useful at all		
Any other benefits you gained from this system?	Patient management facility is very useful to manage the prescriptions		
Are there any complaints to be made about the system?	-		

Name: Roy De Silva

Date: 02/02/2021

Appendix F Figure 3

Give us your feedback!			
Are you satisfied with the new system?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> Partially	<input type="checkbox"/> No
How useful was this system to you?	<input checked="" type="checkbox"/> Very usefull <input type="checkbox"/> Useful <input type="checkbox"/> Not useful <input type="checkbox"/> Not useful at all		
Was the patient profile management feature useful for you?	<input checked="" type="checkbox"/> Very usefull <input type="checkbox"/> Useful <input type="checkbox"/> Not useful <input type="checkbox"/> Not useful at all		
Was the mobile testing facility useful for you?	<input checked="" type="checkbox"/> Very usefull <input type="checkbox"/> Useful <input type="checkbox"/> Not useful <input type="checkbox"/> Not useful at all		
Was the online consultation sessions useful for you?	<input checked="" type="checkbox"/> Very usefull <input type="checkbox"/> Useful <input type="checkbox"/> Not useful <input type="checkbox"/> Not useful at all		
Any other benefits you gained from this system?	Very useful during this time of the COVID 19 pandemic		
Are there any complaints to be made about the system?	-		

Name: Saman Perera

Date: 02/02/2021

Appendix F Figure 4

Glossary

Bio chemistry - It is the study of the chemical substances and vital processes occurring in living organisms

General pathology - It is the study of the causes and effects of disease or injury

Hematology - It is the branch of medicine concerned with the study of the cause, prognosis, treatment and prevention of diseases related to blood

Serology - It is the scientific study of serum and other body fluids

Ad hoc reports - Creation of dynamic, real time reports by users on an as-needed basis

Stakeholders - Parties that have an interest in a company and can either affect or be affected by the business

Cardiology – The study and treatment of disorders of heart and blood vessels

Pediatrics - The branch of medicine dealing with the health and medical care of infants, children and adolescents

Gynecology - The study and treatment of disorders of the female reproductive system

Psychology - The study and treatment of disorders of mind and behavior

Dermatology - The study and treatment of disorders of the skin

Endocrinology - The study and treatment of disorders of the endocrine system

Nephrology - The study and treatment of disorders of the kidneys

Neurology - The study and treatment of disorders of the nervous system

Urology - The study and treatment of disorders of the male and female urinary tract system

Radiology – It is medical disciplines that uses medical imaging and diagnoses and treat diseases

Oncology - The study, diagnosis and treatment of cancer

Unstructured interview – A non directive interview is an interview in which questions are not prearranged

Bottleneck – A bottleneck is point congestion in a production system

Query optimization – The overall process of choosing the most efficient means of executing a SQL statement

Open source software – Software with source code that anyone can inspect, modify and enhance

Stand alone system – A system that operates independently of, or is not connected to an electric transmission system

Off the shelf – Standard software applications that are mass produced, available to the general public and fit for the immediate use

Cloud based software – Allows users to access software applications that run on shared computing resources through the internet

Kernel – The central part of an operating system

Operating system – The interface between the computer user and the computer hardware

Document object model – It is an application programming interface for HTML and XML documents

Framework – It is a platform for developing software applications

Relational Database – It is a type of database that stores and provides access to data points that are related to one another

Business logic – The custom rules or algorithms that handle the exchange of information between a database and user interface

Bugs – Coding error in a computer program

Logical errors – A mistake in a program's source code that result in incorrect or unexpected behavior

Hypermedia – A system in which various kinds of information such as data, text, graphics, video and audio are linked together by a hypertext program

Multimedia – Use of a computer to present and combine text, graphics, audio and video with links and tools that let the user navigate, interact, create and communicate

Program Specification – A precise statement of the effects that an individual program is required to achieve.