

MIDLANDS STATE UNIVERSITY



FACULTY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION SYSTEMS

RESEARCH TOPIC

EASYPHARM ANDROID APPLICATION

BY

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ABSTRACT

The purpose of this study was to come up with a mobile health EasyPharm Android application is a system that will integrate the manual functions being performed by the patients, doctors and the pharmacy. The development of this system comes out after the identification of numerous problems which are associated with the current system. The different types of information gathering techniques were used to unveil these problems. Techniques which were used are interviews, questionnaires and observations. The results obtained shed light that there is need of a new system in the organization. This system was developed using Android and PHP. The database which was used was xampp in efforts to store data in huge quantities and at the same time to minimize data redundancies. The system testing and implementation of the hardware and software was done to ensure that the functions and operations of the system were working as per to the objectives. The project was successfully implemented as that change proved very useful to the members of the community and management in making decisions. This resulted in the project team making recommendations to the organisation that included security of the system and backing up of system data after a complete success of the system implementation. After it was implemented the system was reviewed to check whether it is performing up to standard, the results from the users were positive which means it was successful. The EasyPharm Android application was greatly appreciated at the organization, this at the same time calls for the future advancement of the system.

DECLARATION

I, **Sunungurai Ashley Mayisva**, hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature: Date:

APPROVAL

This dissertation, entitled **EasyPharm Android application** by **Sunungurai Ashley Mayisva** meets the regulations governing the award of the degree of **BSc Honours Information Systems** of the **Midlands State University**, and is approved for its contribution to knowledge and literary presentation.

Supervisor's Signature:

Date:

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DEDICATION

Every challenging work needs self-efforts as well as guidance of others, especially those who are very close to our heart. My humble effort I dedicate to my sweet and loving mother, Angeline Pahlá whose love, encouragement and prays of day and night make me able to get a success and honour. The whole journey would not be possible without the grace of God.

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LIST OF ACRONYMS

AI	Artificial intelligence
Www.....	World Wide Web
SQL.....	Structured Query Language
DB.....	Database
MSU.....	Midlands State University
EER.....	Enhanced Entity Relational diagram
ROI.....	Return on investment
NP.....	Net Profit
VARCHAR.....	Variable character
Int	Integer
PK.....	Primary key
DBMS.....	Database Management System
PHP.....	PHP: Hypertext Pre-processor

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Chapter 1: Introduction

1.1 Introduction

This is a research was aimed on addressing the improvement of health service delivery in the public health initiatives and pharmacy services by integrating patients' tasks using EasyPharm Android Application. The first chapter described the background, purpose, objectives, and research questions, scope the outcome, limitations and significance of this project study.

1.2 Background of the study

The implementation of EasyPharm android application preparation for a proposed intervention in the health sector, in Zimbabwe, this study investigates the expected benefits, challenges and limitations associated with the current service delivery in the health sector, approaching these expectations as a form of situated knowledge, inseparable from local conditions, practices and experiences.

1.2.1 Background of Parirenyatwa Hospital

The health sector has drastically changed throughout the years into a global family by the innovative changes taking place. The technological changes have positively impacted certain aspects of the organization such as its competitive advantage, effectiveness and efficiency. Numerous services offered by clinics/ hospitals globally are moving from the traditional desk work into paperless so as to improve effectiveness and efficiency. Parirenyatwa General Hospital has become one of the biggest health centre in Zimbabwe formerly been to have been Andre Fleming Hospital during the colonial era, starting as a small hospital in 1890. After independence in 1980 the hospital was renamed to Tichafa Samuel Parirenyatwa who was born in 1927 and passed on in 1962 as the first black Zimbabwean to have qualified to be a medical doctor. The hospital is now not only a health centre but has a health college based on it from University of Zimbabwe. Over the years the quality of health delivery has improved with the management of an on-going program by Mr Museka Godwin.

1.2.2 Organisational Structure

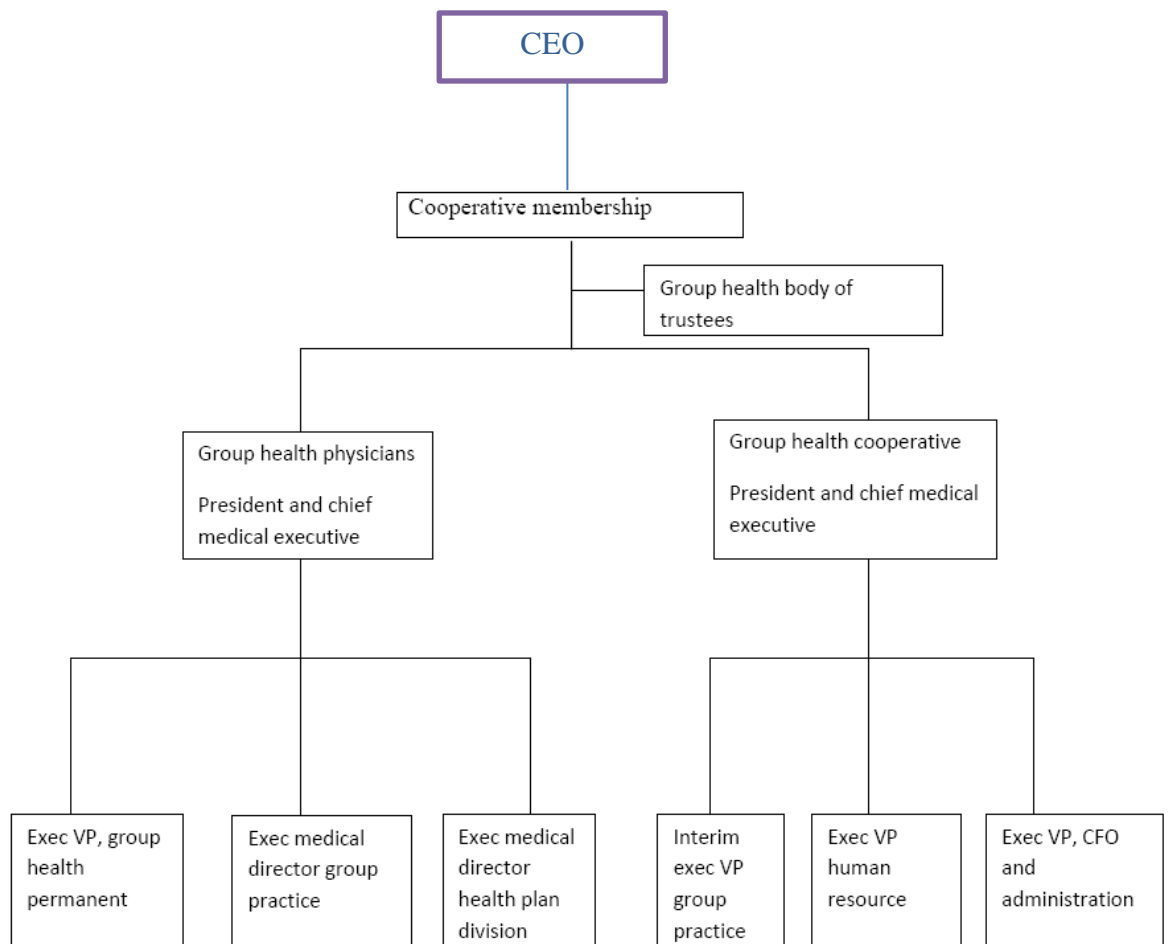


Fig 1.1 Organogram of Parirenyatwa Hospital

1.2.3 Vision

To promote the health and quality of life of the people of Zimbabwe.

1.2.4 Mission Statement

A centre of excellence in the provision of specialist health care services, training and research opportunities in Zimbabwe and the Region by 2025.

1.3 Problem Definition

- Patients have to stand in long queues waiting to purchase the prescribed drugs and this can be a very tedious and tiring process.

- There is no proper decision making, without any proper patient records stored. Data handling processes have not been improved, data is just store and not made useful or analyzed to draw meaningful decisions.
- Prescriptions at the pharmacy can be falsified therefore there is no guarantee of reduction of administration errors and completeness of medical records.
- Prescriptions can easily be lost and torn as it is in paper form, therefore the patient has to repeat a doctors booking appointment.
- Report generation can be easier has it helps professional pharmacists and doctors to be able to track their patients help recording peak flow readings, giving EasyPharm Android Application great impact on pharmacy practice.

1.4 Aim

The major aim of this research is to develop an application system that enables doctors, pharmacists to engage in eliminating queuing and prolonged waiting and poor service delivery.

1.5 Objectives

Below are the goals intended to be met at the end of the development and implementation EasyPharm Android application:

- Electronic booking of appointments by patients.
- To develop application that allows the doctor to make electronic prescriptions for patients.
- To develop an application that can allow system users to report cases.
- Develop an android application that uses AI Chabot for automatic response.
- To develop an application that can show the patients on the availability of all the registered doctors.

1.6 Instruments and methods

1.6.1 Instruments

To develop EasyPharm Android application, the following development tools will be used:

- **PHP:** Programing Language used for developing web based application, which is supported on platforms such as UNIX, Windows NT and LINUX.

- **Android studio:** Android Studio is the official IDE from Google. It is for the development of android applications that are for android devices. It has the entire required API for application development.
- **XAMPP:** Web server used for hosting PHP applications. It is for the interpretation of scripts that would have been developed using PHP.
- **Macromedia Dreamweaver:** Interface designer that is going to be used for the coding and programming for the new application.
- **MySQL:** Database management system for defining data structures. It is also referred to as the relational database management system.
- **Web Browser:** This is a browsing application used to access information on the World Wide Web (www). In this research will be making use of the Google Chrome and Firefox Mozilla to access information.

1.6.2 Methods

Internet: This is a platform to acquire more content or information of the research. The internet will give access to the World Wide Web (www).

Books: These are published documentation that is going to be used for analysis as well as to acquire information under a certain topic.

Change Notes files: We are going to be looking at the documented files so as to see the procedures of the previous system used.

Research assistants: This is information that will be acquired from the patients of the Parirenyatwa Hospital.

1.6.3 Data collection methods

1.6.3.1 Questionnaires

A few targeted members are selected to answer the prepared questions. The participants are supposed to be directly using the current system. The questionnaire will help the developer know how the proposed system can be developed and implemented as to address the problems being faced by the current system users.

1.6.3.2 Observations

The method is used to actually be on the ground examining the current operations and how the patients respond to the current system. It helps in examining service delivery to the patients and how well it can be improved and advanced to improve service delivery.

1.6.3.3 Interviews

This is a one on one conversation between the interviewer and the interviewee asking questions to get a clear understanding of how the current system is operating and how the proposed system can be used to address the problems being currently faced.

1.7 Justification and rationale

The development and implementation of EasyPharm Android application will bring forth many benefits to the Health services, however challenges might be faced during the process and these include the following;

- Facing resistance to change from the patients who are comfortable making use of the current system and will not embrace new innovations.
- Limited resources such as; access to the required technological hardware and software.
- Privacy – the issue of privacy pose risks of abusing the new system to falsify prescriptions and hacking.
- Time can hinder the completion of the proposed system development and implantation.
- The programmer’s ability to develop the new proposed system may also be a limiting factor since the programmer will only implement things within her capability.

1.8 Conclusion

In conclusion, this chapter has been discussing about the EasyPharm Android application recommended to be developed for the purpose of improving service delivery to patients. It has discussed the need to develop a new system and its objectives, tools to be used in the process to come up with a system and the justification. The background information of the organization, its vision and values has been given as well.

Chapter 2: Planning Phase

2.1 Introduction

Having completed chapter one, the next stage was the planning phase. The possibility of the phase was to obviously plot and clarify the reasons that prompted the requirement for the improvement of the current system to the proposed EasyPharm android application. This study also focused on the feasibility study that evaluated to see if the research was operationally, economically, technically and socially feasible. This measured the success of the projects given some impediments or hindrance factors. Other aspects in consideration for this phase are the business values which are the main principles of business or ministry operations throughout its institutions that will be obtained using the proposed application. This lead to the cost benefits analysis that compares the benefits and the costs of the obtained in the feasibility analysis. Work plan was then drawn after evaluating that the benefits outweigh the cost meaning the project study is feasible. Further analysis will then be discussed in the next chapter after making planning phase conclusion.

2.2 Business Value

The health sector has drastically changed throughout the years into a global family by the innovative changes taking place. The technological changes have positively impacted certain aspects of the organization such as its competitive advantage, effectiveness and efficiency as stated by Stoner et al, (2010). The new proposed system will solve the current issues faced and as well as adding business value to Parirenyatwa hospital by the following:

- Auditing can be more efficient using the data analytic tools. Also the system can be configured to follow the required regulations according to the selected board to ensure security such as ISO and COBIT. The board will have to benchmark its policies with the international standards. This will move Parirenyatwa in the international standards of operating its business and in service delivery.
- With the use of paperwork it may not be easy to manage the hospital resources efficiently and effectively.

2.2.1 Shareholder Value

A shareholder refers to an individual or a group of individuals that have a direct interest in the business and have an influence or can be affected by the business direction Stoner et al, (2010). Their support is very relevant, without it no new decision will cease to exist.

2.2.2 Customer Value

This refers to the client's perception of the health service delivery being offered to the patients of the Hospital as compared to the other competitors or possible alternatives of medical service delivery. The patients are the motivation of the new proposed system and they are the drive to for the Hospital to improve its service delivery by implementing a new system.

2.2.3 Employee Knowledge

Employees are an asset and how well they are knowledgeable about the business. Whether it is about understanding the need of the patients or understanding the business environment better, it is all valuable to the business.

2.2.4 Supplier Value

The business value is shown by relationships with its suppliers such as pharmaceuticals and other medical equipment suppliers as well as the regulators such as MCAZ. The new system will be aid to build a better relationship with the suppliers.

2.2.5 Managerial Value

The managerial value will improve as the new system will aid in giving guiding principles that can utilized in managing.

2.2.6 Societal Value

The system will allow on improving on societal value because customers will always continue to choose services that are aimed on improving on its societal value, positive impact and environmental values.

2.3 Feasibility Study

To identify the net advantages of the proposed system, an analysis is needed to help management make rational decisions. The feasibility analysis helps the board to decide whether the proposed system will be beneficial to the business and evaluate the availability of resources required as stated by Skidmore (2014). This analysis is classified into four categories namely:

- Operational analysis
- Technical analysis
- Economic analysis

2.3.1 Technical Feasibility

This is the study that evaluates the availability of the required technical expertise for the proposed system to be developed. The availability of the software and the hardware requirements need to be met. The developers should be able to have the required development skill and having attained the required knowledge to develop the new system.

2.3.2.1 Technical Expertise

After performing the technical analysis the following was found:

- Developing team: The developing team is equipped with the necessary knowledge of the essential developing languages such as PHP and android studio.
- Users (patients): Most of the clients agreed to the availability of internet, smartphones and computers, which they are comfortable to use it. The users did not show any discomfort with the required technical tools.

Overview of the technical feasibility: all the technical tools are available to spearhead the implementation of the new system. The analysis has passed technical feasibility test.

2.3.2.2 Hardware and Infrastructure Requirements

The following are required for the development of the new system:

QUANTITY	ITEM	SPECIFICATION
1	HP Client Server	<ul style="list-style-type: none">➤ 4Gigabyte RAM.➤ Quad 4 Processor.➤ 3.2 GHz Speed.➤ 240GB Hard Drive.
2	HP Backup Server	<ul style="list-style-type: none">➤ 512MB RAM.➤ Pentium 4 Processor.➤ 2.4GHz Speed.➤ 40GB Hard Drive.
5	HP DX2300	<ul style="list-style-type: none">➤ 256MB RAM.➤ Pentium 4 Processor➤ 2.4Hz Speed.➤ 40GB Hard drive
1	Printer	<ul style="list-style-type: none">➤ Laser Jet
	Network cables	<ul style="list-style-type: none">➤ RaLink RT3090 802.11b/g/n

		➤ WIFI adapter
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Table 2.1 Hardware Requirements

2.3.2.3 Software Requirements

QUANTITY	ITEM	SPECIFICATION
1	PHP	PHP 7.1 / 2016
1	Android studio	Android studio 3.2
1	XAMPP	XAMPP 7.2.9/ 2018
1	Macromedia Dreamweaver	Dreamweaver 8
1	MySQL	MYSQL 8/2018
1	Google Chrome	CHROME 72

Table 2.2 Software Requirements

Technical Feasibility Overview: all the technical tools are available to spearhead the implementation of the new system. The analysis has passed technical feasibility test.

2.3.2 Economic Feasibility

The economic feasibility study is based on the analysis of whether the implementation of the new proposed system can be done within the stated budget. The new proposed system needs to be economically feasible therefore the Cost Benefit analysis and the cash flow projections need to be favourable bringing in our investments in a short period of time.

2.3.3.1 Cost Benefit Analysis

Cost Benefit Analysis weighs the possible expenses that can be incurred by the implementation of the new system as compared to the benefits associated to the new implemented system. Some benefits and costs cannot be valued into monetary value therefore there are methods that can be used to evaluate the value of these costs and benefits. For the project to go on, the benefits should outweigh the costs being incurred.

Costs are classified into two categories namely; developmental costs and operational costs. Both costs need to be evaluated separately.

➤ **Developmental costs**

These are costs associated with development of the new proposed system. These costs are estimated in the beginning of the project and need to be revised afterwards. The development

costs include technological tools and all non-human resources costs. The following were the cost incurred.

ITEM	COSTS(\$)
HP Client Server	1 800
HP Backup Server	1 550
Client Machines	1 600
Total Cost	<u>4950</u>

Table 2.3 Development costs

➤ **Operational costs**

These are costs associated with the day to day operations or running of the business. These costs that are generally shown on the income statements therefore include maintenance, utility and all components of operational costs in a business.

Operational requirements	2019 (\$)	2020 (\$)	2021 (\$)	Total Cost (\$)
Consumables.	-	500	1500	2000
Hardware and Software Maintenance.	-	-	3000	3000
User Training cost.	900	50	50	1000
Total Cost	900	550	4550	<u>6000</u>

Table 2.4 Operational costs

Benefits can be classified into tangible and non-tangible benefits. The types of benefits are:

➤ **Tangible benefits**

Tangible benefits can be easily measured. Tangible benefits include reduction in errors, increase in sales, improved management and control. The following table shows the tangible benefits calculated as an estimate is shown below:

	2019 (\$)	2020 (\$)	2021 (\$)	Total Cost (\$)
Reduction of cost	3000	3000	4500	10500
Increase in productivity	4000	4000	4000	12000
Reduced stationery	150	150	500	800
Less patient lead time	250	1500	2250	4000
Total Cost	7400	8650	11250	<u>27300</u>

Table 2.5 Tangible benefits

➤ Intangible Benefits

Intangible benefits cannot be easily measured or quantified. These include competitive advantage, goodwill, good public relations and improved employee morale. The following is a cost benefit analysis (CBA):

	(USD)	(USD)	(USD)
BENEFITS:			
Tangible Benefits		27300	
Intangible Benefits		8300	
Total Benefits			19000
COSTS			
Development Costs		4 950	
Operating Costs		6 000	
Total Costs.			10 950
NET BENEFITS/LOSS			<u>8 050</u>

TABLE 2.6 Cost Benefit Analysis Table

Interpretation: We evaluated the benefits of the project as well as the cost. The CBA is used to calculate how badly or good the proposed system can be concluded. From the above table, the benefits of this proposed system outweigh the cost. The benefits were positive therefore the project is favourable.

2.3.3.2 Investment Analysis

There are various methods that can be used for investment analysis. These methods are used to evaluate the best option of cash flow that is available. The two methods that we will use are the Net Profit and the (ROI) Rate of return.

Net Profit

Net Profit is the difference between the calculated costs and the calculated income of the proposed system lifecycle. The formula of calculating Net profit is as follows:

$$\text{Net Profit} = \text{Total Income / Benefits} - \text{Total Expenses/ Costs}$$

$$\text{Net Profit} = 19\ 000 - 10\ 950$$

$$\text{Net Profit} = \underline{\underline{8\ 050}}$$

Interpretation: The total income of the proposed project is showing a positive net. Therefore the implementation of the new proposed system results in more income that exceeds expenditure. The project is favourable.

Return on Investment (ROI)

It is also referred to as the (ARR) Accounting rate of return. Also known as the Accounting Rate of Return (ARR), ROI is used to compare the efficiency of the investment with a number of other investments. It gives the percentage of profitability of investments. The formula of ROI is shown as follows:

$$\text{ROI} = (\text{Average Annual Profit} / \text{Total Investment}) * 100$$

$$\text{Where: Average Annual Profit} = \text{Net profit} / \text{number of years}$$

$$= (8050 / 10950) * 100$$

$$= \underline{\underline{73.52\%}}$$

Interpretation: The ROI is favourable as the benefits are able to outweigh the costs in the first three years after the proposed system has been implemented.

2.3.3 Social Feasibility

The new proposed system will be able to benefit the community by improving the service delivery making it more effective and efficient. This will also reduce fraudulent of

prescription for illegal purchase of drugs and forming a black market. The research will be declared feasible if the benefits are able to reach the targeted beneficiaries. In this analysis we are more concerned with the patient supporting the implementation of the new project. There are factors to consider in dealing with social analysis, such as:

- **Ethics:** this is focused on the issue of information security. Information needs to be protected. Additional security measure should be put to place to minimise unethical use of patients' information.

The development team is ensuring that the system is secured benchmarking the practise by the ISO standards.

2.3.4 Operational Feasibility

This study focuses on whether the stakeholders are in support of the implementation of the new proposed system. To evaluate this, we used the PESTEL analysis to evaluate the impact that the external environment has on our proposed project. The factors that have an impact on the operations of the organisation are political factors, economic factors, social factors, technological factors, environmental factors and legal factors.

- **Political factors:** It is very evident that the Parirenyatwa has to be doing business by aligning to the requirements of the government. This means the organization should adjust to the government legislation requirements.
- **Economic factors:** How a business can be profitable is dependent on economic factors. The introduction of bond notes that are now currently referred to as RTGS currency has an impact on how profitable the business can be. Also the exchange rates and inflation has an impact on the business.
- **Social factors:** This refers to involvement of shared cultural beliefs of the society. Understanding the social factors of the environment that is being operated in, helps to understand the patients on what they require and would be interested in. Parirenyatwa is located in the capital city in a low residential area hence understanding population growth as well as career interest helps in understanding how the introduction of technology can impact them.
- **Technological factors:** Introducing technology can change how business operates, therefore technological factors take into consideration all the events that are likely to affect the use of technology.
- **Environmental factors:** These are factors that are influenced by the environmental aspects such as the accessibility of the hospital.

- **Legal factors:** The organization needs to focus on what is legal and illegal in doing business and trying to increase their service delivery. This means they have to take into consideration legal regulations that involve patients' rights, health and safety and technological standard boards such as COBIT and ISO.

Having completed the PESTEL analysis this will help in identifying the weakness and the strength of the proposed system using the SWOT analysis.

The main stakeholders also need to be evaluated to see whether they supporting the proposed new system using data collection techniques such as interviews and questionnaires.

- **Management:** the management does support the new project and have understood how it will benefit the business in terms of competitive advantage and improve their supply chain. CBA (cost benefit analysis) and other supporting methods were performed to support the implementation of the proposed system. Management concluded that they were in support.
- **Users (Administrator):** The Users are the actual initiators of the system after realizing how the service delivery to patients was being overwhelming resulting to long queues and dissatisfied customers. The increase of the customer base has resulted in finding new and innovative ways of being effective and efficient. The proposed system is being fully supported by the users as it solves all their stated complaints.
- **Users (Patients):** The use of technology has become very convenient for users by just a click of a button. Most of the patients are in full support of the new proposed system as this will reduce waiting long queues and improve clientele service.

Overview of the operational feasibility: All the stakeholders were in support of the implementation of the new system. The PESTEL analysis also helped to identify the strength of the project and encouraged strategic thinking in designing the proposed system that will avoid or minimise anticipated risk. The analysis has passed operational feasibility test.

2.4 Risk Analysis

There is need to have a risk analysis for every new system so as to have an idea of the risks that are likely to occur therefore come up with contingency plans as well as ways to monitor

the risks. According to Skidmore (2014) contingency plans are necessary for business continuity and reduce the magnitude of loss if a risk occurs. These risks include Technical risks, Economic risk and Quality Assurance risks.

2.4.1 Technical Risks

These are risks associated with the technical aspects of the new system. The functionality of EasyPharm may not meet the Users requirements. Also technical problems such as power cuts and failed backup can costs the business. The risk has been projected to be 65%. To minimise this problem, the organisation has power backup of a generator. The system will be backed up using real-time system backup so as to retain information if the system crashes.

2.4.2 Economic Risks

With the current economic crisis of lack of currency and the RTGS currency makes the funds availability scarce. The required hardware components need to be imported therefore without the foreign currency (US Dollars) this becomes a huge challenge. This risk is projected to be 80%.

2.4.3 Quality Assurance Risks

Zimbabwe being in the third world country, would suffer from its developments being perceived as poor quality. Due to the increase of IT practitioners having the required know-how have led to the silencing of these perceptions. These quality assurance risks have been projected to 70%. The solution to these risks is to ensure that the proposed system is to be made according to the benchmarked standards of IEE and ISO.

2.4.4 Other Risks

The increase of virus attack cases such as Ransom ware is a cause of concern and should be acted upon to be minimised putting necessary firewalls and anti-viruses and malware.

2.5 Stakeholder Analysis

Stakeholder Analysis is very important as it as a technique that focuses on identifying and identifying the various needs of the stakeholders. It evaluates all the issues of interest that are linked to the implementation and issues that may disrupt the implementation of the new system. The stakeholder analysis is able to offer the strategic view of all issues and interest pertaining stakeholders. There are classified into two groups namely:

2.5.1 Internal stakeholders

According to Murali, C (2013) these are stakeholders that are directly involved in the day-to-day operations of the business. They are directly financially involved in the business operations and have a part to play in the decisions made. These include the following:

- **The board of directors:** these are designated individuals that are responsible for the supervision of the organization. Their role is to support the implementation of the new system and support with the developmental costs as well as the operational costs of the system.
- **Managers:** are responsible for spearheading the entire project. There are not entirely technically involved, but are responsible for the controlling and monitoring of the project so that the project is finished on time and within the budget constraints.
- **Employees (end users):** these are the motivators of the new system; their complaints are used in the development of a new project. They are the masterminds of suggesting the objectives of the project. They also are responsible for the approving of the system during the User Acceptance Testing phase.
- **System designers:** they are responsible for the writing of command code lines that instruct the computer system to communicate with the user. They are responsible of accommodating the user requirements and making use of them to develop the new proposed system.

2.5.2 External stakeholders

These are stakeholders that are not directly involved in the day-to-day operations of the business but are impacted by the implementation of the new system by patients that will be making use of the new proposed system.

2.6 Work Plan

2.6.1 Work Plan

The project is expected to be done within the estimated period given below.

Activity	Starting date	Finishing date	Duration
Project Proposal	04/11/2018	12/05/2018	1 weeks
Introduction	13/11/2018	08/08/2018	1 week
Planning	09/11/2018	23/08/2018	2 week
Analysis	24/11/2018	07/09/2018	2 week

Design	08/12/2018	22/09/2018	2 weeks
Implementation	23/12/2018	21/10/2018	4 weeks
Maintenance	02/01/2019	Ongoing	1 week ++
Documentation	08/01/2019	Ongoing	1 week ++

Table 2.7 Work Plan

2.6.2 Gantt Chart

Activity/ week	1	2	3	4	5	6	7	8	9	10	11	12
Proposal	■											
Introduction		■										
Planning			■	■								
Analysis					■	■						
Design							■	■				
Implementation									■	■	■	■
Maintenance									■	■	■	■
Documentation									■	■	■	■

Table 2.9 Gantt chart

2.7 Conclusion

This chapter was based on the feasibility analysis of the proposed system so as to evaluate if it can be feasible to build. To come up with a decision we evaluated the technical feasibility, the operational feasibility, the economic feasibility and the social feasibility study. The next chapter will be focusing on the analysis of the project.

Chapter 3: Analysis Phase

3.1 Introduction

This chapter was mainly focused on the analysis of the proposed system. In this phase we looked at the current system being used at the Parirenyatwa Hospital and how its data flows. I also considered the loopholes in which the current system has. The data gathering methods that were utilized highlighted the process modelling. The data gathering techniques assisted the development and implementation of the new system, improving on the current issues being faces. The findings highlighted what development method to use, whether it is in-house development or outsourcing the new proposed system.

3.2 Information gathering methodologies

According to Yeates et al (2014) data gathering is a way of getting an overview and a better understanding of patients using different sources of information. To get a clear overview of the research data was collected from the patients of the Parirenyatwa Hospital. This assisted in acquiring precise and accurate of how the business was currently operating and how it was affecting the patients. This is essential so that no important information is overlooked or wrongly interpreted and generalized. The following procedures were used to gather information, these include:

- Questionnaires
- Interviews
- Observations

3.2.1 Questionnaires

This is a data gathering tool that involves a series of questions that can be either open ended or closed questionnaires. According to Hancock *et al* (2009) this method of gathering information is essential when collecting data that can be used for statistical overview. The questionnaires are to be given to the patients so that they fill in information to do with the current system and the service delivery to patients. A few targeted members are selected to answer the prepared questions. The participants are supposed to be directly using the current system as highlighted by Venkataramanan (2015). The questionnaire will help the developer know how the proposed system can be developed and implemented as to address the problems being faced by the current system users. There is more emphasis on the patients input and their suggestions that can help in the development of the new system. The

questionnaires were drafted and distributed at the Parirenyatwa general hospital for the patients to give their input. The other questionnaire was designed for system users making use of the current system. The questionnaire comprised of both open and closed questions

➤ **Closed questionnaire**

The researcher designed questions that can be responded with a “YES” or a “NO” answer. These are questions that do not give the respondents much room to respond otherwise. Since the participants are provided with a set of answers to respond from, this makes the data quantifiable. Since the structure of questionnaire is restricting, this narrows down the respondents responses and results in fast answering.

➤ **Open questionnaire**

The questionnaire also consisted of open ended questionnaire. Unlike closed questionnaire, these questions were designed to capture the respondent personal feelings and opinions. The respondents are allowed to express themselves to give a clear understanding.

Advantages of Questionnaires

- The participants were able to fill in information that was well expressed as the questionnaires were anonymous.
- We were able to gather the patient’s response much faster as the questionnaires could all be filled out by many patients at once as the wait in the queue.
- The results were quantifiable and easy to analyze.

Disadvantages of Questionnaires

- Some of the questions were not filled out and left as blank as the patient would go in for the doctor’s consultation.
- Since the questions were not presented in a face to face scenario, the interpretation of the questions being asked were different, hence incorrect information was provided by the patients or the system users.
- The use of questionnaires only captured what we wanted to gather therefore by the lack of personalizing the questions it led to inaccurate information gathered.
- Some patients were very sick and unwilling to respond to questionnaires

Findings from questionnaires

Data source	Target population	Response rate
Patients	20	15
Employees	7	5
Managers	3	3

Table 3.1 Questionnaire response

- The current system was inefficient and ineffective in terms of service delivery therefore the digitalizing the current system was being supported.
- The system users were more comfortable with this technique due to its anonymity.
- From the data source of patients, employees and managers we noted that the existing system was not being effective and hence this results in poor health service delivery.

Find attached in the Appendix Section D the questionnaire questions asked.

3.2.2 Observations

Alshengeet (2014) observed that this method is used to actually be on the ground examining the current operations and how the patients respond to the current system. It helps in examining service delivery to the patients and how well it can be improved and advanced to improve service delivery. The researcher paid a visit to the Parirenyatwa Hospital for two consecutive days to make an observation of the loopholes of the current system. The researcher was able to gather all the relevant information. The purpose of this gathering technique was to understand the process from the analyst's perspective according to Jewell (2010).

Advantages of observation

- We were able to observe what really happens on the ground rather than what the patients were saying.
- Some emotions that could not be expressed well in the interview could be noticed such as the frustration of the long queues when people have to wait long or have somewhere else to be at.
- The method did not require any form of setup.

Disadvantages of observations

- Not all the processes were open for observation as some of the processes are confidential for the patients to allow the researcher to observe.

Findings of Observation technique

- There were areas that required improvement within the system operations.
- The patients were quite frustrated with the long queues.
- As an analyst, I observed that it took longer for one patient to have their file located and hence with the delay this resulted in longer queues hence it takes longer to get service at the hospital. Patients had to wait for the doctor for consultation without any clear idea what time he would be available.

3.2.3 Interviews

As stated by Jewell (2010), this is a one on one conversation between the interviewer and the interviewee asking questions to get a clear understanding of how the current system is operating and how the proposed system can be used to address the problems being currently faced. The interviews were conducted for three days involving the patients and the system users of the Parirenyatwa Hospital. The interviewer used semi-structured questions giving the interviewee a direction of what the scope of research is looking at and hence giving them room to respond. We managed to gather data from the patients and system users that were well detailed and well expressed. We managed to know the challenges which were being faced and how to improve on the current system, this helped us to know what the users are looking forward to in the new proposed system. The researcher made use of the following types of interviews:

- Structure interview
- Unstructured interview

Structured interview

This is known as the panel interview, as it is formal and has an organized set of questions according to Fox (2009). It ensures that every interview was conducted the same with the same set of questions being asked as observed by Driscoll (2011). Structured interviews were more effective and helped the researcher acquire the required information from all data sources participants.

Unstructured interview

The interviewer was interested in knowing information from the respondents asking them open ended questions. The interview questions asked in an unstructured manner were referred

to the patients as some of them were old age and could not engage in a formal interview panel.

Advantages of interviews

- The researcher was able to customize how we conduct the questions by personalizing the interview questions hence getting accurate information.
- The researcher was able to take down the exact responses of the interviewees.
- The researcher was able to clarify on the questions we were asking hence we managed to get accurate data.

Disadvantages of interviews

- The interviewing process was time consuming as we could not interview more than one person at a time.

Findings from interviews

- The current system was time consuming and resulted in poor health service delivery to the patients.
- The current system made it time consuming when auditing for end of year as paperwork can be easily misplaced or destroyed.
- Patients end up visiting number of pharmacies when unable to get the required medication on one stop shop.
- Prescriptions can be lost or easily destroyed.

Find attached in the Appendix Section B the interview questions asked.

3.3 Analysis of existing system

The data gathering techniques helped the research to have a clear overview of how the current system was operating. The data gathering techniques highlighted the strengths and the weaknesses of the current system.

3.3.1 Description of the existing system

When patients visits the Parirenyatwa hospital for consultations, they have to go at the reception and request for their file if it's not their first time at the hospital, if it is their first time a new file is created for them. The patient is given a file then joins the queue for consultation. When it's their turn to be consulted the doctor consults the patient and writes a

prescription prior to the problems faced. The patient takes the prescription and starts looking for the preferable pharmacies. If the prescribed drugs are not available the search continues with different pharmacies. If these drugs are not found the patients has to go back to the doctor for another prescription with alternative medical drugs. When the patient finds the pharmacy with the prescribed drugs, the pharmacist is given the prescription and the patient is able to make a purchase. This current system is basically a manual system and will be influencing the development of a new proposed system.

3.4 Process analysis

This is the flow diagram design to depict the flow of elements within the processes. This is a step by step procedure that shows the breakdown of all phases. The process analysis is utilized to show the inputs of system, the output of the system and the business operations. This gives a better understanding on the description of the current system, this is essential as it shows areas that are in need of improvements.

Inputs

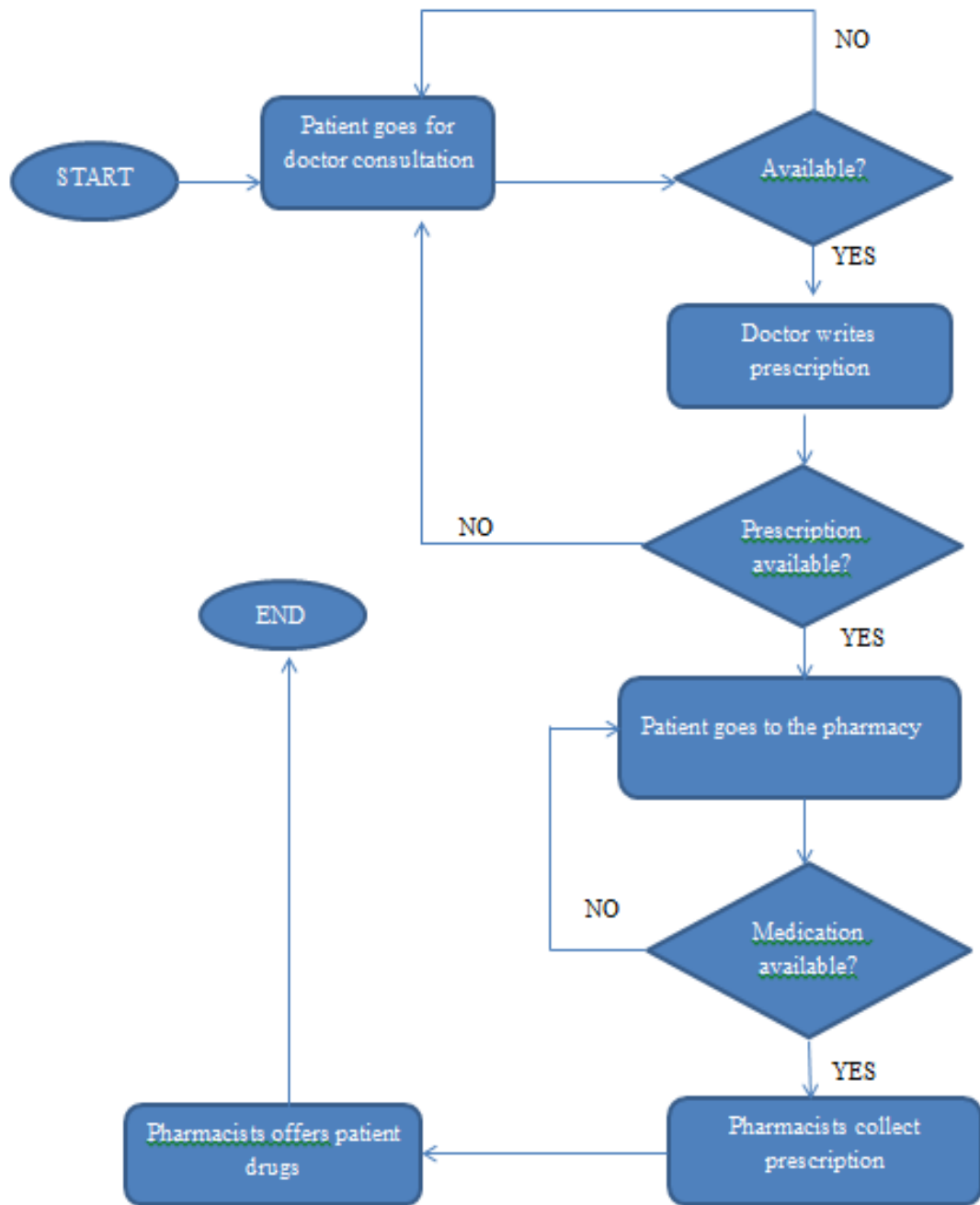
The current system operated in an input method that produced an output as the result that inputs information once the data has been collected successfully from the data sources such as the patients.

Outputs

These were data that was filed from the consultation with the doctors.

3.4.1 Activity Diagram of current system

This is a flow chart that shows the flow of all the entities that are involved. The current system can be visualized as the following:



KEY





	Activity
	Data flow
	Decision
	End/ Start node

Fig 3.1 Active diagram of current system (Source: Own construction)

3.5 Data Analysis

This is a step by step method of showing how each procedure is performed and which entities are impacted. This is a visual representation of the procedure that was actually performed on the current situation. The following is the Context Diagram and DFD of the current system.

3.5.1 Contextual diagram of the current system

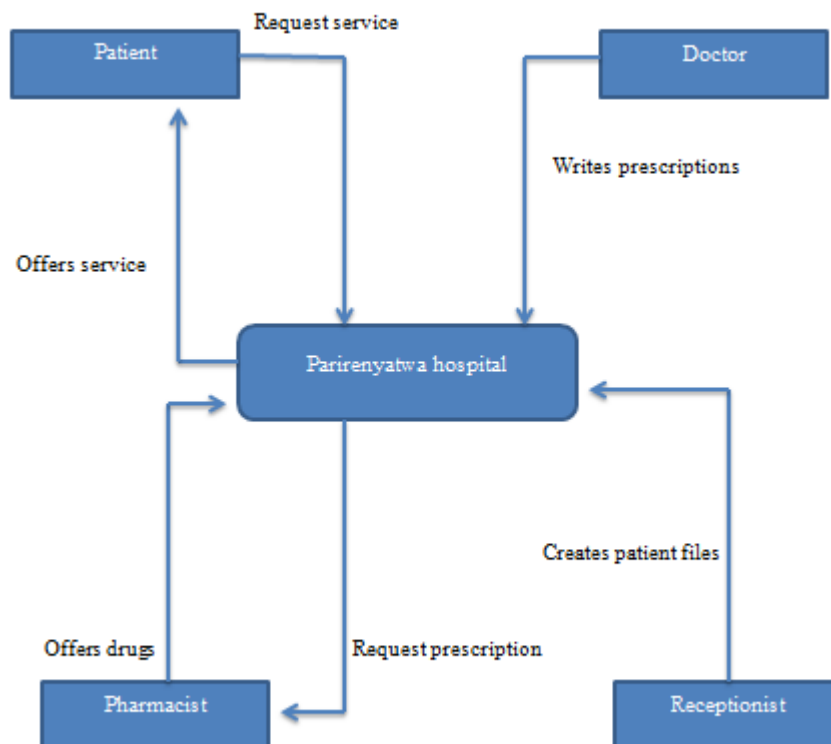


Fig 3.2 Context diagram

3.5.2 Data flow diagram (DFD) of the current system

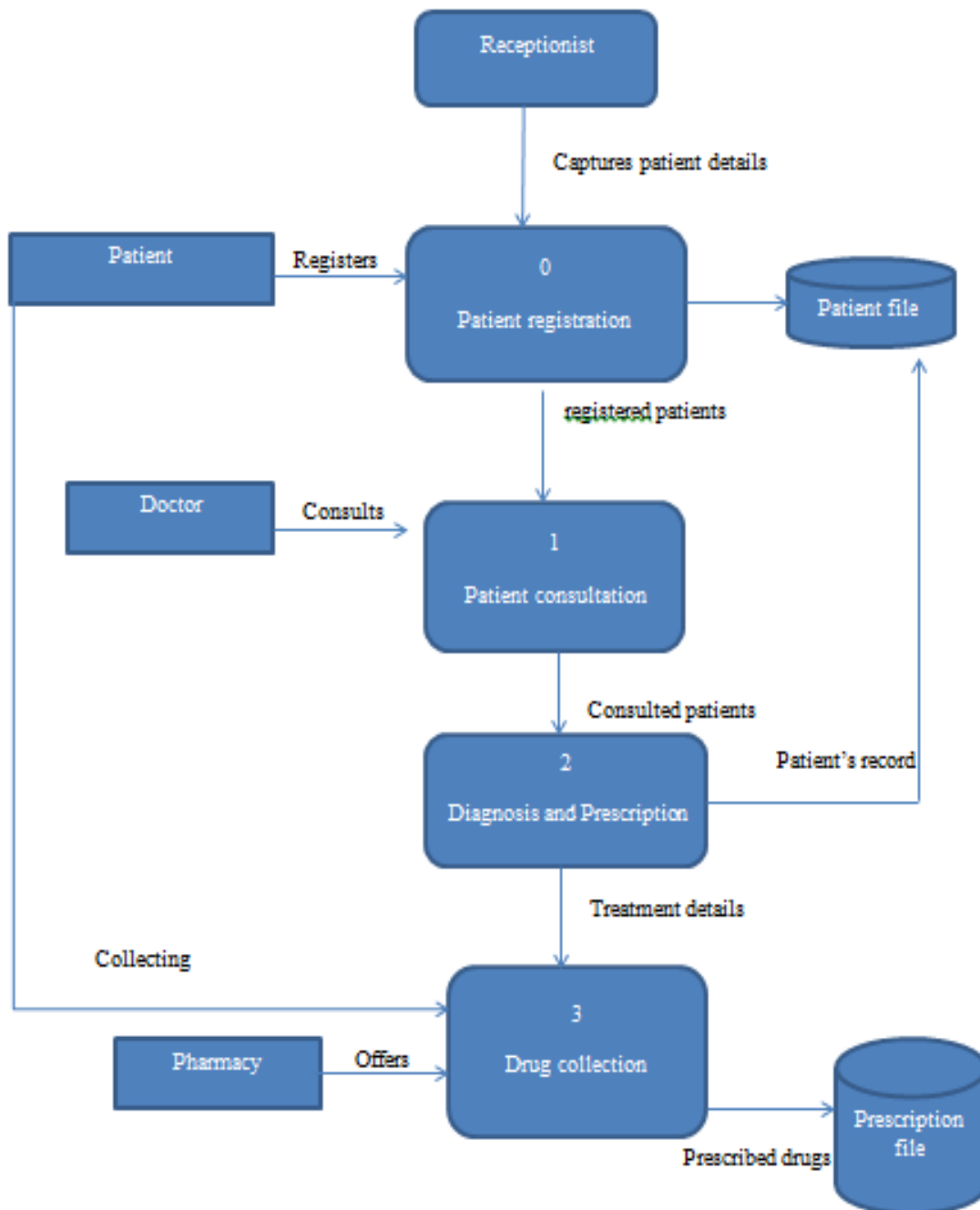






Fig 3.3 Data Flow Diagram (Source: Own construction)

KEY

	Data store
	Data flow
	Entity
	Process

3.6 Weaknesses of current system

These are the current findings that we found from the gathering techniques methodologies. The current system had loopholes and which were identified as follows:

- The patients have to queue longer waiting for the doctor to arrive. This is because there is no way of making an appointment and to be scheduled for a specific time slot.
- The prescribed prescriptions were easily lost, misplaced or damaged as it is in paper form.
- There was no way of verifying the prescription and to check if it was not a fraudulent act. Therefore prescriptions can be falsified.
- Patients are not able to verify the availability of the prescribed medication within the pharmacies. Therefore if the medication is not available, this may lead into patients having to visit more than one pharmacy.

3.7 Evaluate Alternatives

After performing the analysis of the current system as well as performing a feasibility study in the previous chapter, the researcher concluded that the development of the new system would be the best solution to address the weakness of the current system. The alternatives of the development of the new system were improvement by outsourcing, improving the current system and development.

3.7.1 Outsourcing

This is the contracting of a third party of experts to develop the new proposed system for the organisation according to Denscombe (2010). When an organisation involves a third party to be in charge of the development of the proposed system, the contracting party is given the

user requirements and develop the required system. The contractors become in charge of the new development as well as its maintenance.

Advantages of outsourcing

- Outsourcing allows the hospital staff members to continue focusing on their usual task without splitting their focus.
- Choosing a contracting party that mainly focuses on development will lead into efficiency of the development as they are specialist.

Disadvantages of outsourcing

- The delivery can be of poor quality if the user requirements are not correctly understood. It can be hard to understand how the organisation operates if you are not part of the organisation.
- Putting confidential information in the hands of another party, can pose risk of confidentiality issues. If information is put in the wrong hands or carelessly handled, this can cost the organisation. The issue of security is quite sensitive hence without much control of how information is handles by the third part, outsourcing poses a huge risk.
- Changes that affect the contracting party have a direct effect to the organisation as well. If the contracting party is affected by bankruptcy, this affects the Parirenyatwa Hospital as well. The image of the third party can ruin the reputation of the organisation.

3.7.2 Improvement

This is the adjustment of the current existing system to operate as required by the users as stated by Cochran and Patton (2002). The current system involves manual procedures. To improve the system is quite not the best solution in improving service delivery as we are trying to eradicate handwritten prescriptions and to deliver health services on a much larger scale. The manual system cannot be improved but needs to be replaced by automating the procedures.

3.7.3 Development

According to Denscombe (2010) this is development of the new proposed system within the organisation, by assigning a dedicated team of skilled developers instead of outsourcing. The

organisation makes use of its own staff members and resources for development to take place.

Advantages of development

- There is completely control of the project. This gives us control of the delivery of the project and we can add resources to speed up delivery time.
- The developers understand the requirements of the project and organisational culture hence able to deliver the system as required.
- This grows the knowledge about the development domain due to proper project management as the whole team is available.
- There is certainty of proper training that the development team has all the expertise and skill to develop the new project.

Disadvantages of development

- The resources can be allocated to other projects of higher priority hence completion will take quite longer.

3.7.4 Alternative analysis

ALTERNATIVE	COST (USD) \$	DECISION
Outsourcing	20000	Not favourable
Improvement	15000	Not favourable
Development	4950	Favourable

Table 3.2 Alternative analysis

Based on the analysis we decided to choose development alternative because the disadvantages it had were minor and did not pose any threat to the organisation such as outsourcing. The costs of developing the new system on our own were also of lower costs compared to the other alternatives.

3.8 Requirements Analysis

According to Sarngadharan and Minimol (2010) this refers to the procedure of determining the system user requirements for the new proposed system. This analysis is very essential as it is able to reveal what is expected of the new proposed system. To understand the user requirements the analysts should understand the process flows of the existing system. They are classified into functional and non-functional requirements.

3.8.1 Functional Requirements

The system will deliver the following:

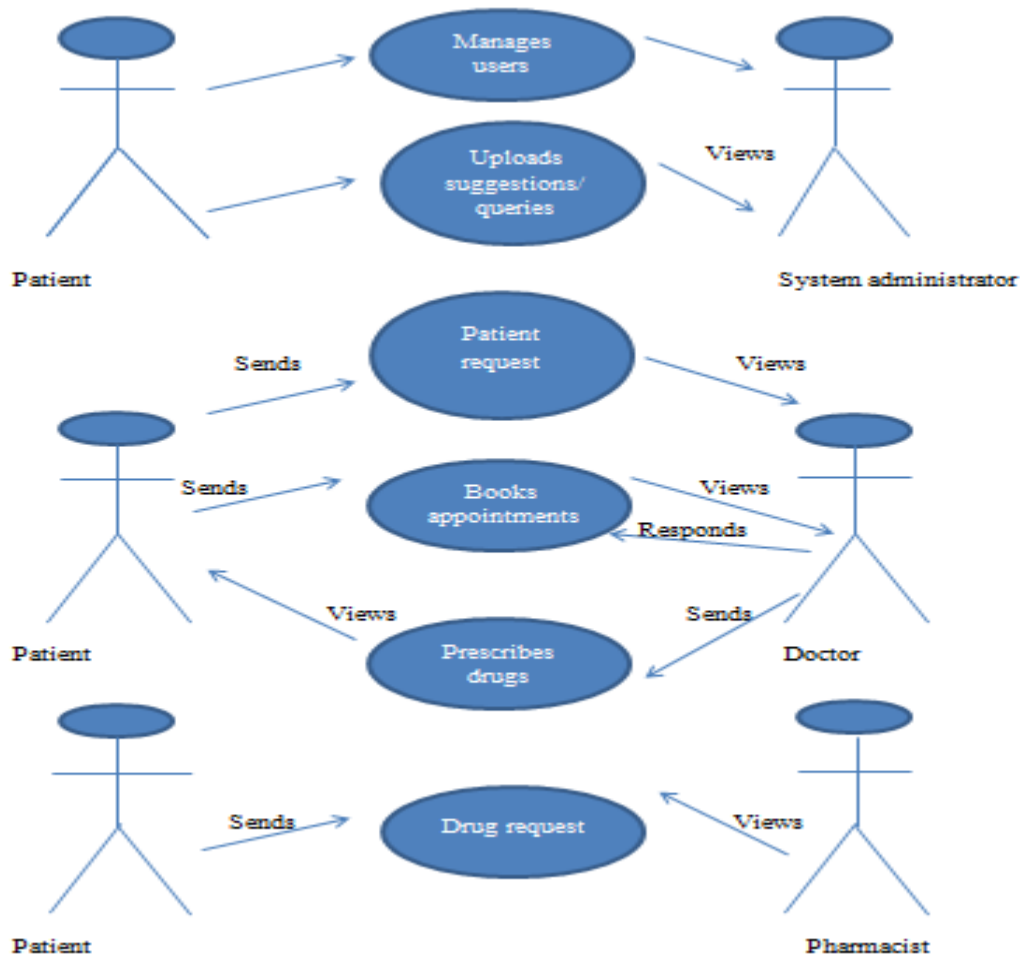
- Appointment booking
- Electronic prescription
- Interface that is easy to use
- Automatic responses by AI Chatbot

Case

This shows the order of phases for example the interaction between the patient and the doctor. What will be expected of the system was clearly defined.

Actors in the system

- Patients: these are the hospital clients or customers of the hospital services.
- Doctors: individuals responsible for diagnosing the patient
- Pharmacies: this is a board that is responsible for selling medications to the public.
- System Administrator: responsible for monitoring the system as well as the users of the system



KEY

	Actor
	Use Case
	Communicator

Fig 3.4 Case diagram (Source: Own construction)

The functionality should focus on addressing the weakness of the current existing system therefore achieve the following:

- The new proposed system should have a functionality that allows patients to set appointments for doctor’s consultations.

- To have the functionality that allows the doctor to check the availability of the prescribed drugs at the registered pharmacies.
- To allow doctors be able to generate electronic prescriptions that is sent instantly to the pharmacy.
- To generate a random code that verifies is used by the pharmacist to identity of the patient and drug verification at the pharmacy.

3.8.2 Non-functional requirements (outline constraints)

The system allows the system administrator to add, delete and modify system users. The system was given room for improvement maintenance in the near future. These quality attributes include:

Performance

This is the computer's useful work accomplished in a certain time period by a computer system. It is measured by the computer's efficiency, accuracy, processing speed. Therefore the system response time is an estimate to the system performance.

Portability

This refers to the ability of the system to be used with the users or installed into their devices for utilizing. In this situation analysis is on whether the clients will be able to install this application in their android application.

Security

This ensures proper secure system, making use of user authentication to minimise unauthorised user access and data encryption.

Access levels

Access is granted according to the roles performed by the user within the system. user privileges was implemented to give the user access to the modules that they only need to work with.

System interfacing

Since the resistance of technology can easily rise if the system is complicated, therefore the system was design to be of ease of use, having simple operating interfaces.

Backup

In case of the system crashing, the system should always be performing backup so that no information is lost.

3.9 Conclusion

This chapter has highlighted that the current system features can be inherited by the new proposed system. The existing system was used to analyse the alternative that could be used in the development of the new proposed system. The analysis showed us that in-house development is relatively the best alternative as compared to outsourcing and improving the current system. The next phase is the actual design of the system making use of the System development life cycle (SDLC).

Chapter 4: Design Phase

4.1 Introduction

This phase was mainly focused on the functionality of the proposed new system, and how the EasyPharm Android application would achieve its stated objectives. It showed the design activities of the EasyPharm Android application, all components required for the implementation of the proposed system, architecture and the data flow of the software structure. The proposed system was assessed to ensure that EasyPharm will be designed to desired quality before implementation.

4.2 System Design

Siddiqui, (2015) defines system design as a process that allows the visualisation of the proposed system before its implementation. This is the utilization of programming instruction to attain the desired user requirements by use of interfaces, modules, components and architecture and data of the system. The purpose of this system is to manage the patients' process from e-booking, e-prescribing of medical drugs; verification of prescription to patient collection. To ensure the quality of the new proposed system, the following features were in cooperated as follows:

Reliability

This is the ability of the system to function as it has been designed to function for a specific environment, purpose and time. To evaluate the reliability of the proposed system are the following input, processes and out.

Maintainability

In the event that there are changes to be made to the system with added functionality, the system should be maintained. Changes can be due to improving functionality or corrective performance by debugging. Therefore the system is flexible to any of these changes.

Effectiveness

The new system was able to work effectively by cutting costs and increasing service delivery of the Hospital. All the system users were involved in the design of the new system so as to ensure that it is efficient.

4.2.1 Context and DFD diagram of the proposed system

The proposed system is to be utilised at the Parirenyatwa hospital to improve health service delivery. The EasyPharm Android application is a system that will integrate the manual functions being performed by the patients, doctors and the pharmacy. The proposed system is going to allow patients to register the required details and create accounts. These accounts will enable them to book appointments and choose their preferable doctor for the appointment. The system will enable to give the doctors a platform to schedule their appointments according to their availability. When the patient has an appointment with the doctor, after consultation the doctor will generate an electronic prescription. A track number is generated that can be used to verify the prescription at the pharmacy of the patient's choice (considering the pharmacy is registered to the EasyPharm Android application). When the patient is at the pharmacy the pharmacist is able to retrieve the patient's profile using the track number therefore viewing the prescriptions. The pharmacist offers the patient the prescribed medical drugs after a purchase has been made.

Input

- E-booking – patient registration details
- E-prescription – doctor specifying drug information(quantity and name)

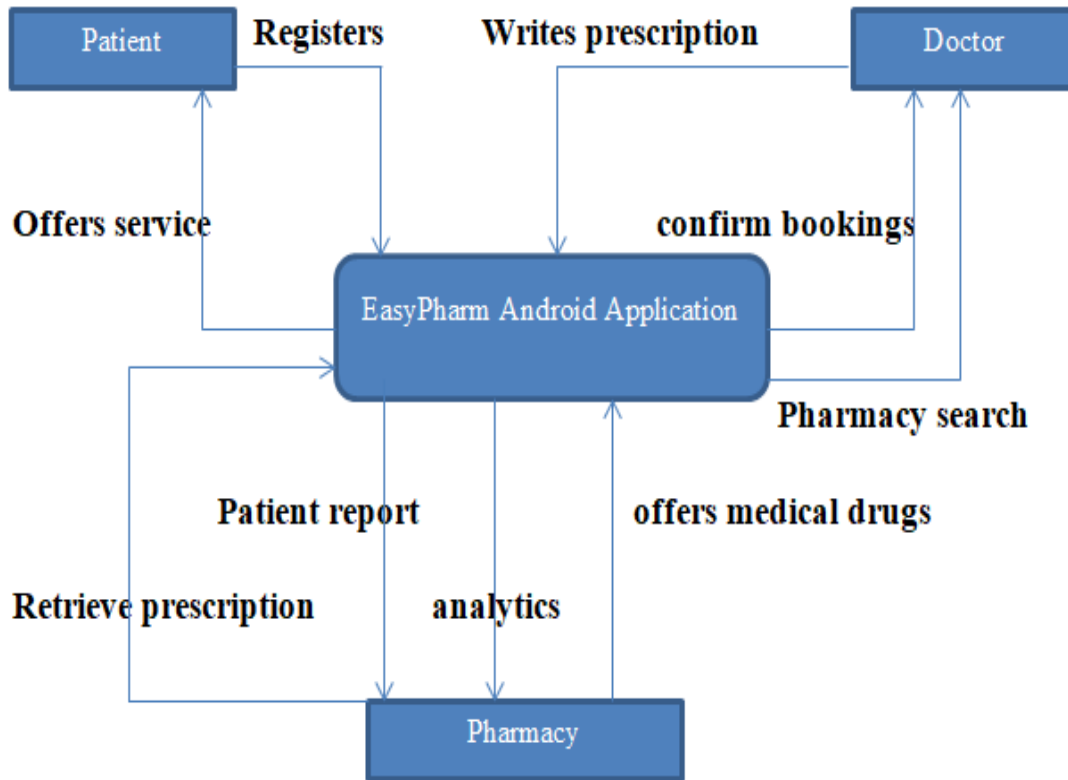
Processes

- Pharmacy validation of drugs
- Doctor Verification of availability of drugs in pharmacies

Output

- Doctor's statistics of accepted and rejected doctor's appointments.
- Pharmacy report for issued medical drugs.
- Patient records.

4.2.1 Context Diagram and DFD of the proposed System



KEY

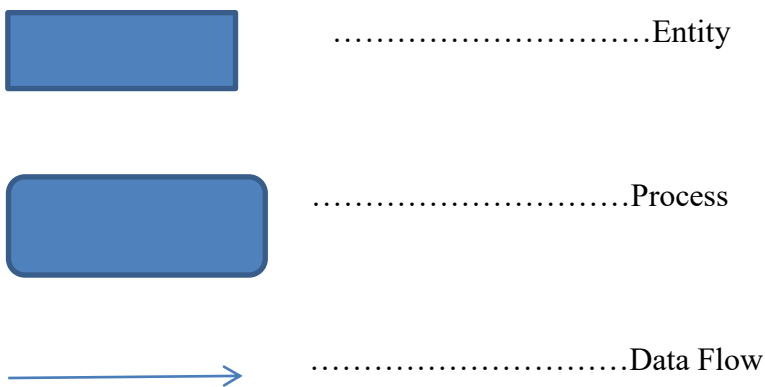


Fig 4.1 Context diagram

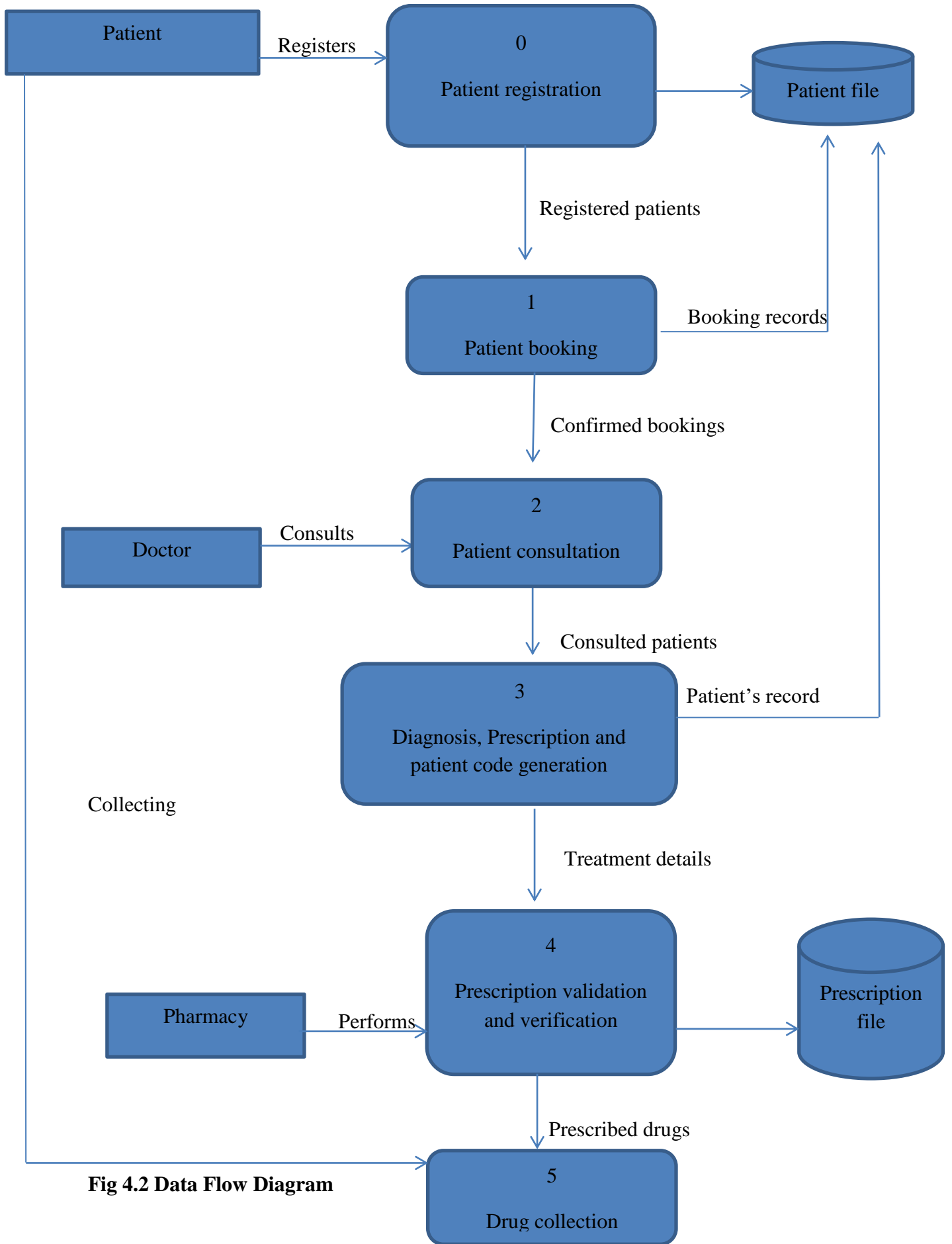


Fig 4.2 Data Flow Diagram

4.3 Architectural design

This is the schematic design of the proposed software defining all components establishing a framework and unifying the system into a coherent functional system as stated by Somerville (2004). The architectural design will consist of three layers namely database layer, web server layer and applications program. The database and the web server will be centralized.

The client server architecture

This refers to the architecture of a computer network as well its components according to Somerville (2004). A computer runs software named client or a remote processor and interacts with the other software named the centralized server or the computer host located at a remote computer. Since the client is usually a browser, it uses a set of instructions to interact with the server. These set of instructions are referred as protocols. These protocols ensure that the transferring of data is accurate by requesting the browser and getting responses from the server.

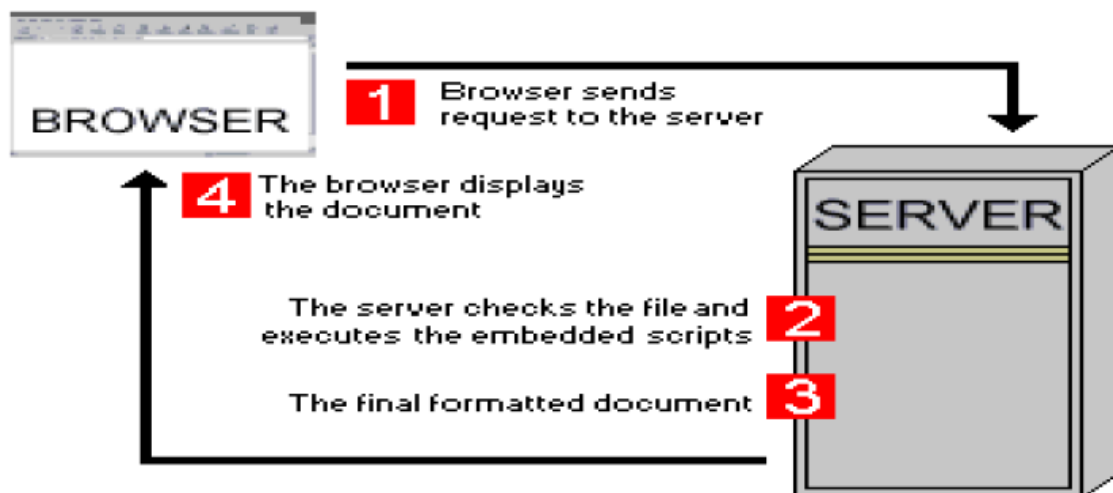


Fig 4.3 Client server architecture model (Source: Somerville 2004)

The major components of the system both at client and server level are as follows:

Server components

It is composed with application database such as MYSQL. The server component is responsible for residing all the information and data relevant to the EasyPharm android application.

Client components

All client workstations shall consist of the following components:

- Browsers (Google chrome, Firefox Mozilla)
- Internet connectivity

Communication between machines will be facilitated through the use an interface that can provide communication with the database server.

Network architecture

It is the design of a computer network showing the framework of the specifications of the physical, operational and functional components that are required as stated by (Burde 2007). It also specifies operational and communication protocols or procedures to be utilised according to (Burde 2007). The EasyPharm will be making use of LAN (Local Area Network) for the employees that will be making use of the system and as for the patients; they will be using WAN (Wide Area Network). The client (patient) nodes will be connected the central server (Central computer).

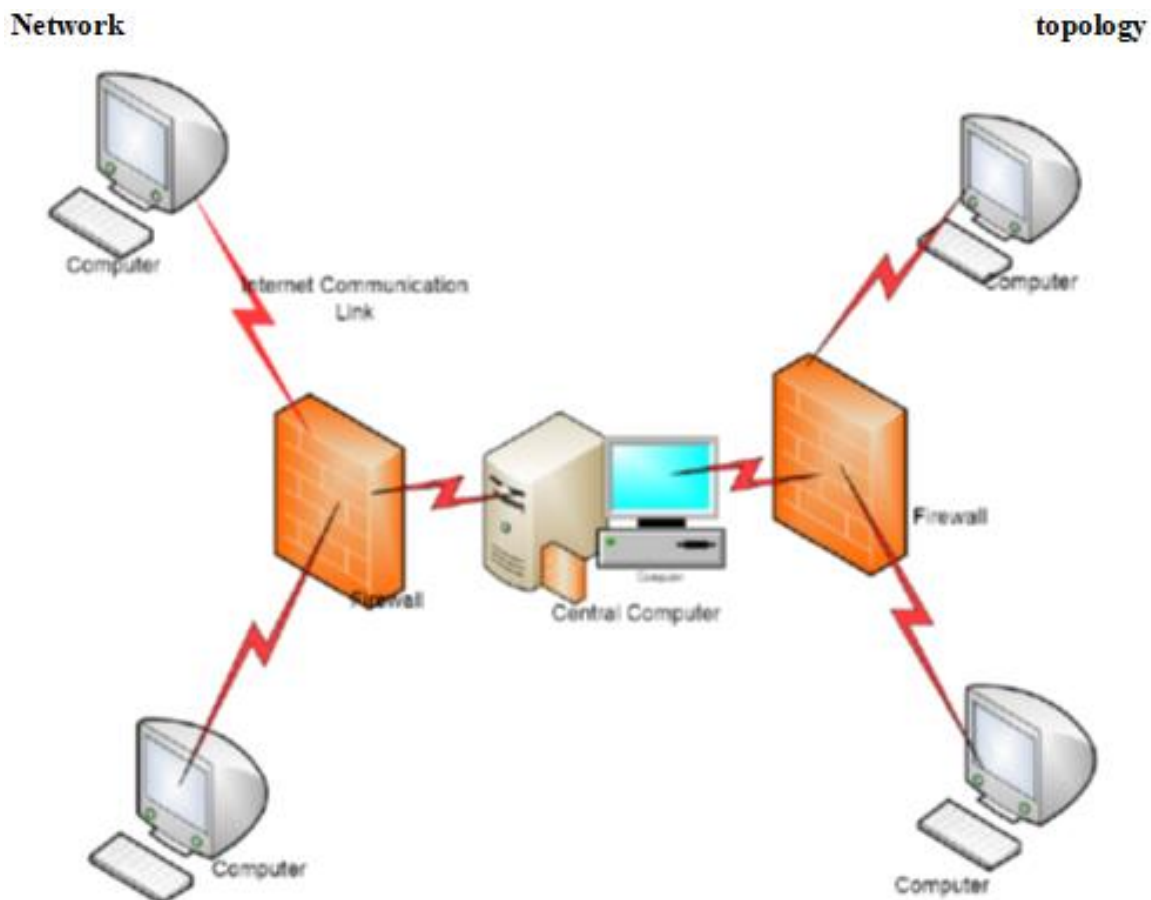


Fig 4.4 Network topology (Source: Burde 2007)

4.4 Physical design

This refers to the technical environment of the proposed system, specifying the hardware required and how it is going to be setup and how it will be networked (Burde 2007). There was consideration of how and where our hardware will be located such the servers or printers. The most important aspect is the interaction between the hardware and software as it will be located in an already existing infrastructure. All nodes will be connected to the central server and networked using network cables.

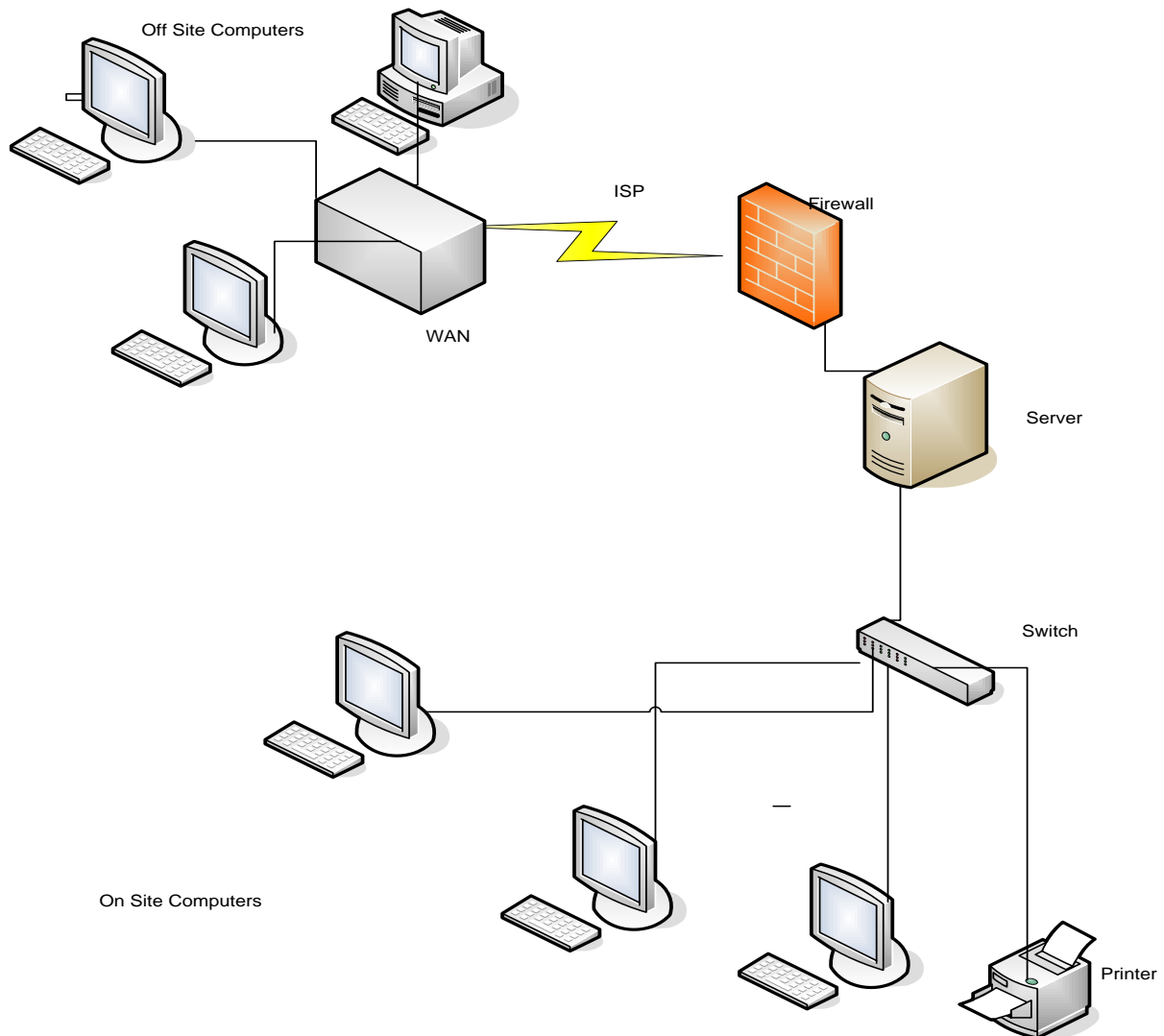


Fig 4.5 Physical design model (Source: Burde 2007)

4.5 Database design

Database design refers to the organisation of data in relation to the database model according to (Wesy, 2007). This process will facilitate the development process, design and the

implementation of the proposed system. Functional database and software application will be transformed from the logical data and process models that were designed.

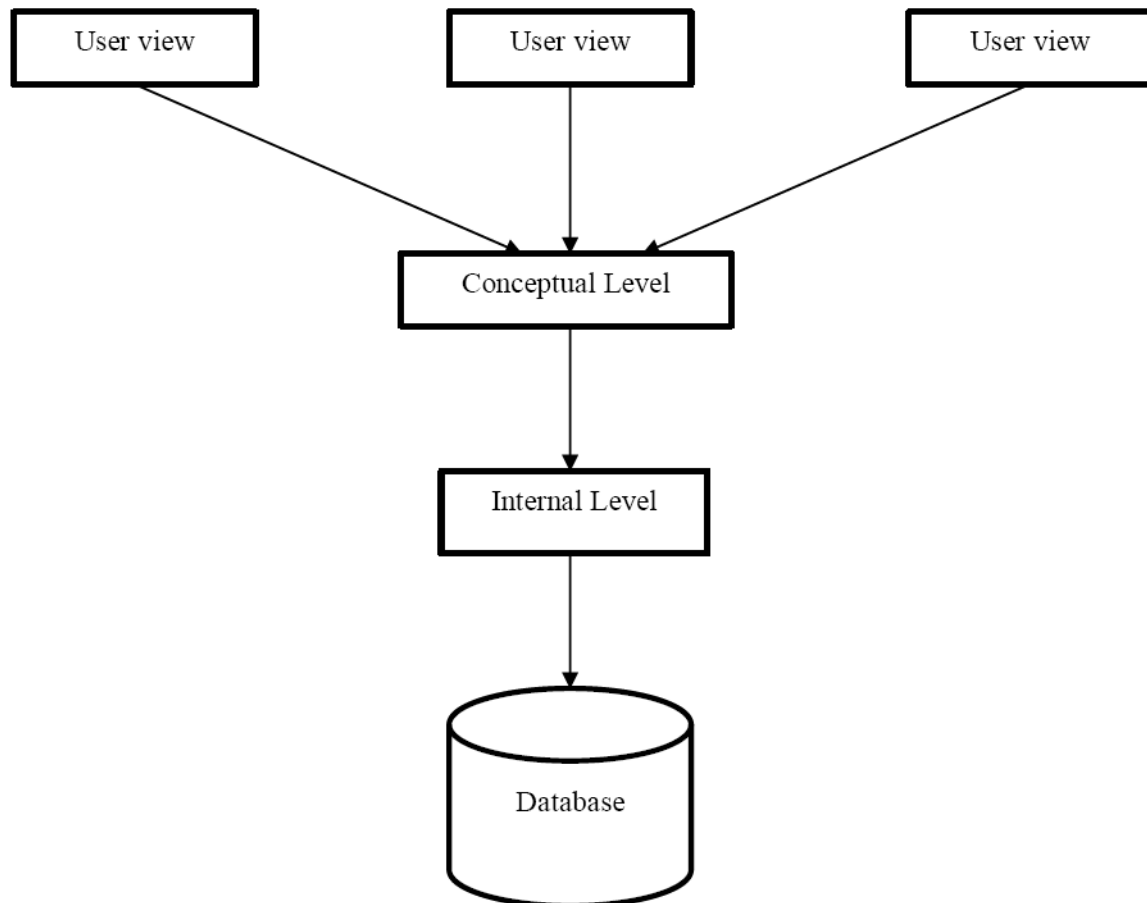


Fig 4.6 Database design (Source: Wesy, 2007)

External level

This refers to what the system user can view as stated by (Wesy, 2007). The view is customized to the user's interest and only can they access information that is relevant for them to view only. The external schema responds directly to the users view. The external level is made in a way that improves security and only the authorized user can make authorized changes and gain such access.

Conceptual level

This refers to the community view of the database. It describes the relationships at which is between the data being used and all data elements that are stored in the database according to (Wesy, 2007).

Internal level

It is referred to as the actual data that is stored in the database. It shows the computerized data structures for the conceptual schema implementation according to (Wesy, 2007). It also describes on how data is being stored. In overall this is the presentation based on how the operational system and the relational database management system views data.

Database tables

This is the representation of data objects that are being managed by the database management system according to (Wesy, 2007). The tables will show the data structures and description as shown below:

Patient registration details:

FIELD	DATA TYPE	DESCRIPTION
Full Name	Text[15]	Full name of user
Email address	Text[15]	Email address of user
Username	Varchar[20]	Account name of user
DOB	Date	Date of birth of user
Password	Varchar[20]	Unique password of user
Confirm password	Varchar[20]	Unique password of user
ID Number	Int[10]	Unique identity number of user
Mobile number	Int[10]	Contact number of user
Address	Varchar[50]	Physical address of user

Table 4.1 data tables of Patient Signup

FIELD	DATA TYPE	DESCRIPTION
Username	Varchar[20]	Account name of user
Password	Varchar[20]	Unique password of user

Table 4.2 data tables of Patient Sign in

Doctor registration details:

FIELD	DATA TYPE	DESCRIPTION
Full name	Varchar[30]	Full name of user
Email address	Varchar[20]	Email address of user
ID Number	Int[10]	Unique identity number of user
Mobile number	Int[10]	Contact number of user
Physical address	Varchar[50]	Physical address of user
Doctor number	Int[10]	Unique identification number
Password	Varchar[20]	Unique password of user
Confirm password	Varchar[20]	Unique password of user
Select specialist	Varchar[20]	Speciality of the doctor
Select gender	Varchar[10]	Gender

Table 4.3 Data tables of Doctor Signup

FIELD	DATA TYPE	DESCRIPTION
Doctor number	Varchar[20]	Account name of user
Password	Varchar[20]	Unique password of user

Table 4.4 Data tables of Doctor Sign in**Pharmacy registration details:**

FIELD	DATA TYPE	DESCRIPTION
Pharmacy name	Varchar[20]	Name of the pharmacy
Admin email address	Varchar[20]	Email address of pharmacy
Admin mobile number	Int[10]	Contact number of pharmacy
Pharmacy address	Varchar[50]	Physical address of pharmacy
Pharmacy number	Int[10]	Unique identification number
Password	Varchar[20]	Unique password of pharmacy
Confirm password	Varchar[20]	Unique password of pharmacy

Table 4.5 Data tables of Pharmacy Signup

FIELD	DATA TYPE	DESCRIPTION
Pharmacy number	Varchar[20]	Account name of pharmacy
Password	Varchar[20]	Unique password of pharmacy

Table 4.6 Data tables of Pharmacy Sign in

EER Diagram

This is the graphical representation of all the existing entities as well as their relationship with the entity sets found in the database. Below is the ER diagram of the proposed new system:

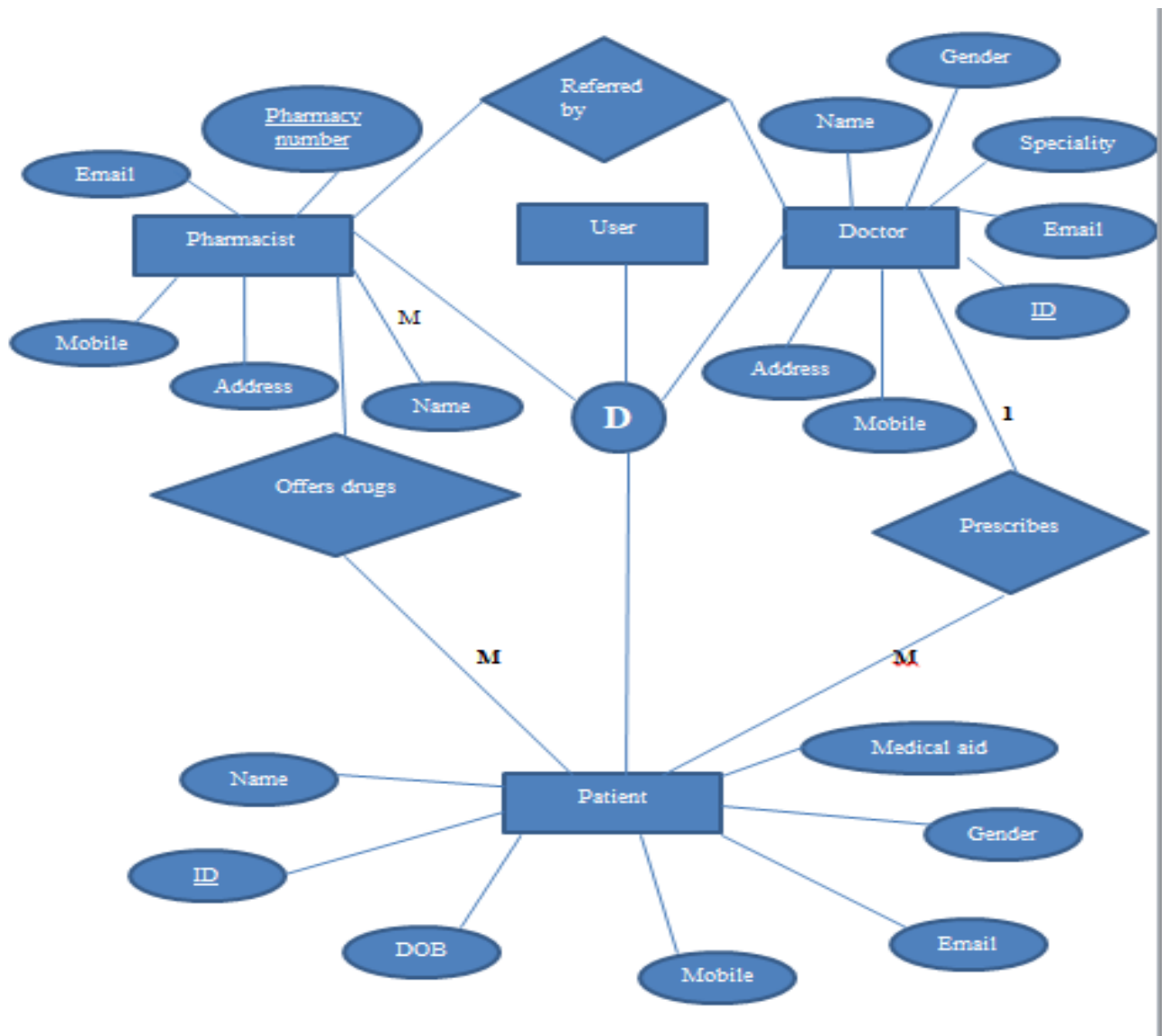


Fig 4.7 EER diagram (Source: Own construction)

4.6 Program design

This is a method for designing and documenting methods and procedures in software (Wesy, 2007). We utilized the package, class and the sequence diagrams to show the software procedures.

➤ Package diagram

A package diagram is a Unified Modelling Language diagram composed only of packages and the dependencies between them. A package is a Unified Modelling Language construct that enables you to organize model elements, such as use cases or classes, into groups (Wesy, 2007). Packages are depicted as file folders and can be applied on any Unified Modelling Language diagram.

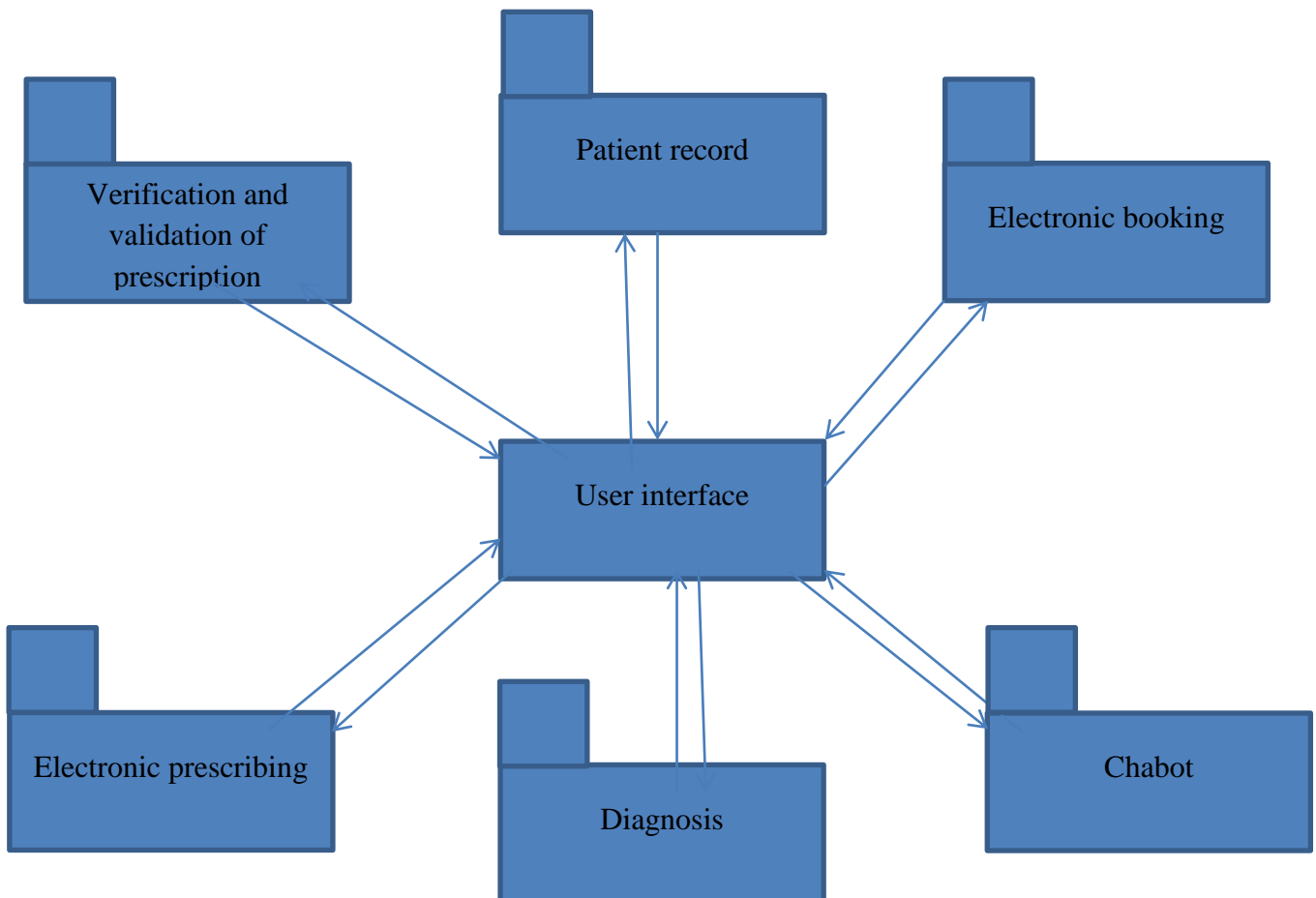


Fig 4.8 Package diagram (Source: Own construction)

➤ **Class diagram**

Class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing, and documenting different aspects of a system but also for constructing executable code of the software application (Wesy, 2007). Class diagram describes the attributes and operations of a class and also the constraints imposed on the system.

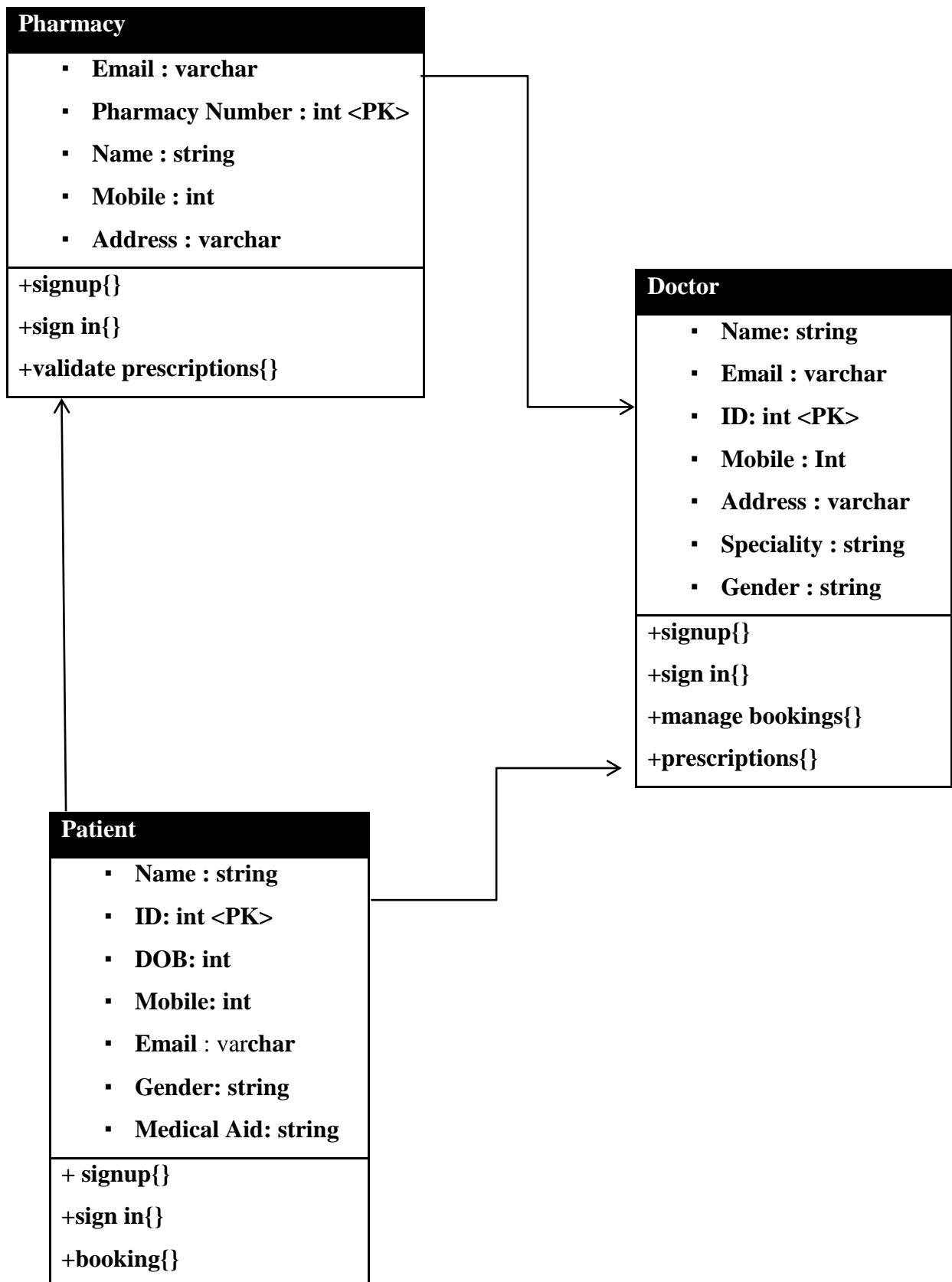


Fig 4.9 Class diagram (Source: Own construction)

➤ **Sequence diagram**

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.

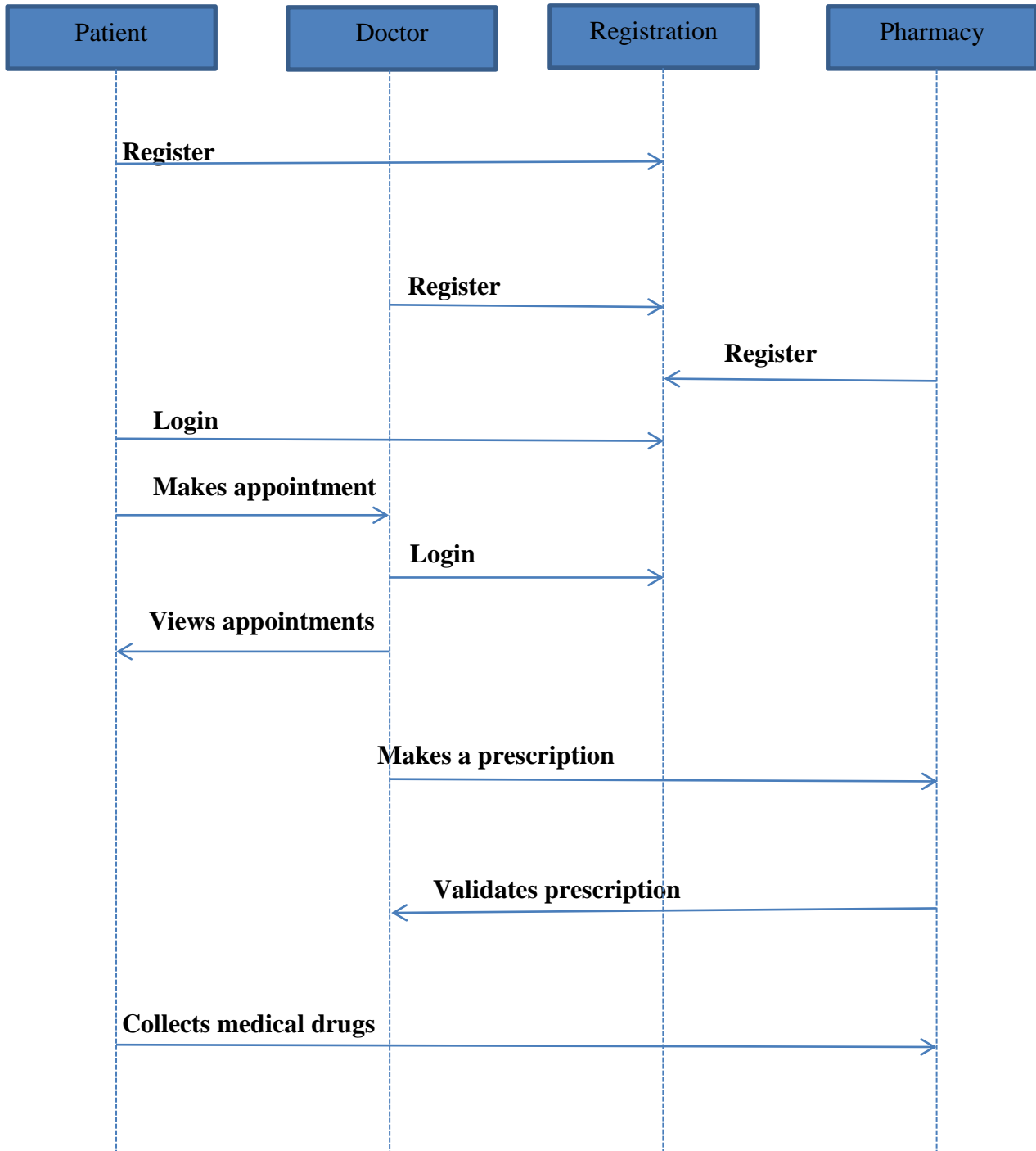


Fig 4.10 Sequence diagram (Source: Own construction)

4.7 Interface design

Interface design refers to how the system user will be interacting with the system. It is the visual layout that will be interacting with the system users. The design interface makes it easy for users to interact with the computer making use of icons and alluring functions. The EasyPharm android application will be designed to ensure the following rules before data is input in the knowledge base:

- There will be validation of data on entry
- Completion of all relevant fields before submission

4.7.1 Menu design

It is very important for the developer to design a menu that is easy for the user to familiarise with as well as navigate so that tasks are carried out effectively and efficiently.

4.7.1.1 Main menu

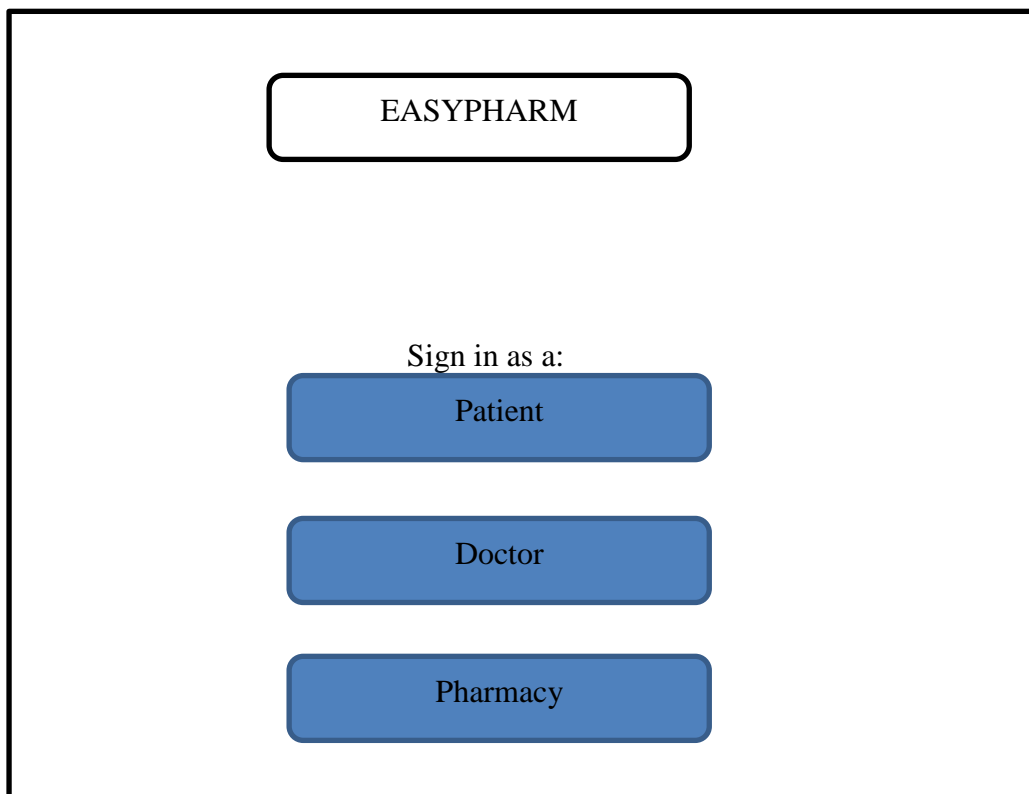


Fig 4.11Main menu

4.7.1.2 Sub-menus

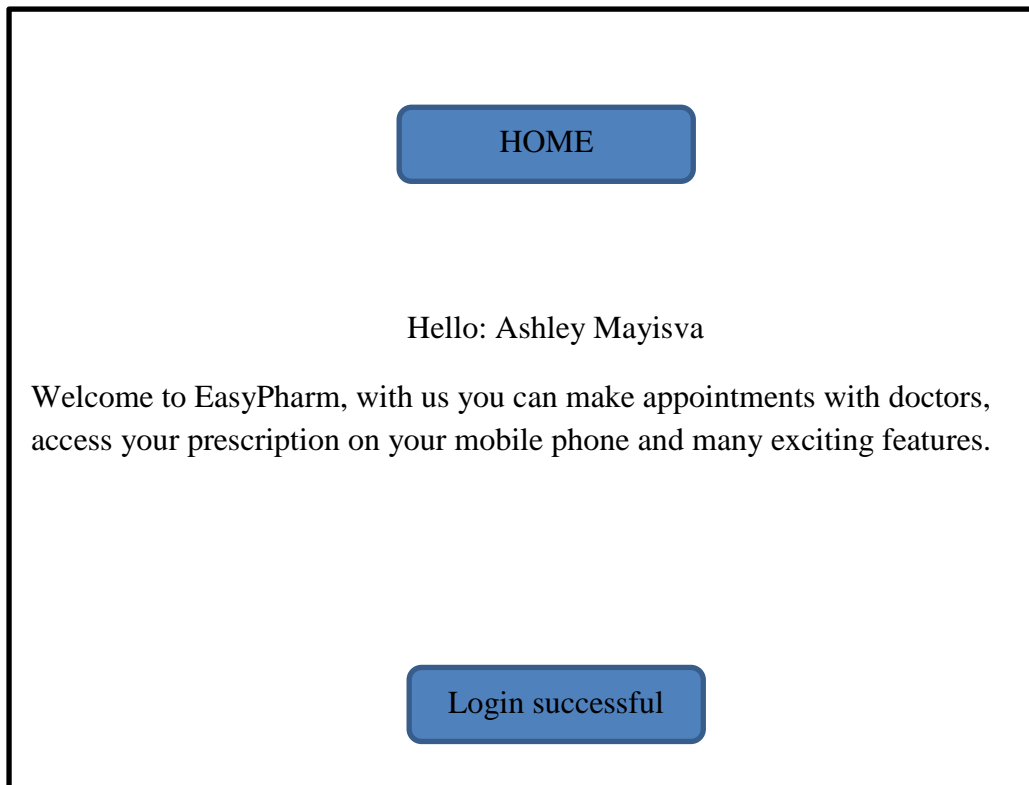


Fig 4.12 Submenu of welcome page

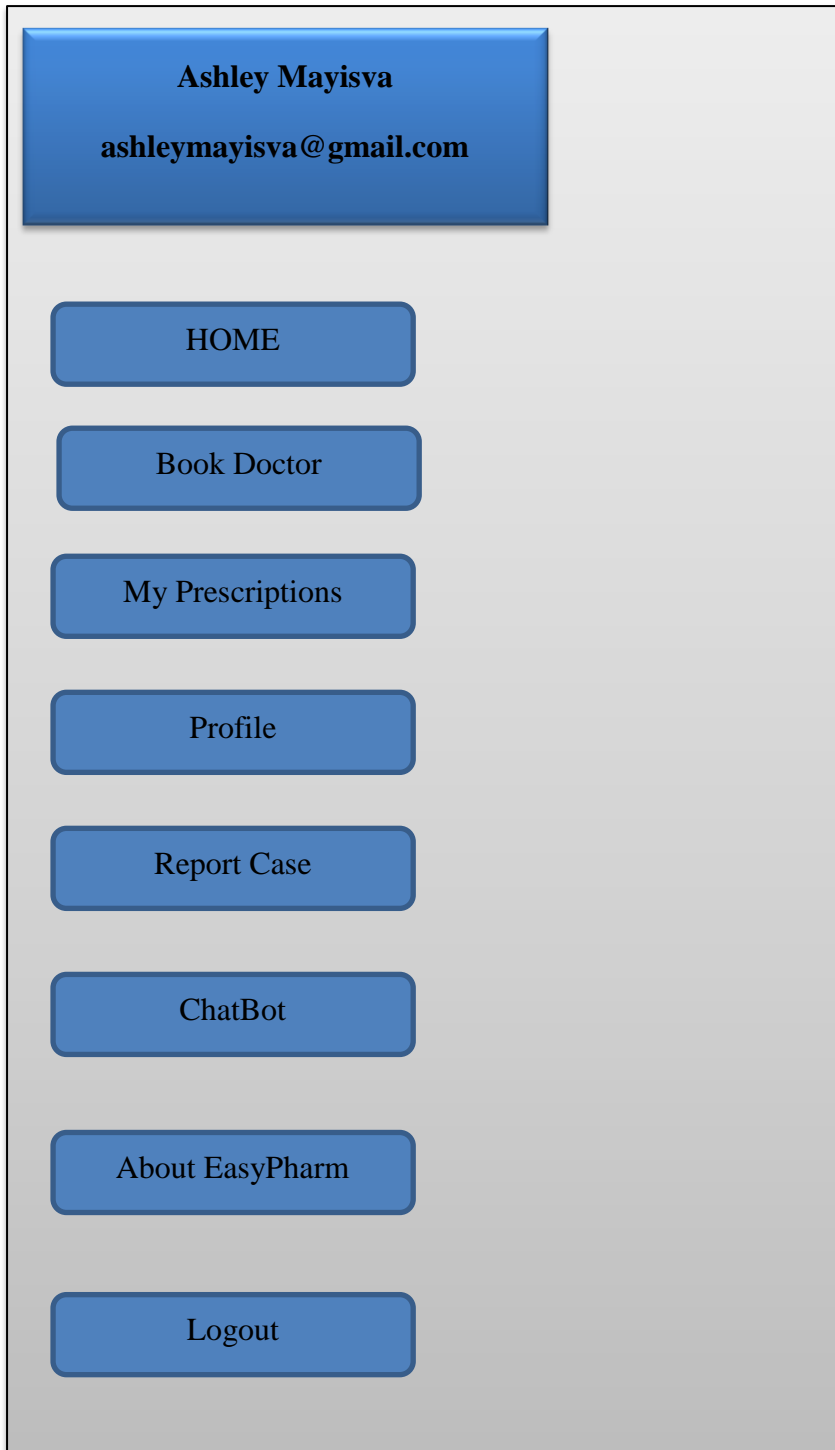
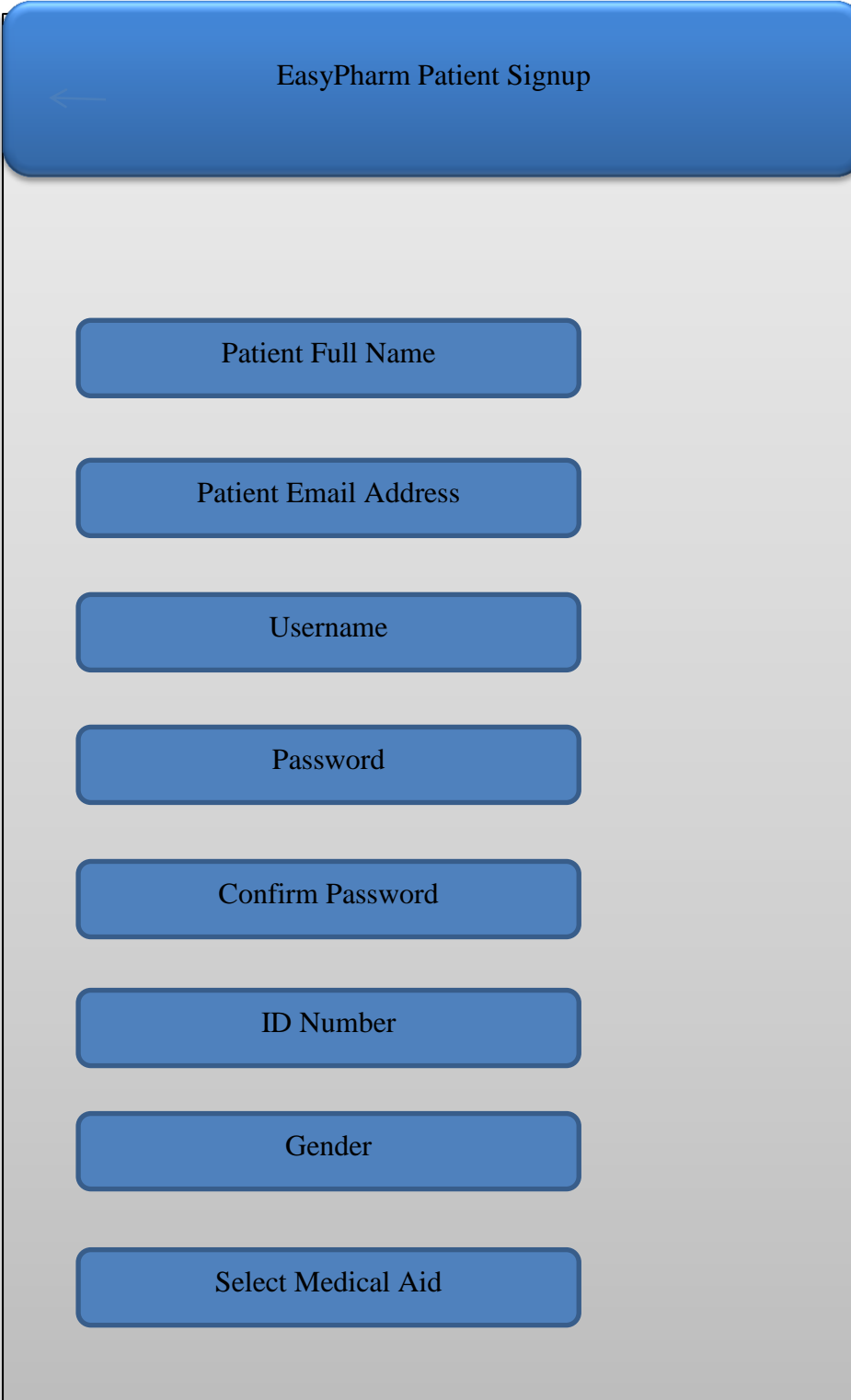


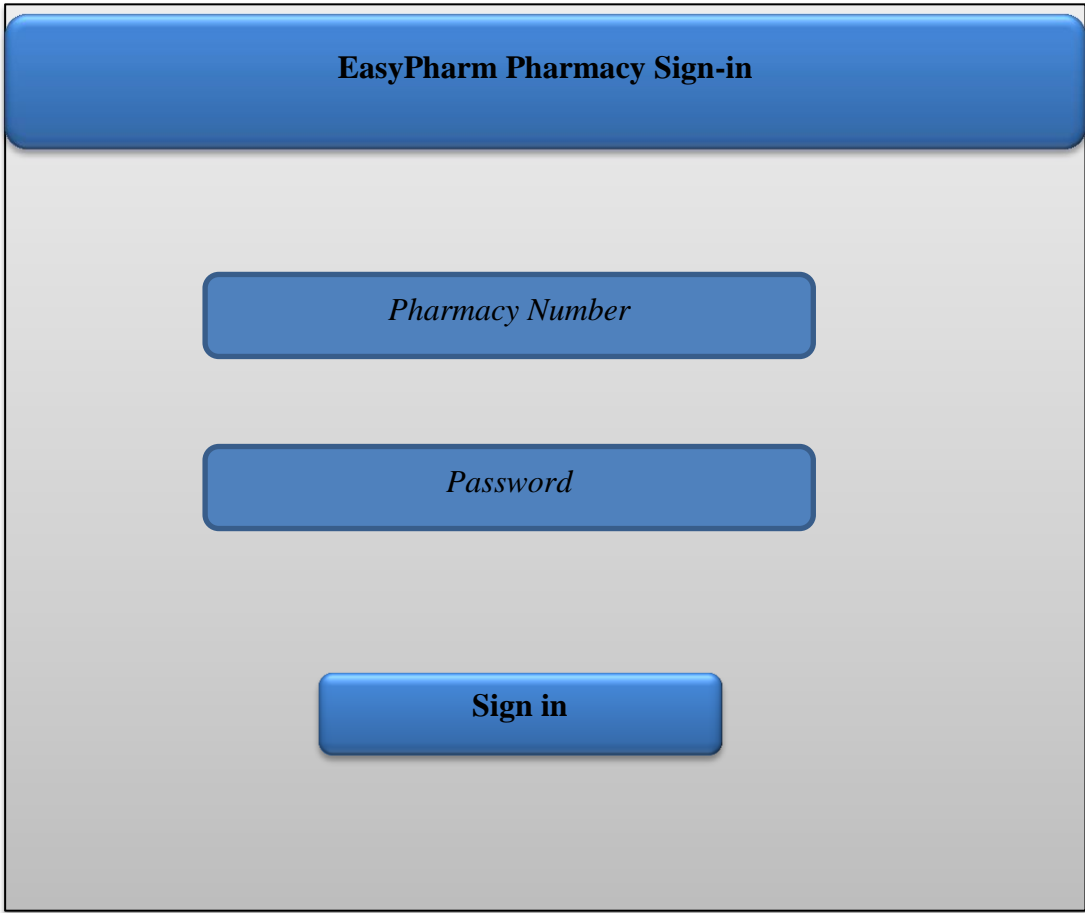
Fig 4.13 Submenu Successful login

4.7.2 Input design



The image shows a mobile application interface for patient signup. At the top is a blue header bar with a white left-pointing arrow and the text "EasyPharm Patient Signup". Below the header, on a light gray background, are eight blue rounded rectangular input fields stacked vertically. Each field contains a label for a different piece of information: "Patient Full Name", "Patient Email Address", "Username", "Password", "Confirm Password", "ID Number", "Gender", and "Select Medical Aid".

Fig 4.14 Patient signup page



The image shows a sign-in form for EasyPharm Pharmacy. It features a blue header bar with the text "EasyPharm Pharmacy Sign-in". Below the header, there are three blue input fields: the first is labeled "Pharmacy Number", the second is labeled "Password", and the third is a "Sign in" button.

Fig 4.15 Patient sign in page

EasyPharm Doctor Signup

Full Name

Email address

ID Number

Mobile number

Physical address

Select Speciality

Select gender

Signup

Fig 4.16 Doctor Signup page



The image shows a sign-in form for EasyPharm. It features a blue header bar with the text "EasyPharm Doctor Sign-in". Below the header, there are three blue input fields arranged vertically. The first field is labeled "Doctor number", the second is labeled "Password", and the third is a "Sign in" button. The background of the form is a light gray gradient.

Fig 4.17 Doctor sign in

4.7.3 Output design (Include all output forms/reports in the system)

The image shows a patient profile form with a blue header and several blue rounded rectangular boxes containing text. The text is as follows:

- Full name: Ashley Mayisva
- Username: ashley
- Mobile number: 0777777777
- Home address: 21 Madokero Estate
- Sex: Female
- Email address: Ashley@gmail.com
- ID Number: 6525252525G65

Account Status: Active

Fig 4.18 Patient profile

Appointment: Approved

Patient name: Ashley Mayisva

Medical aid: Corporate 24

Gender: Female

Address: 21 Madokero Estates

Mobile number: 0777777777

Status: Approved

Fig 4.19 Approved Appointments

Appointment: Declined

Patient name: Ashley Mayisva

Medical aid: Corporate 24

Gender: Female

Address: 21 Madokero Estates

Mobile number: 0777777777

Status: Declined

Fig 4.20 Declined appointment

Appointment List	
Tanatswa Foroma Steward health (12/05/19, 10:00am)	Pending
Enock Pahla CIMAS (1/05/19, 10:00am)	Accepted
Angeline Pahla PSMAS (12/05/19, 9:00am)	Declined

Fig 4.21 Appointment List

Available Doctors	
James Brown (Gynaecologist) Email: jbrown@gmail.com	Active
Proud Macheke (Physiologist) Email: pmacheke@gmail.com	Active
Getrude Maramba (Neurologist) Email: gmaramba@gmail.com	Active

Fig 4.22 List of available doctors

4.8 Pseudo Code

These are algorithm based instructions that gives an overview of how the programmer to show the processes of the EasyPharm android application from the data inputs, processing and the output. It does not show the programming syntax but it is just a readable description of the application processes.

User login module

Accept Username, Password

//code ensures authentication of user detail for access control

{

Repeat

{

Select username and password from the users table

Where username and password match

}

If credentials match then

{

Direct user to EasyPharm homepage based on their access level

}

Else

{

Display error message

}

Booking module

// validates if the user is registered

```

{
  Accept appointment details

  Repeat
  {Select patient ID
  :KSDWFF,PDWFM,SDWFFV,UFDOVFFH
  }

  If a match,
  Then {
    Accept appointment
  }

  Else {
    Prompt error message
  }

  Doctor module

  If {
    Patient ID matches credentials}

  Then {then accept booking
  Else {booking declined
  }}

  Capture patient details;
  Capture prescription details
  Capture prescription ID
  }}

```

Pharmacy module

Validate patient details

Validate prescription ID

Store data in patient table

}}

End

4.9 Security design

This is the way the hardware and software that makes them not prone to vulnerabilities and attacks through measures such as authentication checks, maintenance, continuous testing and development making use of the best practises such as ISO and COBIT (Ulrich, 2000). The developer should ensure that attacking the new application system is multifaceted and ensure that an enemy is unable to intrude the system. The EasyPharm android application is designed with the security concerns that address physical security, network security and operational security.

4.9.1 Physical security

This are referred to as measures taken to deny access to unauthorised personnel (Ulrich, 2000). The project team has come up with a drafted plan of securing the servers from unauthorized access. There server room has is located in the fifth floor where only IT personnel are only able to access with their access tags. There is a highly secured room which was selected to be the server room therefore having biometric measures to only grant access to selected personnel. Book logs have also been implemented so that a record is kept of who visits the server room. These book logs will be used in case of audit purposes hence auditors will be accompanied into the server rooms. There has been a surveillance camera installed to monitor the server rooms at all times. The server rooms are also where backup tapes will be stored.

4.9.2 Network security

Network security involves securing the computer infrastructure from network vulnerabilities. It is aimed on securing the data and information and maintains reliability, usability and integrity of the network and data. Network security is ensured by the network administrator who ensures that there is a security policy that governs and secures the network. Network

software as well as the hardware required to ensure the security of the network system should be put in place. Firewall to protect the information of the organisation by creating a barrier has been implemented. Antivirus was also implemented to ensure that the organisation will not be prone to virus attacks such as Ransom ware. Reports will be generated from passive devices to be able to see the intrusion attacks, undesirable traffic and penetration testing devices. There is going to be detection scans that can help detect which devices with an out-dated antivirus as well as automatic updating of antivirus software when the computers are connected on our network.

4.9.3 Operational security

These are referred to effects that sustain the organisation's security system. This is a risk procedural assessment of managers assessing and review operation reports. This will assist in protecting important information rather than utilising all resources to protect all the information regardless its sensitivity. The procedural security is also the planning ahead of contingency and business continuity plan in case of a disaster occurs. There has been a disaster recovery site that has been setup which has been located 15km away from the production site.

4.10 Conclusion

In conclusion, this chapter has shown the flow of data so as to aid the developer to be able to develop the system as required by the researcher and the system users. The system design and system architecture assisted to give an interface that the system users can easily understand and interact with. There have been implemented security measures that will ensure the safety of the data of the EasyPharm android application preparing for implementation stage.

Chapter 5: Implementation Phase

5.1 Introduction

This is the phase of checking the actual system that has been developed, testing its workability, efficiency, effectiveness, security of usage, authentication, accuracy as well as training staff members. The main focus was on ensuring that all the objectives mentioned on paper were all met and functioning properly. All the designing that was performed in the previous chapter as well is transformed into a proper function system. The system testing was performed to ensure that there are no bugs and errors in the EasyPharm Android application before final implementation. System maintenance was also performed throughout the system lifetime to improve the system functionality, adding functionality (system updates) and to advance with technological advances.

5.2 Coding

According to Whitten et al (2013), these are a set of instructions that are executed in a computer using Android language. Android Studio as a programming language used in development of the new system is the official IDE from Google. It is for the development of android applications that are for android devices. It has the entire required API for application development. Secure code was used to limit invasions and intrusion from unauthorised system clients and sanitisation of code.

5.3 Testing

Testing of software leads to the quality of the software product as stated by James (2014). This involves checking errors in the system syntax and functionality before it is implemented. Testing is mainly performed by system analysers that take the system under various types of testing to identify even the smallest loopholes of the system. The testing of EasyPharm Android application was performed according the expectations of the system user's requirements and objectives, therefore the system went through the following tests:

- Unit testing
- Module testing
- Subsystem testing
- System testing
- Acceptance testing

Fig 5.1 Testing phases (Source: James 2014)

5.3.1 Unit testing

This is the smallest part of a software system that has a few or a single input and single output to test and validate functionality James (2014). Each component or unit is closely scrutinized for any loopholes and checking proper operation of each unit. The unit can be a procedure, interface or class that can be logically isolated within the system. All the units were logically isolated to try and identify if there were any bugs or errors in syntax or runtime that would occur during operation. Two methods of testing were used namely, black box and white box testing.

➤ Black box testing

This is a software testing method that is used mainly by the testers and not the developers of the system (Limey, 2013). The testers are mainly interested in the general outputs produced by the system as they do not have much knowledge of the code structure or the internal structure of the software program. This is just functional testing based on the system requirements.

➤ White box testing

This software testing method is performed by the software developers and not by system testers (Limey, 2013). The developers are more focused on the internal structure of the system. This software testing requires knowledge of programming languages used. White box testing mainly tests code structure, and the conditions.

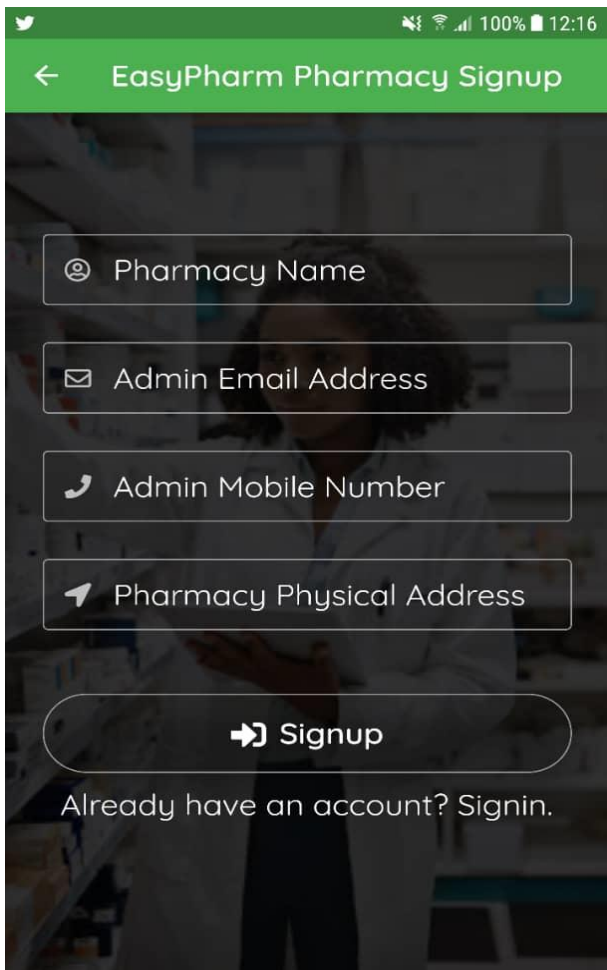


Fig 5.2 Unit testing registration form

5.3.2 Module testing

Several units are combined and tested together as a module. The combined units are tested together for identify loopholes in functionality and testing for system coherence. We also tested if the modules could operate simultaneously.

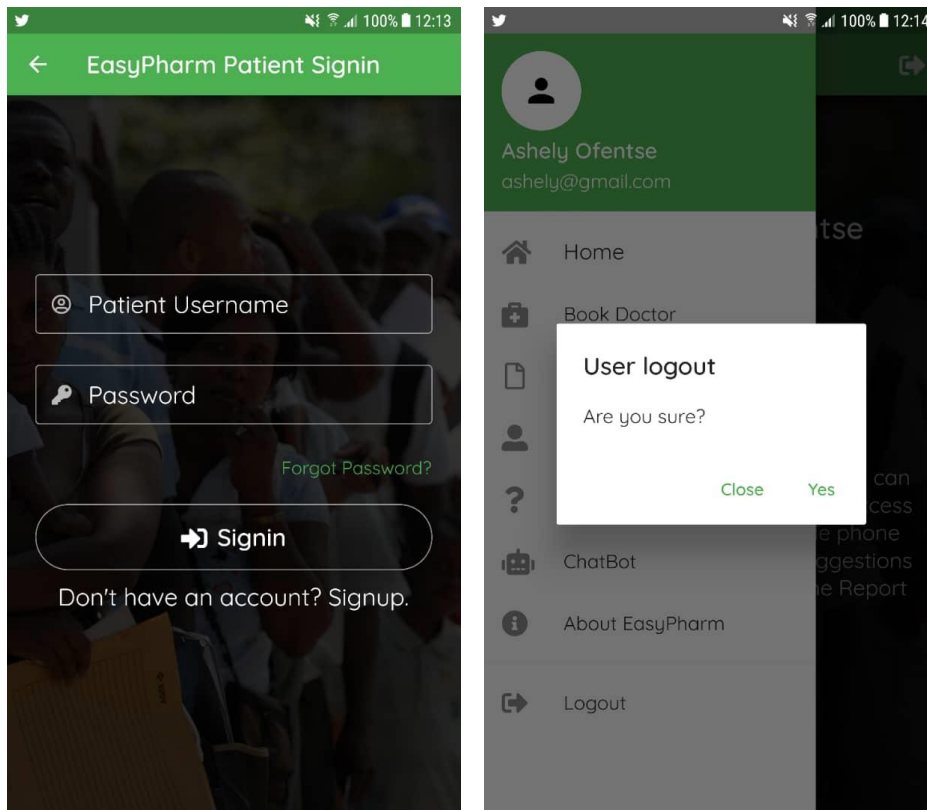


Fig 5.3 Module testing

5.3.3 Subsystem testing

This is the isolation testing of functionality to ensure correct functioning of the system. This testing focuses on the interaction of the isolated modules. Modules are integrated together and form a subsystem therefore their interaction together need to be tested.

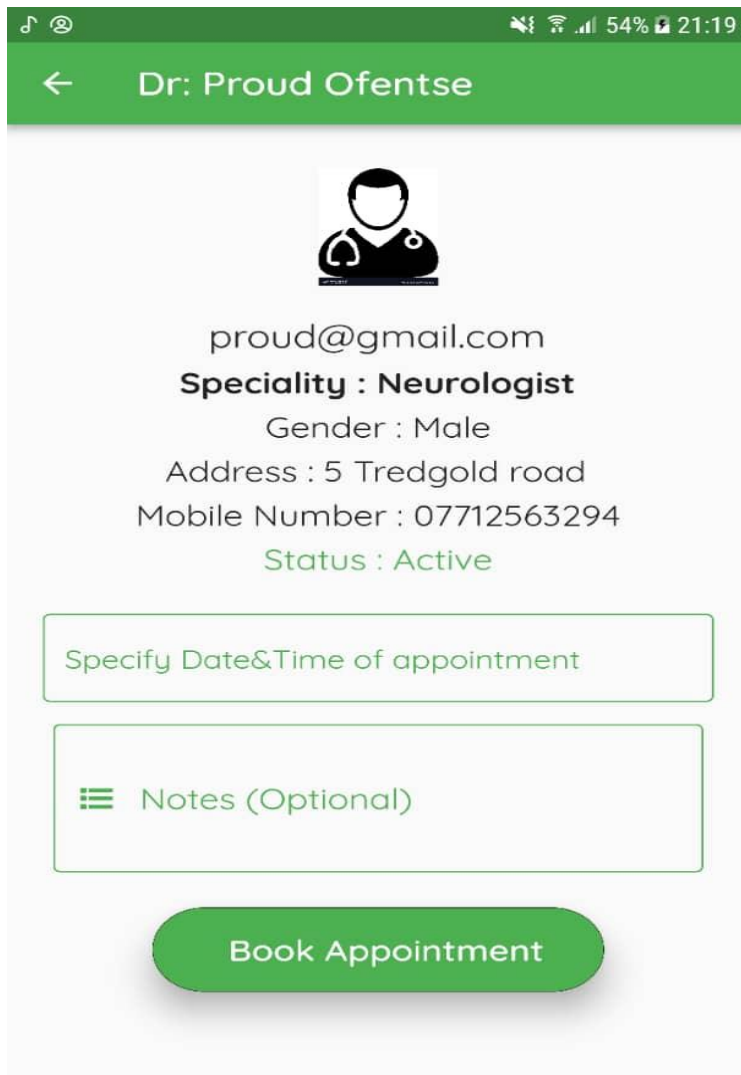


Fig 5.4 Subsystem testing

5.3.4 System testing

Sub systems are the integrated together then tested together to ensure that all the subsystems are operating together perfectly. The whole system is tested to ensure that there are no errors. All the functional and non-functional requirements need to be met.

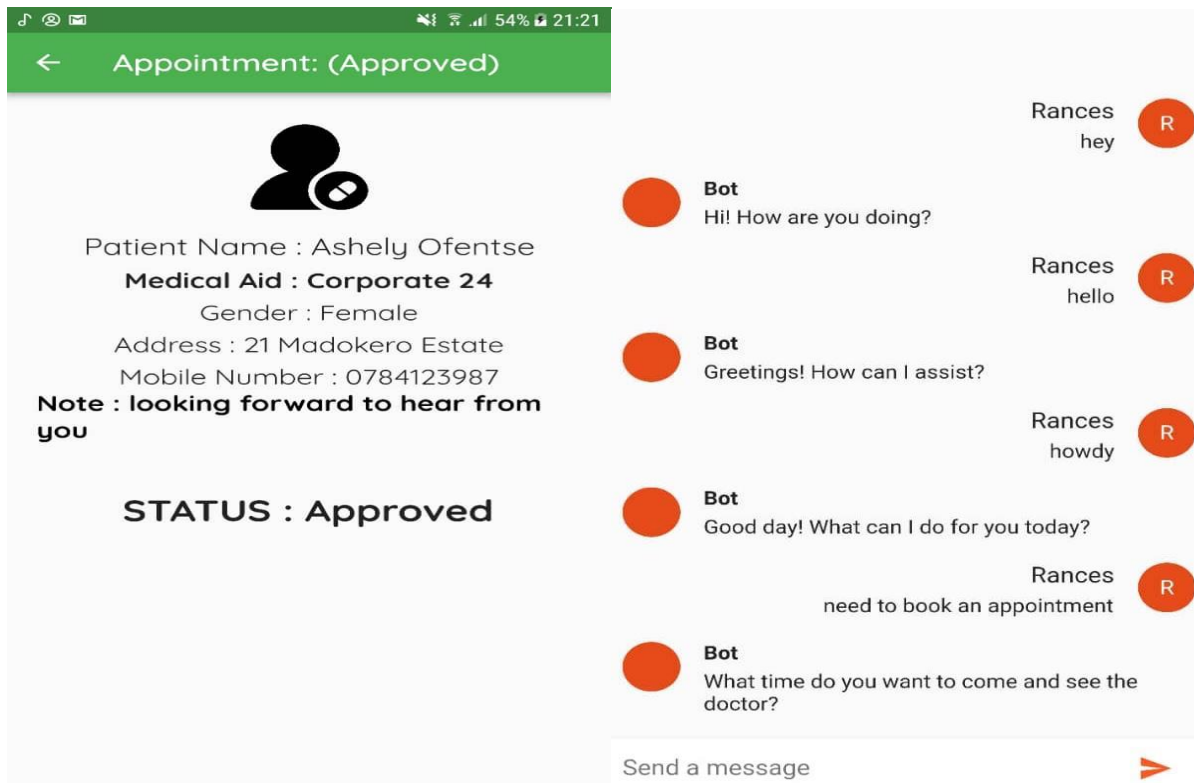


Fig 5.5 System testing

5.3.5 Acceptance testing

This is the final stage of software testing; the system is taken and accepted for use in the operational field. It is tested using data that is simulated to check and validate its functionality. At this stage if there are any requirements that were not met or have been omitted, they can be identified. A group of testers (users) are given the system to evaluate its functionality and feedback is taken to improve on the software application.

5.3.6 Alpha testing (Verification)

This is the testing that is performed after the software has been accepted by the users. The alpha testing involves trying to identify bugs before the software is released into the live environment. This test is performed at the developer's site hence the developers observe the users making use of the system and fix the errors being noted. Errors and omissions will be tested in relation to the user requirements. To test for errors we looked at the following:

➤ **Login testing:**

We tested if the username and password could be verified before granting access to the system user. When testing, we verified the login menu to see if there is a prompt message if the user credentials are incorrect as shown below:

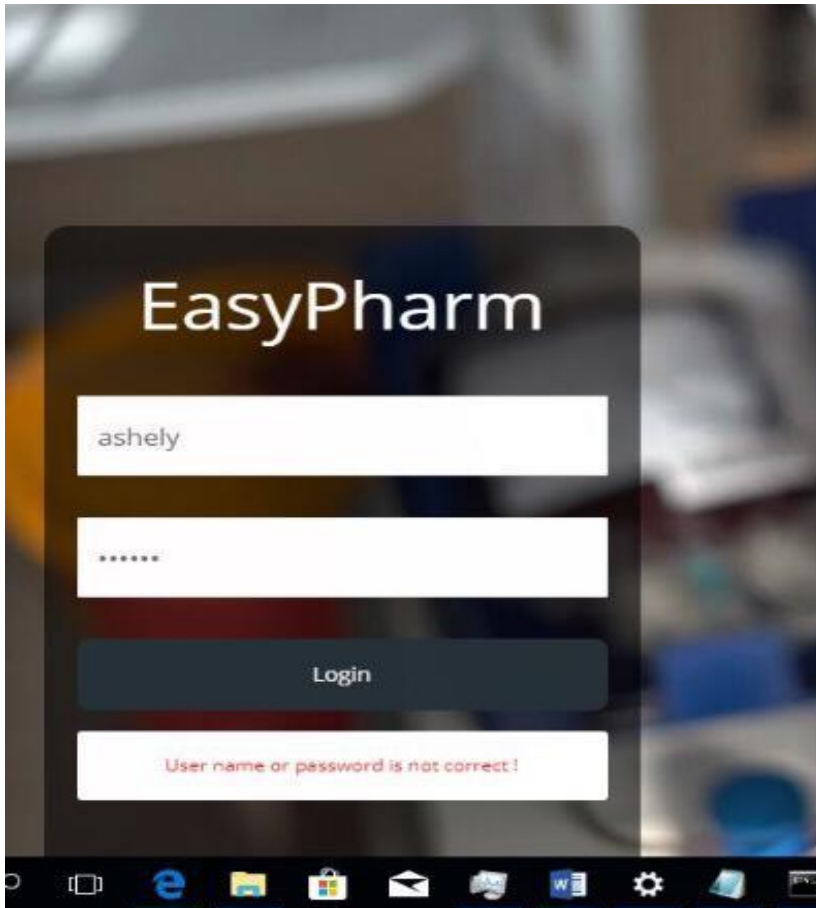


Fig 5.6 Verification testing

5.3.7 Beta testing (Validation)

This is the testing of the software system by the actual users of the system in the real environment. This is basically done so that we get the patients' validation of the system functionality. Beta testing is mainly to reduce risk failures and ascertain the software product quality. The system is tested to see if it can validate the data input before processing it. The EasyPharm Android application was tested with actual data to evaluate if it has the ability to validate the inputs.

➤ Null value validation

When the user omits certain fields, the system should be able to prompt the user of the null fields as shown below:

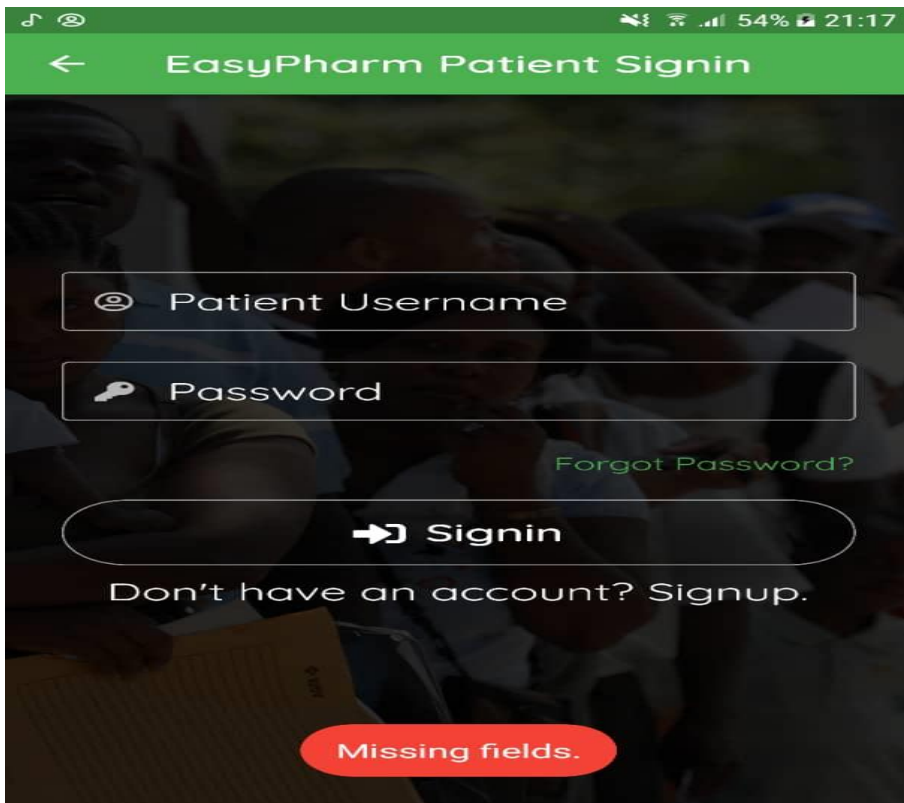


Fig 5.7 Patient login verification

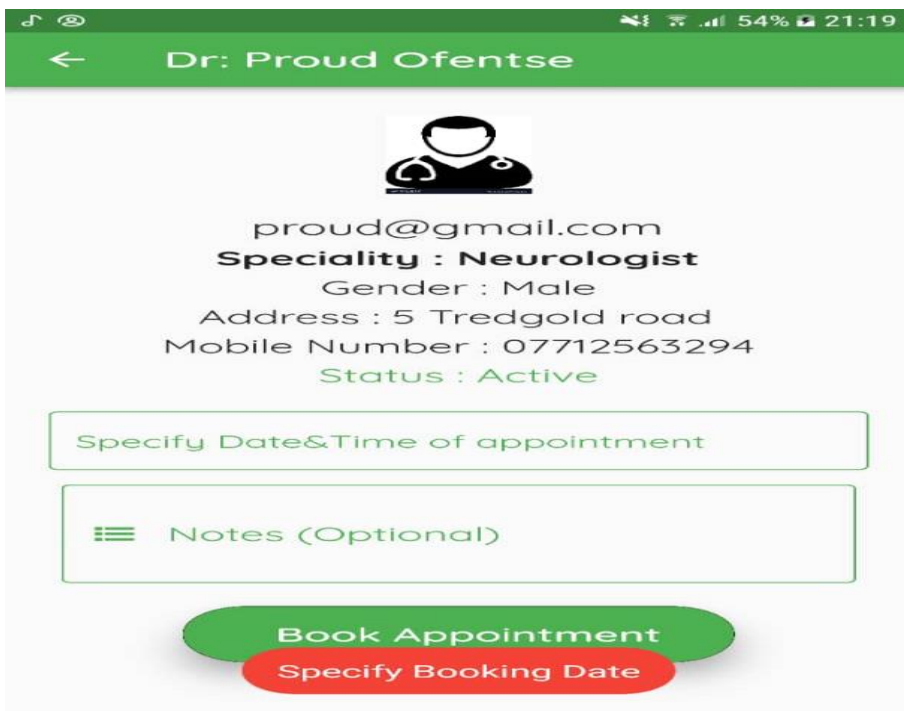


Fig 5.8 Appointment null values

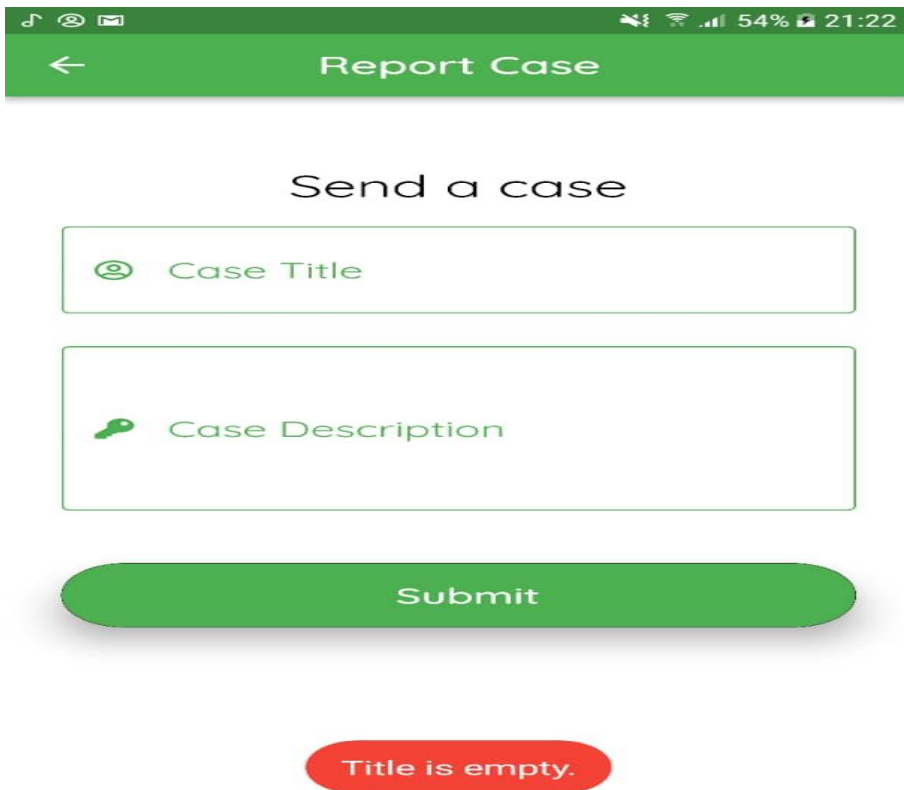


Fig 5.9 Report case null values

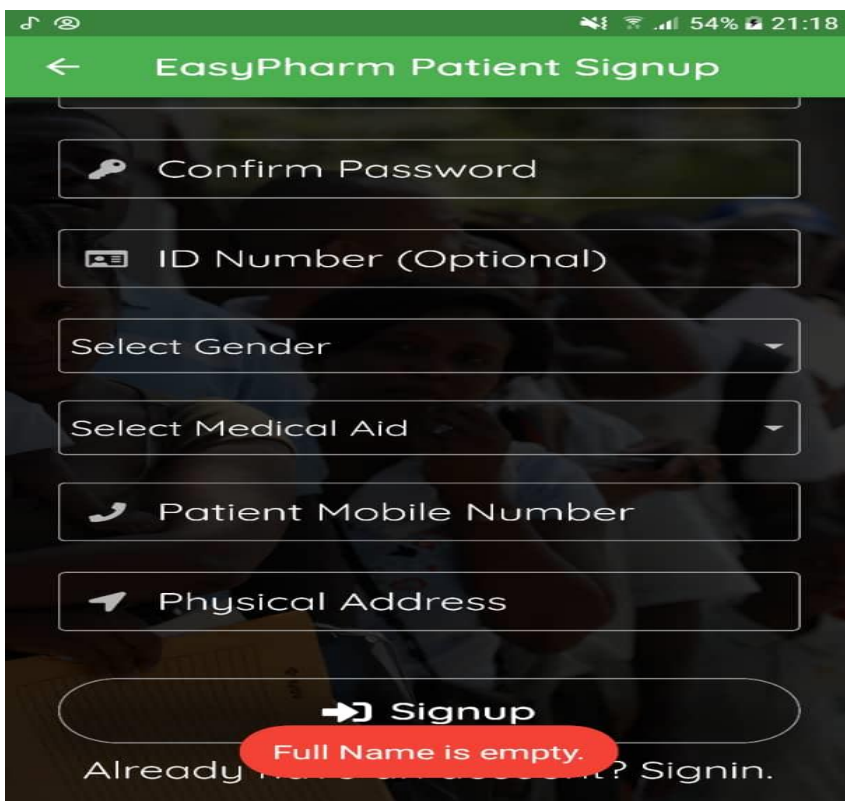


Fig 5.10 Pharmacy signup null values

5.4 Installation

Mathers, M. (2015), is when a developed system is being installed or being put in place of operation. This means the EasyPharm will be put in place of operation to be used as the old system will be phased out. The new system is installed in the appropriate hardware.

Installation steps

- The system is installed from the CD.

Fig 5.11 Application software installation

- Install the EasyPharm android application to path (programs should be installed in the local disk C).
- Ensure that the system has been successfully installed

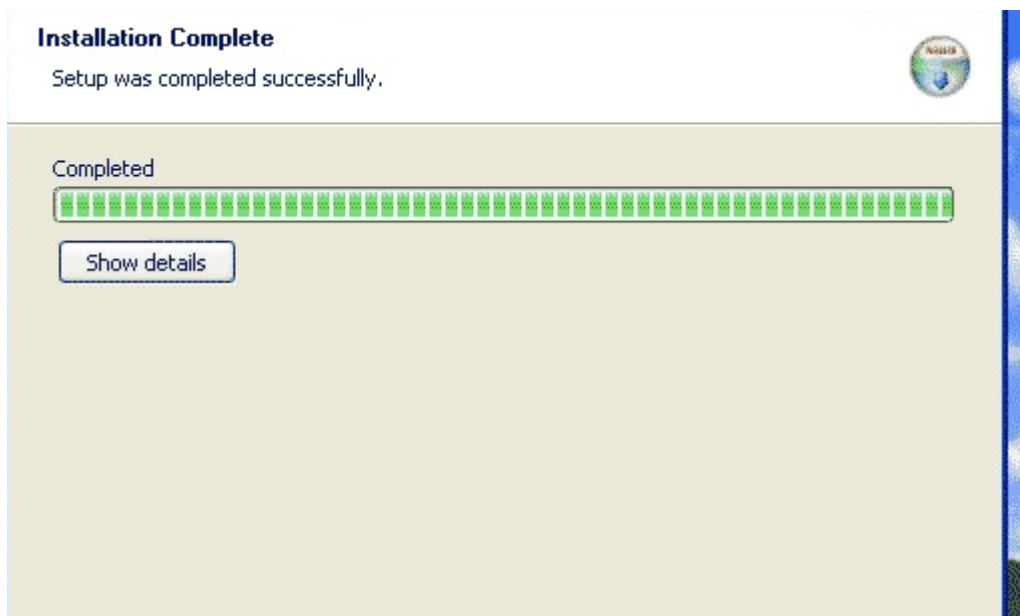


Fig 5.12 Successful installation

- Add system data source
- Connect the data source to the database on the main server

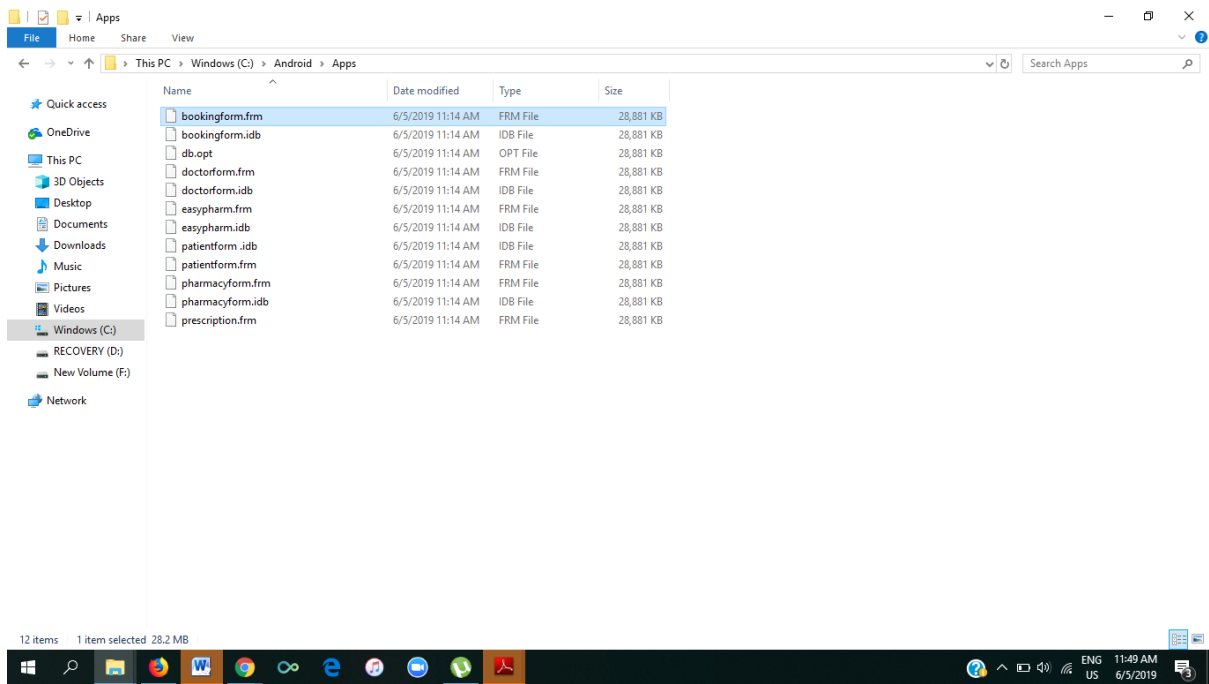


Fig 5.13 Software installation

5.4.1 User Training

The training of the end user on how to operate the installed software application is one of the important steps that ought to be performed for a successful implementation. Involving the end users at the earliest stage is very important as this will get them excited and learn how to utilize the system early. This will ensure there is no resistance of the new digitalized system as the end user become familiar with system.



Fig 5.14 End user training

5.4.1.1 Training Plan

Session 1

Trained team	System Administrators and Support system engineers
Training scope	Helpdesk(EasyPharm), Troubleshooting and system overview
Requirements	Projector and three laptops
Trainer	Sunungurai Ashley Mayisva (System Developer)

Table 5.1 Training session 1

Session 2

Trained team	System Administrators and doctors
Training scope	Systems overview, Reports Generation and Extraction and Logs Review
Requirements	Projector and three laptops
Trainer	Sunungurai Ashley Mayisva (System Developer)

Table 5.2 Training session 2

Session 3

Trained team	System Administrators and pharmacists
Training scope	Systems overview (EasyPharm), Patient reports generation and Extraction and Logs Review
Requirements	Projector and three laptops
Trainer	Sunungurai Ashley Mayisva (System Developer)

Table 5.3 Training session 3

Session 4

Trained team	Receptionist
Training scope	Patient registration, appointment booking, Chatbot utilization and patient suggestion of cases.
Requirements	Projector and three laptops
Trainer	Sunungurai Ashley Mayisva (System Developer)

Table 5.4 Training session 4

5.4.2 Changeover

This is a process of moving from the old system to the new implemented system for operational use (Cliff: 2014). Data conversion are utilised to minimize patients resistance to the new system, therefore change should be gradual. There are several conversion methods classified as the following:

- Pilot conversion
- Direct conversion
- Phased conversion
- Parallel conversion

5.4.2.1 Pilot conversion

A small group of users or a certain department is given the new software application to implement and the rest of the organisation keeps using the old system according to Cliff (2014). The users making use of the new system will then give feedback of the system and eventually the whole organisation will roll out and start using the system. The new system will be assessed in a secure domain. The risk is relatively lower than other conversion methods as the risk is only impacting a small fraction of the organisation.

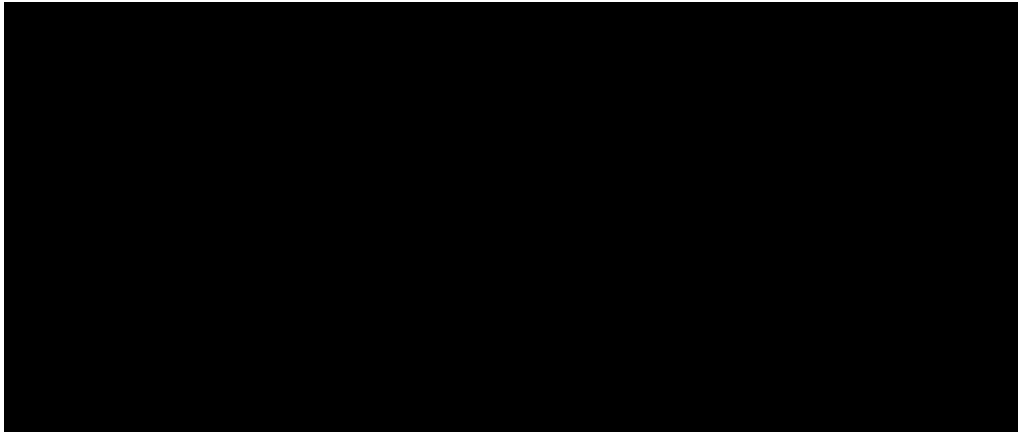


Fig 5.15 Pilot changeover

Advantages of pilot changeover

- It poses medium risk as the risk is only impacting a small fraction of the organisation.

Disadvantages of pilot changeover

- It longer to get the system fully implemented
- Can be costly to implement.

5.4.2.2 Direct conversion

According to Cliff (2014), this conversion method involves the complete changeover from the old system to the new system. The system users have to all stop using the old system moving to a full functioning EasyPharm Android application. This has lower costs as implementation is performed once but on the other hand, poses high risks if the implemented system fails to operate as expected by the patients or the system users. This method is used if there is high certainty of the implemented system functionality.

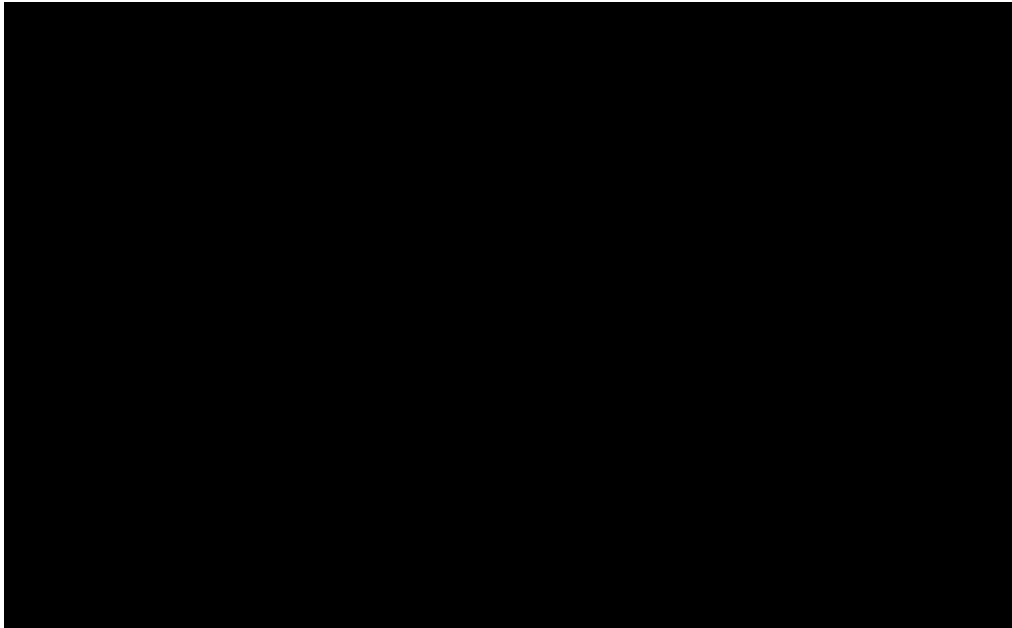


Fig 5.16 Direct changeover

Advantages of Direct changeover

- It is a cheaper data migration method as it completely stops the operation of the new system.
- It takes a short period of time to implement.
- There is no duplication of data.

Disadvantages of Direct changeover

Poses high risks if the implemented system fails to operate as expected.

5.4.2.3 Phased conversion

The new system is broken into phases and each phase is implemented after the previous phase has been successfully functioning without errors according to Cliff (2014). The users will gradually adjust to using the new system as the changes come in phases. It takes a longer time period to fully implement and use. This conversion method is less likely to face resistance from clients as change is slow.

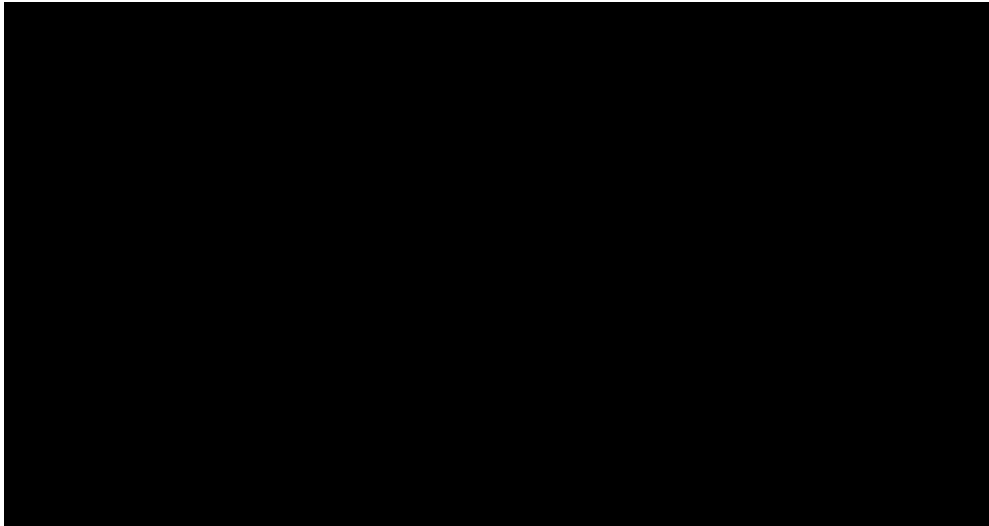


Fig 5.17 Phased change over

Advantages of phased change over

- The users will gradually adjust to using the new system as the changes come in phases.

Disadvantages of phased change over

- It is a lengthy method of data migration.
- It can be costly if the budget is tight.

5.4.2.4 Parallel conversion

This is the simultaneously running of both the old and the new system until the new system has been judged to be satisfactory as stated by Cliff (2014). Then the new system will be fully running alone without the old system. Although with this method of conversion, there is no loss of information, but it is very costly because until the old system is eliminated, the data is recorded twice in both systems (old and new). This is the recommended method of conversion as compared to the rest of the other methods.

Reasons of using parallel conversion

It allows adequate time for the users to fully understand the new system operations and functionality.

- It poses lower risks as no information is lost.
- It allows users to give feedback before full changeover.

- This conversion has backup in case of any problem, we can revert back to the old system.
- There is full satisfaction of the new system from users before full changeover.

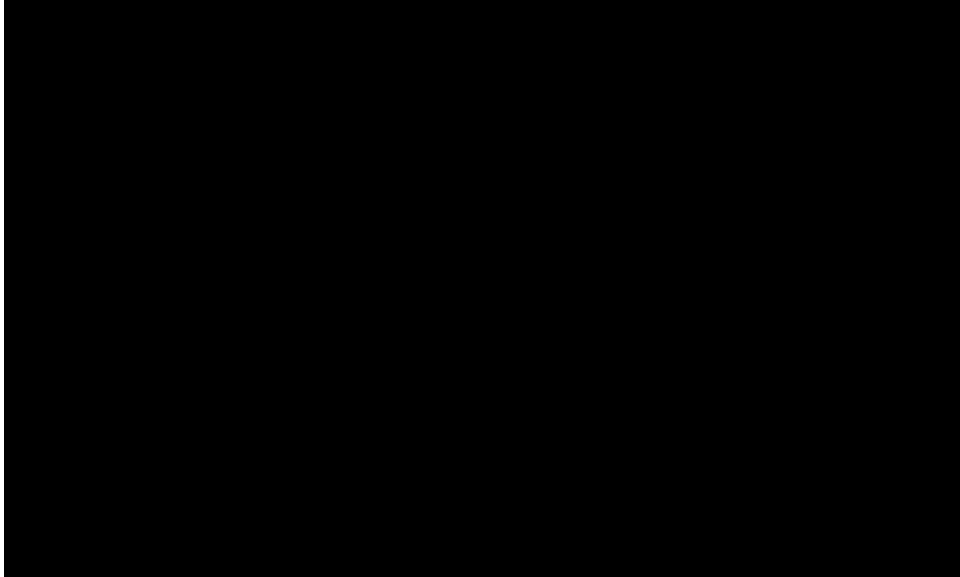


Fig 5.18 Parallel changeover

5.4.3 Data migration

Data migration is referred to as the process of transferring data from one location to another new and improved system or location (Sommerville, 2005). It effectively selects, prepares and transforms data to permanently transfer it from one system storage to another. With the focus of enterprises increasing on optimization and technological advancements, they are availing database migration services to move from their on-premises infrastructure to cloud-based storage and applications. The different types of data migration available include the following:

- **Cloud Migration:** It is the process of moving data, applications and all important business elements from on-premise data centre to the cloud, or from one cloud to another.
- **Application Migration:** Involves transfer of application programs to a modern environment. It may move an entire application system from on-premise IT centre to the cloud or between clouds.
- **Storage Migration:** It is the process of moving data to a modern system from outdated arrays. It enhances the performance while offering cost-effective scaling.

We chose the storage migration as this was more cost effective and efficient for our data migration plan.

5.5 Maintenance

This is an on-going process of keeping the system functioning properly, removing system errors, updating the user documentation (Sommerville, 2005). This process ensures that there is monitoring, controlling and modifying of the existing system so as to improve the system life cycle of the implemented system.

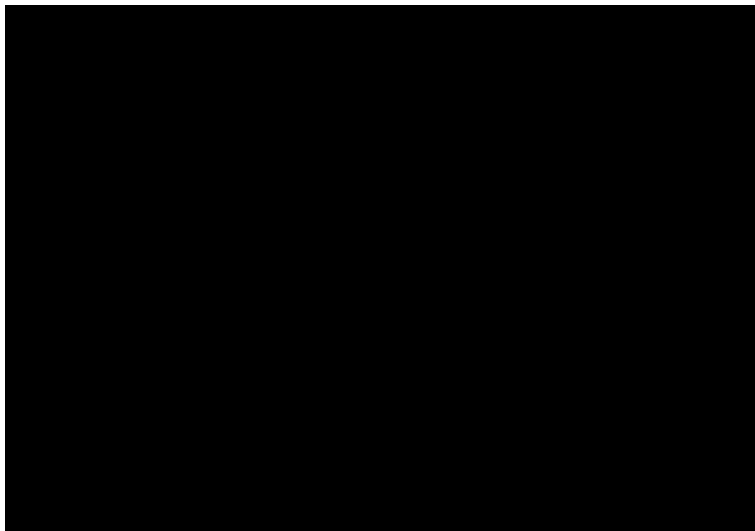


Fig 5.19 Maintenance types

5.5.1 Corrective maintenance

This is a task of finding errors and defects with the usage of the system (Sommerville, 2005). These defects are set out to be corrected as a maintenance process. The main aim is to correct errors that would not have been noticed during testing phases (Alpha and Beta testing). Once an error is identified when using EasyPharm Android application, investigations are to be carried out right way and corrective maintenance takes place. Reviews of the changes made are taken into account; these changes are documented and recorded.

5.5.2 Adaptive maintenance

In the Information Technology field, change is always evolving, therefore the system need to be up to date with the technological adjustments as well as to adapt to these adjustments

(Sommerville, 2005). There are also changes that are occurring in the health sectors, thus the EasyPharm Android application should be able to adapt to these changes and be modified to accommodate them. As to date there have not yet been any changes that have occurred.

5.5.3 Perfective maintenance

According to Sommerville (2005) the goal is to add a better version of the already existing system. This means adding functionality and improving the EasyPharm Android application system. We need to assess the validity of perfecting the already existing state; if there are adequate reasons then changes are to be performed. These changes are recorded and documented.

5.5.4 Preventative maintenance

This is basically maintenance of replacing, restoring system data at a fixed interval time. System should have the capacity to prevent system failure (Sommerville, 2005). This routine maintenance ensures that the EasyPharm Android application does not experience downtime period and unanticipated failure of the system functionality. To ensure preventative maintenance inspections, repairs and replacement of equipment should be always up to date by the system administrator.

5.5.5 System evaluation versus system objectives

The EasyPharm Android application was tested to analyse whether the system objectives were met by the developers.

- Electronic booking of appointments by patients.

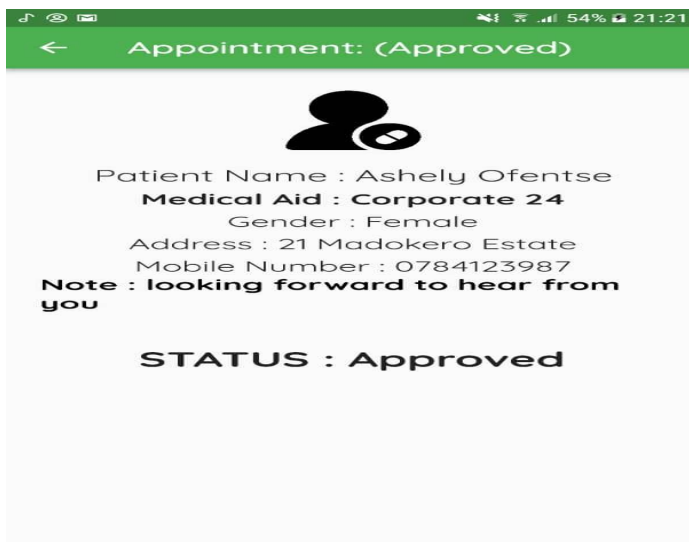


Fig 5.20 Patient appointment

- To develop application that allows the doctor to make electronic prescriptions for patients.

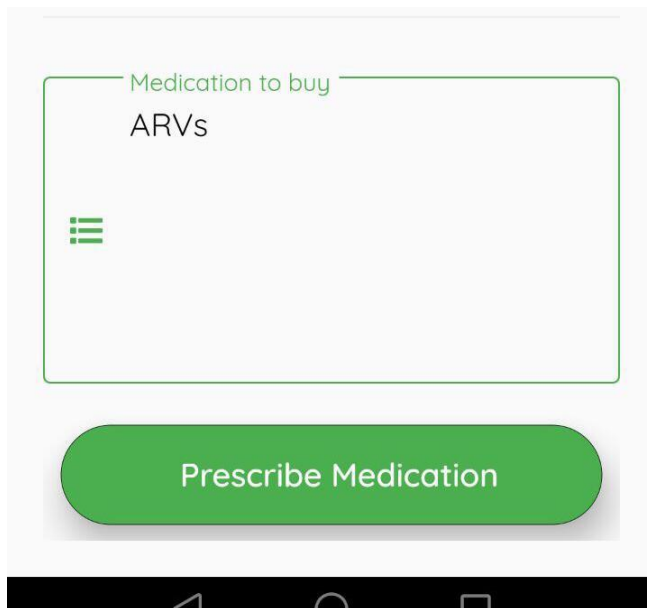


Fig 5.21 Prescribe Medicine

- To develop an application that can allow system users to report cases.

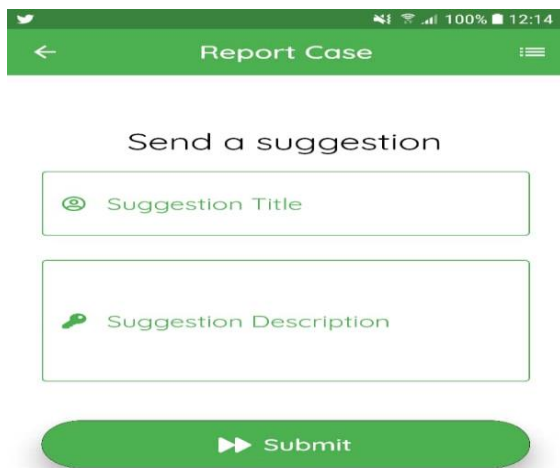


Fig 5.22 Report Case

- Develop an android application that uses AI Chabot for automatic response.

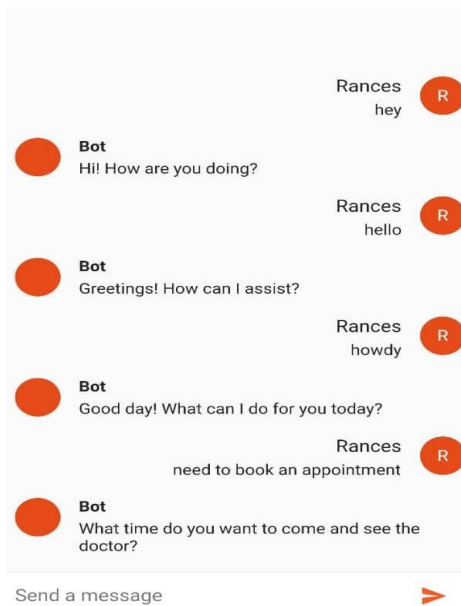


Fig 5.23 Chatbot

- To develop an application that can show the patients on the availability of all the registered doctors.

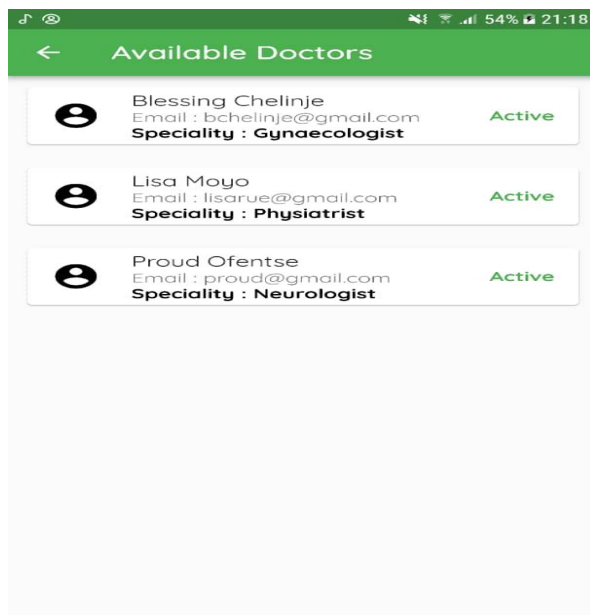


Fig 5.24 Available Doctors

5.6 Recommendations for future/further development

Given that the EasyPharm Android application was successfully implemented, there is room for improvement such as:

- The EasyPharm should also accommodate other governmental hospitals and private hospitals so that patient records could be viewed from any hospital once a patient is registered into the system

5.7 Conclusion

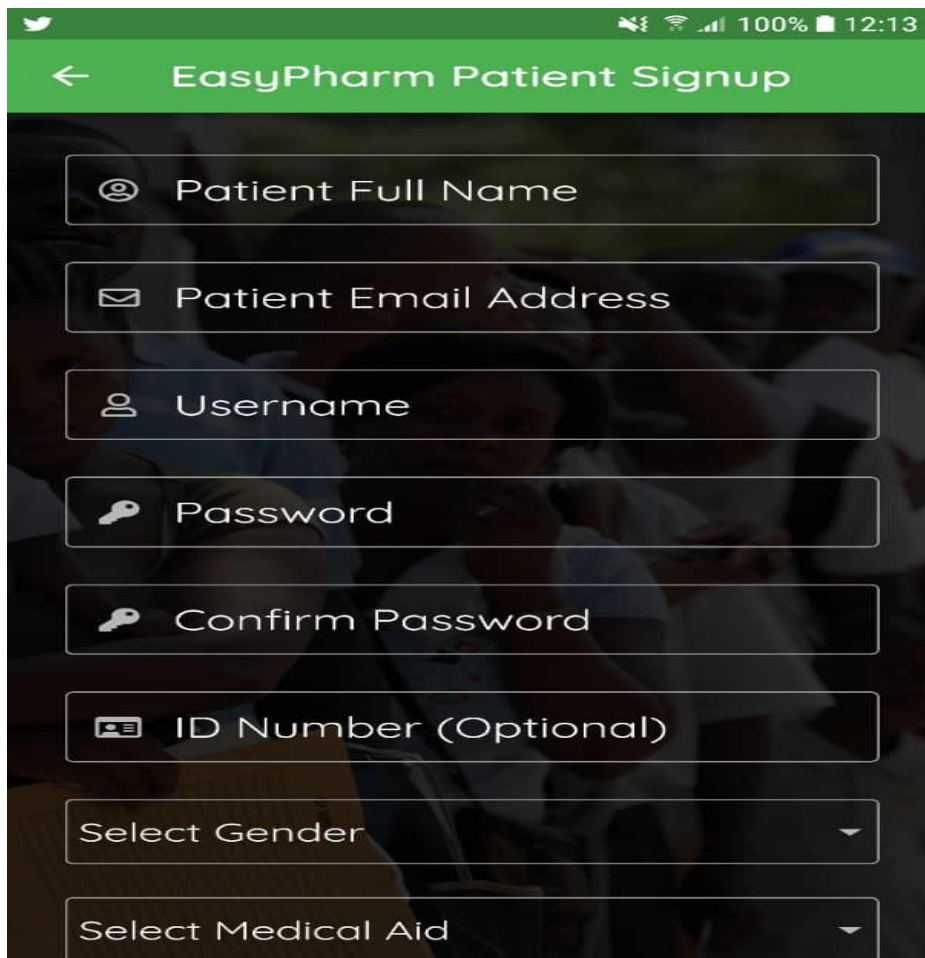
The EasyPharm Android application has been implemented successfully; the project has been a great success. Data integrity of the system was ensured through the process of validation and verification. Proper security measures have been put in place to ensure data security and reliability of our information. Maintenance measures have been put in place also to ensure that the system will perform correctly throughout its system life span.

APPENDIX A: USER MANUAL

The EasyPharm Android application was designed to be very interactive with the user and be easy to use. The command buttons guide users for example to submit data of capturing user registration, there had to click a create button to process all the information that was entered for that user profile. The system ensures there is execution any transaction without any complications. For a user to access the system should enter the correct username and password. Once logged in the user will be directed to account home where he/she will view forms that he/she can choose from. Below are steps the user is to undergo when using the system.

STEP 1: User registration

The user provides the required information so that a profile can be created. This information is stored into the database and the user profile is created. Only registered users can make use of the EasyPharm android application therefore all users are required to sign-up first.



The screenshot shows the 'EasyPharm Patient Signup' screen. At the top, there is a green header with a back arrow and the title 'EasyPharm Patient Signup'. Below the header, the form consists of several input fields, each with a corresponding icon: 'Patient Full Name' (person icon), 'Patient Email Address' (envelope icon), 'Username' (person icon), 'Password' (key icon), 'Confirm Password' (key icon), 'ID Number (Optional)' (ID card icon), 'Select Gender' (dropdown menu), and 'Select Medical Aid' (dropdown menu). The background of the form is dark with a faint image of a person's face.

Fig A1: Patient Signup

Login form:

This form requires the user to input their login credentials (username and password) to access the system. If the credentials are all correct the system will grant the user access.

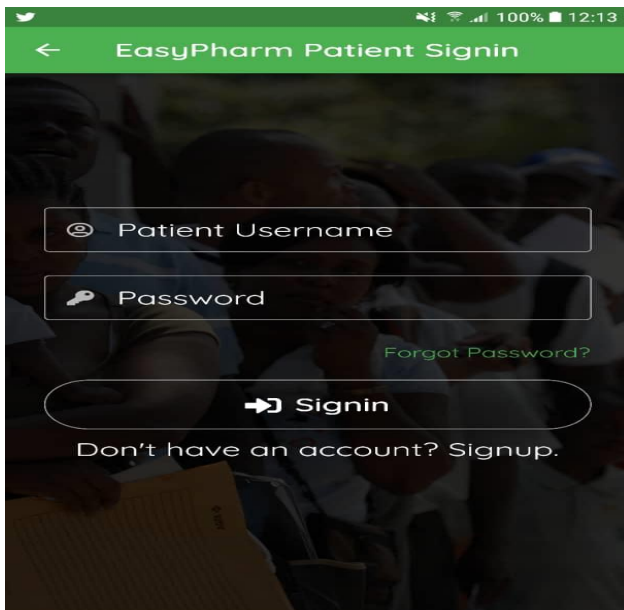


Fig A2: User login

User Profile:

Once the user is logged in a screen as below appears with a greeting of that user name in this instance the user is Ashley.

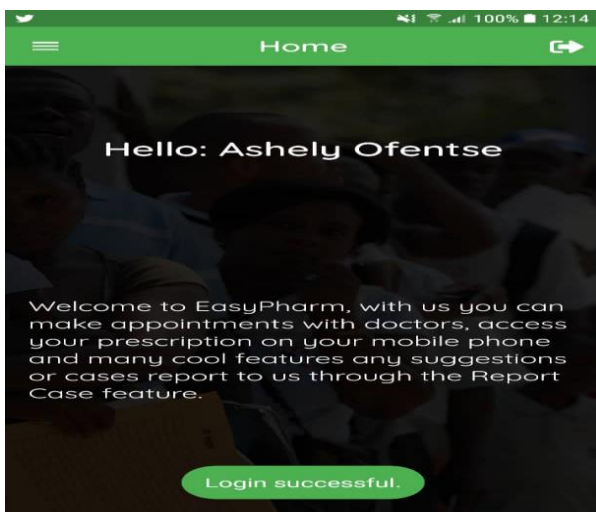


Fig A3: Welcome page

User navigation tab

Now that the user has login successfully, the user should be able to select and navigate through the system.

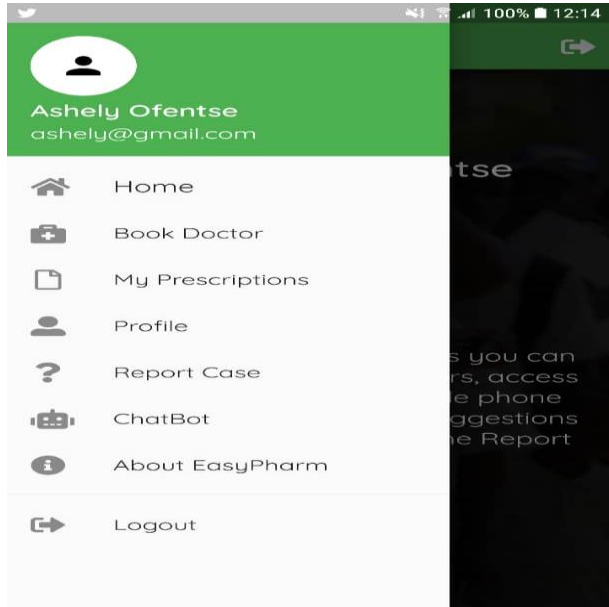


Fig A4: User Main menu

User bookings

The patient should be able to book for an appointment for a consultation with the doctors available.

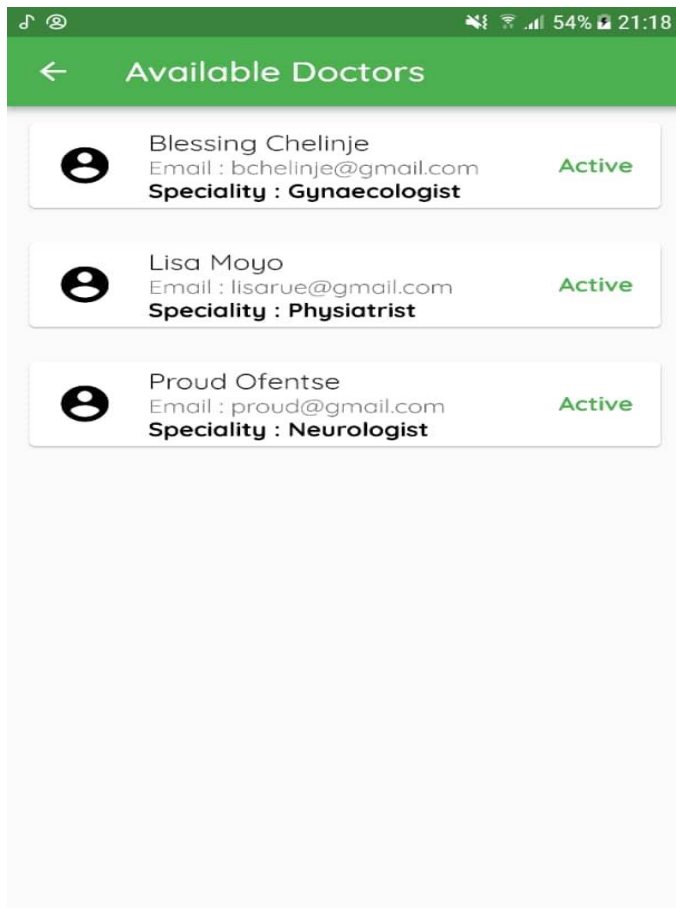


Fig A4 Available doctors

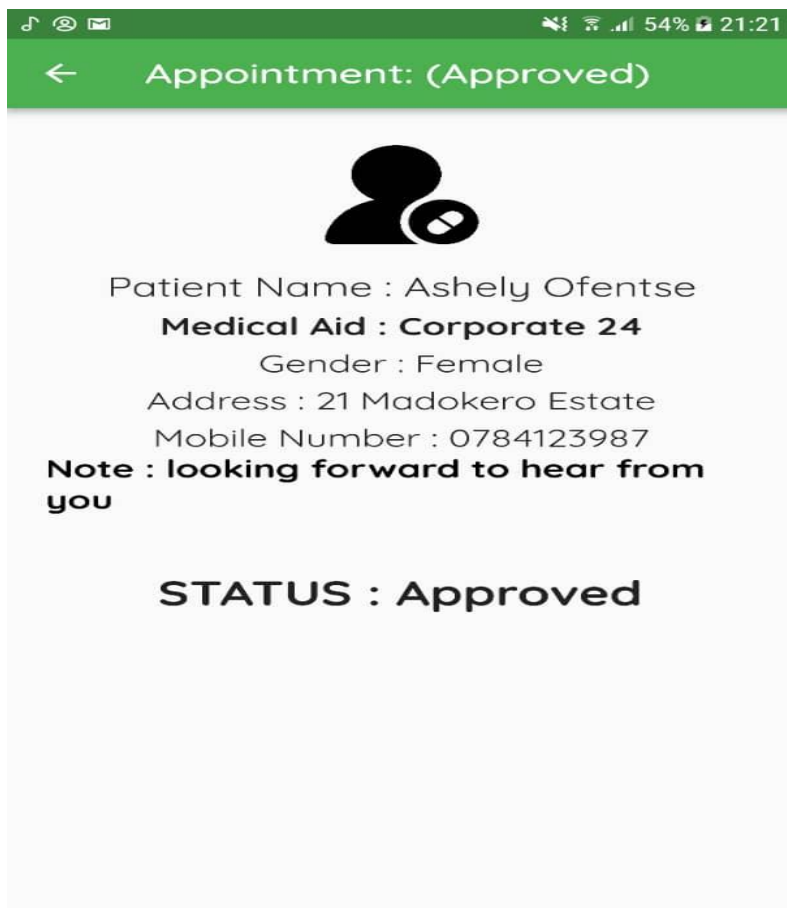


Fig A5: Appointment approval

Report case

The EasyPharm Android application enables the users to report cases.

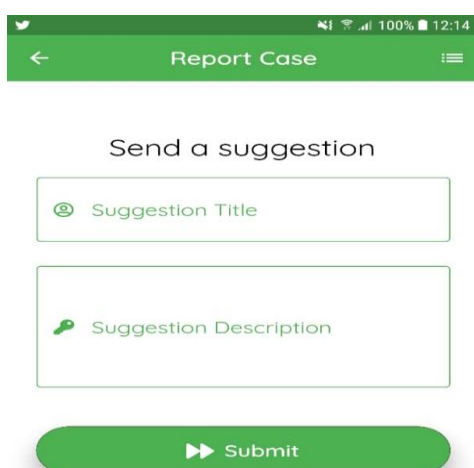


Fig A6 Report case

Chatbot

The system has an artificial intelligent conversational bot which conducts a conversation via textual methods simulating health service delivery by the receptionist.

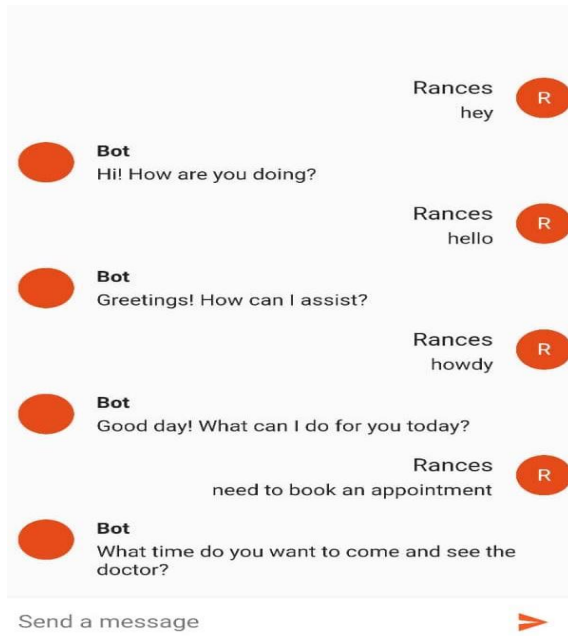


Fig A7 Chatbot

APPENDIX B: Interview Checklist

Ministry of health

Interview Details with Patients

Name of Interviewer _____

Position of Interviewee _____

Department of Interviewee _____

1. How many times have you been treated at the Parirenyatwa hospital?

2. How would you rate the current system of health service delivery to the patient ?

POOR	MODERATE	EXCELLENT
------	----------	-----------

3. What are the problems that are arising from this current system?

4. What is the average time required to get service?

0-1 HOUR	1-2 HOURS	3-4 HOURS	4+ HOURS
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5. Are doctors always available for consultation?

6. Are the files for patients always available and retrievable?

7. Are you comfortable with the current system? YES/NO. If not then state why

8. What do you suggest be done to improve the current system?

9. What challenges are being faced with manual prescriptions?

10. How well do you think the previously changes will be accepted by the society?

SIGNITURE.....

STAMP

APPENDIX C: Interview Checklist

Interview Details with Employees

Name of Interviewer _____

Position of Interviewee _____

Department of Interviewee _____

1. How many years have been employed at the Parirenyatwa hospital?

2. How would you rate the current system of health service delivery to the patient ?

POOR	MODERATE	EXCELLENT
------	----------	-----------

3. What are the problems that are arising from this current system?

4. How long does it take to compile or retrieve a patient file?

5. What do you suggest be done to improve the current system?

6. Do you think everyone is comfortable with the current system?

YES NO

If not, what do you suggest be done to improve the current system?

7. Do you think the introduction of an EasyPharm Android application would be appropriate?

YES NO

If yes, please explain why?

8. How well do you think the above change will be accepted by the other employees?

SIGNITURE.....

STAMP

APPENDIX D: Questionnaire

QUESTIONNAIRE: PARIRENYATWA HOSPITAL

NOTE: Please try to answer all questions since there is confidentiality and tick one box where appropriate.

1. Are you satisfied with the current system?

YES NO

2. Do you think decisions that are made using the current system are accurate?

YES NO

3. Do you experience any difficulties with the current system?

YES NO

4. Do you keep track of your patients?

YES NO

5. How do you feel about introducing the EasyPharm Android application?

6. What benefits do you think the EasyPharm Android application will bring to the health sector?

.....**THANK YOUR FOR YOUR COOPERATION**.....

APPENDIX E: Observation Score Sheet

Name of Observer: _____

Department: _____

Date: _____

Conclusion:

Signature.....

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REFERENCES

- Ammann. P and Offutt. J (2008), Introduction to Software Testing, Cambridge University Press, United States of America.
- Blaxter, L. (2010), How to Research, McGraw-Hill Education, UK.
- Chemuturi. M (2013). ‘ Mastering IT Project Management: Best practices, Tasks and London: J. Ross Publishing.
- Cliff Butt (2014), Systems Analysis and Design for beginners.
- Desikan. S (2006), Software Testing: Principles and Practice, Pearson Education, New Delhi, India.
- Denscombe (2010). Structured System Analysis and Design, Firewall Media, New Delhi, India.
- Engel. A (2010), Verification, Validation and Testing of Engineered Systems, John Wiley and Sons, New Jersey, Canada.
- Gray, William (1998), The computational Beauty of Nature, MIT Press, UK.
- Gupta. A. K (2007), Taxonomy of Database Management System, Firewall Media, New Delhi, India
- Howe, D. R (2001), Data Analysis for Database Design, Butterworth-Heinemann, USA.
- James A. O. (2014), Management Information System, Cape Town Printers, SA.
- Jewell, B. (2004). ‘ *An Integrated Approach to Business Studies*’, 4th Edition. London: Longman.
- Jeffrey, O. G. (2010), System Requirements Analysis, Academic Press, USA.
- Jeya (2013), Object Oriented Analysis and Design Using UML, Tata McGraw-Hill Education
- Kendall, K and Kendall, J. (2013), Systems Analysis and Design, Pearson Education Limited, UK.
- Maidasani. D (2007), Software Testing, Firewall Media, New Delhi, India.
- Myler. H. R (1998), Fundamentals of Engineering Programming with C and Fortran, Cambridge University Press, United Kingdom.
- Overby, S. (2001), Information Technology Outsourcing, Routledge, India.
- 109
- Shelly.G.B, Rosenblatt. H. J (2011), System Analysis and Design Cengage Learning, Boston, USA.

Singh. S. K (2011), Database Systems: Concepts, Design and Applications, Pearson Education, New Dehli, India.

Toby. J. T, Lightstone. T.N and Jagadish. H. V (2011), Database Modelling and Design: Logical Design, Elsevier, USA.

Wesy. T, (2007) *Management Accounting*, Bloomsbury Publishing Incorporated, USA