Web Based Appointment and Patient Management System for Dermatology Clinic at Teaching Hospital Ragama

A dissertation submitted for the Degree of Master of Information Technology

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Abstract

The aim of the project is to develop a web base patient appointment and management system for the Teaching Hospital Ragama. There are lots of hospital in the private sector of Sri Lanka which provides online services and mobile services for the patients and the hospital staff to make their life easy and spend it efficiently. The hospitals of government sector provide more services to their patients and staff than the private hospitals, but with poor technology and less efficiency. It makes a vast gap between the government hospitals and private hospitals in efficiency, attraction, and convenience. This project is an aim to bridge the gap between the services of the government hospitals and the services of the private hospitals.

This Web Based project is to solve most of the inefficiencies in the areas of patient's appointments, registration and diagnosing in the Dermatology clinic at Teaching hospital Ragama.The system helps the patients to get an appointment through SMS or e-mail without visiting the hospital. It lets the patients to visit the Clinic shortly before their visiting without coming very early. If the patient makes an appointment on a date when the clinic will not be held, the patients will be informed by the system. This system provides fast, accurate and efficient patient registration and issue of clinic numbers. It is easier for the clinical staff to schedule the patients. In this system a special dermatology template which is designed for the doctors to enter the patient's diagnostic information saves the doctor's time on documentary works and increases their patient's diagnosing time. The pharmacist of the hospital pharmacy is provided with the patient's prescription with the clinic number to make sure the medicines are ready when the patient visits the pharmacy. This could avoid the rush inside the hospital pharmacy in the Dermatology clinic at Teaching hospital Ragama. It helps to store relevant data on patient's and provide necessary reports on time.

The system was implemented using WAMP server (Windows operating system, Apache web server, MySQL database and PHP programming language). The system consists with a separate template for the dermatologists to enter the patient's diagnostic information. The system is authorized for different user categories conveniently. The system users are allowed to logon the system remotely through internet or mobile app. The system is provided with simple message notification service and email service through AWS(Amazon Web service)and ASN (Amazon simple Notification service)

It is portable and it has user friendly interfaces. Therefore it can be easily implemented and extended to facilitate for the entire hospital clinic system. It will help to solve problems of more patients and staff members .It can be used in the Dermatology clinics in other hospitals there is a diagnosing template designed for the Dermatologist to enter patient's records. The system can be implemented to send reports to another hospital in referral of a patient.

Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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This is to certify that this thesis is based on the work of

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under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: Prof.K.P.Hewagamage

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Signature: Date:

Acknowledgement

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Neelika Hewasinghe

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List of Acronyms

WAMP	-	Windows Apache MySQL PHP
SQL	-	Structured Query Language
ENT	-	Ear Nose and Throat
OPD	-	Out Door Patient Department
SMS	-	Simple Message System
E.MAIL	-	Electronic Mail
DB	-	Database
URL	-	Uniform Resource Locator
APP	-	Application
PHP	-	Hypertext Processor
E-CHANNELING	-	Electronic Channeling
SLT	-	Sri Lanka Telecom
FN	-	Functional Requirements
NFR	-	Non Functional Requirements
GB	-	Giga Bytes
RDBMS	-	Relational Database Management System
WINDOWS NT	-	Windows Network Environment
HTML	-	Hyper Text Mark up Language
CSS	-	Cascading Styling Sheet
AWS	-	Amazon Web Service
ASNS	-	Amazon Simple Notification Service
UML	-	Universal Modeling language
URL	-	Uniform Resource Locator
SDD	-	System Sequence Diagram
OOP	-	Object Oriented Programming
UI	-	User Interface
UAT	-	User Acceptance Test

01: Introduction

1.1 Area of Study

Teaching Hospital Ragama conducts their Dermatology clinic on all six days of the week except Sundays. There is an average of 180 patients per day and maximum of 6 doctors are appointed to treat the patients. ENT, Cardiology, Neurology and Diabetic Clinics also conduct in the same clinic hall at the same time with another recruited set of doctors. Therefore the clinic hall is fully crowded from different types of patients, from the morning to the end of all the clinics. Lack of space in the clinic hall and its facilities is a direct cause for the decreased number of patients per day. They issue only one hundred and eighty visiting numbers to the patients.

The clinic issues the visiting numbers in first come, first serve basis for the patients. Therefore, patients come early in the morning and make a rush to get a place in the waiting queue. There are two queues for two different patients for whom red and blue numbers are getting; “Blue numbers” for regular patients and” Red numbers” for the patients who visit the clinic first time and for the Out Patient Department (OPD) referral patients. Every day few numbers of patients return back without a chance to get a visiting number.

Doctors spend more time on documentary work on a patient's clinic book than examining and treating a patient. Doctors write two prescriptions for one patient; one for the patient clinic book and the other writes for the dispensary of the hospital.

Nurses register the new patients as well as the regular patients every day. Regular patient registry is a time consuming and resource consuming extra documentary work.

1.2 Current problems in the existing system

Q1. Patients are served on first come first serve basis therefore patient visits the location as early as possible. The clinic hall handles a number of clinics at the same time and it is fully crowded from morning to the evening.

Q2. Nurses register the new patients as well as the regular patients every day.

Q3. Doctors spend more time on recording the patient’s examination details in their clinic book.

Q4. Doctors write two prescriptions for the same patient one for the clinic book and another for the dispensary of the hospital.

Q5. Doctors consult the consultant for advising. If the consultant is not available in the clinic, they have to send all the manually created patients’ records for reference of the consultation with the patient.

1.3 Motivation

As discussed in the section 1.2, there are many drawbacks relating to the areas such as patient appointment management, patient's registration, patient's examination and consultation. According to the discussion I had with the patients, doctors and other staff members and thoroughly the site observations I realized that they spent more time on their functions unnecessarily without knowing the new features of computing technology. Most of them are unhappy and have much stress on their work .This situation of Dermatology Clinic has motivated me to consider a computerized system to manage most of the tasks there and to add a value to the Dermatology clinic at the Teaching Hospital, Ragama.

1.4 Solutions Proposed

Q1 Giving appointments

Patients make online appointments as well as manual appointments .System erases manual appointments from the online scheduling. When an appointment is made it checks the events of medical calendar. Automated confirmation is sent to the patients, doctors and other staff members about the date, time, and patient's registration number of the appointment. It allows patients to update their appointments. Appointment reminders are sent through SMS, and e-mails.

Q2. Patient's registration

This provides a registration number for each patient and to Store patient information. Authorized users are allowed to access the database any time any location .Access is allowed through computers or mobile phones.

Q3. Patients diagnose recording

This allow doctors to check the patient's history and enters new examination details easily, on dermatology related template, to select drugs with their correct dosage to make the prescription. A copy of a prescription is sent to the pharmacy of the hospital

Q4. Clinic Calendar

This maintains the patient appointments with the time and date, and it displays the doctors on leave, Government holidays and cancellation of clinic.

Q5. App for Mobile users

This allows authorized users to access the patient database through their

mobile phones .
It is too allows Doctors to send images of lesions and get advices from the consultant on treatments.

Q6. Reports for management

- Patient registration information
- Patient appointment information
- Clinic information
- Patient diagnose information
- Patient's prescription

Assumptions

- Patients can use their preferred language to make an appointment. The system accepts Sinhala, English or Tamil ,
- Different user logins for the doctors, patients, nurses and other staff members to access the database

1.5 Scope

The proposed computerized system will be a web application which is primarily concerned about patient appointment management with the responses of SMS messages and emails, patient registration and database management, creating a template to record the dermatology investigation information of the patient and creating a mobile app for the doctors to consult the consultant and access the patient's database.

1.6 Dissertation Structure

Dissertation is the document which contains overall information of the project in chapter wise. This dissertation contains six main chapters followed by reference and appendix.

Chapter 1 : Introduction

Chapter one gives an introduction to the problems handled through the project. This chapter explains the objectives and scope of the project. Furthermore, it gives an introduction to other chapters in the dissertation.

Chapter 2: Background

This chapter describes the existing similar systems to identify the drawbacks. It also explains the alternative ways of technologies available.

Chapter 3: Methodology

This chapter describes the functional and nonfunctional requirements for the new system and privileges of the system and it also includes the design of the solution. In this chapter the chosen system development method is described together with the high level architecture.

Chapter 4: Evaluation

This Chapter contains the evaluation of the developed system. Testing strategies have been used to evaluate that the system has achieved its objectives.

Chapter 5: Conclusion

This chapter contains a critical evaluation of the system and suggestions for any further work

Reference:
This section is included with all the referred books, URL references and other materials used on the work of the project.

Appendix:
This section includes with further details and supplementary documents relating to chapters .

02: Background

2.1 Review of similar system

The review of recent literature aims to provide a systematic overview of solutions for online clinic appointments, online patient's registration and this provides templates for the doctor to enter patient dermatology information and mobile App for doctors and patients to access the system online The review summarizes and evaluates the existing similar systems in order to establish a current knowledge of the patient management and appointment areas.

2.1.1 Online Doctor Appointment Booking System - Book My Doctor

1. "Book My Doctor" is a multi-functional online doctor appointment scheduling software for doctors, clinics and large hospitals built up on PHP with Code Igniter framework. This is an open source scheduling system. Book My Doctor is a tool for both doctors and patients. This medical doctor appointment scheduling software meets the challenges that may surface during an appointment scheduling and hospital management. The software is user friendly for both front end and back end users. The process of booking appointments and scheduling management is easy for both patients and the doctors. Book My Doctor makes a start to provide digital healthcare for the patient. It attracts new patients by adapting their medical practice digitalized.

2. **Key Features**
    1. Appointment booking
    2. Appointment management
    3. Schedule a timing (leave, Vacation)
    4. Easy and user friendly signup and sign in.
    5. Manage patients
    6. Manage doctors
    7. Account password recovery

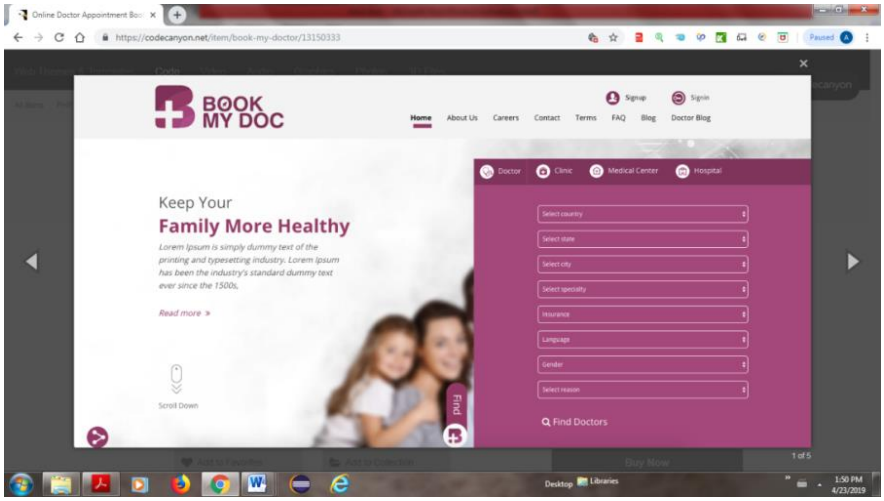


Figure 2.1: Main view of Book My Doctor Software

2.1.2 Doc990

1. Doc 9990 is operated by Digital health Private limited Sri Lanka .It is a pioneer digital health solutions service provider who offers medical services to their subscribers for convenience of their mobile phones and website.

   At present there are more than 1500 doctors in over 80 hospitals are connected to Doc990 .It was launched in 2016.It is a digital health platform which is accessible to their users through the website www.doc.lk by dialing 990 0r via the Doc990 app, available both android and ISO.

   Doc 990 currently offers a range of medical services including island wide doctor channeling session for physical consultation. The Tele –doctor service where the leading consultants can be contacted over the phone for consultation, delivery of medicine and access to laboratories through web portals .This is a leading booking app integrated to all mobile phone operators and banks for multiple payment options as eZ Cash, Genie, Amex, Visa and master cards.

   This service is open and available for nearly 22 million citizens of Sri Lanka. Also it aim to transform the digital health care service sector and experience for all Sri Lankan's and serve as a integrated health care solutions in the Asia-Pacific region.

2. Key Features

1. Appointment booking through web or mobile app
2. Appointment management
3. View doctor and doctors on leave
4. Manage patients
5. Manage doctors
6. Convenient Online payments
7. Recovery of account information

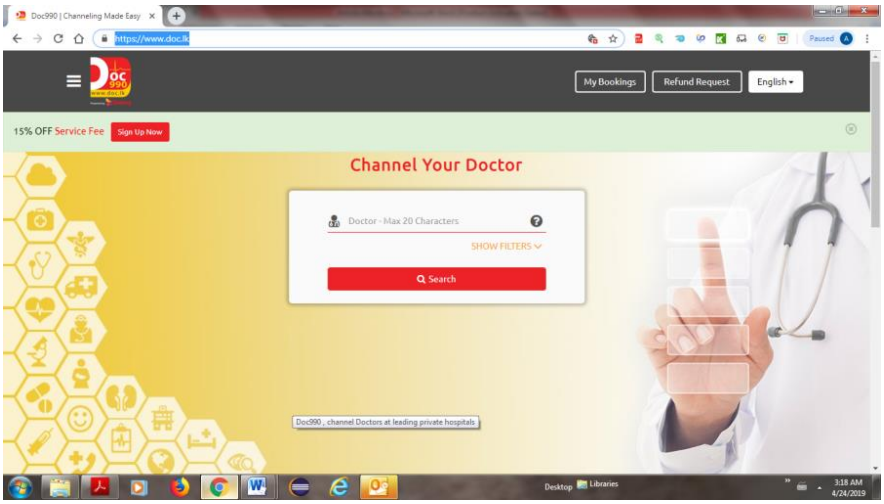


Figure 2.2: Main view of Doc990 Software

2.1.3 E- channeling

1. E-channeling is a well famous ICT provider and pioneer software development provider in the health care industry of Sri Lanka. It is the first company in Sri Lanka.

   E-channeling PLC was established in 2001 by a group company of the London Stock Exchange called Millennium IT. It eliminates the hassle and inconvenience faced by the general public to obtain an appointment in meeting a doctor or a specialist .It provides a convenient time and place for the patient to meet and consult their doctors

   When e-channeling was established there were no services to interrelated patients, doctors and hospitals through internet by using the vast facilities of the Internet and the e- commerce.

E-Channeling PLC is now a fully-owned subsidiary of SLT (Sri Lanka Telecom) PLC It is a subsidiary of Mobitel Private Limits as well as Sri Lanka's national Mobile Service Provider

2. Key Features

1. Doctor Channeling system and service (SMS Notification for the patients about update doctor appointment status, SMS notifications to doctors to inform about their appointments)
2. Offer discounts for Patient Island wide
3. Doctor channeling mobile application
4. Hospital information System
5. Easy ways to automate a hospital, a lab , a Pharmacy and a clinic
6. Easy and secure Online payments

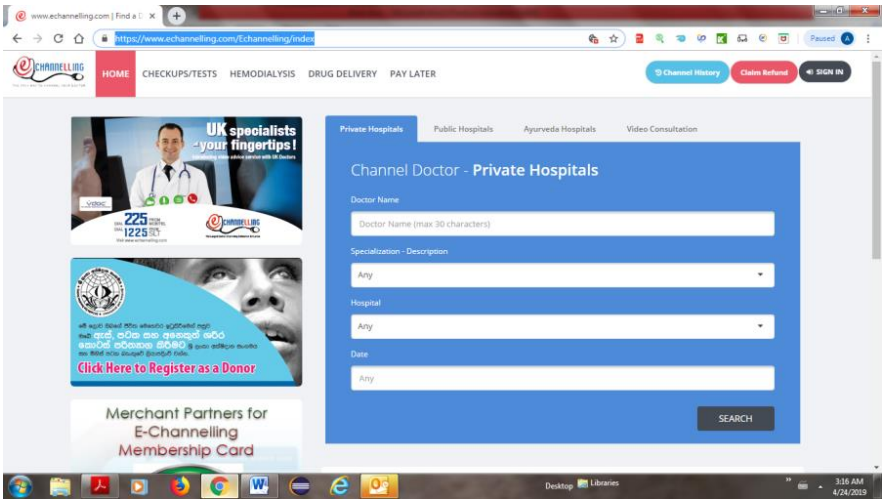


Figure 2.3: Main view of E-Channeling Software

2.1.4. Practice Suite

1. It is a free patient appointment scheduling software .It has a feature of being integrated with a billing and practice management system. It provides free chat service for the patients, appointment scheduling and management, messaging patients and the doctors about the appointments. The system is available for 24 hours for the patients and doctors.

2. Key Features

1. Appointment booking
2. Appointment management
3. Schedule a timing (leave, Vacation)
4. Easy and user friendly Sign Up and sign in
5. Account password recovery
6. Sending E-mails

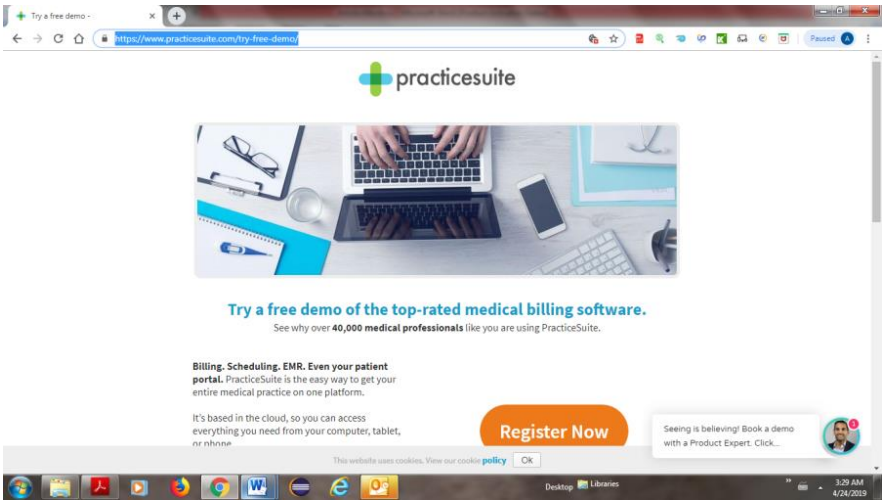


Figure 2.4: Main view of Practice Suite Software

2.2 Comparison of similar existing systems

	Present System	**Book My Doctor**	**DOC909**	**E-channeling**	**Practice Suite**
Easy to Use	yes	yes	yes	yes	yes
Handling appointments	yes	yes	yes	yes	yes
Mobile app on appointments	yes	no	yes	yes	no
Mobile app for doctors	yes	no	yes	yes	no
Patient registration	yes	yes	yes	yes	yes
Templates for doctors	yes	no	no	no	no
Web based system	yes	yes	yes	yes	yes
Generate various reports	yes	yes	yes	yes	yes

Table 2.1 : Comparison between similar systems

2.3 Importance of having a web based system

The main objective of this patient's appointment and management system is to introduce a web based solution for both backend and front end users on clinic appointments, patient registration, investigation recording and messaging. This system frees up the clinic staff from scheduling for more important and pressing tasks. The patients who make appointments save their traveling time and cost, as they don't have to commit a part of their busy life to visit the hospital to get a clinic appointment

It provides a monetary saving. The time savings experienced by a facility of the system can translate into monetary savings. In here both staff time and services translate into

expenses and revenue, respectively. As staff resources can now be directed at other tasks, a scheduling system can eliminate the need for a staff member to work overtime or to request an extra member to handle the work overload created by clinic and appointment process.

It provides 24-Hour convenience communication .This avoids the inconvenience for most patients, as they too are working at this time

It controls all the data in the database located in the server. It is easy to maintain the database. The web based system allows enhancing this system to link with users at any location DPCC will be able to communicate directly and helps to get necessary details quickly.

2.4 How propose System is differ from others

The proposed system is simple and user friendly like the other systems .It has a separate template for the doctors to enter the patient's diagnosis information on the observation of the patient. Also, it provides an interface for the doctors to enter the patient's prescriptions to the system as well as a copy of the prescription to the pharmacy of the hospital. The pharmacist can view the prescriptions and issue the drugs, according to the patient clinic number. When a doctor wants a report of the patient's diagnosis history or if patient transfer to another hospital the patient's diagnosis information, the drug information can be provided in report format.

When doctors want to get the expertise knowledge and if the consultant or the senior doctor is not available at the clinic in the current moment, doctors can get a photograph of the lessens (skin rashes) and can send it through the system. The consultant can study the patient diagnosis history and check the photograph and recommend the treatments and drugs.

Key Features

1. Giving Appointments for the patients through SMS and Emails
2. Convenient language (English /Tamil/Sinhala) for users to get an appointment
3. Patient's registration and issuing of clinic numbers
4. Patients Diagnose recording
5. Check patient's Diagnose history
6. Create a prescription and send a copy to the outdoor pharmacy
7. Create a clinic calendar
8. An App for the mobile users to use the system
9. Generate Reports for the management

03: Methodology

3.1 Introduction

The methodology chapter gives an overview of the methodology with the system analysis and system design. Requirements gathering and requirement analyzing are very essential practices for a sacksful project. The main process of this phase is included understand of the domain, collection of requirements, requirement classification, structuring the process, prioritization and validation.
Appropriate methods and processes are used to carry out the analysis phase in an effective and efficient way.
In software design phase, the gathered requirements are translated to a “blueprint” in building the system. Software design phase is an iterative process stage. Afterwards requirements are elaborated into detailed functional and behavioral requirements. System specification is the output of the design stage [1].

3.2 Analyzing the current system

It is necessary to analyze the current system methodologies to recognize the main functionalities of the system. Domain analysis is carried out through the fact gathering techniques. Fact gathering techniques used in this system are interviews, questionnaires, site observation and consultation of domain experts in the domain’s own terminology. Current web based patient appointment system is a fully manual system with some repetitive tasks. They register the new patients and regular patients daily as there is no proper storage and retrieval system. Also the doctors write two prescriptions on the same patient one for the patient and one for the pharmacist of the hospital at the investigation of the patient. In a case of lost or physical damage of the clinic book there is no way of studying the patient diagnosing history and drug history. The current system is with lots of paperwork for the doctors as well as the nurses. It is a time consuming system on both patients and medical staff. It is less efficient and has much stress for both medical staff and the patients.

This chapter aims to identify the requirements progressively. The functional and nonfunctional requirements are identified according to the user’s point of view .According to an analysis of the system the following system functionalities are identified.

Refer Appendix A for fact gathering (interviews , Questionnaires and site observation) to understand the existing system and get the requirements

3.2.1 Functional Requirements

Functional requirements define the functions of the system to be achieved. Functions are described as specifications of behavior between outputs and inputs. The plan for implementing the functional requirements is detailed in system design. It describes what system does[2].

FN1- Patient registration

In order to reduce the repetitive manual tasks and to make the identification of the patient, the system provides a patient registration.

FN2- User logins for doctors, nurses patients and pharmacist

To provide security, the system will provide separate logins for the users based on their level of authority. Deleting and editing the users, editing the user profiles of existing users and adding new users also be possible.

FN3- Issuing a clinic number and a time for the patient

The Clinic number provides identification for the patient and the time duration provided avoids the rush inside the clinic and place a control over the a number of patients gather inside the clinic hall.

FN4- Display the clinic dates and the cancellation of the clinic

Patients and medical staff can view clinic dates and cancellation of clinic before one week they get an appointment .

FN5- Create a template for the doctors to enter investigation details of the patient

This feature reduces the paper work of the doctors and save their time.Doctors can focus their attention productively on investigation of patients rather than on documentary work. Doctors can use time effectively when entering the patient's diagnosis information by making selections through radio buttons, combo boxes check boxes and drop down lists. If necessary for further, details the text areas are provided.

FN6- Maintain patient registration information

This allows editing patient's mobile number, residence address, email address, date of birth if necessary.

FN7- Maintain patient diagnosis information

This allows editing patient's diagnostic information if necessary.

FN8- View patient diagnosis history

This allows viewing patient's diagnosing history, information when medical staff need.

FN9- Create patient's prescription

Doctors create the patient's prescription here and save it in the patient's database. It can be viewed by the pharmacist to issue the drugs and other medical staff members if necessary.

FN10- Access the system through a mobile application

Medical staff and patients can access the system to any mobile device like their mobile phone or the tab. It is a convenient and cheaper way of accessing the system for the system users.

FN10- Report generation

The system should be able to generate reports to make summaries and to be given to management authorities, Medical staff or to the patients for special purposes.

Following are the reports to be generated

- Patient registration information
- Patient appointment information
- Clinic information
- Patient diagnose information
- Patient's prescription

3.2.2 Nonfunctional requirements (NFR)

Nonfunctional requirements are used to judge the operation of the system rather than checking the specific behavior of the system. The plan for implementing the nonfunctional requirements are specified in the system architecture.It defines how the system supposed to be [3].

NFR 1- System Performance

Processing Time: The report processing time taken should be within few second

Response Time: The system should be able to run smoothly and respond to commands quickly without getting frozen.

NFR 2-Usability

Usability means how difficult it will be to learn and operate the system.[4] Here the doctors are computer literate, but only few nurses are computer literate, whereas most of the patients and pharmacists are not computer literate. There for the system interfaces should be designed without using excessive amounts of colours and backgrounds. Besides it, should avoid excessive amount of text in a single window

NFR 3-Security

Security means requirements about protection of the system and its data. Security measurements are expressed in variety of ways. Some of those are the time taken to break into the system and the effort taken to access the system unauthorized, skill level need to break in to the system [5].

NFR 4-Reliability

Reliability means how trustable the software. Whether the system fails in functioning, how often it fails. Reliability of the system is expressed by mean time between failures

NFR 5-Modifiability

Modifiability means the requirements about the effort to change the software Modifiability measures by personal effort (person months) software.

3.2.3 Relation between functional and nonfunctional requirements

Functional Requirements	**Non Functional Requirements**
Patient registration	Usability, System performance
User logins for doctors nurses patients and pharmacist	Security, Reliability
Issuing a clinic number and a time for the patient	Reliability, System performance
Display the clinic dates and the cancellation of the clinic	Modifiability,
Create a template for the doctors to enter investigation details of the patient	Usability, System performance, Modifiability,
Maintain patient's registration information	System performance
Maintain patient diagnosis information	Usability,
View patient diagnosis history	Usability
Create patient's prescription	Usability, Reliability, System performance

Access the system through a mobile application	Usability, Reliability, System performance
Report generation	System performance

Table 3.1: Functional and Nonfunctional Requirements of the system

3.3 Software Architecture

The architecture of a system describes its major components of the system their, relationships and the interaction between them. Software architecture and design includes Business strategy, quality attributes, human dynamics, design and its IT environment. [6]

Software architecture serves as a blueprint for the system. It helps to manage the complexity, communication and coordination among it's components. When the System architecture nonfunctional decisions are taken, it gives a structured solution to all technical and operational requirements. It optimizes the quality attributes like security and performance. It also, involves with a decision about the organization related to software development with impact of quality, maintainability, performance, and overall success of the final product.

3.3.1 Proposed architecture for the system

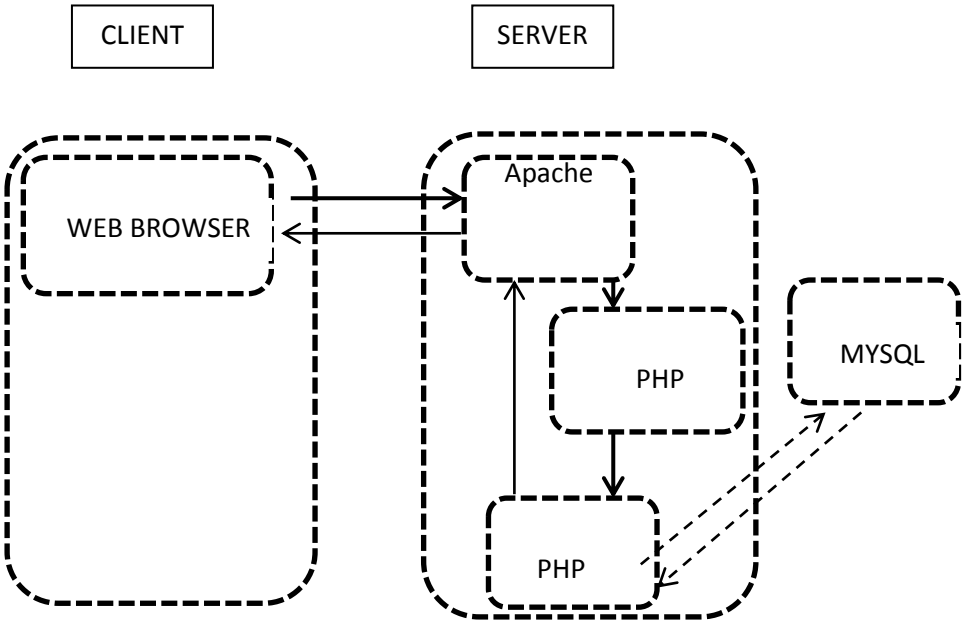


Figure 3.1-Software architecture

3.3.2 Server environment

This is the system hosted location. Also server provides the environment for the operations of client server architecture. This environment used to host the developed system. It handles all data processing activities of the system. [7] The minimum server requirements are Mid Upper range server with 8 GB Ram and 100 GB Storage.

3.3.3 Client environment

A client used to access the service made by the server. The client can be software or hardware. In this system the client is the software which runs in between the user and the server which provides a user interface to interact the users with the system. [8]As an example the Chrome web browse can act as client software. As the system is consisted with latest technologies and software tools it is better to use updated browser software to avoid the browser compatible issues. The system is capable of working with latest hardware and software. The minimum hardware and software requirements are given below

3.3.4 Other software and Hardware Requirements

The backend MYSQL which is an open source RDBMS based on structured query Language to maintain the data in the database. MySQL runs on windows, Linux base operating systems and mobile operating systems like Android and Motorola .It receives requests to process data from the client browser performs the work to process those requests and sends the results back to the clients .

Windows 10, Windows 7 and Windows NT are the best platforms for the MYSQL server because of their true multitasking nature. Therefore MYSQL can run as a service here.

Web browsers like Google Chrome 74.0 ,or any other version ,Opera , Mozilla Fire Fox supports for the system. Further these web browsers make the system interfaces between user and the system.

The front end is the user interface of the system. The developer uses development technologies like PHP 5.6.18, HTML, CSS, Java script, and Apache web server to support database MYSQL5.7.11

Free and open source CSS based framework Bootstrap is used to develop the themes of front end. The templates in the framework which has designed with JavaScript are used to design forma, buttons ,typography and other elements in the interfaces. It works as a reusable tool to use when necessary.

SMS is sent through AWS (Amazon Web Service)l. ASN(Amazon Simple Notification) which is a global SMS gateway. makes it easy to connect, interact and transact with customers on their mobile phones without any matter where they are located. A variety of services are provided by the gateway.

The web site hosting is done through AWS in a secure and effective way

Mail account is used to send emails to the patients. PHP script sent to SMTP server and then it directs to the Gmail server.

Android is used to create a mobile app for the system to use by different usurers in the system in an easier way. The PHP TCPDF is used to prepare the reports in PDF and in PHP.

The client environment is supposed to be with an Intel 2GHz or higher processor, a Ram with 4 GB or higher and broadband network service to provide the internet connection.

3.4 Software design

Software design provides a description called design plan which describes the elements of the system and how they fit and work together to fulfill the system requirements. It acts as a blueprint during the development. It guides the implementation, including detail design, coding, integration and domain requirements and risk analysis. It also negotiates the system requirements to satisfy the system users. Here the functional requirements are accomplished. [9]

3.4.1 Design Techniques

System design techniques are used to translate the requirements into a diagram representation of the software. UML (Unified Molding language) is a standard language consists with different types of integrated diagrams to help develop system and software developers for visualizing, specifying constructing and documenting the system. There are two different types of UML diagrams as structured diagrams and behavioral diagrams [10].

Structure diagrams show the static structure of the system, their components and relationships. Class diagrams, object diagrams, profile diagram are some of them.

Behavioral diagrams show the dynamic behavior of the objects in the system .Use case, Activity and sequence are some of them.

3.4.2 Proposed system design

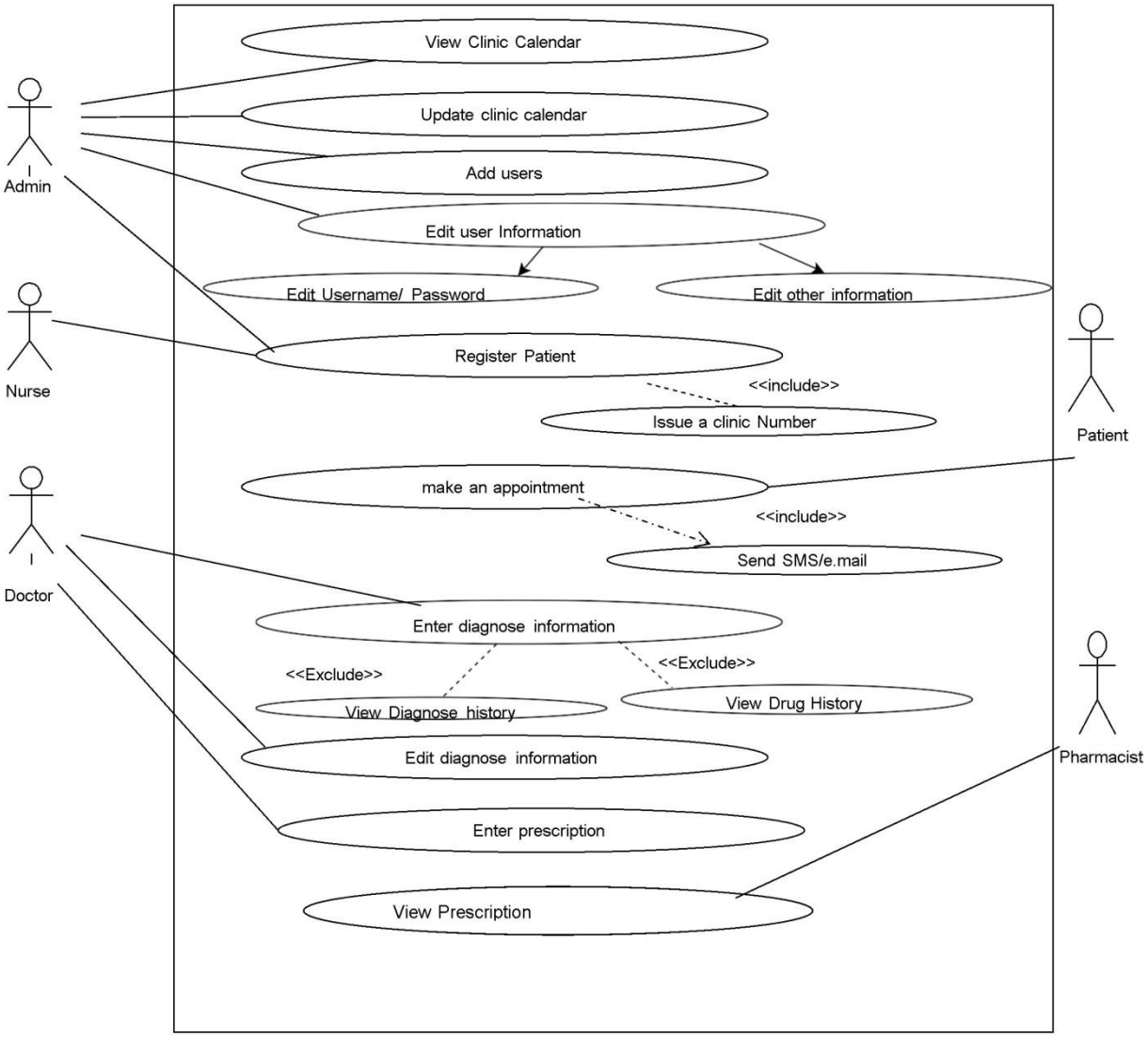


Figure 3.2: High level Use Case diagram for the proposed system

Assumptions: Admin is fully authorized to access the whole system

i) Use Case Diagram

Use case diagrams are helpful to capture the dynamic behavior. It consists of actors, use cases and their relationships. Activity diagrams, sequence diagrams, collaboration diagrams and state charts are the other types of diagrams which help to capture the dynamic aspects of the system. Use case diagram differs from others because it is

used to gather the requirements influenced internally and externally. When an initial task is completed, used cases are modeled to present the outside view.

Therefore Use cases are used gather the system requirements, to get the outside view of the system, to identify internal and external factors which influence the system, and to show the interaction between requirements and the actors.

ii) Use Case Narratives

Use case narratives are text-based description of use cases .It acts as an important tool between system developers and the system users. The discretion is written in the user's language. These follow a structured format. It specifies the use case, a brief description of the use case, primary and secondary actors, who involved in the use cases, pre-condition and post condition of the use case[11].

Use Case Narrative Documents for each use case Identified

Table 3.2: Case Narratives for View Clinic Calendar

Use Case :View Clinic calendar	ID-01
Brief Description: View clinic information	
Primary Actor: Admin, Nurse, Doctor	
Secondary Actor: None	
Precondition: Request on clinic details	
Main Flow :1.View Calendar	
Post Condition :View clinical Information	

Table 3.3: Case Narratives for Update clinic calendar

Use Case :Update clinic calendar	ID-02
Brief Description: Make changes in the calendar	
Primary Actor: Admin, Nurse, Doctor	
Secondary Actor: None	
Precondition: Request for a change	
Main Flow :1. Retrieve Calendar 2. Edit Calendar	
Post Condition :View Changed clinical information	

Table 3.4: Case Narratives for Add Users

Use Case :Add Users	ID-03
Brief Description: Add System Users	
Primary Actor: Admin, Nurse, Doctor	
Secondary Actor: None	
Precondition: Request on add user	
Main Flow :1. Add new User	
Post Condition :New User for the system	

Table 3.5: Case Narratives for Register Patients

Use Case :Register Patients	ID-04
Brief Description: Register patients for the Clinic	
Primary Actor: Admin, Nurse	
Secondary Actor: None	
Precondition: login to the system	
Main Flow :1 Fill Registration Form 2.Get a clinic number	
Post Condition :Get a Clinic Number	

Table 3.6 :Case Narratives for Make an appointment

Use Case :Make an appointment	ID-05
Brief Description: Get an appointment to meet the doctor	
Primary Actor: Patient	
Secondary Actor: None	
Precondition: Successful issue of clinic number	
Main Flow :1.Send an SMS/E-Mail 2.Get an Appointment	
Post Condition : Get a visiting time	

Table 3.7: Case Narratives for Enter diagnosis information

Use Case :Enter diagnosis information	ID-06
Brief Description: Enter patient's diagnosis information	
Primary Actor: Doctor	
Secondary Actor: None	
Precondition: Enter Clinic Number	
Main Flow :1. Enter clinic number 2.Enter diagnosis information	
Post Condition : Store patient diagnosis information	

Table 3.8: Case Narratives for Edit diagnosis information

Use Case :Edit diagnosis information	ID-07
Brief Description: Edit Patient Diagnosis Information	
Primary Actor: Doctor	
Secondary Actor: None	
Precondition: Request for a change	
Main Flow :1.Enter clinic Number 2.Change the information	
Post Condition :View Edited Information	

Table 3.9: Case Narratives for Enter prescription

Use Case :Enter prescription	ID-08
Brief Description: Enter prescription for the pharmacy and the patient	
Primary Actor: Doctor	
Secondary Actor: Pharmacist	
Precondition: Complete Diagnosis	
Main Flow :1.Enter clinic Number 2. Enter drugs	
Post Condition : Send a copy to patient db /Copy to access by pharmacist	

Table 3.10: Case Narratives for View prescription

Use Case :View prescription	ID-09
Brief Description: View a copy of the prescription	
Primary Actor: Pharmacist, Doctor	
Secondary Actor: None	
Precondition: Enter Prescription	
Main Flow :1.View Prescription	
Post Condition : issue drugs	

Table 3.11: Case Narratives for Send SMS/email

Use Case :Send SMS/email	ID-10
Brief Description: Send Visiting time	
Primary Actor: System	
Secondary Actor: None	
Precondition: Making Appointment be Successful	
Main Flow :1.send SMS/E-mail to Patient	
Post Condition : Patient receive the SMS/E-mail	

3.4.3 User categories and their privileges

As the Medical staff is busy at their routine work, the system administrator can be a selected nurse of the Medical staff. Patient registration can be done by the administrator or by the patient .The administrator and Doctors are fully authorized users of the system. All the other nurses are allowed to view system for patients, drugs and clinic information. Pharmacist can view prescription drugs issue.

The features available for the administrator

- Make registration
- Issue a clinic number/time
- Add, delete records
- Generate various reports
- Maintain patient history detail

The features available for the doctors

- View patient investigation and drug history
- Enter investigation information
- Create a prescription

The feature available for the nurses

- View patient investigation and drug history

The feature available for the patient

- View patient investigation and drug history

The features available for the pharmacists

- View patient investigation and drug history
- View current prescription

3.5 Database Design

Database design is the process of organizing data according to the database model of the system. Database design involves with classification of data and identification of their interrelation ship. The ontology is the theory which is behind the database design. Here the database tables are normalized into its third normal form to reduce the redundancy, partial dependencies and Transitive dependencies. Also it specifies the structure of objects used in client server model [12].

Refer Appendix C for Database Design Structure diagram of the system.

3.6 Sequence diagram

Sequence diagram or system sequence diagram (SSD) shows the events that external actors generate and their order and possible inter –system events on the system. It is also called as the visual summaries of the individual use cases. Sequence Diagram specifies the External actors, Messages, Return values and iteration areas of the system activities[13].

Patient Registration

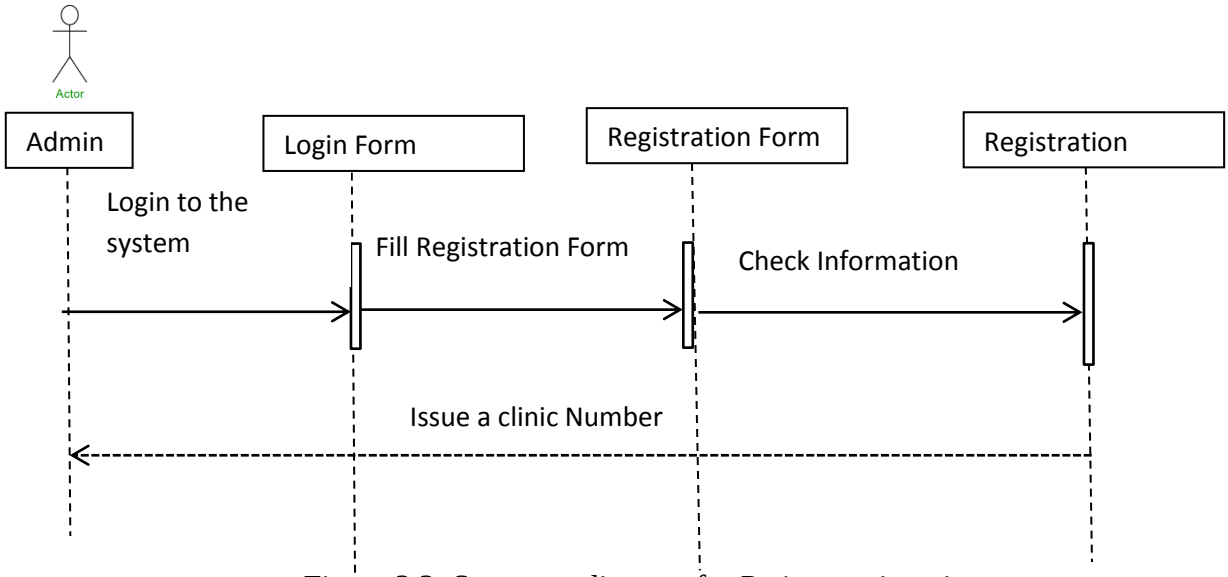


Figure 3.3: Sequence diagram for Patient registration

Make an appointment

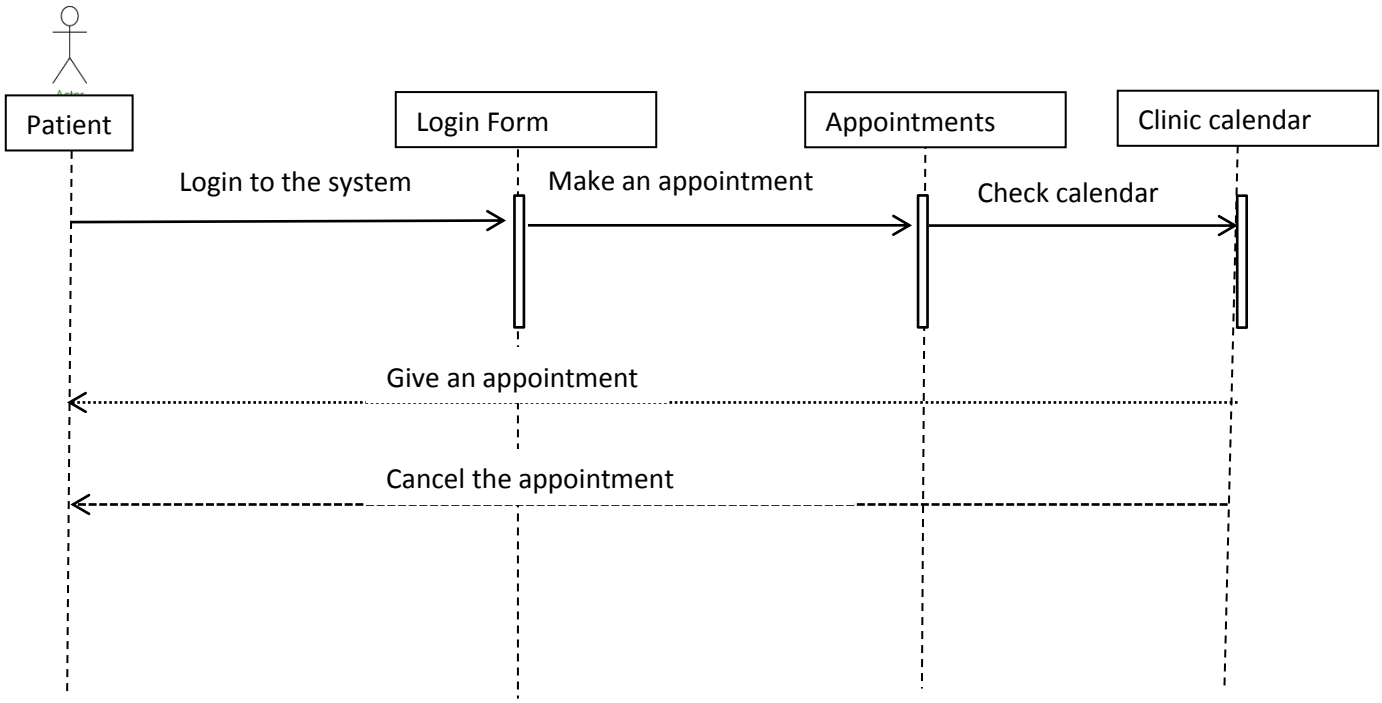


Figure 3.4: Sequence diagram for Make an appointment

Enter diagnostic Information / Change patient information

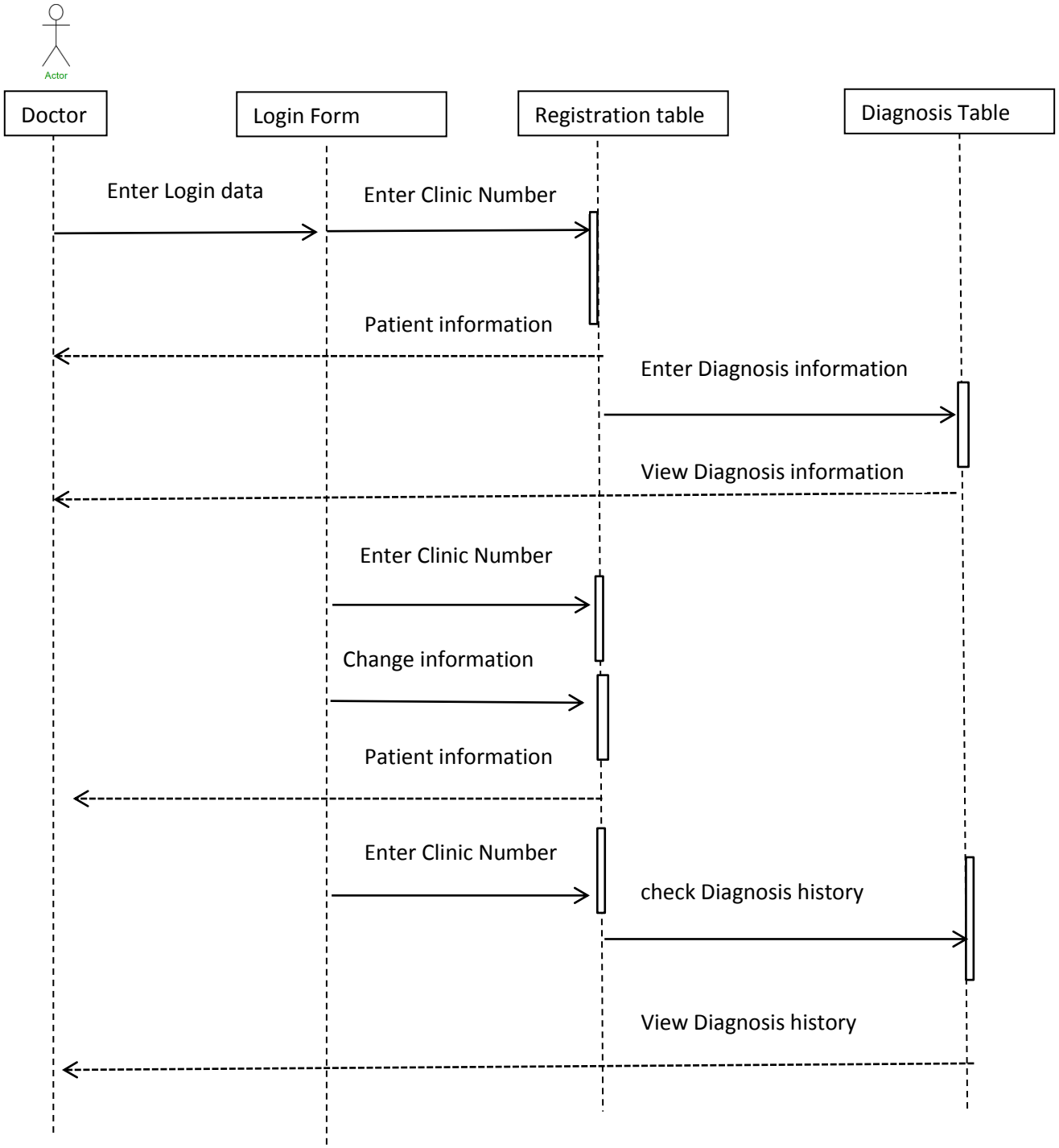


Figure 3.5: Sequence diagram for enter diagnostic information

Enter prescription and view prescccription

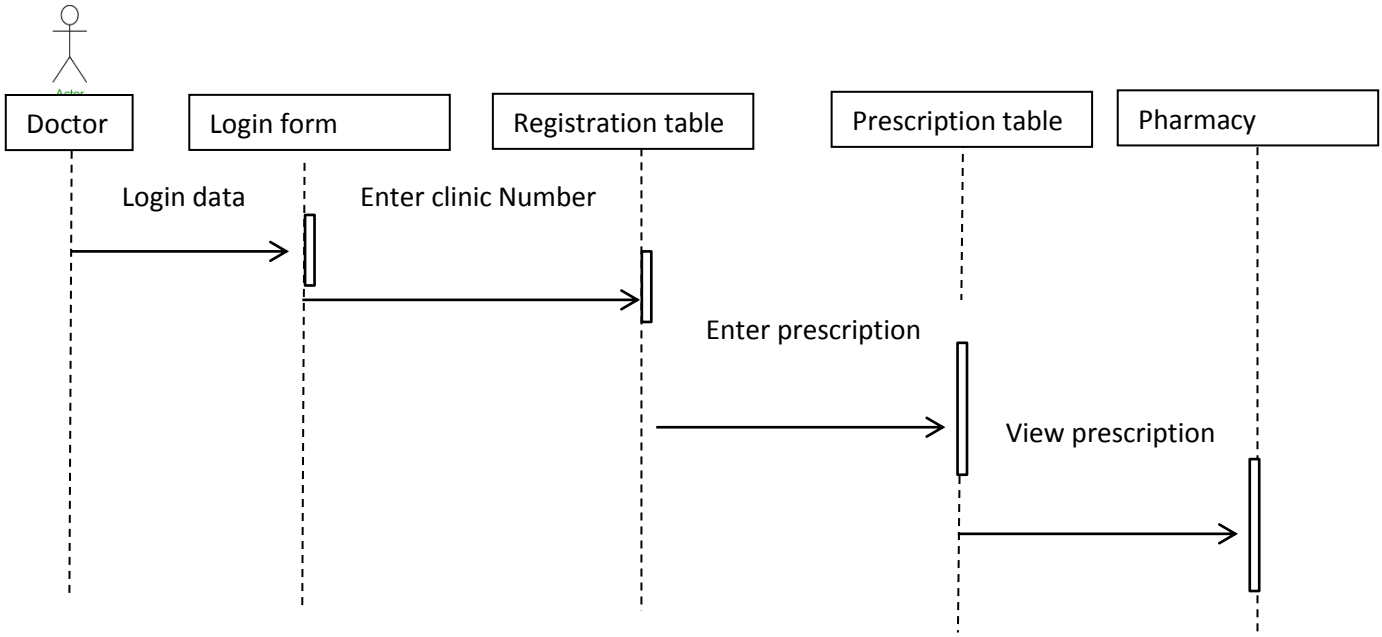


Figure 3.6: Sequence diagram for enter prescription and view prescription

3.7 Class Diagram

Class diagram is an UML diagram which describes the structure of the system by showing the classes of the system. It represents both the main elements, interactions and the classes to be programmed. Class diagram is the main building block of the OOP(Object Oriented Programming) [14].

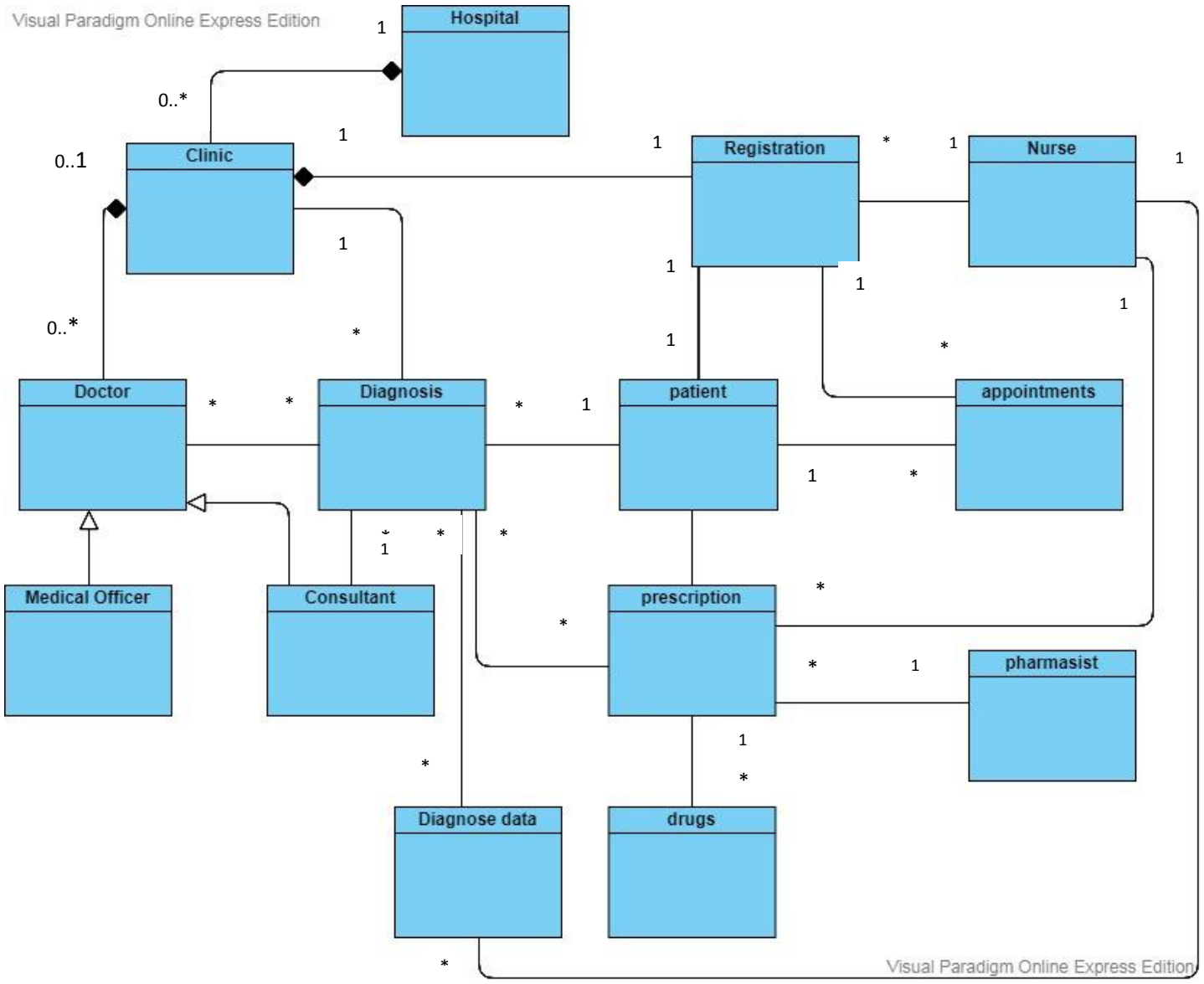


Figure 3.7: Class Diagram for the proposed system

3.8 User Interface design

User interface design (UI) design is the process of making interfaces in software with a focus on style .The UI is the access point for the user to interact with the design. There are different types of UI as graphical user interface which interact with WIMP tools, face and voice controlled interfaces which recognize the face significant and voice .,and gesture- based interfaces which identify body movements**Error! Reference source not found.**

There are some properties that user interface must have.

1) Keep interface simple and make user an "invisible" feel. Make every element serve a service
2) Respect the user's eye and attention on the layout
3) Make elements (buttons and other common elements) perform predictable.
4) Maintain high discoverability
5) Minimize the number of actions perform on a task
6) Put controls near necessary objects
7) Use reusable design patterns
8) Consider defaults and reduce the user burdens.

3.9 Security Design

Security measures have been taken to secure the data in the system. It decides what the applications allow to do and what the users of the applications are permitted to do. The surety measures define restrictions to determine what application and users are not allowed to do .

Input validation methods like presence check, type check, lookup tables are used to reduce the risk of entering invalid data into web application.

Authorization of the system does not allow the unauthorized access. The nurse who act as the administrator is the full authority to do all the functionalities while the other users given limited functionality to avoid any misuse of data. The passwords are encrypted and store in the system to prevent someone reading and misusing it

Backup of the database is taken regularly to another external device and keep in a locker securely.

Even though applying of security methods data loss can happen in many ways. There can be physical failures , accidental errors, theft or disaster like fire. If the data gets changed or deleted it would take considerable time to restore

3.10 Implementing the system

In the implementation process the system specification is converted into an executable system. In this phase convert the design into user-friendly front end interfaces and back end systematic logic for performed functionalities. A suitable language and tools are selected in coding and development. The codes are written and arranged in readable format. Remarks are added to help for future implementation.

In this system the client server environment is used as implementation environment.

The environmental requirements basically divided as hardware requirements and software requirements.

3.11 Network Architecture

The system consists with client server architecture. The clients connected to the main web server through their browsers**.** The main web server connected to the internet and protected by a firewall.

3.12 Main user Interfaces

In this section few main interfaces of the system are displayed to show the system interface structure.

Login page:

Login Page allows the users to log in to access the system in different user authority levels by using different usernames and passwords.

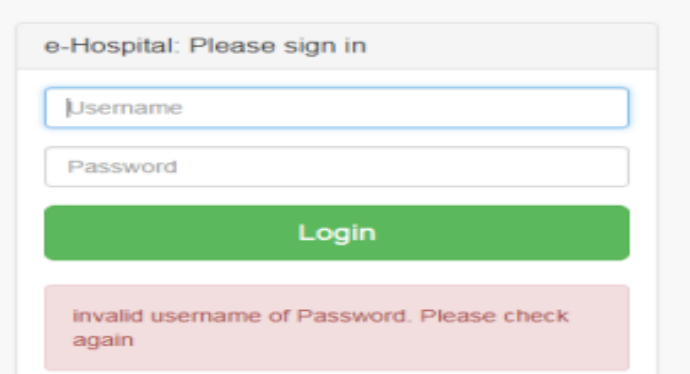


Figure 3.8.: User Login Screen

Home page:

Home page provides the link to all the other pages in the main web site .Also it provides buttons to navigate easily throughout the whole website.

Figure 3.9: Home Page Screen

Get an Appointment

Get an appointment screen is used to enter patient clinic number and get an appointment to visit the clinic.

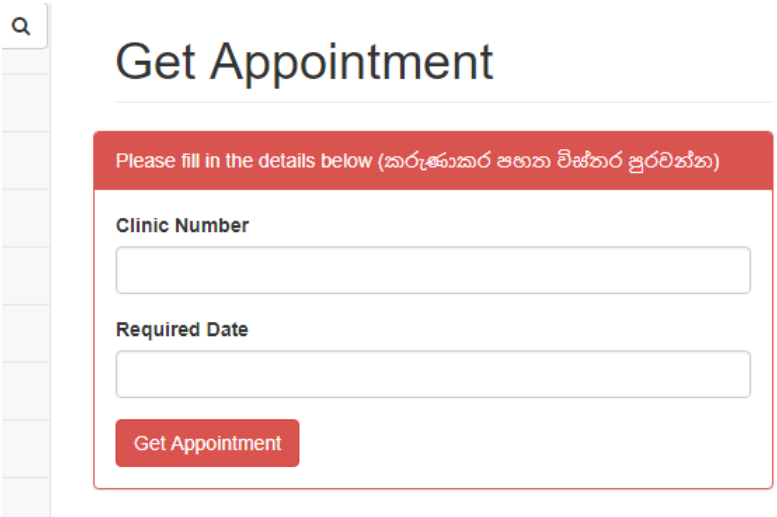


Figure 3.10: Get an appointment Screen

Add new patient

Add new patient screen used to enter patient details for patient registration

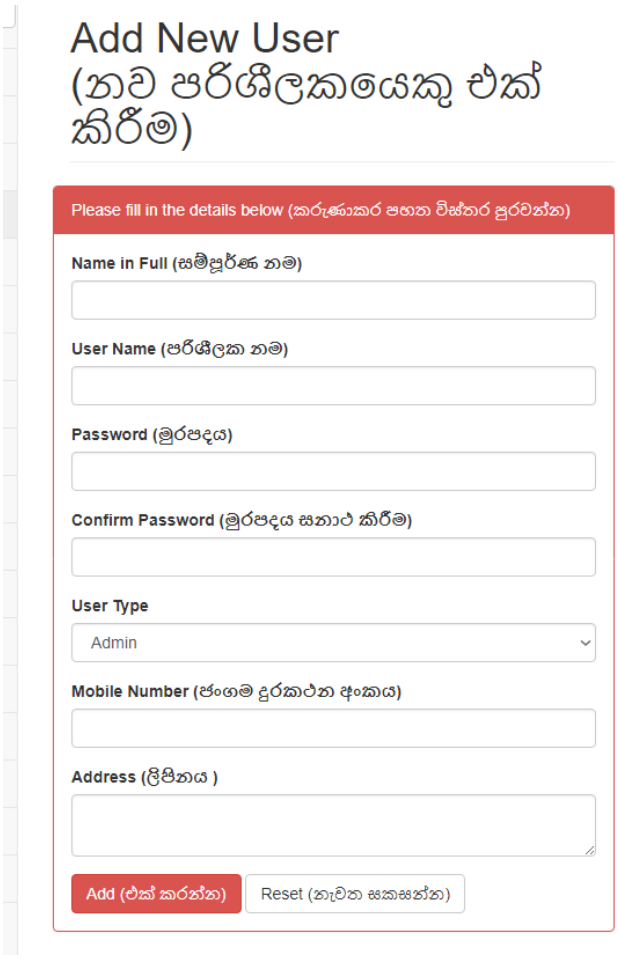


Figure 3.11: Add New User

3.13 Main Source code

3.13.1 Sending SMS

Loading Amazon Web Service

```
6
7       use Aws\S3\S3Client;
8       use Aws\Sns\SnsClient;
9       use Aws\Exception\AwsException;
```

Figure 3.12: Loading AWS

Organization Amazon Simple Notification Service(ASNS)

Figure 3.3 shows the php coding to organize te environment for SMS

```php
$params = array(
    'credentials' => array(
        'key' => 'AKIASGLKC2ULMX4IIV7Z',
        'secret' => 'LVOjYy10n4v8939+91bCEqeI96YZKQEU6U0HFJ8B',
    ),
    'region' => 'ap-southeast-1', // < your aws from SNS Topic region
    'version' => 'latest'
);
$sns = new \Aws\Sns\SnsClient($params);

$newNumber = preg_replace('/^0?/', '+94', $_POST['mobileno']); //convert leading zero to country code

$args = array(
    "MessageAttributes" => [
                'AWS.SNS.SMS.SenderID' => [
                    'DataType' => 'String',
                    'StringValue' => 'ehospital'
                ],
                'AWS.SNS.SMS.SMSType' => [
                    'DataType' => 'String',
                    'StringValue' => 'Transactional'
                ]
            ],
    "Message" => "Ayubowan!! :-) Oba e-Hospital sevaye liyapadinchi karana ladi. Obage liyapadinchi ankaya: {$newpatientno}",
    "PhoneNumber" => "$newNumber"
);
//var_dump($args);

$result = $sns->publish($args);
```


Figure 3.13: Organizing ASN

Appointment SMS

Figure 3.14 shows the php coding to create a SMS appointment

```php
$params = array(
    'credentials' => array(
        'key' => 'AKIASGLKC2ULMX4IIV7Z',
        'secret' => 'LVOjYy10n4v8939+91bCEqeI96YZKQEU6U0HFJ8B',
    ),
    'region' => 'us-east-1', // < your aws from SNS Topic region
    'version' => 'latest'
);
$sns = new \Aws\Sns\SnsClient($params);

$newNumber = preg_replace('/^0?/', '+94', $thisuser->mobileno); //convert leading zero to country code

$args = array(
    "MessageAttributes" => [
                'AWS.SNS.SMS.SenderID' => [
                    'DataType' => 'String',
                    'StringValue' => 'ehospital'
                ],
                'AWS.SNS.SMS.SMSType' => [
                    'DataType' => 'String',
                    'StringValue' => 'Transactional'
                ]
            ],
    "Message" => "Ragama Shikshana Rohale obage Vaidayavaraya hamuvima sandaha ven karana lada dinaya havelava: {$thispatientstimestring}",
    "PhoneNumber" => "$newNumber"
);
//var_dump($args);

$result = $sns->publish($args);
```


Figure 3.14: Appointment SMS

04: Evaluation

4.1 Introduction

The software testing is a critical component of software quality assurance. The basic goal of software testing is to check whether the actual results of the system is matched with the expected results of the system. Software testing ensures that the software system is not defective .It helps to identify errors -gaps or missing requirements when comparing to the actual requirements of the system. Software testing method is basically combined with the system verification and system validation. The Verification checks whether the system implements the specified functions properly and validation checks whether the system satisfy the Nonfunctional requirements properly.
Software testing can be done either manually or using automated tools like Test management tools, 'Functional Testing' tools and 'Load Testing' tools. Now days there are variety of software testing tools available for free and paid. [15]

4.2 Testing Procedure

Software testing is an 'Activity Check'. It checks whether the actual results match the expected results and ensure that the software system is bug free. It involves the execution of system components to evaluate the properties of interest. It helps to identify errors, gaps or missing requirements compared to the actual requirements. It can be done either manually or using test automation tools. System testing is a combination of white box testing and black box testing.

Black box testing refers to the testing techniques which check the internal structure design in which the implementation of the item being tested is not known to the tester. White box testing refers to the testing techniques which test the components of the system known to the tester.

Typically, software testing is classified into three categories: functional testing, perform testing and regression and maintenance testing.

4.3 Test Plan and Test Cases

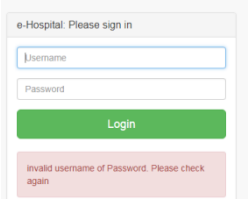
A test case is a documentation which defines the procedures, scenarios, descriptions, testing environment, expected results and actual results. It used for a single test scenario. There are both a positive and negative test cases for each of the test scenario. The purpose of test cases is to find bugs in the system and to show whether the system performance correctly according to the user needs [16].The test plan is designed to test a given scenario. It lays out all major activities associated with the testing scenario. A test plan is typically included with the system objectives, scope of the project, target market, testing cycle, testing environments, deliverables, major risks, defect reporting and mitigation and testing end date.

Testing begins with the implementation. Table 4.1 specify some of the test cases

Here Manual testing methods and procedures are used to check the system rather than using automated system tools. The Table 4.1 tabulate test cases for testing the basic functions.

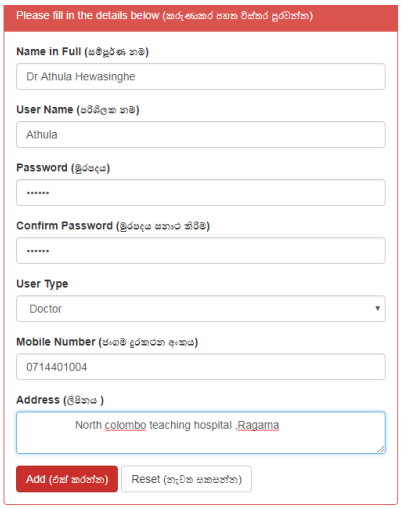
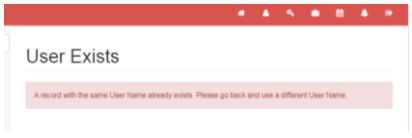
4.3.1 Login Module

Table 4.1 : Test case Login Screen

Test Case Id		01	
Tested Component		Login	
Module Name		Login Module	
Test Case		Login screen	
Test Case Description			
No	Test case	Actual output	Status
1	Login (positive).	Enter valid username and password. Validate and redirect to correct user home page	pass
2	Login (Negative).	Enter invalid username and password. Error message display with reason 	pass

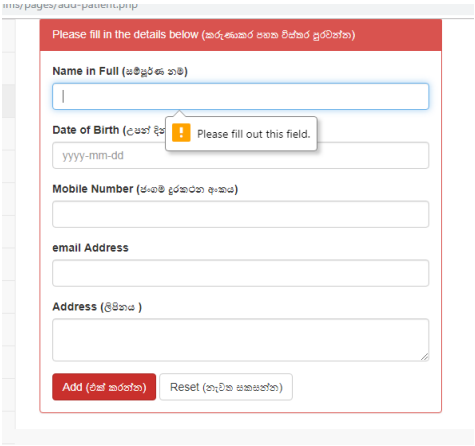
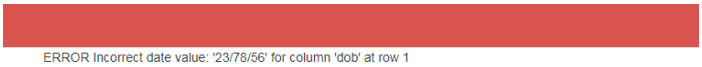
4.3.2 Add New User

Table 4.2 : Test Case Add New User

Test case Id		02	
Tested component		Add New User	
Module name		Add New User Module	
Test case		Add new User screen	
Test case description			
No	Test case	Actual output	Status
1	Enter Information for a new user	Create an acceptance message and store data inside the database 	pass
2	Reenter information for a current user	Create an error message 	pass

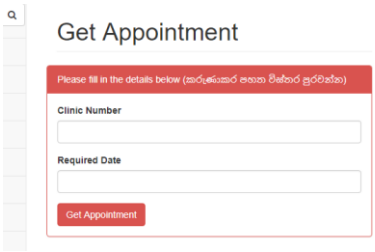
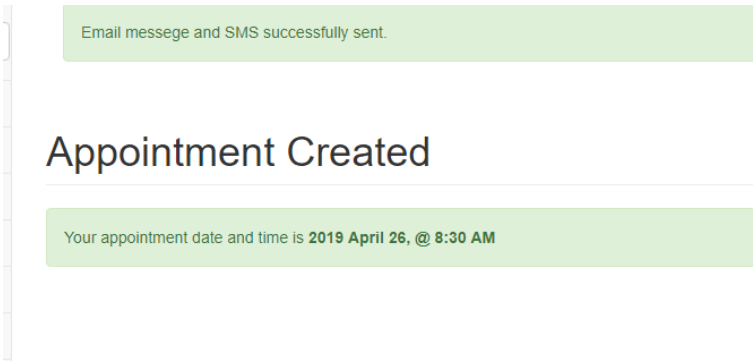
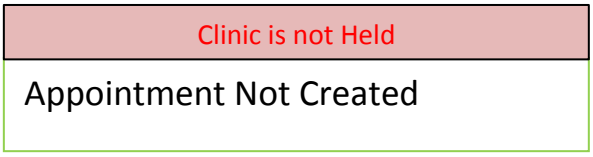
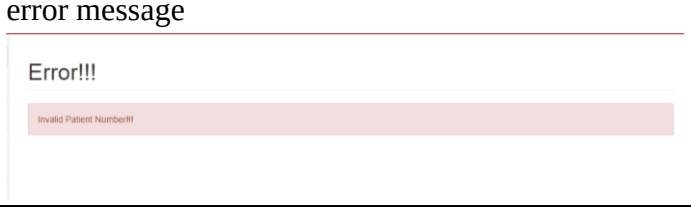
4.3.3 Patient Registration

Table 4.3 : Test Case Add New Patient

Test case Id		03	
Tested component		Add New Patient	
Module name		Patient Registration Module	
Test case		Add New Patient	
Test case description			
No	Test case	Actual output	Status
1	Enter Relevant information on patient registration	Enter data in correct format And submit to the patient database 	pass
2	Recording (Negative).	Miss filled form boxes create error messages 	pass
3	Recording (Negative)	Data with incorrect format (date of birth)cause error messages 	pass

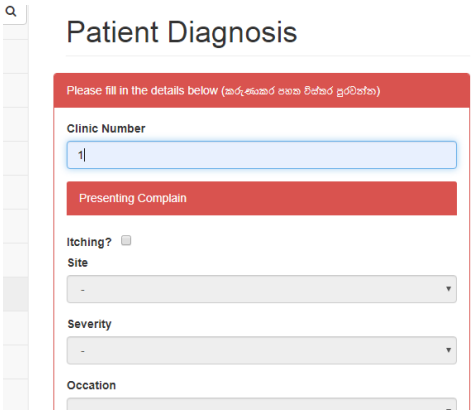
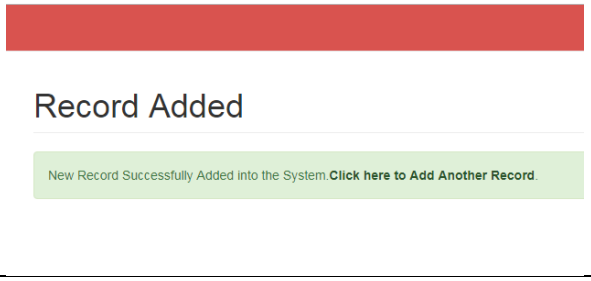
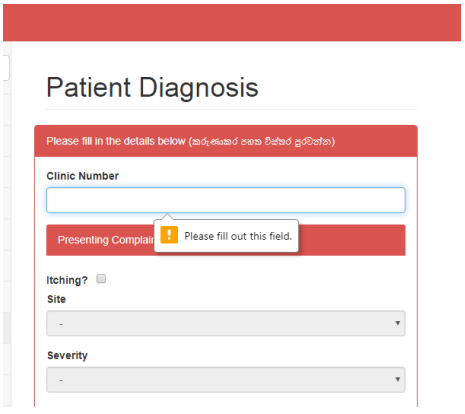
4.3.4 Patient Appointment

Table 4.4: Test Make an Appointment

Test case Id		04	
Tested component		Get an Appointment	
Module name		Patient Appointment Module	
Test case		Make an appointment	
Test case description			
No	Test case	Actual output	Status
1	Enter Clinic number	Enter clinic number and time required to the system 	pass
2	Recording (positive).	Provide a time for the patient through a SMS or an email. 	pass
3	Recording (Negative)	If the clinic is not held provide a message without an appointment 	pass
4	Recoding (Negative)	If mobile number or the email is incorrect it provides an error message 	Pass

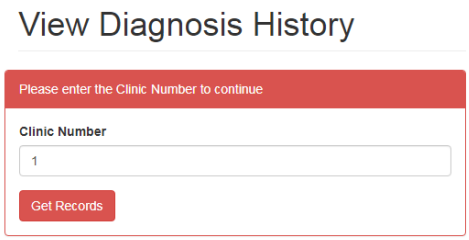
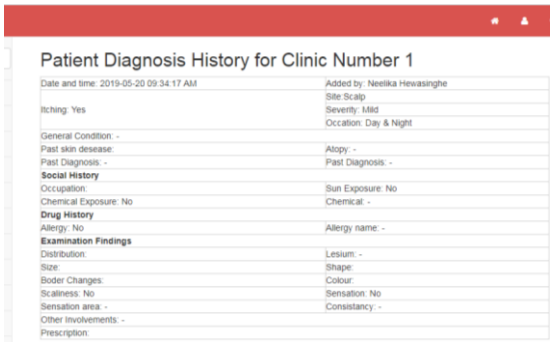
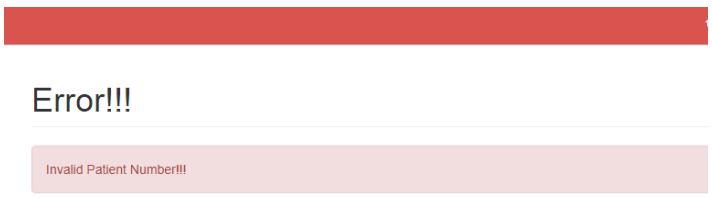
4.3.5 Enter patient's diagnostic information

Table 4.5: Enter patient's Diagnostic information

Test case Id	04	
Tested component	Enter patient's Diagnostic Information	
Module name	Doctors Template Module	
Test case	Enter patient diagnostic information	
Test case description		
No	Test case	Actual output	Status
1	Enter Clinic number	Enter clinic number and fill the information 	pass
2	Recording (positive).	Enter information properly to the database 	pass
3	Recording (Negative)	If data is not filled properly an error message is provided 	pass

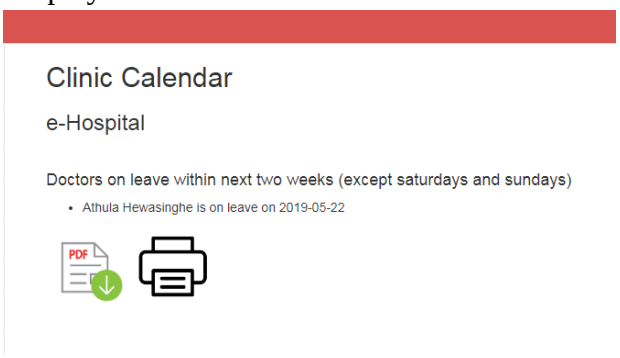
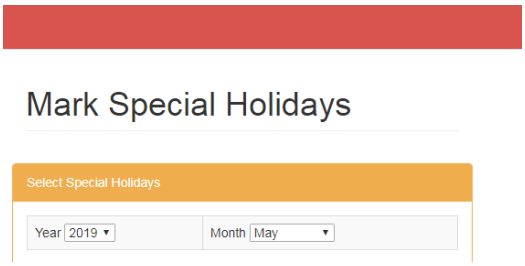
4.3.6 Check patient's diagnostic information

Table 4.6: Check patient's diagnostic information

Test case Id	04	
Tested component	Check patients Diagnostic Information	
Module name	Doctors Template	
Test case	Check patients diagnostic history	
Test case description		
No	Test case	Actual output	Status
1	Enter Clinic number	Enter clinic number and access the system 	pass
2	Recording (positive).	Display the diagnostic history of the patient 	pass
3	Recording (Negative)	If Clinic number is incorrect or miss filled information it displays an error message 	pass

4.3.7 Check Clinic calendar

Table 4.7: check clinic calendar

Test case Id	05	
Tested component	Clinic Calendar	
Module name	Clinic Calendar Module	
Test case	Display clinic calendar	
Test case description		
No	Test case	Actual output	Status
1	Display clinic calendar	Display clinic calendar 	pass
2	Recording (positive).	Display the calendar with proper updates 	pass
3	Recording (Negative)	Display it without correct updates	pass

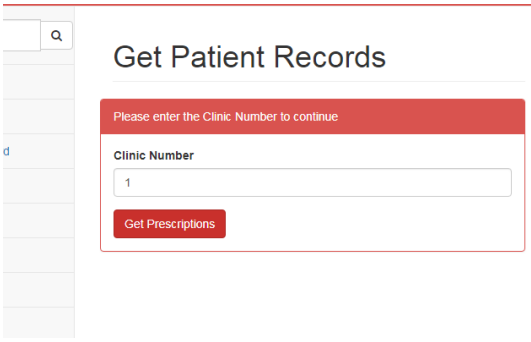
4.3.8 Mobile App for the users

Table 4.8: Check mobile app for the users

Test case Id		06	
Tested component		Mobile app	
Module name		Mobile App for the users Module	
Test case		Total System	
Test case description			
No	Test case	Actual output	Status
1	Enter Clinic number through the mobile phone	Enter clinic number and click on the option you want	pass
2	Enter clinic number successful through Mobile phone	Display the patient's diagnostic history	pass
3	Recording (Negative)	If Clinic number is incorrect an error message is generated	pass

4.3.9 Generate Reports

Table 4.9: Check reports

Test case Id	07		
Tested component	Reports		
Module name	Generate reports module		
Test case	Report generate fields		
Test case description			
No	Test case	Actual output	Status
1	Enter Clinic number	Enter clinic number and click on the report type you need 	pass
2	Enter clinic number successful	Display the report page successfully. It can be print or save for lateruse. 	pass

Date and time: 2019-02-05	Added by: Neelika Hewasinghe
Itching: Yes	Site:Scalp
	Severity: Mild
	Occation: Day & Night
General Condition: Fever	
Past skin desease: Yes, three years ago	Atopy: Hay Fever
Past Diagnosis: Heart Disease	Past Diagnosis: Psoriasis
Social History	
Occupation: Farmer	Sun Exposure: Yes
Chemical Exposure: Yes	Chemical:
Drug History	
Allergy: No	Allergh name:
Examination Findings	
Distribution: Sample Distribution	Lesium: pustale
Size: medium	Shape: circuler
Boder Changes: dsdffsdf	Colour: Red
Scaliness: No	Sensation: No
Sensation area:	Consistancy: Firm
Other Involvements: hair	

4.4 Acceptance Testing

User Acceptance test (UAT) is the last stage in the software testing process. During the user acceptance testing the end users check the system to make sure it can handle the required functionalities in real world scenarios according to the system specification.

It is a critical software procedure which must occur before the deployment of the new system. UAT is also known as end user testing or beta testing [17]

The test strategy is outlined during the test planning stage. Then test cases are designed to cover all functional scenarios of the system. A test team is selected through the real world end users. After all bugs have been fixed they signed off the application to show that it meets the user requirements.

The User Acceptance Testing was conducted in actual working environment of teaching hospital Ragama with real transaction data sets. Users were selected from the doctors, nurses, pharmacist and patients and those selected users were asked to work with related modules in the system according to their privileges. Activities were monitored while users working with the system.

To consider as a successful project the final outcome needs to be accepted by the end users. The system was handed over to users for a ‘test run’ with a questionnaire to capture the customer feedbacks. A sample questionnaire was designed to give users.

4.4 Summary

After full testing cycle the system allows the user to comment on the development of the system whether it is developed successfully or not. The positive user reactions show that the users accept the system. The user acceptance test checks whether all functional requirements given by the system users are fulfilled or the users can carry out their functions effectively and efficiently with the newly developed system. Little minor modification included to the system according to the user feedback.

05: Conclusion

5.1 Introduction

The Conclusion discusses about the objectives achieved and the future enhancements of the developed system. It also explains the identified deficiencies in the final development.

Dermatology clinic at Teaching hospital, Ragama plans to computerize day to day routine work of their clinic which handles everything manually .They are planning to make efficient and time saving clinic system for both patients and clinical staff. The areas of patient's registration, patient's appointments, patient's diagnosing and drug issuing are selected to be computerized with a web based system.

5.2 Work carried out

A Structured system analysis and design methodology are used to develop the web based clinic appointments and patient management system to Dermatology Clinic at the Teaching hospital, Ragama to overcome the problems of the present manual system.

Initially, full description of the system and method currently in use in the area of the patient appointment handling, patient registration and patient diagnosing and origin of the data used were gathered. Patients, doctors and nurses were involved to get detailed requirements. Alternative approaches have been analyzed in depth by reviewing similar systems and technologies in order to get an idea of how the existing system would be improved. Secondly the design specification completed to develop and test the end user requirements .The system was developed using HTML, CSS, PHP, MySQL, and AWS (Amazon Web Service) .The system was tested with sample data which evaluates the effectiveness of the system against the set of objectives.

5.3 Findings

From the evaluation and evidence presented, it can be concluded that all requirements are fully met to satisfy the end users. Some users are in the idea that the user interface should be upgraded since most of the users are in the mind that the system makes the task easy. It gives a positive feedback that the system will help users to complete their activities. More than 67% have positively responded that they could log into the system without any difficulty. According to this high rate of positive responses to the questions based on the features and facilities of the system, it is clear that the features and the facilities of the system are useful. The users have no prior experience in managing web based appointment system. Most of them are interested in learning the system.

The time of total project conclusion was extended than the proposed time in the original project scheduled because of the excessive development time.

5.4 Problems Encountered

From the beginning, the capturing of the correct requirements were difficult because of the busy and stressful work schedule of the clinic staff. Also the patient's tiredness in the clinic and very poor IT knowledge affect the gathering of accurate requirements. It took long line to meet the clinic staff and patients and to get their necessary requirements. So the time planned on system analysis and design delayed. Some major requirements were changed while developing the system and also database structure was changed according to changed requirements. Therefore modifying of code segments of specific modules consume lot of time.

Other major problems which encountered during the development process are the lack of knowledge regarding the development tool used and the languages. Searching gateways for SMS handling and hosting the web site take a very long time because of the unfamiliarity of the area. Online tutorials, books, videos are used to capture the essential level of knowledge

5.5 Lesson learnt

Since the author of the dissertation does not possess any experience in developing a web application, it was challenging to carry out the implementation. Most of the concept and technologies were new and comprehensive. Initial knowledge was required to develop the application. Rather than using web application frameworks, learning the technologies available to develop the web application such as PHP CSS JavaScript MySQL within a limited time period was very difficult. Initially author started to learn how to

Perform simple functionalities of a typical web application such as user login maintaining data in a database, creating links to the relevant pages, creating reports, searching , sending SMS/emails project planning scheduling and how to deal with users when requirement gathering .Error handling was a major issue and took a long period to rectify

5.6 Achievement of objective

The web based clinic appointment and patient management system developed for the Dermatology Clinic at Ragama hospital helps to achieve all objectives expect taking a backup of the database. The web application is very simple to use and all the functional and nonfunctional requirements are achieved. The evaluation facts prove that the web application satisfy all the user requirements to overcome problems in the existing system.

5.7 Future work

The present web based system can be extended to facilitate for the entire hospital clinic system. It will help to solve problems of more patients and staff members.

It can be used in Dermatology Clinics in any other hospitals as there is a separate patient's diagnostic template is prepared for the doctors

Under the current situation of the country, the system can be implemented with a higher security background. Here in patient registration, the system can get the thumb print signature of the patient and can match it by the system when the patient visit the clinic.

Can implement the system to send the reports as email attachments to patients or to another hospital in referral of a patient would be very essential.

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Appendix

Appendix A: Fact Finding

The system was investigated by giving questionnaires to the patients, doctors, nurses and the pharmacist. An interview carried out with them for further investigation. There was a site observation too.

The following is the script of the interview carried out by the users of the system on (05/05/2018)

Interview with a nurse

Q1) Madam, when a patient wants to get an appointment to visit the dermatology clinic what is the normal procedure of giving an appointment?

A) When a patient wants to visit the clinic at first they have to get an approval of a doctor. The approval can be given by an OPD doctor or a consultant. Then the patient has to get registered for the clinic. We issue a clinic card, clinic book and a clinic number at their registration. We write the next clinic date on their clinic card. On the given day, they have to visit the clinic before 8.00 a.m. and get an appointment to meet the doctor.

Q2) When do you issue the clinic numbers?.

A) We issue the numbers from 7.00 a.m. to 10.00 a.m. on the clinic day morning.

Q3) Is there a possibility to get a number early before the clinic date?

A) No, We give them the next visiting date only. They have to visit the clinic on the given date and get a clinic number.

Q4) Do the patients return without getting a number ?

A) Yes, Sometimes.
We issue the numbers according to the order they arrive. There will be only 30 numbers for the new patients. If it exceeds they have to return and come on another day .They will examine by the registrar or the consultant. We have only six doctors in the clinic Therefore we issue only 180 numbers per day. Otherwise, there will be no time for the doctors to examine the indoor patients.

Q4) Is there a rush of patients to get a clinic numbers?

A) Yes, there is a very big rush on each day. They visit the hospital at the time hospital Opens for the visiting of the indoor patient and make a queue at the entrance of the clinic hall and wait till it open. All the numbers will get over around 8 O' clock.

Q5) Do you register the new patients only.

A) Not only the new patients, we register both daily.

Interview with a Doctor

Q1) Doctor how do you handle the clinic work?

A) Nurses send the patients to us according to the clinic number. We read the patient clinic history and drugs issued from their clinic book. Then we examine the patient. We write the investigation report in their clinic book .We write two prescriptions; one in their clinic book and the other one for the pharmacy of the hospital.

Q2) Do you consult the senior doctors if necessary

Yes, we send the patient with their reports to the consultant. If the consultant is absent, we send the patient to the senior registrar who examines the new patients join the clinic.

Q3) Is the consultant available in the clinic

A) No, the Consultant is busy with the indoor patient in the dermatology ward with other two doctors.

Interview with a patient

Q1) **H**ow do you feel the present method of patient registration and issue of the clinic numbers.

A) It is very tiresome for the patients as well as the clinical staff. Even though The clinic issues numbers till 9.00 am we visit the hospital early in the morning to get a number. The clinic issues only 180 numbers per day and we will miss the chance to visit the doctor if we get late.

Q2) How do you get your medicine?

A) We are suppose to be in another queue to get the medicine in the pharmacy of the hospital. There is a big rush .The patients queued according to their arrival order as they don't issue the numbers .

Q3) How long will be in the hospital on your clinic day

A) We spend the whole day.

Interview with a Pharmacist

Q1) Madam, how do you issue the drug for the dermatology clinic patients in the hospital.

B) We have a separate queue for the dermatology patients as well as for the other clinical patients. We check their prescriptions and issue the drugs, according to their arrival order. There is a big rush in the pharmacy till we close it at 4.00p.m

Questionnaires which were given in English Sinhala and Tamil to get the feedback are given in this page

Dermatology Clinic at teaching Hospital Ragama

Questionnaires for fact Gathering (Language-English)

1) What is your position in the clinical staff?
   [x]Doctor
   [ ] Nurse
   [ ] Pharmacist
   [ ] Patient

2) How long have you been to the clinic?
   [ ] Less than one year
   [x]One year
   [ ] Two years
   [ ] More than two years

3) How do you feel the time you have to spend in the clinic?
   [ ] Manage the time successfully
   [x]Waste time unnecessarily

4) How do you feel about a new computerized system?
   [ ] no idea
   [ ] worse
   [ ] fine
   [x]better

5) What are your requirements in the new system?
   [ ] Online appointment system for the patients
   [ ] Template to enter diagnostic information
   [ ] Computerize Clinic Book
   [ ] Ability to access patient information through a mobile app

Dermatology Clinic at teaching Hospital Ragama

Questionnaires for fact gathering (Language-Sinhala)

චර්ම රෝග සායනය

ශික්ෂණ රෝහල - රාගම

ප්‍රශ්නාවලිය (භාෂාව - සිංහල)

01. තනතුර
    - ( ) වෛද්‍ය
    - ( ) හෙද
    - ( ) ඖෂධවේදී
    - (✓) රෝගීන්

02. සායනයට සම්බන්ධ වී සිටින අවුරුදු ගණන
    - (✓) අවුරුද්දට අඩු
    - ( ) අවුරුදු 01
    - ( ) අවුරුදු 02
    - ( ) අවුරුදු 02 ට වැඩි

03. සායනයේ ගතකරණ කාලය පිළිබඳ ඔබගේ අදහස්
    - ( ) කාල කලමණාකරණය සාර්ථකය
    - (✓) කාල කලමණාකරණය අසාර්ථකය

04. නව පරිඝණක පහසුකම් සහිත සායනයක් ගැන ඔබගේ අදහස
    - ( ) අදහසක් නැත
    - (✓) සාමාන්‍යයි
    - ( ) හොඳයි
    - ( ) නරකයි

05. නව පද්ධතියක් සඳහා ඔබගේ අවශ්‍යතාවයන්
    - ( ) සායනය තුළ තදබදය අවම කිරීම
    - ( ) කාර්යක්ෂම බව
    - ( ) මුද්‍රිත සායනික පොතක් ලබාදීම.
    - ( ) සායනයේ රැදී සිටින කාලය අවම කිරීම.

Dermatology Clinic at teaching Hospital Ragama

Questionnaires for Fact Gathering(Language-Tamil)

தோலு நோய் பயிலுனர் வைத்தியசாலை -ராகம

பெயர் அகந்தனீ திகதி 24/05/2019

1) மருத்துவத்துறையில் உங்கள் பதவி என்ன?

[ ] வைத்தியர் [ ] தாதி

[ ] மருந்தகர் [✓] நோயாளி

2) நீங்கள் மருத்துவத்துறையில் சேர்ந்து எத்தனை வருடங்கள் ஆகின்றன?

[ ] ஒரு வருடத்திற்கு குறைவு [✓] ஒரு வருடம்

[ ] இரண்டு வருடம் [ ] இரண்டு வருடத்திற்கு மேல்

3) நீங்கள் மருத்துவத்துறையில் செலவிடும் நேரத்தை எப்படி உணர்கின்றீர்கள்?

[ ] நேரத்தை வெற்றிகரமாக நிர்வகிக்கின்றேன்.

[✓] நேரத்தை தேவையில்லாமல் வீணடிக்கின்றேன்.

4) புதிய கணினிமயமாக்கப்பட்டதை பற்றி நீங்கள் எப்படி உணர்கின்றீர்கள்?

[✓] தெரியவில்லை [ ] மோசமாக

[ ]. நல்லது [ ] மிக நன்று

5) புதிய கணினிமயமாக்கப்பட்டதில் உங்கள் தேவைகள் என்ன?

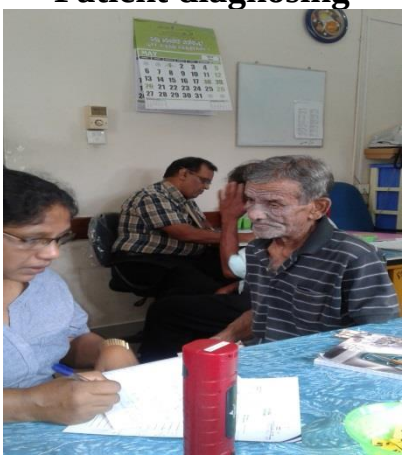
01 நோயாளரீகளின் எண்ணிக்கையை குறைத்தல்.

02 நோயாளர்கள் வரிசையில் நிற்கும் நேரத்தை குறைத்தல்

03 நோயாளரீகள் மருத்துவமணையில் காத்திருக்கும் நேரத்தை குறைத்தல்

Dermatology Clinic at teaching Hospital Ragama

Site Observation (Date-05/05/2018))

Patient registration 	**Issue of clinic numbers** 
Patient diagnosing 	**Issue of drugs in the pharmacy** 

Appendix B: Evaluation of Usability

Questionnaires for the usability

Instructions

Select the most suitable option

Participant(1): Dr Wasantha Jayarathne

Date :24/05/2019

Factors	**User satisfaction**			**Any comments**
Design of the Interfaces	Bad	✓ Good	Excellent	Better if you can group similar things to reduce number of screens to enter diagnostic information
Report layout and the content	Bad	✓ Good	Excellent	
Time taken to do basic operation	Slow	Average	✓ Fast	
Navigation Links	Difficult	✓ Easy	Very Easy	
Frequency of Errors or problem	✓ Low	Medium	High	
Ease of learning and familiarizing system	Difficult	✓ Easy	Very Easy	
Achieving requirements	Worst	✓ Good	Very Good	
Data security	Low	✓ Medium	High	

Evaluation of the patient appointment and management system

Questionnaires

Instructions

- ✓ Tick off the most suitable option

Participant (1): Dr Wasantha Jayarathne

Date: 24/05/19

Test No	Purpose/Scenario	Yes	No
1	Can user navigate to important forms and information from home page?	✓	
2	Will user easily add details	✓	
3	Will user easily search existing details	✓	
4	Will user be able to edit existing details	✓	
5	Will user view existing details	✓	
6	Will user be able to generate various reports	✓	
7	Will user be able to get appointments through SMS	✓	
8	Will user be able to get appointments through emails	✓	
9	Will user be able to access the system through the mobile app	✓	
10	Will user be able to send images of the lea sons to the consultation	✓	
11	Will user be able to take a backup of the system		✓
12	Will the data entry be easy and convenient	✓	
13	Will the outputs provide within few seconds	✓	
14	Will user be able to continue even after the minor errors	✓	
15	Will the data secured	✓	
16	Will system stop unauthorized access	✓	

Questionnaires for the usability

Instructions

Select the most suitable option

Participant(2): Mrs Maliika Pathiraja (Nurse)

Date :24/05/19

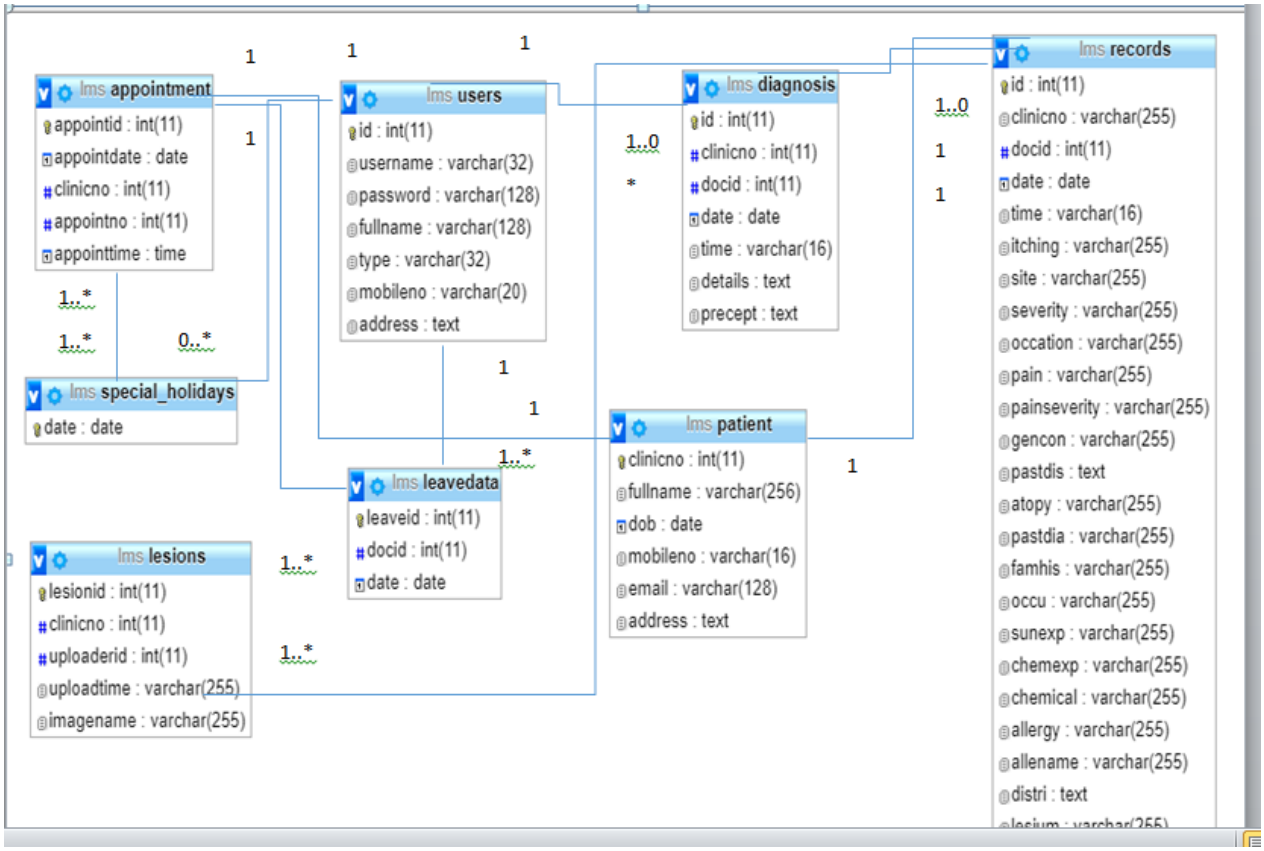
Factors	**User satisfaction**			**Any comments**
Design of the Interfaces	Bad	✓ Good	Excellent	Better if you can group similar things to reduce number of screens to enter diagnostic information
Report layout and the content	Bad	✓ Good	Excellent	
Time taken to do basic operation	Slow	Average	✓ Fast	
Navigation Links	Difficult	✓ Easy	Very Easy	
Frequency of Errors or problem	✓ Low	Medium	High	
Ease of learning and familiarizing system	✓ Difficult	Easy	Very Easy	
Achieving requirements	Worst	✓ Good	Very Good	
Data security	Low	✓ Medium	High	

Test No	Purpose/Scenario	Yes	No
1	Can user navigate to important forms and information from home page?	✓	
2	Will user easily add details	✓	
3	Will user easily search existing details	✓	
4	Will user be able to edit existing details	✓	
5	Will user view existing details	✓	
6	Will user be able to generate various reports	✓	
7	Will user be able to get appointments through SMS	✓	
8	Will user be able to get appointments through emails	✓	
9	Will user be able to access the system through the mobile app	✓	
10	Will user be able to send images of the lea sons to the consultation	✓	
11	Will user be able to take a backup of the system		✓
12	Will the data entry be easy and convenient		✓
13	Will the outputs provide within few seconds	✓	
14	Will user be able to continue even after the minor errors	✓	
15	Will the data secured	✓	
16	Will system stop unauthorized access	✓	

Appendix C: Database Structure

The following diagram specify the structure of the database.it shows primary keys foreign keys of the tables and the relationship between them in detail manner

The primary keys of the tables are displayed with key token and the foreign key relationship displays at bottom lines after main fields. The relationships displayed in lines and their relationship type is displayed with figures for each relation.

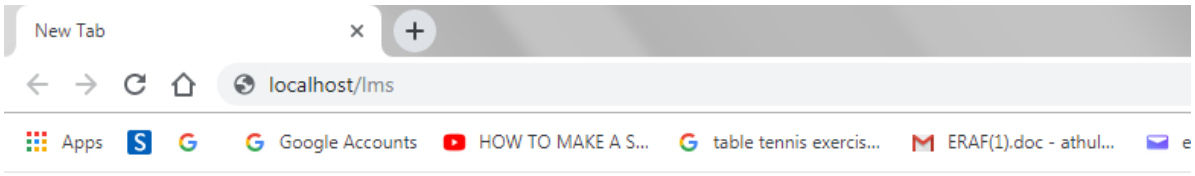


Appendix D: User Documentation

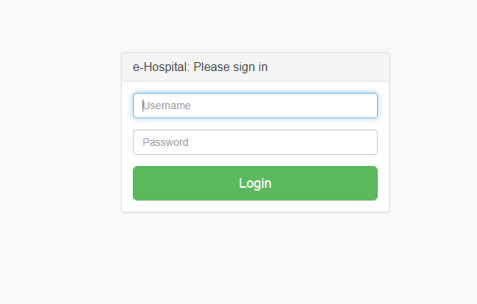
The user documentation guide the users of the system to use the system without any hesitate**.**

Developed System is for several Users like Doctors, Nurses, Patients and Pharmacists. The system users are in different authority levels for system security. System administrator is fully authorized to use all the services and facilities of the system .A nurse of the clinic can be work as the administrator. This documentation provides the guidance for the system administrator to use the system.

Type the URL in the address bar of the browser



The user should provide the username and the password to gain access to the system



User can log on to the system by giving correct username and the password. The Home page view display after the initial login The modules can be reached by using the menu bar in the side navigation bar