GWERU HOSPITAL TELEMEDICINE APP

PERRENCE MUNYARADZI MUZAVAZI

(R125710X)

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BY

PERRENCE MUNYARADZI MUZAVAZI (R125710X)

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Supervisor: MR S. S FURUSA

Abstract

In line with National Development Priorities and the UN Millennium Development Goals as documented in the Zim-Asset blueprint under the Social Services and Poverty Eradication cluster, the health care system is not greatly benefiting from the wide spread use of ICT solutions countrywide. Every process in the medical sector requires the patient and the health practitioner to be in the same room regardless of the nature of visit. Thus unnecessary meetings like consultations, education, and data sharing even check-ups are not benefiting from the virtualisation that technology brings. Gweru Hospital Telemedicine is an android application used by patient to interact with remote doctors to send and receive data about prescriptions, consultations, referrals, bills.

This project is aimed to provide remote communication and collaboration between patient and health care workers. The platform is to be modularised into consultation, education and data transfer components to provide a minimum viable product for proof of concept. A thorough feasibility study of the system was weighed to enable assessment of the practicality and application of the system and enabled the determination of the system's viability. The inputs, processes and outputs of the system were designed as well as the flow of data accompanied with entity relationships and databases. As designing was done, proper verification and validation for the system follows so as to come up with a system with data integrity. Finally, after the system was designed successfully, it was tested to see if it meets the user expectations. Vulnerability scanner tools were used to identify development errors, configuration faults and transaction sequence faults. Java, XML, SQLite and the Firebase I/O were used for the design and development process.

Declaration

I Perrence M. Muzavazi (R125710X), hereby declare that I am the sole author of this project. I authorize the Midlands State University to lend this project to other institutions or individuals for the purpose of scholarly research.

Signature _____ Date _____

Approval

This project "Gweru Hospital TeleMed MOBILE APPLICATION" by Perrence M Muzavazi (R125710X), meets the regulations governing the award of the degree of Bachelor of Science Information Systems Honours Degree of the Midlands State University, and is approved for its contribution to knowledge and literal presentation.

Supervisor_____

Date_____

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Lastly I would love to thank my BELOVED twin mothers who have been an unceasing mainstay of forte, through your constant prayers I am now here, my Sisters Fadzie and Yvette may the Lord Bless you and my Big Bro Trevor I love you.

Dedication

This dissertation is dedicated to my twin moms and my late father, friends and my family at large. Their love, social and financial support in my entire academic expedition is second to none, if it had not been for them as my fountain of hope, inspiration and motivation, this dissertation was going to be a thorn in the flesh to me. May the Almighty Lord bless them abundantly?

To my twin moms, love you always…

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List of Acronyms

CBA	Cost Benefit Analysis
DFD	Data Flow Diagram
MDC	Mobile Data Collection
NPV	Net Present Value
RAM	Random Access Memory
ROI	Return on Investment
SQL	Structured Query Language
UI	User Interface
UML	Unified Modelling Language
UPS	Uninterrupted Power Supply
URL	Universal Resource Locator
UX	User Experience
XML	Extensible Mark-up Language

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Various definitions of telemedicine have been proposed and according to an online publication by India Telemedicine research network defined telemedicine as the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities. The topic in discussion encompasses all the medical actions and or procedures that extend the act space of health care practitioners beyond the face-to-face connexion with their patient in the direct surroundings. It is practice of medicine at a distance (remote health care facilities). This includes consultation, health care delivery, treatment, diagnosis, education and the transfer of related data.

1.2 BACKGROUND

1.2.1 BACKGROUND OF ORGANISATION

Gweru general hospital is one of the biggest state owned hospital in the midlands province. It is underneath the Ministry of Health and Child Welfare and is registered with the Health Authority. It was officially opened by Prince George on the 27th of March 1934. It was established to provide all-inclusive health care services .The government of Zimbabwe needs to have uppermost level of health care services and quality life for all its people achieved through combined determinations of individuals, societies, administrations and governments which will permit them to contribute entirely in the social-economic growth of the country.

1.2.2 ORGANISATIONAL STRUCTURE

An organizational structure is a pictorial depiction that shows the information flow and possible channels of communication within the organization. The fig overleaf depict the organogram of the hospital.

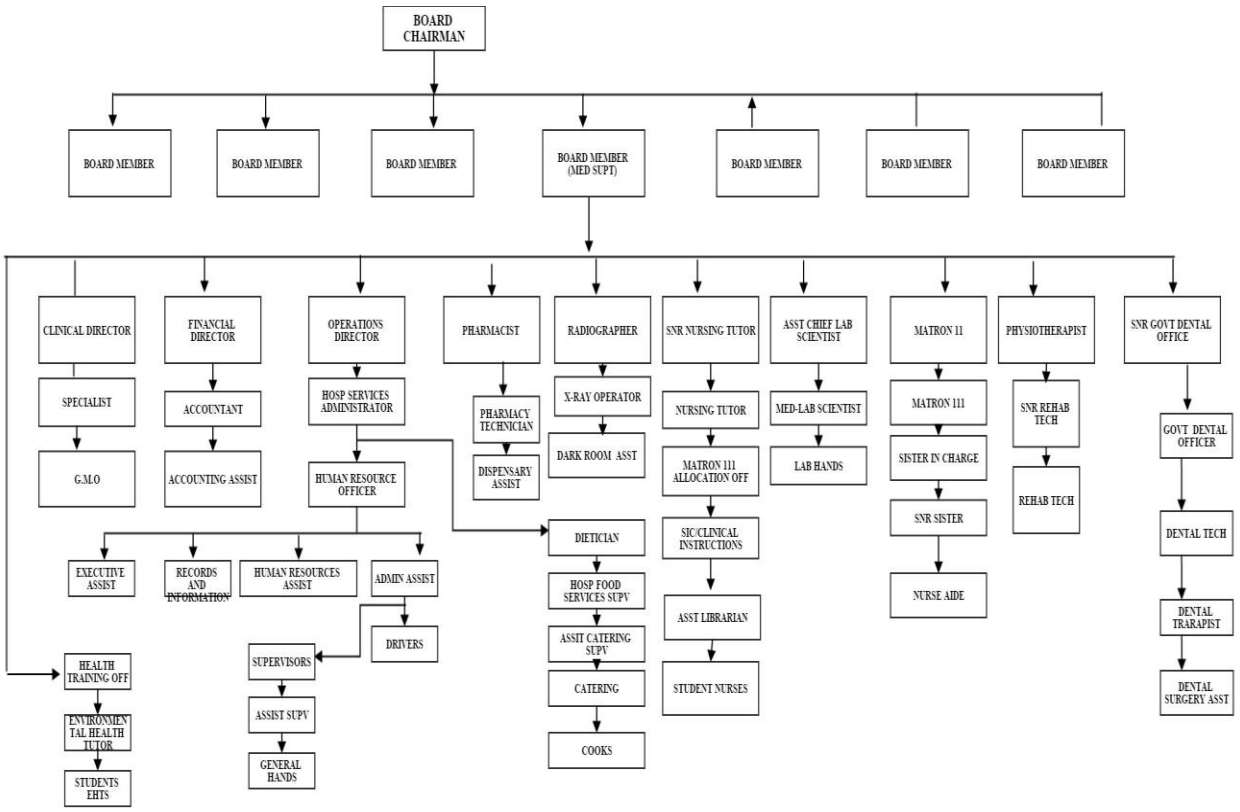


Fig 1: Organogram

The above is a traditional style of organisational structure in which the organisation is highly decentralised and division operate in parallel. It depicts a strict chain of command in its operations and this comes with its own advantages and the related disadvantages. It does not suite in the ever changing industries and its strict to chain of command can cause time sensitive decision to be delayed until superiors give a go ahead. Regardless of the inherent drawbacks, it is quite efficient in running big corporations like the ministry of health.

1.2.3 VISION

To thrive being a model excellency in facilitating world class health care services delivered to all members of the community through efficiency in all dimensions of management.

1.2.4 MISSION

- To keep the community in healthiness and fit.
- Provision of appropriate quality health care services for those in need of it.

1.3 PROBLEM DEFINITION

In line with National Development Priorities and the UN Millennium Development Goals as documented in the Zim-Asset blueprint under the Social Services and Poverty Eradication cluster, the health care system is not greatly benefiting from the wide spread use of ICT solutions countrywide. Every process in the medical sector requires the patient and the health practitioner to be in the same room regardless of the nature of visit. Thus unnecessary meetings like consultations, education, and data sharing even check-ups are not benefiting from the virtualisation that technology brings.

1.4AIM

The major reason behind this project is to develop a TeleMed application for remote communication and collaboration between patient and health care workers. The platform is to be modularised into consultation, education and data transfer components to provide a minimum viable product for proof of concept.

1.5 OBJECTIVES OF THE STUDY

- Promote interoperability by sharing records of patients by doctors.
- The system shall avoid unnecessary visits to health institutions by allowing the remote transfer of medical data (text, voice, images etc.) between patients and health care workers.
- Facilitate patient to make appointments to medical doctors remotely.
- To facilitate prescribing of treatment to remote patients and sending it in the most convenient format.
- Enable the doctor to refer a patient to a specialist

1.6 INSTRUMENTS AND METHODS

The following is a list of the instruments that would be used in the project development and implementation.

- **PHP**: a server-side scripting language that is suited for dynamic web applications.
- **JAVA:** an object-oriented language simplified to counter language features that root shared programming errors.

- **MySQL**: Relational Database Management System (RDBMS) that uses Structured Query Language (SQL).
- **SQLite**: a local database engine imbedded in the android OS.
- **ANDROID STUDIO:** IDE for building rich end user android apps.
- **XAMPP**: a multi-operating system open source Application Server used to simulate the server for PHP and Perl scripting languages.
- **XML**:

1.7 JUSTIFICATION AND RATIONALE

Currently the rural community face specific problems with regard to accessing health care services, in history of service delivery they have suffered health inequalities compared to the close to shop urban communities. There is relatively high costs that are caused by unnecessary visits to the clinics and hospitals that can be countered by remote interaction between the patient and doctors. Telemedicine increasingly is vibrant to the health care delivery services, allowing health care providers to associate with their patients and consulting practitioners across long distances.

Time is an important resource that cannot be regained, the current set up cause patient to waste much of their time travelling and in waiting rooms just to see a doctor for a follow up or one of those ordinary visits. Zimbabwean hospitals and surgeries should embracing the use of telehealth technologies because of the benefits they offer such as simulated consultations using remote-based specialists and the ability to execute high-tech nursing without the need of having the disadvantaged patients to visit the hospital or surgery premises, less costs involved and a wide range of care selections for the patients.

From an economic perspective, the use of telemedicine paves way for additional generation of revenue. As the consultation can they can be done quickly, without any increase to office overhead, more patients can be seen each day, potentially representing a sharp increase in revenue. Increased use of TeleMed features in other parts of the world shows a shifting health care setting with a move towards integrated delivery and robust payment models. This use of

ICT in the health care delivery system has great potential to increase quality and access of healthcare to individuals in distant rural communities.

1.8 CONCLUSION

This chapter has shed light to the current problem of not implementing ICT in some for the key health care facilities like consultation, education and remote collaboration in the form of sharing of information. The phase to follow discuss more about planning and evaluate whether the proposed system is feasible enough for further development and also the risks that comes with it.

CHAPTER TWO: PLANNING PHASE

2.1 INTRODUCTION

The second stage in the software development lifecycle is planning phase. It involves establishing the required modules and choosing the most appropriate actions that can be accomplished over the given time period. Pressman (2005) states that the process of planning in project management is that it ensures that an achievable framework that can be used by the developers to make justifiable estimations of resources and agenda is formulated.

This chapter contains discussions that seeks to give justifiable basis for the significance and the real need of developing and implementing the proposed system and also considering the costs of building it. The chapter also gives a detailed account of the business value the organization is to gain and the relative feasibility of undertaking the project in all dimensions as these are the key areas that need to be examined to conclude if the proposed project is viability enough for development to continue. This will be followed by a detailed and realistic proposed project plan the developer is will too undergo and take note on risk analysis and the work plan. This chapter seeks to give a supportable basis towards qualifying the project.

2.2 BUSINESS VALUE

Shelly and Rosenblatt (2010) document that business value of a project is the prominence, essentiality and value of a project. The discussion of getting to know the business value is essential as it shed light on the possibilities gained after the introduction of the TeleMed mobile application. The proposed project will enhance the information flow in health care services that can be undertaken that may include education, communication and or diagnosis. Ultimately this may improve the general health of the public leading to improved living standards making everyone better off after. There is possible greater efficiency as health care services will be offered virtually and remotely.

On the economic side, telemedicine has the ability to tamp down the rising cost of health care by allowing consumers to use less face time with doctors. Telemedicine saves money, because physicians charge less for a telephone call than from an in-person visit. About 50 percent of office visits are unnecessary. If one considers a patient visit, the travel time and expense does not add value to the customer. Time spent in the waiting room adds no value but rather the value is derived from direct interactions with providers. Telemedicine is the perfect way to eliminate all

of that waste for many types of visits including follow-up care, chronic disease management, lifestyle coaching and other types of cases hence it adds value and eliminate waste.

Telemedicine visits represent a significant opportunity to increase revenue. Because they can be conducted quickly, without any increase to office overhead, more patients can be seen each day, potentially representing a sharp increase in revenue. In addition, they make it possible to work with patients in a larger geographic area, increasing the potential market. Finally, they do not have to be confined to the hours when regular office staff is present. This gives providers the flexibility to offer non-traditional appointment times and expand or shift the hours they work.

2.3 FEASIBILITY STUDY

It is the process of scrutinizing the main aims of a proposed project. Considerations of the required resources for the project completion and other essential influences that play a pivotal role in the success of the given project are made (Luckey and Philips, 2006). On another viewpoint the study can be discussed as an examination to evaluate whether a project's cash inflows and outflows are in line with the business aim and vision. (Hazra 2012). The elements of feasibility analysis (study) include:

- Technical feasibility.
- Economic feasibility.
- Operational feasibility.
- Social feasibility

2.3.1 TECHNICAL FEASIBILITY

This is the process of evaluating the capacity of project sponsor to commence a proposed project in comparison to the resources at hand. The resources being considered may include software modules to the high end hardware that is to be used in development and implementation (Valacich et al, 2012). Project leader should also study the system compatibilities with the currently used technologies. In this feasibility study technical expertise and hardware and software are analyzed.

2.3.2 TECHNICAL EXPERTISE

This is the required personnel with the right skills needed in the development and the maintenance of the system. El-Sharkawy (2011) highlight that a software development team should contain vital and technically capable personnel and also the required technologies for the project to be production ready. Born (2001) states that project sponsor use technical specialists in coming up with systematic findings. From the above arguments, this process is greatly dependent on the accessibility of dedicated solution experts necessary to successfully develop the proposed mobile application. Currently the hospital does not have a dedicated team that is responsible for development and system support and maintancae hence need to outsource services is available

2.3.1.2 HARDWARE AND SOFTWARE REQUIREMENTS

Item	Item Description	Required Quantity	Available Quantity
i7 Laptops	8-12GB RAM, 4GB Graphics Card, 500GB HDD	3	1
Firebase IO Server	Real Time Back-end Database	1	0
Uninterrupted Power Supply	5500watts	2	0
Client Phone, Tablet, Android Wear	Testing Devices	3	1

Table 2.1: Hardware requirements

Item	Item Description	Required Quantity	Available Quantity
Video Plugins	Video syncing for android and web mobile application	1	0
Network Gateway	USSD Gateway	1	0
Firebase IO Server	Real Time Back-end Database	1	0
Operating System	Windows Server	1	0
Operating System	Windows 8.1 Professional	3	1

ADK	Android Studio	3	1
MySQL Server	RDBMS for testing	1	1

Table 2.2: Software requirements

2.3.2 ECONOMIC FEASIBILITY

Sharkawy (2005) states that a project is considered economic feasible if it generates a satisfactory rate of revenue, which sufficiently covers the respective cost and capital that was forego for it to commence. This process is undertaken to evaluate the costs and benefits of a proposed system development and operation. The system can only be seen feasible if the realized benefits outweigh the related incurred costs. This study is to answer whether the system will be completed within the proposed budget. The cost benefit analysis and investment analysis are going to be used for the determination of economic feasibility

2.3.2.1 COST BENEFIT ANALYSIS

Hughes and Cotterel (1999), define cost benefit analysis also known is an evaluation technique used to identify all costs related to the project and benefits which might be yielded from carrying out the project and then expressing them in common standard units. Luke (2003) explains that CBA encompasses rewards corresponding to costs to reach decisions focused on those comparisons, furthermore Randall (1996) advances that CBA unveils the project's feasibility in fiscal and economic profits and expenses. It focuses on the fact that do the benefits set-off the costs and outlays of developing the application?

2.3.2.2 .COSTS

A cost is the monetary value incurred in, or attributed to, a specific item or activity (Drury, 1997). In light of this endeavor it is largely the expenditure incurred in advancing and refining the application features. In relation to this projects, costs can either be classified as developmental or operational costs

2.3.2.2.1 DEVELOPMENT

Booyens (1998) states the development costs as the ones incurred in the progress of system development, for instance the licensing of the software and materials for system development.

The table overleaf is the summary of cost and benefits with considerations of the costs of system development.

Year	2016	2017	2018	Total
User Acquisition	300	500	200	**1000**
Application Maintenance	900	800	500	**2200**
Firebase I/O Licensing	200	200	200	**600**
Backend Analyst	800	800	800	**2400**
Development labour	2500	1000	1000	**4500**
TOTAL	**5300**	**3300**	**2700**	**10700**

Table 2.3: Development Costs

2.3.2.2.2 OPERATIONAL COSTS

Operational Costs				
Stationery	50	0	0	50
Printing and Photocopying	35	0	0	**35**
Consumables	40	0	0	**40**
Communication	50	0	0	**50**
Additional Software	70	0	0	**70**
Transportation	50	0	0	**50**
Further research	3500	1200	500	**5200**
TOTAL	**3795**	**1200**	**500**	**5495**

Table 2.3: Operational Costs

2.3.2.3 BENEFITS

Bradley (2010), defines benefits as the positive results from the operation of an endeavour. Benefits can be categorized in the form of tangible and intangible that is be gained from an information system (Valacich, 2012).

2.3.2.3.1 TANGIBLE BENEFITS

Valacich etal (2012) defines the concept of tangible gains as the gains from the development and operation of an information system, which are measured with certainty in monetary terms. On another note Bagad (2009) states that tangible gains are yields that are calculated in a common denomination. These benefits should be certainly countable and convertible to a monetary value. These may include better-quality info dissemination and increased artefact value. These include:

- Improved information dissemination
- Increased product quality
- Patient increased involvement
- Goodwill
- Health worker Productivity

The table below shows a summary of the tangible benefits that Telemedicine stakeholders will realize:

Year	2016	2017	2018	Total
Improved information dissemination	200	450	600	**1250**
Health Worker Productivity	400	1000	1800	**3200**
Increased Product Quality	400	850	1600	**2850**
Patient Involvement	200	300	950	**1450**
Total Benefits	**1200**	**2600**	**4950**	**8750**

Table 2.4: Tangible benefits

2.3.2.3.2 INTANGIBLE BENEFITS

A documentation by Shelly and Rosenblatt (2010) states that intangible profits are the related gains which one cannot quantify but prove to be important to an entity. Bagad (2009) mentions that these are benefits which one cannot grasp, measure and or confirm.

2.3.2.5 ESTIMATED CASH FLOWS

The project is expected to generate a positive cash flow as evidenced by costs projected to be incurred are less than the benefits to be gained.

2.4.2.5 COST BENEFITS ANALYSIS

ITEM	(2016) USD	(2017) USD	(2018) USD
1. DEVELOPMENT & RESEARCH COSTS			
Stationery	**$50.00**	**0**	**0**
Printing and Photocopying	$35.00	0	0
Consumables	$40.00	0	0
Communication	$50.00	0	0
Additional Software	$70.00	0	0
Transportation	$50.00	0	0
Development labor	$1500.00	0	0
Further research	$3500.00	0	0
2. OPERATIONAL COSTS			
New hardware	**$300.00**	**$150.00**	**$100.00**
Personnel training	$1000.00	$700.00	$200.00
Maintenance	$2500.00	$900.00	$500.00
Backup	$500.00	$250.00	$200.00
TOTAL COST	**$5430.00**	**$2200.00**	**$1100.00**
3. DIRECT BENEFITS			
Reduction in stationery	**$1800.00**	**$1400.00**	**$2000.00**
Reduced telephone costs	$3500.00	$3000.00	$1500.00
Reduction in manual labor	$2900.00	$2000.00	$1300.00
TOTAL BENEFITS	**$3350.00**	**$3700.00**	**$4800.00**
PROFIT(+) or LOSS (-)	**$2080.00**	**$1400.00**	**$3700.00**

Table 2.5: Cost benefit analysis

2.4.2.7 RETURN ON INVESTMENT

This is a method of calculating the productivity of a venture based on the returns and time period. (Randall 1996). It can be calculated as:

Net inflow / initial outlay expressed as a proportion

Net inflow - the difference between the cash inflows and injected capital

Initial outlay - the amount introduced to finance the project (Lucey 1996).

R.O.I = (AVERAGE ANNUAL PROFIT x 100) / AVERAGE TOTAL INVESTMENT

=$(-2080+1400+3700)/3 x 100

$(5430+2200+1100)/3

= (2393.3/8730) x 100

=**27.41%**

Comment: These calculation on ROI shows that with the three estimated years the project is able to yield 27cents for each dollar bill invested, this is advantageous hence the project can be said to be economically feasible to continue with development

2.3.3 SOCIAL FEASIBILITY

Badiru (2012), defines social feasibility is the process that caters for the influences that a project might have on the social setup in the project production environment. It focuses on the influence the system will have on the stakeholders of the hospital both positive and negative. The proposed system will have a positive effect on both the stakeholders and the organization as a whole as the proposed system will bring in education advancement, remote communication in all health care services and offer possible remote diagnosis. Inclusive stakeholder involvement will be done at all stages with staff workspaces and user manuals being made available to all end-users so as to counter resistance to change when the final system is done. This study has shown that the android TeleMed system is socially feasible and justifiable enough for development to continue.

2.3.4 OPERATIONAL FEASIBILITY

This is evaluation of the degree to which the system takes never ending advantage prospects made available to firm and its capability to adapt to ever changing business related problems and solve them accordingly. Thus it is an evaluation of the functionality of the system to be built fits in the daily procedures of the entity in question, in the process questions might arise to determine how the management is eager to support the system development process. If and only if the end-users have an influence in coming up with the system objectives and mobile application features. Is the organization at large going to have positive gain from the proposed project or not. When

the answers obtained is a yes then the project is deemed feasible enough to continue with development (Valacich et al 2012). Currently there is wide use of mobile applications in Zimbabwe and the public is eager to adopt to new technology hence the project can be deemed operational feasible to continue.

2.4 RISK ANALYSIS

Ooe (2005) defines risk analysis as the process of making the right decision under conditions of uncertainty that involve: risk management, assessment and or communication. During the development life cycle of the proposed system there are many forms of risks that may materialize and this discussion will focus on the possible risks and ways to counter them beforehand if possible. The list below shows the noted risk that are linked to the project:

- **Stakeholder Risk Analysis**: this refer to entities that have a concern in the project development, implementation and use. They are can be categorized as internal and external to the organization in question. Efficient communication is key to mitigate the risk that may come along by having entities with different views on the topic. To evade such risk from happening, the management may initiate meeting, request inclusive reports from the team for each stage of project life cycle.

- **Security Risk**: is considered as probability that is assigned to the project's chance of failing to have a positive ending due to the level of technology adoption in this side of the planet. Hence the key stakeholder (project sponsors) should know and be willing to take the risk that their investment into this initiative may go down the drain.

- **Monetary Risk**: the current explosive nature of this country's (Zimbabwe) economy depict a necessity for a vibrant monetary blueprint to prevent and or cover for the discrepancies that possibly will emanate resulting in failure of the project mid-way.

- **Requirements Inflation:** As the project progresses more and more features that were not identified at the beginning of the project emerge that threaten estimates and timelines. Constant involvement of customers and developers and having iterative feedback and by all means sticking to the noted objectives will hinder the project failure.

- **Inherent Schedule Flaws:** Software development, given the intangible nature and uniqueness of software, is inherently difficult to estimate and schedule. Getting the team more involved in planning and estimating is a mitigation plan that solves the mentioned risk. The project leader should get early feedback and address slips directly with stakeholders.

It should be noted that prevention of risks is key to the success of a project. In a complex technology environment, it is not enough to deal with problems as they become apparent. Prevention is key to experiencing flawless performance and getting the most out of systems, applications, and your development team.

2.5 STAKEHOLDER ANALYSIS

This is the identification of entities that have an effect and or are affected by the development and implementation of the project. The following list highlights the key stakeholders and their expectations and interests in the system:

- **Patients:** The want a time saving and hustle free solution to their current set up of health care administration. Their key interest is the efficiency of the mobile application in making their health concerns as simple as it can be.
- **Doctors:** This entity wanted to do away with the paper work system and have the ability to sync schedules, meetings, holidays, appointments and examination sessions without moving around and sorting the paperwork.
- **Hospital:** Its aim is to improve the overall service delivery to the community and also exploring new revenue streams.

2.6 WORK PLAN

A work plan can be described as a task which is broken down into a series of small manageable tasks which are spread equally over a time period showing how a task is to be carried out (Larson and Gray, 2011). A work plan has been generated for the current project and it shows all the activities that are to be done in the development and implementation of the proposed system and their related duration. It also comes with a Gantt chart which provides a graphical view of the work plan.

ACTIVITY	START DATE	END DATE	DURATION (Days)
PROPOSAL	01/12/2015	15/12/2015	2
PLANNING	11/01/2016	25/01/2016	2
ANALYSIS	26/01/2016	09/02/2016	2
DESIGN	10/02/2016	11/03/2016	4
IMPLIMENTATION	12/03/2016	28/03/2016	2
MAINTANANCE	29/03/2016	10/04/2016	2
DOCUMENTATION	01/12/2015	10/04/2016	14

Table 2.6: Work plan

2.7 GANTT CHART

This is a diagrammatical representation of the actual projected time to complete a task or reaching a specific level of development (Encarta dictionary, 2008), it serves to guide developer on meeting deadlines. On the words of Russell (2007) a Gantt chart displays the same tasks, milestones, dates, and time (duration) estimates as done by the critical path diagram or activity network diagram, however arranges them uniquely. The list of activities and their time periods are shown below:

Activity	1	2	3	4	5	6	7	8	9	10	11
Proposal											
Planning											
Analysis											
Design											
Implementation											
Maintenance											
Documentation											

Table 2.7: Gantt. Chart

2.8 CONCLUSION

The planning phase showed evidence of the gains that are meant to be enjoyed by the firm from continuing with the development and implementation of the project. It showed beyond reasonable doubt the economic feasibility that the project have. A work plan was drafted from which the system developer is going to put up with in order for the mobile application finish project in time. The next phase would be to analysis the current system that is available at the organisation noting the key weakness that will lead the development of the solution.

CHAPTER 3: ANALYSIS PHASE

3.1 INTRODUCTION

System analysis otherwise called prerequisites investigation, is a complete evaluation and investigation of the necessities of an application to substantiate a real business issue. It is a process of gathering unique information, considering the techniques included, acknowledging snags and giving practical acclamations in refining the present system. The analysis stage serves as the base for building up the new computerized application. It includes the evaluation of the present system to check for its usefulness, the issues at present being acquired and how, they can be solved (Hassainein, 1989). The section takes at a look at the information gathering methodologies that the engineer used to accumulate the data for system advancement. That information is further evaluated do that it's meaningful and help the development process (Velacich, 2013).

3.2 DATA GATHERING METHODOLOGIES

According to Potter (2003) these are an arrangement of strategies that are utilized by the developer to obtain information for investigation purposes. He further states that these methods may be utilized for information gathering for a specific range of study. Moreover Shahs (2008) proclaims that to completely examine and research on any system, experts need to gather data and each essential and important information. These facts once communicated in a quantitative nature will be known as information, and the triumph of any endeavour is mounted and based on the exactness of the information exhibited. Correspondingly Arora (2007) states that data gathering is a standard methodology used to collect information about application prerequisites, preferences and issues with the utilization of polls, meetings, gatherings and different various procedures. Procedures utilized include:

- Observations
- Interviews
- Questionnaires
- Mobile Data Collection (MDC)

3.2.1 INTERVIEWS

This is a dialog between interviewer and interviewee. The interviewer wishes to gain information from the interviewee. This technique is a useful form of qualitative data collection that can be

used in different set ups. These can be categorized into structured and unstructured. In this analysis phase structured were used as they are easy to construct and analyse the findings. Arora (2007) pointed out that interviews are a form of mutual and collaborative communication that call for a wide-range of interpersonal dexterity to be used by an interviewer to warrant or guarantee that the purpose is accomplished.

3.2.1.1 ADVANTAGES OF INTERVIEWS

- They were useful to get detailed information about the outlooks, perceptions and views of an individual as asked them more on the medical process.
- They was provision for detailed questions to be asked as it was a one on one with the key stakeholder for the project.
- High response rate was evidenced as most of the stakeholders wanted an improvement to the current system.
- Ambiguity was easy to clarify as we were dealing with the actual respondent as patient could not understand the terms that were being used

3.2.1.2 DISADVANTAGES OF INTERVIEWS

- The respondent had fear to speak out because of organisation ethics especially at the hospital.
- A small sample was used meaning other views about the current situation where not be aired out thus only a few doctors and patient were part of this survey.
- High costs were incurred to facilitate the interviews as outpatient needed allowance to com for the interviews.
- Quality of obtained data greatly depended on the ability of the interviewer hence in some cases the data which was obtained from patients and doctors was really meaningful.

3.2.1.3 FINDINGS FROM INTERVIEWS

From this process the analyst managed to get problems on the ground concerning the current setup shortfalls and possible ways of improving service delivery.

3.2.2 OBSERVATIONS

It involves continuous monitoring of the social and behaviour of subjects while they are performing their day to day operations (Patton, 1999). It can be categorized as either covert or overt. Covert observations is the scenario when the subject does not realize that he/she is being

observed and overt can be considered as when the subject is fully conscious about the surveillance. Both forms were used to get data of the old system and ways to improve the business processes.

3.2.2.1 ADVANTAGES OF OBSERVATIONS

- Covert: unbiased information was collected as patients and doctors were observed without them noticing of the activity.
- The information gathered can be considered reliable as it was obtained first by the by the analyst who was doing this project.
- There where high chances of getting neutral evaluation of the project as patients and doctors were not aware there were being monitored.

3.2.2.2 DISADVANTAGES OF OBSERVATIONS

- It was viewed as too subjective thus only what the analyst perceived was happening at the hospital would be the findings
- Not all aspects were observable as the analyst was only considering mostly quantitative things like time, costs etc.

3.2.2.3 FINDINGS FROM OBSERVATIONS

The analysts got an insight of the whole process that a patient will have to go through in order for his/her condition to be catered for. The delays, waiting queues were observed and also the unavailability of the doctors due to their limited availability.

3.2.3 QUESTIONNAIRES

Gillham (2008), defines question as a fact-finding process that involve a sequence of questions and probable responses as a way of collecting data from subjects. An observer will be collecting data from different subject when he/she visits them. This data gathering tool can be done as either open or close ended. In the analysis of the current set up, both types were used to get data of the old system and ways to improve the business processes. A closed questionnaire resembles a list of open ended interview questions written with spaces after each other, where individuals can write their answers. A closed format questionnaire contains closed questions that involve specific responds. Responds are required to choose from a limited number of available responses.

3.2.3.1 ADVANTAGES OF QUESTIONNAIRES

- The process of data collection was somehow easy.
- Questionnaires forms were generally easy to establish as compared to interviews and observations.
- The respondent provided standard responses which match precisely to what the observer needed to get.

3.2.3.2 DISADVANTAGES OF QUESTIONNAIRES

- It consisted of standardised questions hence it was not possible to provide a different view for the question that participants might have misinterpreted.
- Open-ended questionnaire: resulted in large amounts of data that was time consuming too process and analyse.
- Pre-coded questionnaire: it limited what the respondent could answer hence resulted in incomplete responses not revealing the exact existing scenario.
- It was prone to bias as the analyst could direct the respondents line of thinking

3.2.3.3 FINDINGS FROM QUESTIONAIRES

It should be noted that there was a high response from the stakeholders involved as everyone wanted the overall service delivery to improve. The questionnaires were mainly targeted to the patients and doctors as they are the main key stakeholders in the process. All the problems both parties face in the process was discovered and this led them to propose what the new way of doing things would be.

3.2.4 MOBILE DATA COLLECTION (MDC)

Mobile Data Collection (MDC) alludes to the utilization of tablets, cellular telephones as well as PDAs for information accumulation. MDC is extremely valuable in gathering information for assessment or deliberation of information for an assessment (Stems, 2014). As of now there are endless mobile applications (platforms) which permit the development of a mobile data collection survey. These platform permit customization of the study to gather particular information as required, for instance pictures, assembled list determinations, voice recordings and GPS coordinates.

3.2.4.1 ADVANTAGES OF MOBILE DATA COLLECTION

- The process was made easier, the facts were acquired in near instantaneous time period allowing the analyst to interact with data as it was being populated.
- There was provision for instantaneous information visualization e.g. aggregations, maps etc.
- The process was less expensive as compared to other traditional ways of data gathering.

3.2.4.2 DISADVANTAGES OF MOBILE DATA COLLECTION

- The process relied on network coverage and any disruption could have cause the whole data gathering process to be a failure.

3.2.4.3 FINDINGS FROM MDC

There was a high response rate from the audience. The target population was anyone who is and can be affected by the current setup. As a quick way of data gathering, various users responded with their views concerning the way of doing business.

3.3 ANALYSIS OF EXISTING SYSTEM

Giving to Stair and Reynolds (2013) framework investigation depicts the troubles and prospects of the present system. Godfrey (1999) likewise contends that requirements analysis is a comprehensive examination and assessment of the necessities of an application to approve a particular business complication. This examination of the present setup closes with an official system investigative report which is comprised of these components:

- Strengths and weaknesses of the existing system in view of the stakeholders.
- The user's and stakeholder's perspective on the systems' functional requirements.
- The business' needs and requirements concerning a new system.
- An overview on how a new system should perform in order to solve the delinquent.

This chapter (stage) critically scrutinize the operational position of the current system and gives empirical advantages and disadvantages so as to reach a needs analysis.

3.3.1 DESCRIPTION OF THE CURRENT SYSTEM

Currently patients are visiting the health institution to book and or attend a consultation session. In the case of appointment booking, they are given an appointment booking receipt to confirm the date, time and place for the session. On the actual visit, a doctor or specialist examines the

condition of the patient and diagnose the health problems available. A prescription is drafted down for the patient to acquire medical treatment. Also other recommendation can be advised to the patient. All the process may or may not happen during the same day but a lot of time is spent waiting and or moving from one process to the next. It should also be noted that doctors and specialist are not always available and patients may need to rebook for another day when such a situation arises. Referrals and prescriptions are being done manually and if the document is lost the patient ends up stranded while his/her is at risk. Data is only captured at the hospital and is not being shared with other institution when the referred to them.

a) INPUTS

According to Reynolds and Stair (2013) inputs incorporates the assembly and capture of unsorted data. Valacich (2012) insinuates that a process's inputs should be sufficiently fitting to deliver profitable outputs. The operation of the present system has the following inputs

- Patients information

b) PROCESSES

Valacich et.al (2012) states that processes involve the activities executed on data that it can be transformed, dispersed and warehoused. The current system has the following processes:

- Health institution generate session time and place
- Doctor examine a patient
- Doctor prescribe treatment
- Refer to specialist

c) OUTPUTS

According to Stair and Reynolds (2013) an application is process that accepts input, process it and returns output. Output is thus defined as the production of beneficial information, commonly in the form of reports. The current manual system produces the following outputs:

- Consultation booking receipt
- Medical Report
- Prescription
- Referral Report

3.4 PROCESS ANALYSIS

Anderson (1999) stipulated that a process is a sensible arrangement of related occasions that converts application input to a craved outcome. It is alluded to as the black box that converts raw materials which are the inputs of an application to completed outputs (Capron 1995). Sommervile (2011) showed that process investigation is a study led to comprehend the improvements that the new system mean to accomplish, the key structures of the advancement and how the staff included in the advancement expect to accomplish them.

3.4.1 ACTIVITY DIAGRAM OF CURRENT SYSTEM

An activity diagram is a description of the workflow behaviour of the system. It clearly states the sequence in which activities occur. They give a clear picture of the order of activities in a system (Fowler 2004). Sommervile (2011) stated that an activity diagram serves to model the information flow of a process and the control flow.

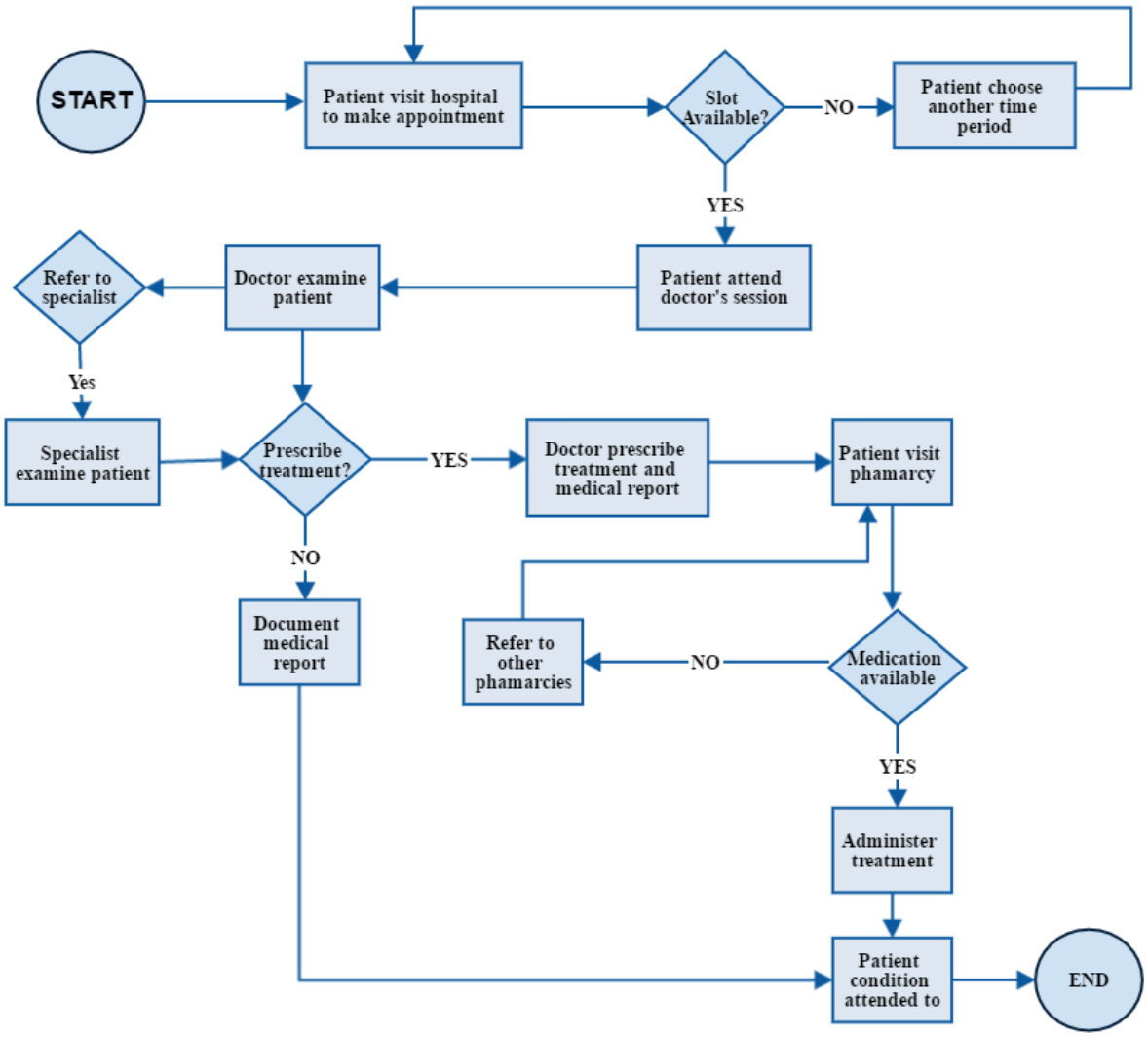
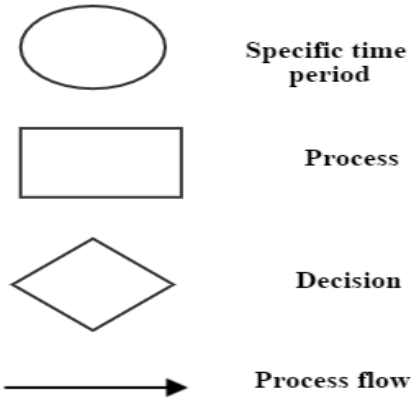


Fig 3.1 Activity Diagram of the Current System

Key:

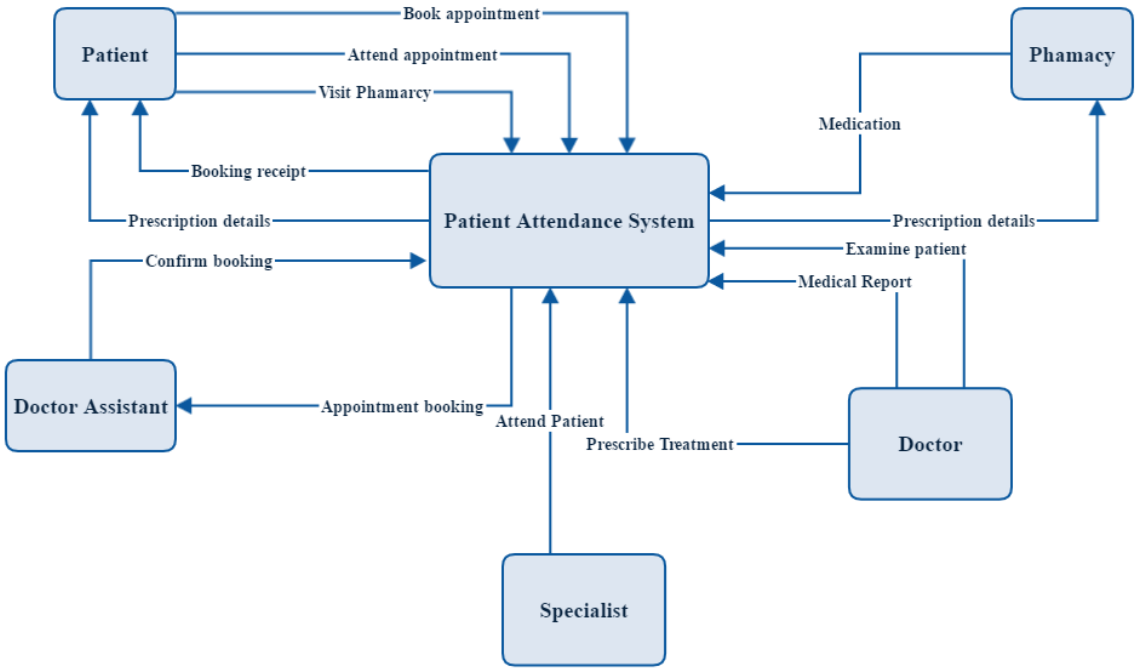


3.5 DATA ANALYSIS

Schwables (2006) described data analysis as the sieving and cleansing of data, transforming it, inspecting the system processes, aiding decision making and data modelling so as to produce useful information. The process according to Stair and Reynolds (2013) involves the control of the data gathered so that the development team gets the best out of the data gathered. Data analysis makes use of DFDs which are data flow diagrams and context diagrams.

3.5.1 CONTEXT DIAGRAM

Mall (2009) characterized a context diagram as a dataflow graph (diagram) which portrays or indicates one process that sums up and rearranges the usefulness of the entire application. This outline can be basically portrayed as a condensed duplicate of the dataflow graph.



Key:

Fig 3.2 Context Diagram of the Current System

3.5.2 DATA FLOW DIAGRAM

Data flow diagram abbreviate DFD is a diagrammatical representation of the entire system which unmistakably portrays the connection of all application modules with each other. It demonstrates the procedures, inputs, the information stores and the outcomes (Kendall and Kendall 2002). As indicated by Valacich et al (2012) a DFD is a graphical outline which serves to show development and movement of information and communication of elements of the application.

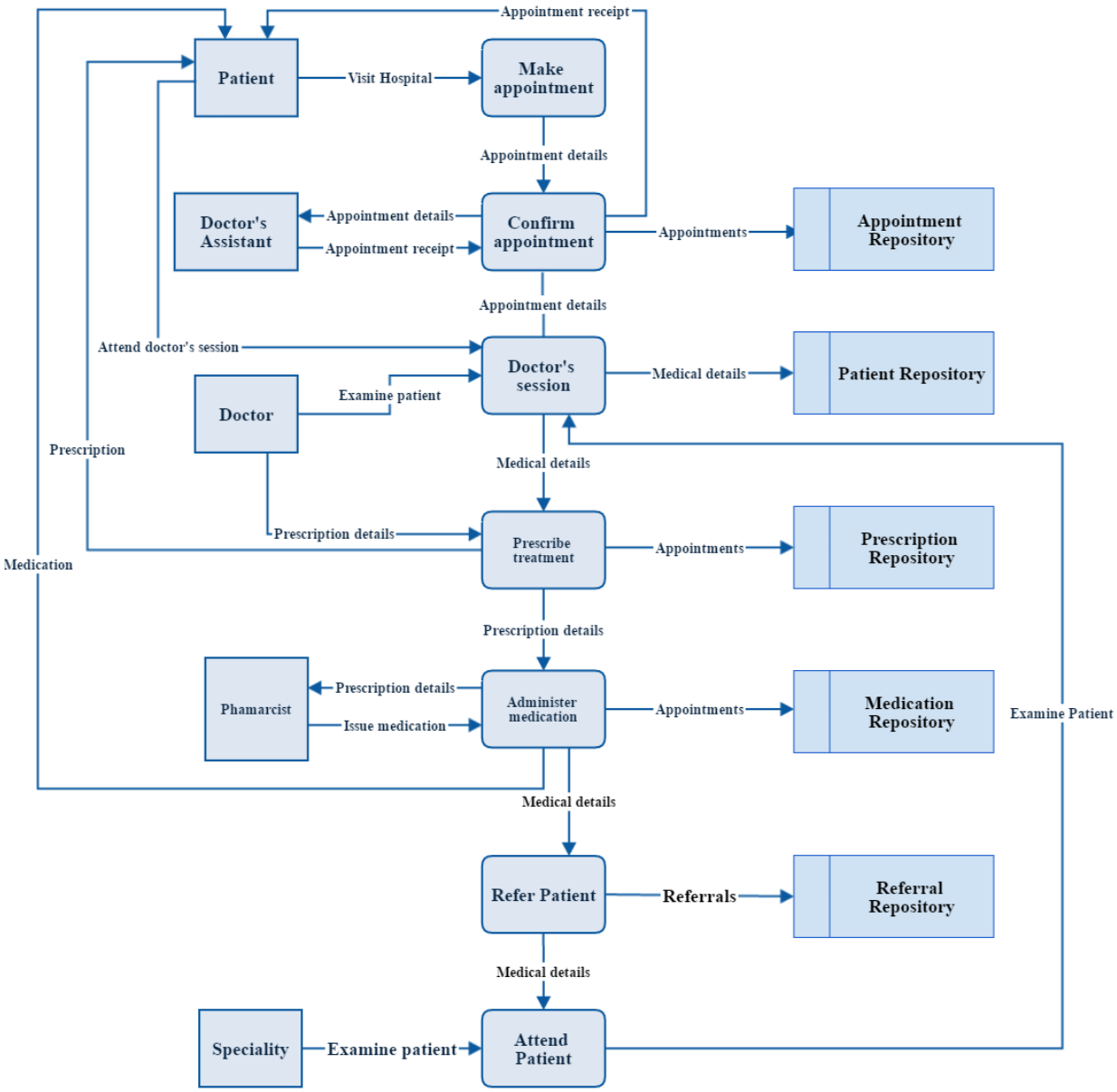


Fig 3.3 Data flow Diagram of the Current System

Key:

3.6 WEAKNESSES OF CURRENT SYSTEM

- Asymmetric information distribution and dissemination.
- The process of visiting a health practitioners is very costly.
- More time is waster in trying to attend a 15 minute consultation session.
- Limited revenue streams for hospitals and specialist institutions.
- Patients are not being referred to external specialist

3.7 EVALUATE ALTERNATIVES

If an organization is to introduce a new information system a number of development substitutes need to be considered. The decision to choose one alternative over others will be influenced by the costs involved, merits and demerits and ultimately if it considers the organisation's needs. Alternatives that are to be evaluated are:

- In-house system development
- Outsourcing system development
- Current system improvements

3.7.1 IN-HOUSE SYSTEM DEVELOPMENT

In-house development is considered as the use of internal developers within an organization to develop a proposed system (Ishenko, 2005). The internal developers will the proposed system from ground up. Krugman (2009) further on described the concept as the use of experts in the local domain for the purpose of a beta version that meets user requirements.

3.7.1.1 MERITS

- Internal developers have a know-how of the current infrastructure and the system functionality hence making the end product suit user requirement
- It's the cheapest option as the developing team is part of the company.
- It helps in cultivating the knowledge and expertise of the IT personnel
- The firm have and keep all rights to the software to themselves.
- It's also cheaper to maintenance the system

3.7.1.2 DEMERITS

- The system may lack proper documentation
- May result in being costly and time consuming.

3.7.2 OUT-SOURCING

Valacich et.al (2012) defines outsourcing as contracting an external entity to build, implement, deploy and maintenance an information systems. This development choice makes the external specialist part of local development team. Hence the organization can consider out-sourcing as a viable option to get the project up and running.

3.7.2.1 MERITS

- There is handover of the related risks to the external entities.
- Since specialist build the software there is less time to deploying the system.

3.7.2.2 DEMERITS

- This choice is more costly compared to in-house development.
- Gold platting can be used to blur the problem thus sometimes old system problems might not be answered.
- Frequent use of developer consultation increases training costs.

3.7.3 IMPROVEMENT

As indicated by Ghezzi (2004) improvement is a procedure where the necessities of another application are evaluated and utilized for system upgrade and adjustment. Upgrading a manual structure is exceptionally prohibitive as it is the core of the requirement for automation.

Difficulties in the current manual setup can be altered through computerization and advancement of the current system.

3.7.3.1 MERITS

- Improvement of the set up lower costs and the development time period.
- There is less resistance to change from the users as there will be minor upgrade from the current set up.

3.7.3.2 DEMERITS

- From the analysis of current system, there is occurrence of human error, wastage of resource and time and ultimately lower generation of revenue.
- The current system setup makes it complex and to improve.

3.7.4 SELECTED ALTERNATIVE

After comparing the above alternatives In-house development proves to be the better option. This is due to these reasons:

- The way in which the selected choice builds the system can result in all the highlighted problems being solved.
- The local developers are well versed with the existing system hence it gives them an edge in developing an mobile application that meets the user requirement
- The cost of using local pool if developers is low as compared to other alternatives.
- The quality of the final mobile application is close to perfection as the team is well experienced in the development of mobile applications.

Description	Cost (USD)
In-House Development	**15 195**
Outsourcing	**19 200**
Improvement	**16 000**

Table 3.1 Costs of Alternatives

3.8 REQUIREMENTS ANALYSIS

Somerville (2011) characterizes requirement analysis as an essential procedure which changes from a high-state dynamic depiction of an application constraint or administration to a comprehensive logical functional requirement. In understanding Langer (2008) suggests that at this phase of improvement and outline the group conducts interviews to gather the business need as associated to the application to be created. The application intends to fulfil the following:

- The system shall avoid unnecessary visits to health institutions by allowing the remote transfer of medical data (text, voice, images etc.) between patients and health care workers.
- Facilitate patient to make appointments to specialist remotely.
- Facilitate communication of dedicated consultation between health practitioners and patients in remote communities in the form of text and or video conversations.

3.8.1 FUNCTIONAL REQUIREMENTS

Functional requirements concern how the mobile application responds to user triggered events, data input, information dissemination and also considering how the mobile application should do in miscellaneous situations (Sommerville, 2008). The requirements unequivocally summaries the boundaries of the mobile application and what it cannot do. Malan et.al (2001) further restates that these requirements are the translated user requirements into functionalities. The functionality of the proposed mobile application is presented in the use case diagram to follow.

USE CASE DIAGRAM

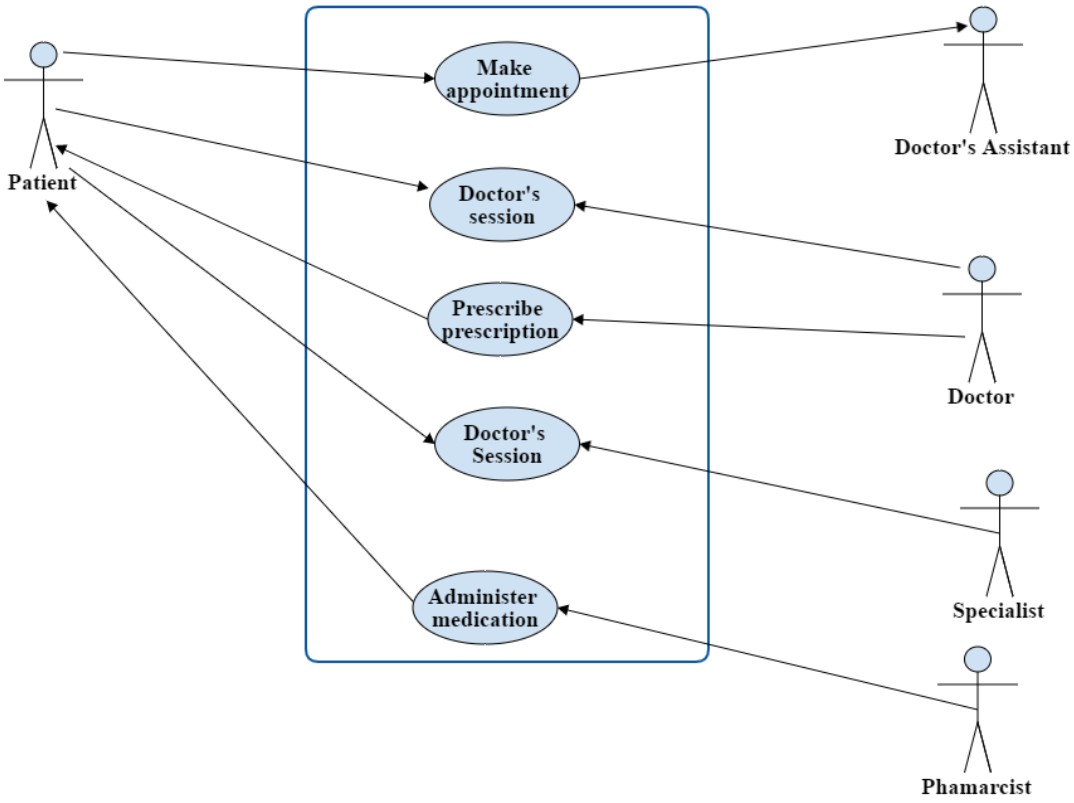


Fig 3.4 Use case diagram

3.8.2 NON-FUNCTIONAL REQUIREMENTS

Sommerville (2011) stipulate that non-functional requirements of an information system are constrains that can be evaluated concerning functionality of the mobile application. These relate to the mobile application with constrains on the build, deploy and maintenance processes, the standards and scheduling involved.

- **UI/UX:** the mobile application is entitled to have an easy and navigable user interface (UI) that results in a comforting user experience (UX). Smooth and efficient transitions and displaying of data should be well catered by the UI.
- **HARDWARE CONSIDERATION:** the mobile application is to be adaptive to multiple possible screen sizes with different resolutions and still perform as expected.
- **SECURITY:** Google Play certificates will be used to ensure user data is secure and have integrity at each possible given time.

- **INTEROPERABILITY:** The mobile application is to cater for the majority of the android mobile phone community that support the necessary hardware to render the application. At the time of development the apk will be targeted to Android API 19.

3.9 CONCLUSION

This stage gathers the validity of the current system as various information gathering techniques were used for the accumulation of the significant information. Application inputs, processes and outcomes were reviewed in this section in order to clarify choices, and accept the trustworthiness and current position of the current system. The following stage is the design stage. It will depict and demonstrate an unmistakable outline on how the proposed project will work in the genuine environment. All inputs, forms, outcomes, database tables and interfaces will be shown.

CHAPTER 4: DESIGN PHASE

4.1 INTRODUCTION

The analysis stage focused on highlighting the principle idea system development, hence the design stage serves to characterize the definite operation of the application. The design phase of an application helps in the determination of the system specifics. The systems administration base that best suits the project, the client interface designs are created amid this stage. The systems architectural design which determines or defines the software is well exploited in this chapter so is the database architecture and the file specifications (Dennis et al 2012).

4.2 SYSTEM DESIGN

The phase system design refers to the whole systems' architectural determination. Thus system design consists of a various elements that range from the processing components to the overall entity communication (Dennis et al 2012). A well designed system should at least have a set of the following characteristics.

- **Efficiency:** the term efficiency in context to system characteristics refers to the ability of a system to run all its operations within a short period of time enabling the end user to process system jobs with very few commands.
- **Security:** a well-designed system should have a very tight security detail so as to protect the system from hackers and allows for the maintenance of user confidentiality and control the access rendered to users.
- **Reliability:** the need of a new system arises because of a rise in problems with the current system. A well-designed system should be able to reduce or rather eradicate most of these problems, therefore the ability of a system to counter system problems is of paramount importance.
- **User friendliness:** the user interaction with the system helps determine the failure or success of a system. Most systems are usually judged by their ability to function up to user expectations with little or minimal supervision and support. A well designed system should be easily operated by even a lay man hence system friendliness is a vital aspect of well-designed systems.

- **Maintainability:** due to the rapid changes in the environment a system should have an attribute that allows it to be easily maintained and updated so that it doesn't become obsolete.

This system will provide a real time data sharing and communication link between patients, doctors and specialist in the context of appointments, consultations, prescriptions, referrals, patient records among other little cool features.

4.2.1 CONTEXT DIAGRAM

Mall (2009) characterized a context diagram as a dataflow graph (diagram) which portrays or indicates one process that sums up and rearranges the usefulness of the entire application. This outline can be basically portrayed as a condensed duplicate of the dataflow graph.

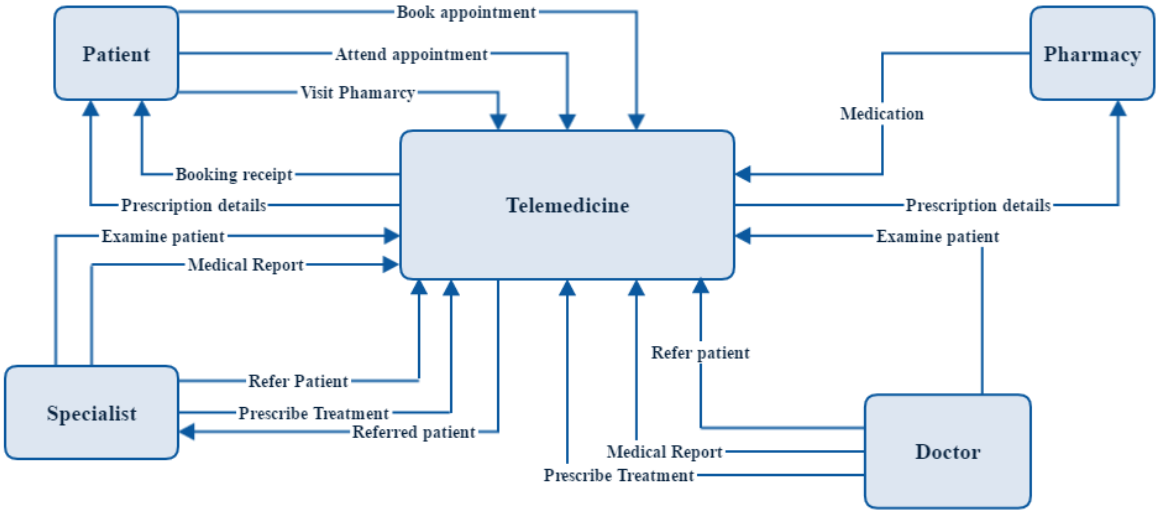


Fig 4.1 Context Diagram of the proposed application

4.2.2 DATA FLOW DIAGRAM

Data flow diagram abbreviate DFD is a diagrammatical representation of the entire system which unmistakably portrays the connection of all application modules with each other. It demonstrates the procedures, inputs, the information stores and the outcomes (Kendall and Kendall 2002). As indicated by Valacich et al (2012) a DFD is a graphical outline which serves to show development and movement of information and communication of elements of the application. The data flow diagrams are displayed below:

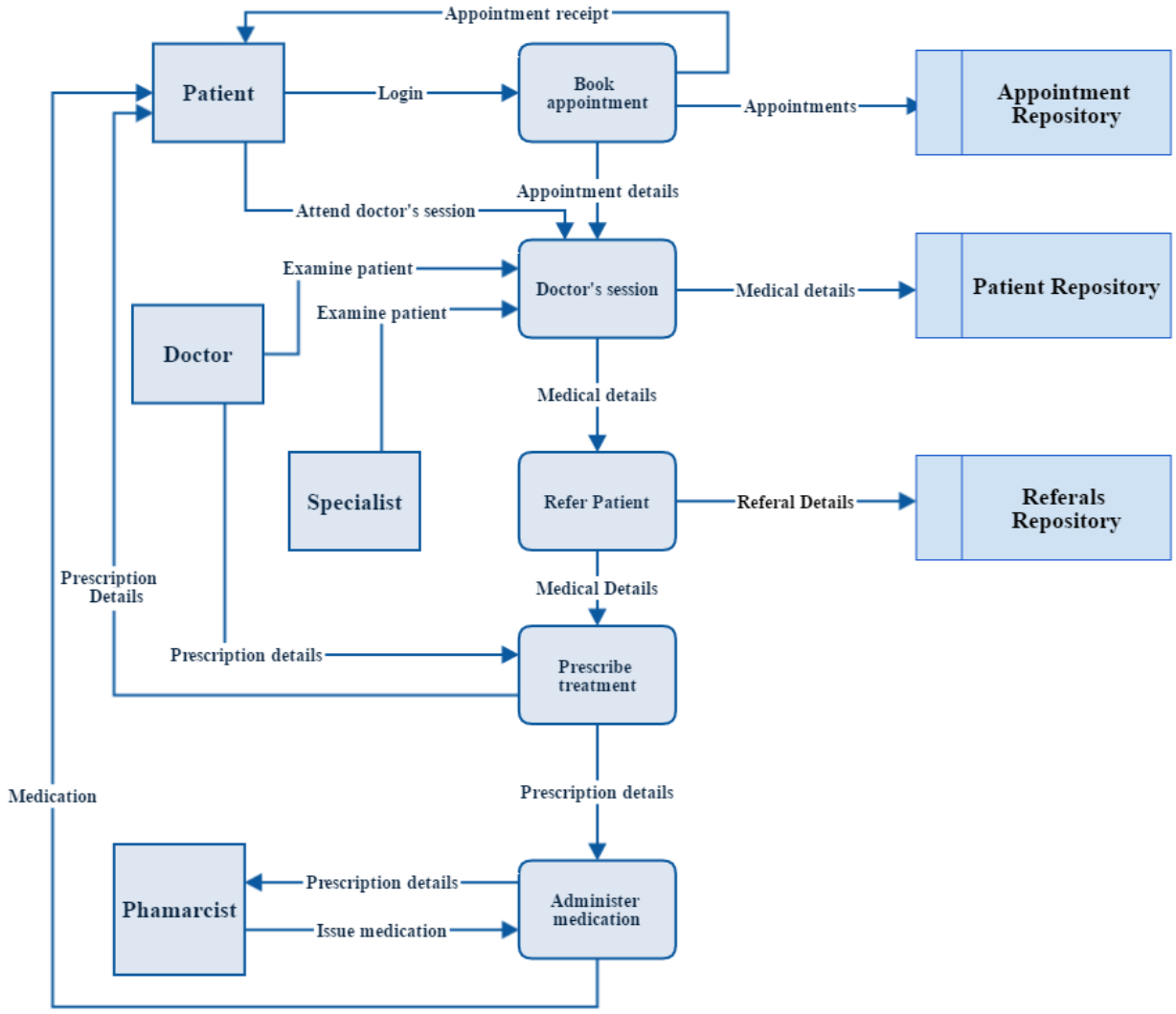
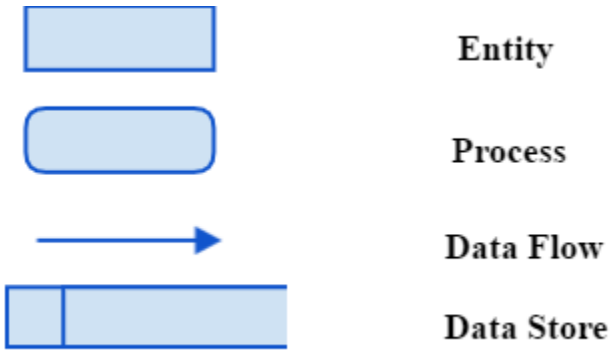


Fig 4.2 Data Flow diagram of the proposed system

Key:



4.3 ARCHITECTURAL DESIGN

Pressman (2000) states that system prerequisites ought to be verbalized into a design that best depicts its structure and segments. The architectural scheme can likewise be portrayed as a thought level where the application designer indicates the application execution and usefulness. It helps in generating the base application structure. In reference to Dennis et al (2005) this design focuses to discover the relationship of the system programming and its hardware equipment segments.

Components

- Database Server
- Application server
- Network adaptor and routers
- Client PC
- Patient mobile phone

4.4 APPALICATION PHYSICAL DESIGN

As a continuance from rational design of the application, one then investigate the physical system plan which is a stage in design that best portrays how the application will be created. The physical design extends to a scope of parts including the physical segments of an application that is the equipment and the interfaces (Rosenblatt, 2013). The physical configuration of a system

can be characterized as a diagram of how it should be created (Keyes, 2002). He included that the physical outline comprehends the developments of a sensible model into an operational configuration.

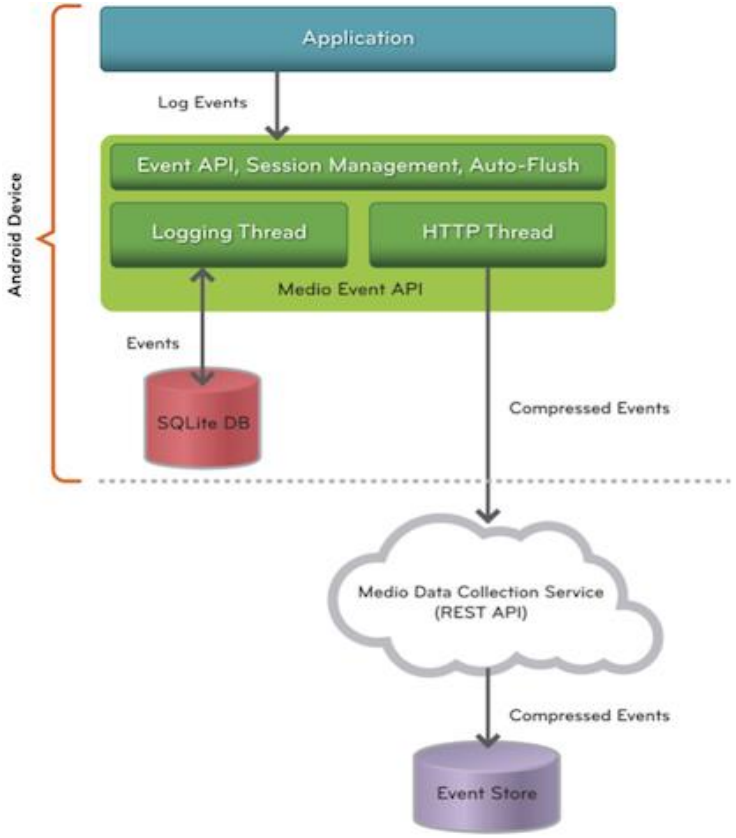


Fig 4.4: Physical design

This shows how an end user is to access data from the local database on his/her phone and the use of web services using threads to access external database sources.

4.5 DATABASE DESIGN

The system functionality basically depends on the system data hence the database design should be articulate. Sommervile (2011) said that during database design that is when the data structures and the way they will be represented in the database ids designed. During database design he further on mentioned that that is when a detailed model of a database is created. It is a prototypical model that has all the required designs from the logical designs to the physical

designs, also the storage constraints needed to come up with a scheme in a Data Definition Language used in database creation (Rosenblatt 2013).

The application usefulness fundamentally relies on upon the framework information thus the database configuration ought to be understandable. Sommervile (2011) said that database plan is the point at which the information structures and the way they will be represented in the database is defined. In database planning that is the point at which a definite model of a database is made.

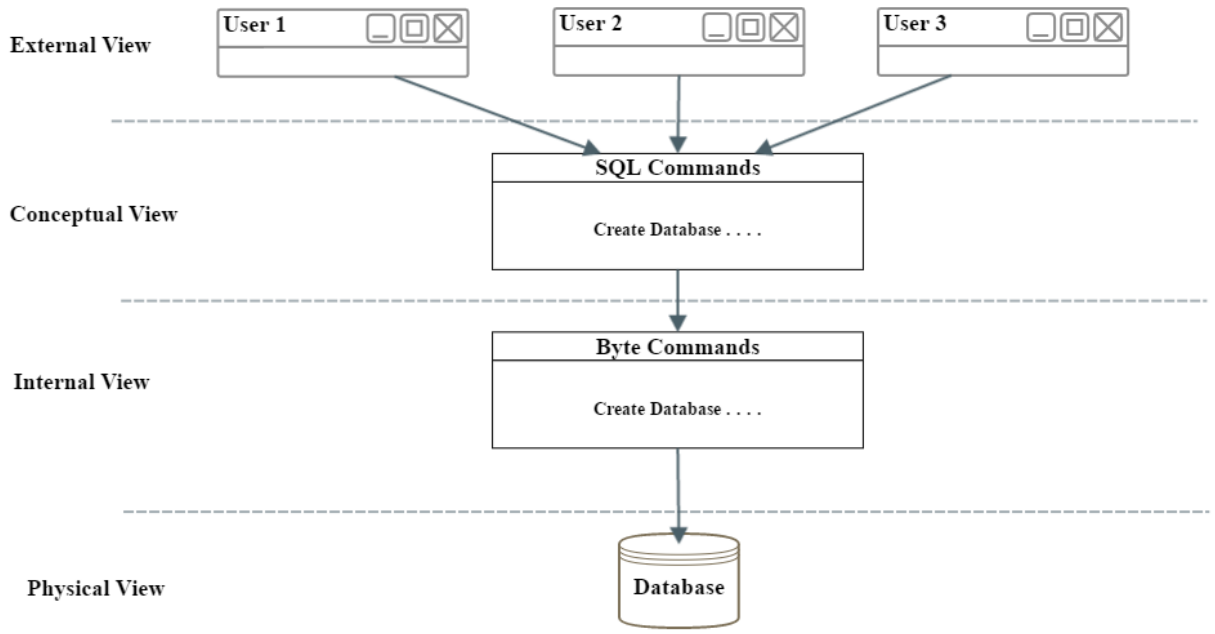


Fig 4.6: Database Conceptual Schema

The diagram above uses UML modelling concept to present a graphical representation of the model. The external views depicts the customized views that each user will get when he/she logs into the system. The conceptual view are the native SQL commands that are used to interact with the underlying database in a native language. After that there is an internal view which is machine language of the translated SQL commands from the view above it. Lastly the physical view if the file system in which the actual data is recorded to disk.

4.5.1 DATABASE TABLES

Appointments

Name	Type	Collation	Attributes	Null	Default
appointment_id	int(11)			No	*None*
patient_id	int(11)			No	*None*
doctor_id	varchar(20)	latin1_swedish_ci		No	*None*
date	date			No	*None*
start_time	time			No	*None*
end_time	time			No	*None*
active	int(11)			No	1
date_created	datetime			No	CURRENT_TIMESTAMP

Table 4.1: Appointments table

Employees

Name	Type	Collation	Attributes	Null	Default
emp_id	int(11)			No	*None*
name	varchar(100)	latin1_swedish_ci		No	*None*
surname	varchar(100)	latin1_swedish_ci		No	*None*
email	varchar(100)	latin1_swedish_ci		No	*None*
password	varchar(100)	latin1_swedish_ci		No	*None*
position	varchar(25)	latin1_swedish_ci		No	*None*
active	int(11)			No	1
date_created	datetime			Yes	CURRENT_TIMESTAMP

Table 4.2: Employees table

Specialists

Name	Type	Collation	Attributes	Null	Default
external_doc_id	int(11)			No	*None*
name	varchar(50)	latin1_swedish_ci		No	*None*
surname	varchar(50)	latin1_swedish_ci		No	*None*
email	varchar(100)	latin1_swedish_ci		No	*None*
address	varchar(100)	latin1_swedish_ci		No	*None*
specialty	varchar(100)	latin1_swedish_ci		No	*None*
active	int(11)			No	1
created_by	int(11)			No	*None*
date_created	datetime			No	CURRENT_TIMESTAMP

Table 4.3: Specialist table

Patients

Name	Type	Collation	Attributes	Null	Default
patient_id	int(11)			No	*None*
name	varchar(50)	latin1_swedish_ci		No	*None*
surname	varchar(50)	latin1_swedish_ci		No	*None*
gender	varchar(7)	latin1_swedish_ci		Yes	*NULL*
age	int(5)			Yes	*NULL*
phone	varchar(25)	latin1_swedish_ci		Yes	*NULL*
addres	varchar(255)	latin1_swedish_ci		Yes	*NULL*
email	varchar(50)	latin1_swedish_ci		No	*None*
password	varchar(255)	latin1_swedish_ci		No	*None*
last_login_date	datetime			Yes	*NULL*
active	int(11)			No	1
date_created	datetime			No	CURRENT_TIMESTAMP

Table 4.4: Patients table

Prescriptions

Name	Type	Collation	Attributes	Null	Default
prescription_id	int(11)			No	*None*
patient_id	int(11)			No	*None*
doc_id	int(11)			No	*None*
condition	varchar(50)	latin1_swedish_ci		No	*None*
prescription	varchar(150)	latin1_swedish_ci		No	*None*
comment	varchar(150)	latin1_swedish_ci		No	*None*
active	int(11)			No	1
date_created	datetime			No	CURRENT_TIMESTAMP

Table 4.5: Prescription table

Referrals

Name	Type	Collation	Attributes	Null	Default
referal_id	int(11)			No	*None*
session_id	int(11)			No	*None*
patient_id	int(11)			No	*None*
condition	varchar(50)	latin1_swedish_ci		No	*None*
external_doc_id	int(11)			No	*None*
refering_doc_id	int(11)			No	*None*
active	int(11)			No	1
date_created	datetime			No	CURRENT_TIMESTAMP

Table 4.6: Referral table

Consultation Sessions

Name	Type	Collation	Attributes	Null	Default
session_id	int(11)			No	*None*
patient_id	int(11)			No	*None*
doctor_id	int(11)			No	*None*
type	varchar(5)	latin1_swedish_ci		No	*None*
conditions	varchar(100)	latin1_swedish_ci		No	*None*
date_created	datetime			No	CURRENT_TIMESTAMP

Table 4.7: Consultation table

4.6 PROGRAM DESIGN

Malik (2014) states that the reference to the programming specifics with the system packages, the specialized necessities which will be consistently articulated to, in order to make coding simple. In the project outline the engineer makes utilization of the package, class and sequence diagrams to distinctly outline the design.

4.6.1 PACKAGE DIAGRAM

A dialect called UML (Unified Modelling Language) is utilized to generate package diagrams. The entire application is separated into smaller modules which will be cooperating and communicating with each other. The package diagram is utilized to emulate the package settings that make up the application (Larman, 2002). Sommervile (2011) went ahead to depict the package diagram as a connected setup of the application that outlines the breakdown of the modules and how they collaborate with each other.

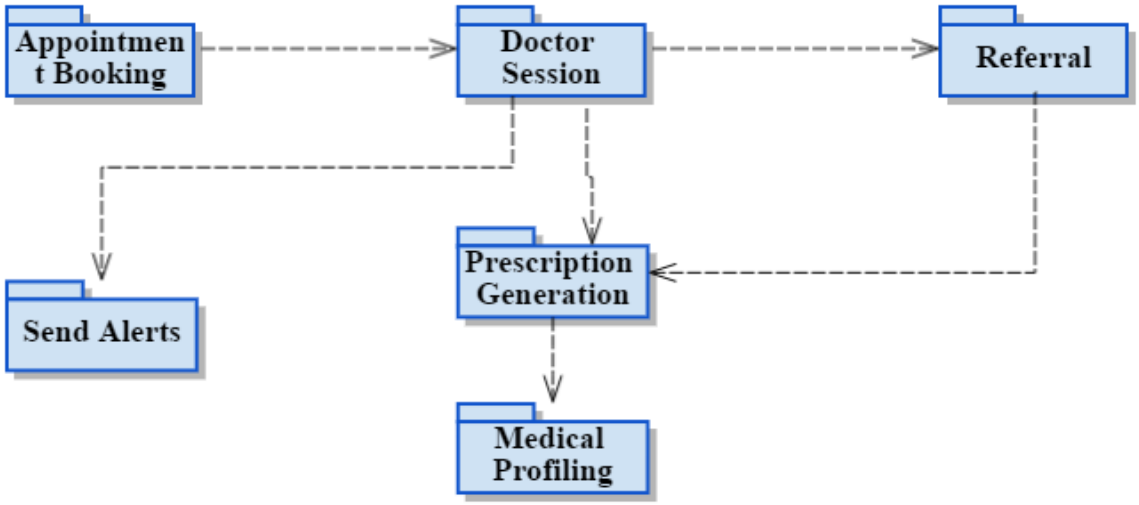
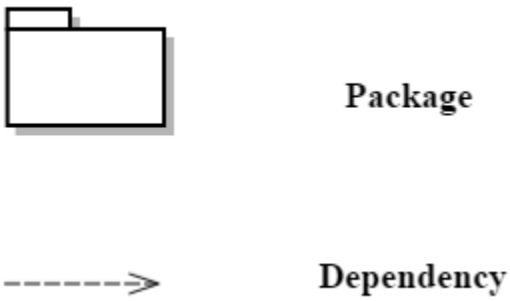


Fig 4.7 Application Package Diagram

Key:



4.6.2 CLASS DIAGRAM

Class diagrams according to Fowler (2004) depicts the system objects types and their various breeds of static relationships existing among them. They show comprehensive operations, and properties together with constrains that apply to the connected objects. More to that Terry (2000) backs it up by saying a class diagram is a superset of an Entity Relationship Diagram. This means we can derive a class diagram from an ER diagram or vice versa.

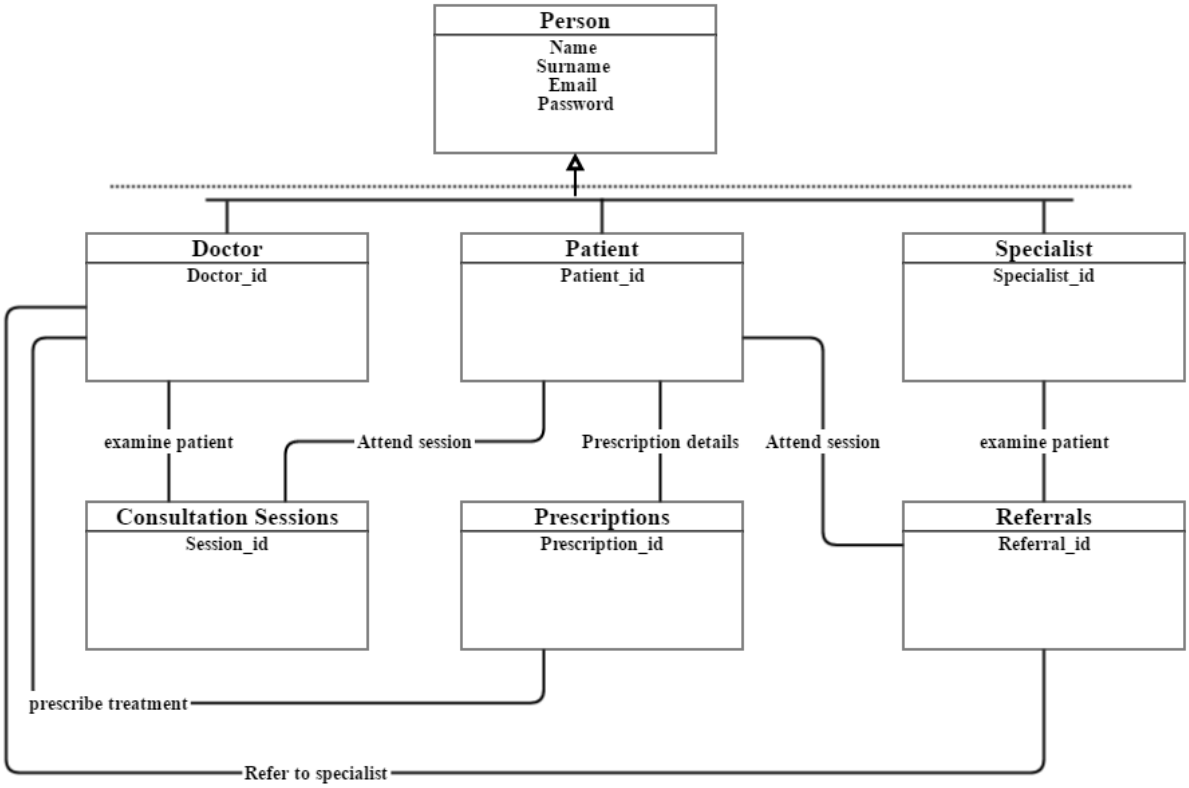


Fig 4.8: Class Diagram

4.6.3 SEQUENCE DIAGRAM

A sequence diagram can be depicted as a representation of the application goals that assist in the system use case and informing sharing that modules share amongst them. It was further on portrayed as a dynamic perspective of the application being created, demonstrating the reasonable channel of communication between items. The sequence diagram is of fundamental significance as it help in grasping the application's continuous conditions (Dennis et al 2012).

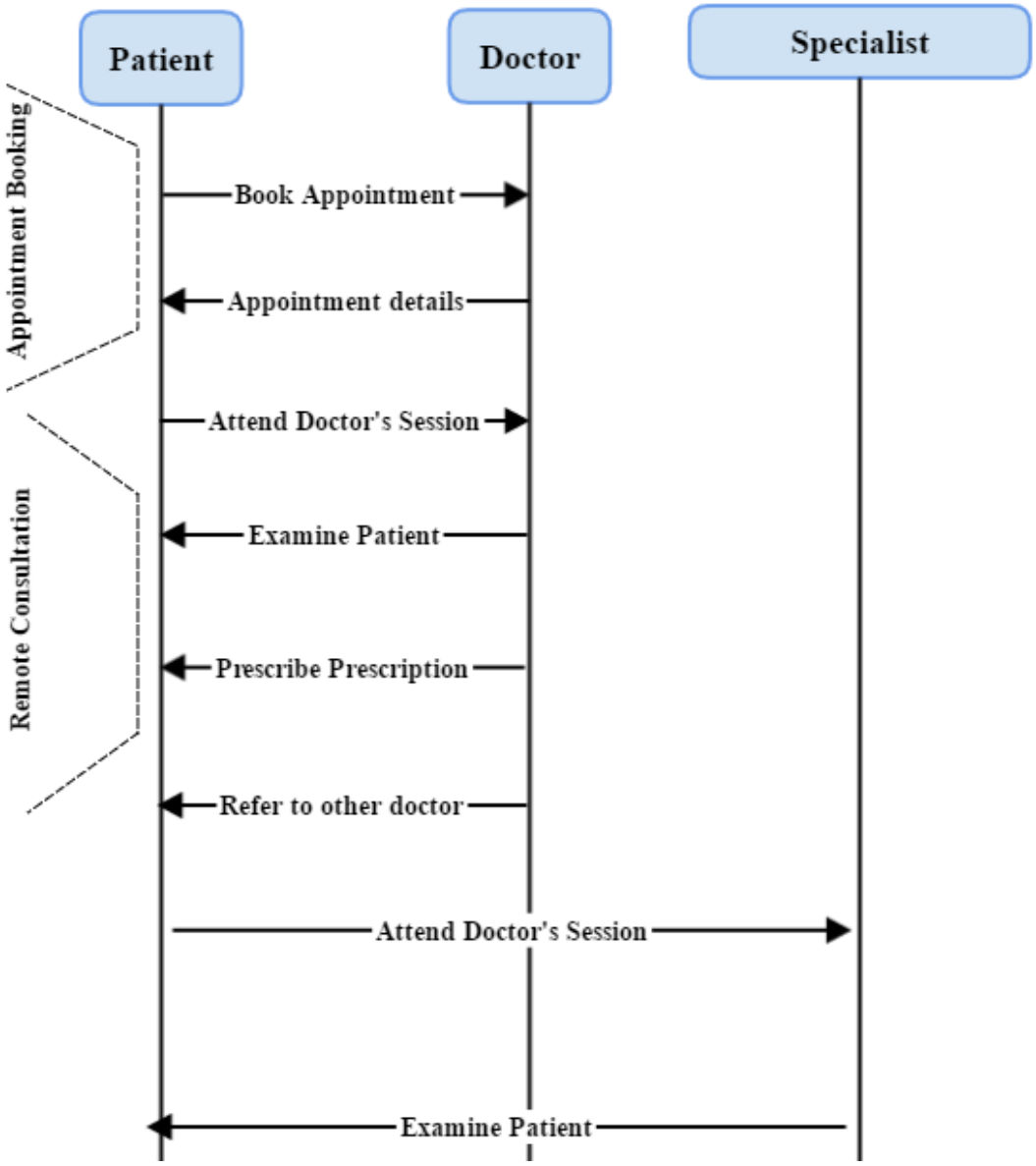


Fig 4.8: Application Modules Sequence Diagram

4.7 INTERFACE DESIGN

The application interface goes about as a state of connection between the application itself and the end clients. These interfaces ought to appeal to a wide range of clients hence it needs to be extremely straightforward and educational. The interface is developed with controls that empower the application end user to information and getting a desirable result (Whitten, 2003).

4.7.1 DATA ACQUISITION

This node show the necessary interface design that will be facilitating data acquisition from the end users and or system.

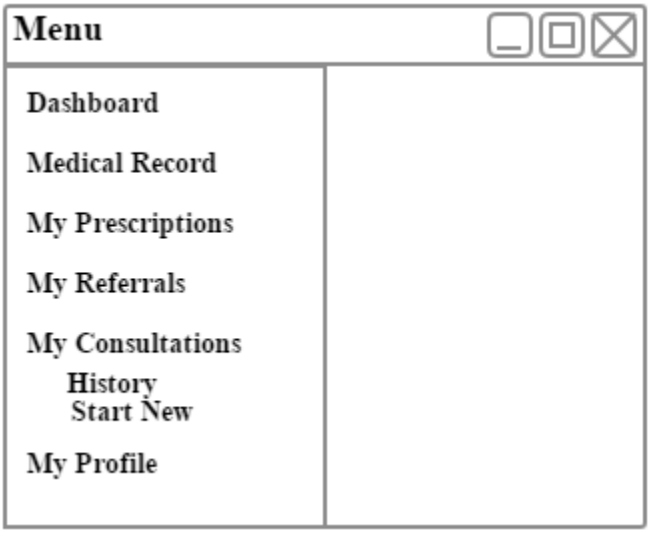


Fig 4.9a: Main menu

Fig 4.9a: Create user / patient account

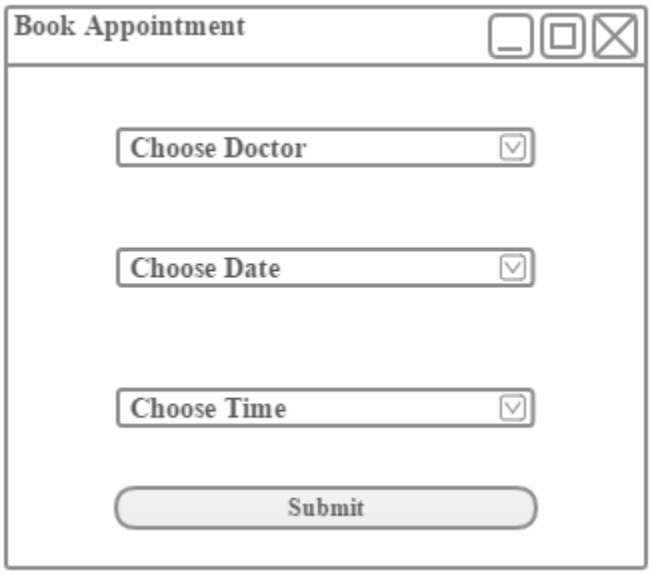


Fig 4.9a: Book doctor's appointment

Fig 4.9a: Doctor video consultation session

Fig 4.9a: Doctor Text consultation session

4.7.2 KNOWLEDGE REPRESENTATION

All the related interface that show the end user display of information after some heavy lifting logic has been applied to basic data stored in the local and remote databases.

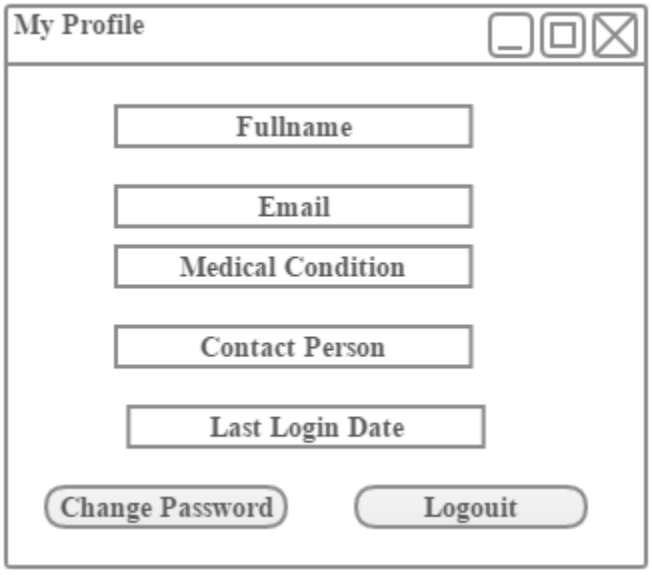


Fig 4.10a: User profile

Fig 4.10b: Booked appointment listing

Fig 4.10c: Consultation Bills

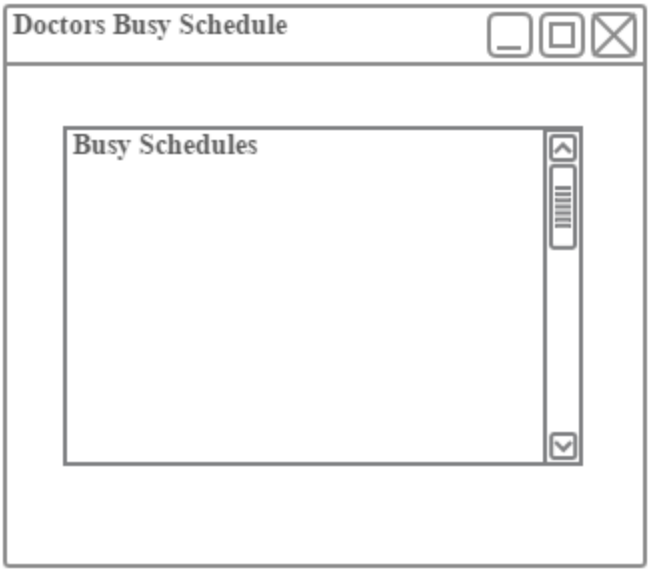


Fig 4.10d: Doctors Schedule

4.8 PSEUDO CODE

Rouse and Smith (2005) explain the term pseudo coding as a simple encrypting or programming jargon that is used to present actual code in simple language.

BOOK APPOINTMENT ACTIVITY

Initiate activity

Inflate the layout files

//User fill in the form

If(date == holiday || date == doctorBusy || date == doctorOutOfOffice || date == s cheduleBooking) {

Save the appointment booking

} else {

Create notification for displaying the relevant error

}

CONSULTATION SESSION

Initiate activity Inflate the layout

Get the scheduled appointments

If(scheduledDateAndTime == currentDateAndTime){

Start consultation session either text chat or video using Pubnub plugin

If(connectionIsBadForVideo){

Patient to log in to web app and use the local text chat app

}

} else {

Display notification that no session is due

}

PRESCRIBE TREATMENT PAGE

Initiate web page

Load all the dependent files

Fill the issue prescription form

Save and send push notifications to patient bout the prescription

REFER PATIENT

Initiate web page

Load all the dependent files

Fill the referral form

Save and send push notifications to patient about the referral

4.9 SECURITY DESIGN

The application is to use inbuilt system security, programmable and third part security feature to ensure no data breach is experience.

Inbuilt Security

- Manipulating the keyboard to only display the required elements e.g. email, phone number
- Only adding android permission that the system need so as to make sure the application cannot be accessed from services not being used

Programmable Security

- Using sessions and shared preference to manage authentication
- Validating all the input received programmatically

Third Party Security

- Making use of secure protocols that need licencing e.g. Secure Socket Layer
- Using firewall as a counter measure against data breach

4.10 CONCLUSION

This stage outlined and demonstrated a distinctive review on how the proposed new application will work in the genuine environment. All inputs, forms, results, database tables and interfaces were shown. The application system, architectural, program and interface designs were articulated in general. The implementation (usage) stage to follow detailing the methods used in deploying, training and maintenance of the mobile application.

CHAPTER FIVE: IMPLEMENTATION AND MAINTENANCE

5.1 INTRODUCTION

The implementation phase mark out the point characterised by a brief change of the ideally pronounced phase into a way that computer bounds can understand depending on its abilities. In this phase system amendments and or the new system is introduced in the real production environment. The start of the stage is steered after application testing and the clients (users) have acknowledged the application. The entire usage period of a system is for the most part unending, this done until the application meets all the client requirements and are rated to be standard. Application coding, installation, testing, upkeep and client training is completed amid this stage.

5.2 CODING

The term coding alludes to an area of programming articulations and scripts in a particular programming dialect (Rouse and Smith 2005). The building of the application joined Extensible Mark-Up Language (XML) for the styling and outline, Java for the genuine application usefulness, PHP for the backed admin panel and JavaScript for associating with the outside PubNub server. For database SQLite was used for data caching and MySQL for syncing data with others entities. All this was being done using android studio as the development platform and xampp as the application server

5.3 TESTING

The entire procedure of application testing is completed in order to find project imperfections before it is acquainted with the end client. The entire programming testing is completed by executing the project making utilization of fake information. While executing the application one can take note of the test run faults, the application irregularities and the data about the non-working properties of the application (Sommervile 2011). Stair and Reynolds (2012) proposed that the entire testing technique is of foremost significance to the system operation. They advance on recommended that there are five testing methods that are to be completed when doing the procedure of system testing.

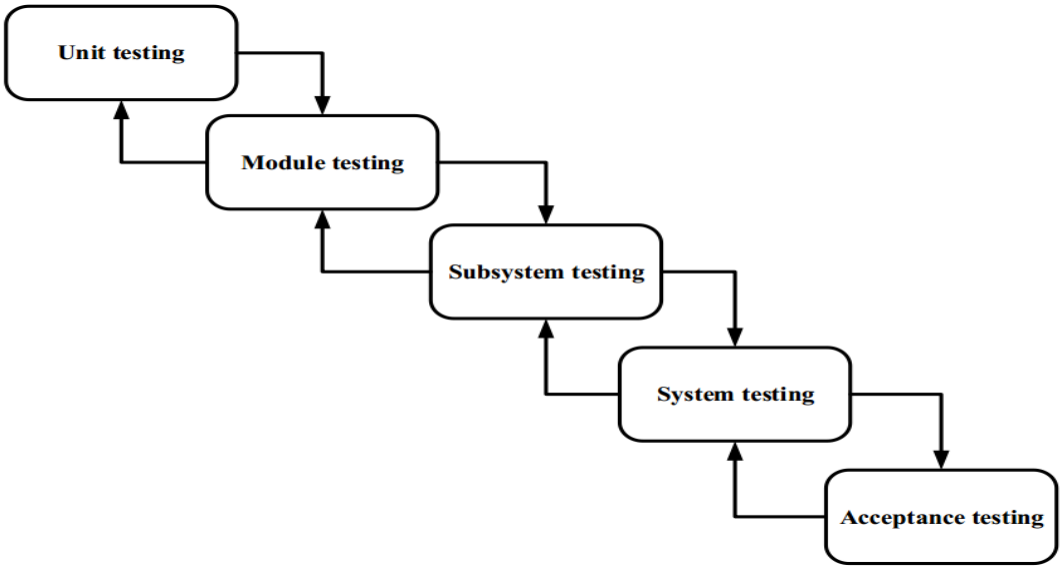
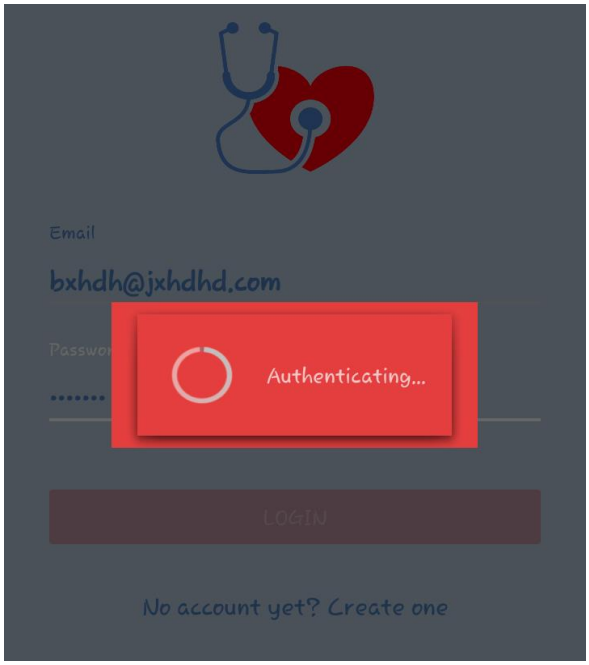


Fig 5.5 Testing Process

5.3.1 UNIT TESTING

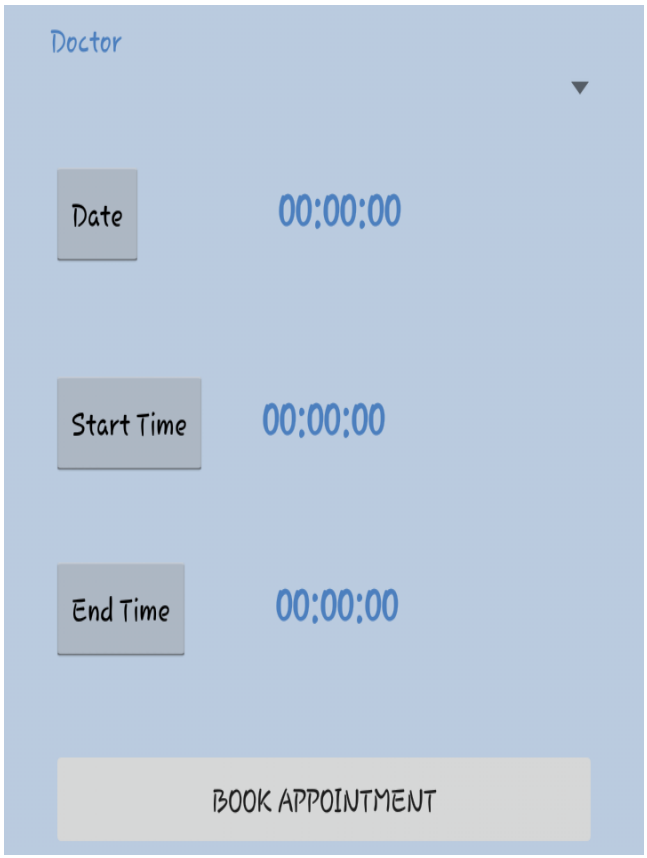
Unit testing can be characterized as the procedure of testing an individual segment or module of a framework. This is done in order to recognize the framework execution mistakes and solve them at the appropriate time. The procedure of unit testing can be conveyed to recognize the rationale error that could have gone unnoticed amid the work area checking. These execution defects may bring about the framework to end or run unusually. In agreement to the book composed by Valacich et al (2012) in unit testing the framework will be separated into little units which will be tried independently for mistakes before they are assembled back for testing the interface in the middle of the units.



Testing the authentication module if the user can actually authenticate and access system resources

5.3.2 MODULE TESTING

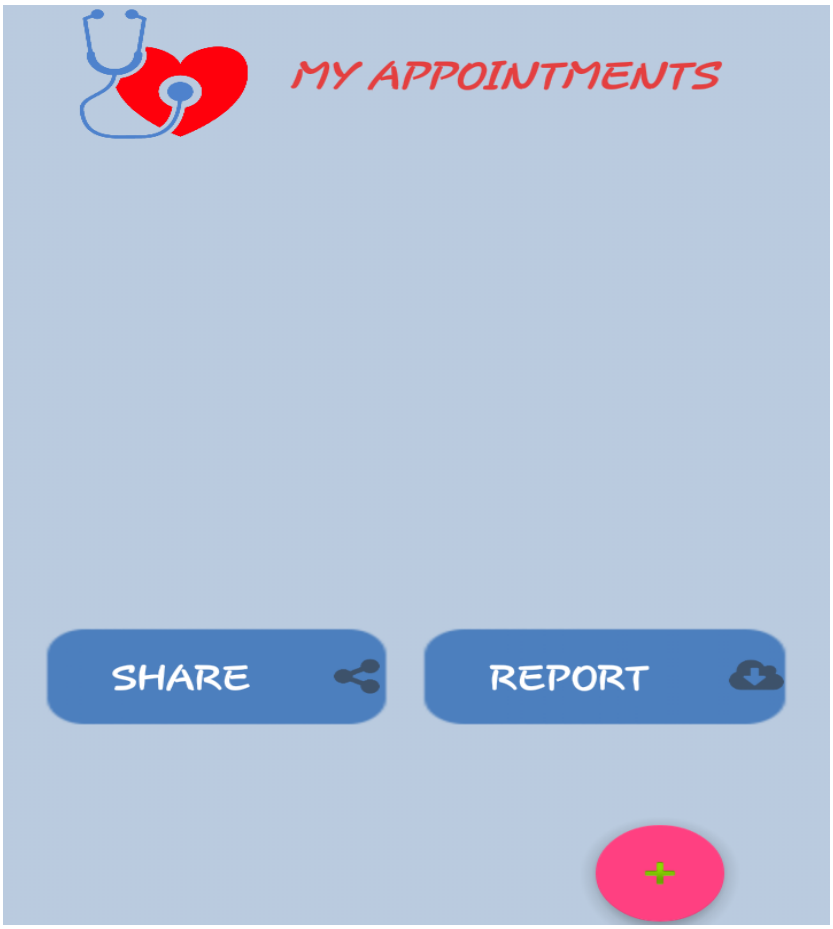
The project units from the past phase of unit testing are then united to shape framework modules. These framework modules are then tried for their similarity with each other Valacich et al (2012). Module testing can correspondingly be termed incorporation testing which is a reasonable augmentation of unit testing, the joined units are tried for interface inadequacies and it's the entire cooperation between the units.



Testing if a logged in user can book an appointment with a doctor.

5.3.3 SUBSYSTEM TESTING

Chonoles (2011) showed that sub-framework testing can be additionally be alluded to as connection testing. Consequently a gathering of amalgamated modules are tried into a more in place subsystem. Yourdon (2001) states that subsystem testing is the procedure in which the framework modules are consolidated to shape a subsystem which will be tried for usefulness and similarity.



Testing the link between displaying, generating, sharing and booking appointment.

5.3.4 SYSTEM TESTING

This stage requires the unification of the entire framework modules to shape a framework. Upon blend the framework is then tried for any interruptions which may frustrate its execution. Amid framework testing framework proficiency and viability is taken into much thought. (Wiegers and Beatty 2013). Information will then be added into the system and then it will be verified whether it had performed up to desires. This phase of framework testing primarily focuses on the issues of report era and framework security (Valacich et al 2013). Framework testing is done through two primary stages black box and white box framework testing.

5.4.4.1 WHITE BOX TESTING

Contrasting black box testing the white box testing mainly emphases the checks to the inmost functionality of given system (Eppingner 2008). Godfrey (1999) further on mentioned that white box testing is a testing method where pure information of object up for testing is resourced to

choose the test data. The complete design of the system is of outmost importance than the function.

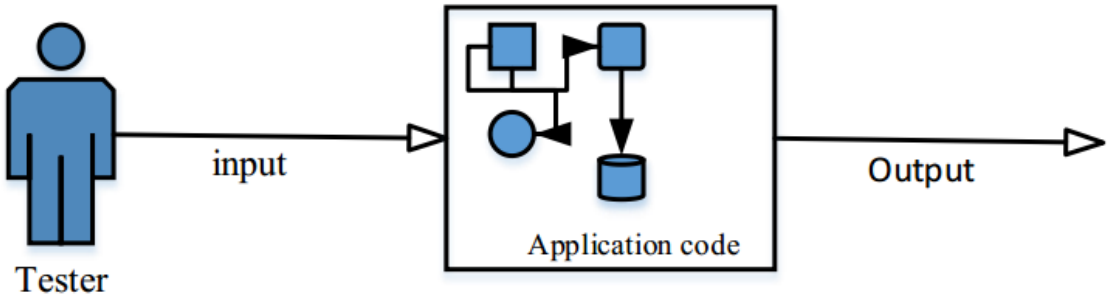


Fig 5.8 White Box Testing

5.4.4.1 BLACK BOX TESTING

Black box testing is a testing concept in which the testers are mainly concerned with the inputs and outputs of a system but he knows not the process in which the system has reached that output. The black box testing method applies to the whole software application (Saleh 2009). Godfrey (1999) further on supported by indicating that the black box testing method in terms of soft wares is where the whole system internal works of element being tested are not recognised by the system tester.

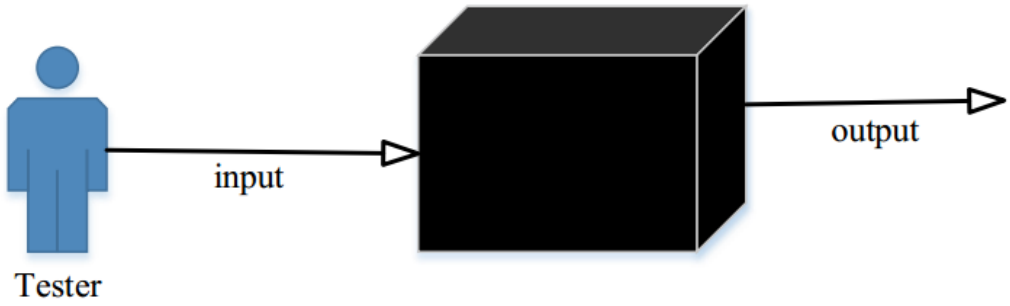


Fig 5.7 Black Box Testing

5.3.5 ACCEPTANCE TESTING

The last period of framework testing is the acceptance testing stage. A framework is mostly made for the clients so their perspectives are vital that is the reason the acceptance testing is done. The acceptance testing is completed by basically utilizing the beta and alpha strategies for testing.

5.4.5.1 BETA TESTING

Rosenblatt (2013) insinuated that beta testing is the point at which a specimen of clients tries out the new framework. Amid the beta testing the framework is tried utilizing the genuine framework information and subsequently there will be close framework checking for errors that may upset business operations. Dennis et al (2012) went ahead to say that the entire procedure of beta testing impact the client impression of the framework as it will be worked in the genuine environment.

5.4.5.2 ALPHA TESTING

This is the point at which the framework is tried utilizing artificial information. A pool of individuals is chosen arbitrarily be it from target business sector to test the framework for mistakes (Dennis et al 2012). Valacich et al (2012) included that alpha testing is the point at which the clients utilize the product with the assistance of the improvement group in an offer to distinguish blunders with the framework

5.4.5.3 VERIFICATION

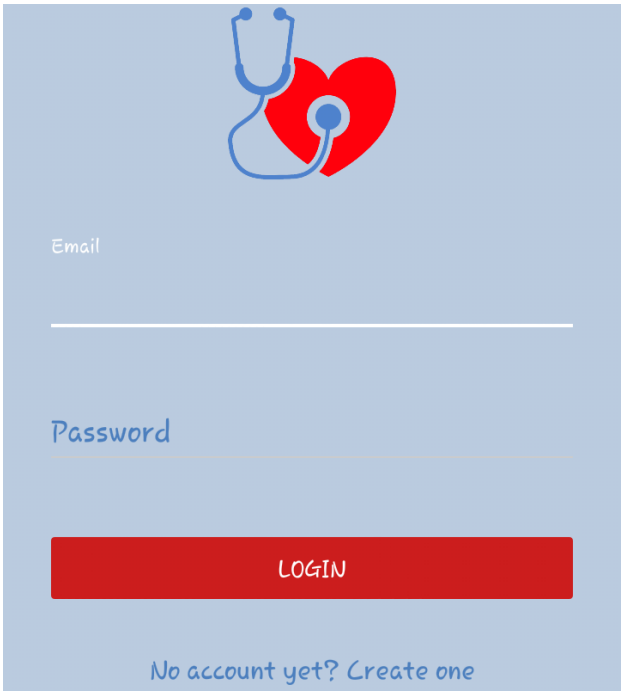
Debbabi et al (2010) insinuated that the verification process is a technique that is utilized to verify that the framework execution is a finished representation of the framework designer's hypothetical portrayal and stipulations. Smith (1993) arguments that verification is a procedure of measuring whether the framework or a given module of improvement meets the necessities set up on the past stage or not. Verification checks if the framework made is the exact and right creation. The client observations and estimates ought to be met meaning the clients need to give the green banner to the framework before execution (Dennis et al 2012).

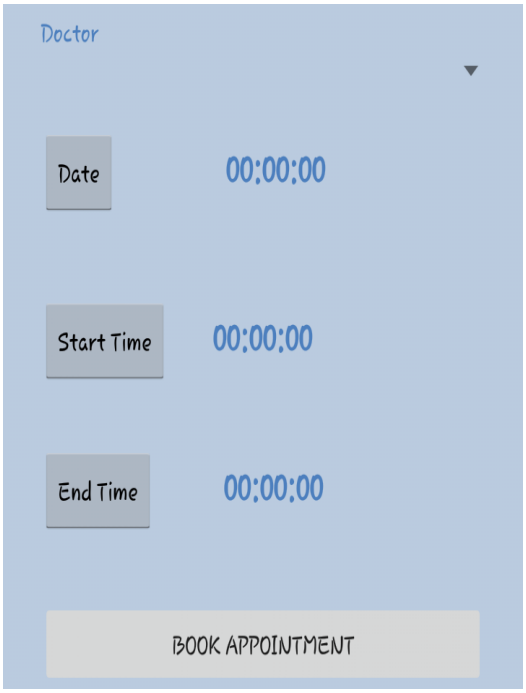
5.4.5.3.1 TEST CASES

Case	Description	Output
1	Users should be able to create accounts	There is an option for signing up using the mobile application
2	User should be able to login	An option is available for authenticating a user
3	Users should book appointment on the mobile	The mobile application has a user friendly book

	application	appointment activity.
4	Display the booking, prescriptions, referrals, consultations history etc.	There mobile application has related activities for displaying data to the user

Table 5.1: Verification test cases





Login and book appointment screens

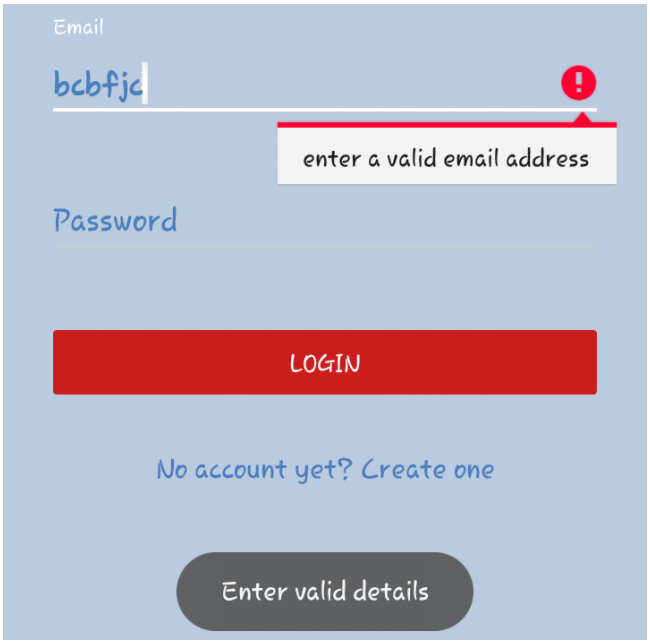
5.4.5.4 VALIDATION

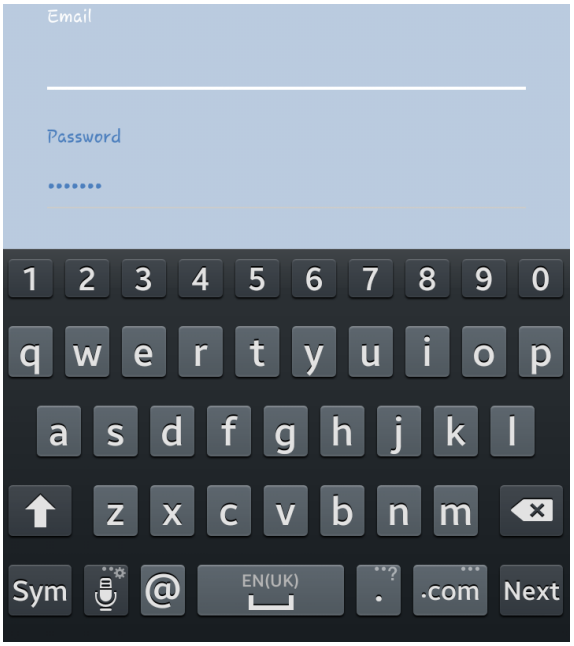
Validation is a procedure of figuring out whether the engineer has followed the client prerequisites and specifics (Grady 1997). Debbabi et al (2010) depicted the procedure of validation as a definitive procedure of the characterizing the level or degree to which a framework and the information utilized for that framework depict this present reality not disregarding the genuine framework use. Not at all like verification which is obviously about making the right framework validation focuses on making the framework right. Valacich further suggested that the acceptance process helps in figuring out if the framework is performing the fundamental framework capacities according to client desires. The framework / system experienced a different scope of evaluation in an offer to search for imperfections and settling those deformities for a deformity free framework.

5.4.5.4.1 TEST CASES

Case	Description	Output
1	When booking appointment, the user should only have the option to choose date and time without allowing any characters	The mobile application uses date and time pickers
2	On sign up and login, the user should be provided with the keyboard that suits the selected edit text element e.g. email, password, age, gender phone number	The mobile application provides customised keyboard for password, email, phone number, choosing gender
3	Only active prescriptions, bills, referrals and consultations should be displayed to the user	There mobile application only retrieve active data from the server on all instances.

Table 5.2: Validation test cases

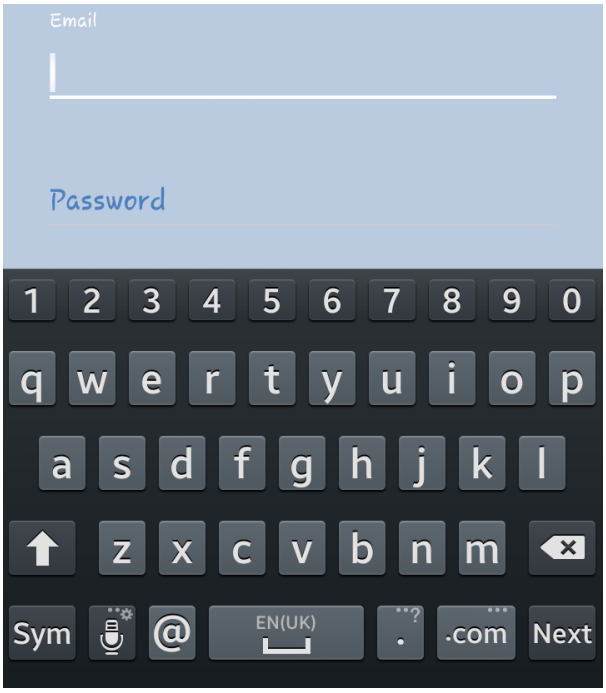


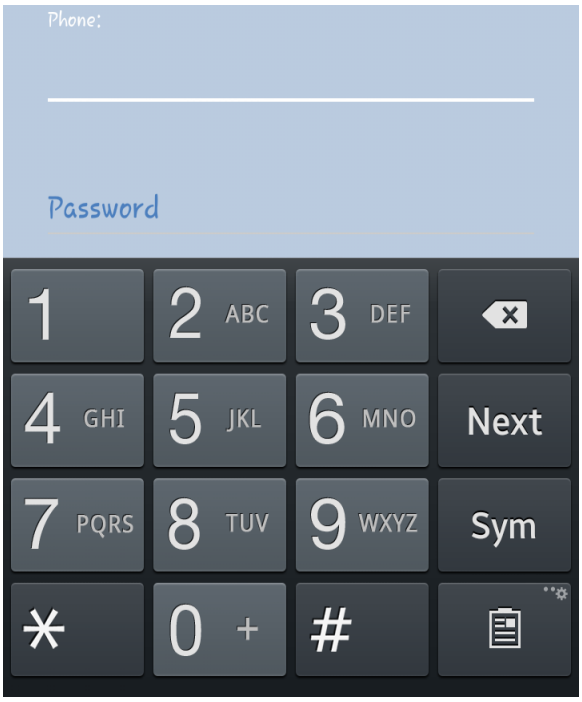


Showing the login validations on both the keyprovided and submiting invali email address

5.3.6 SECURITY TESTING

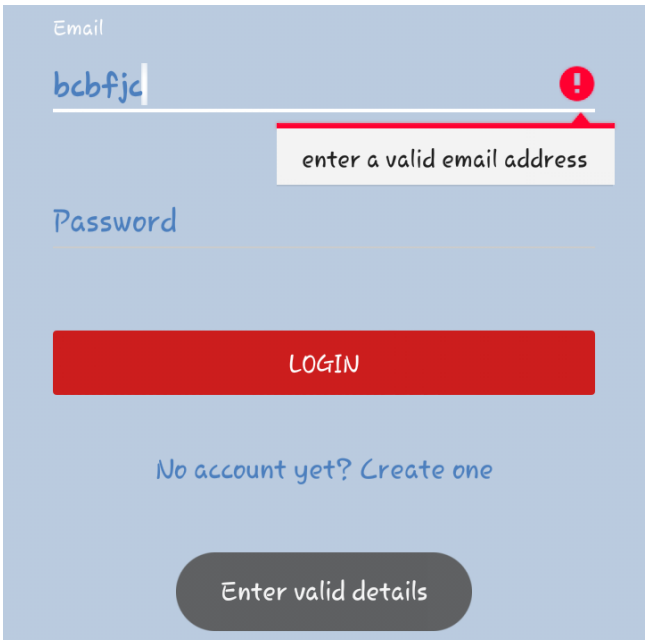
Inbuilt Security





Inbuilt validation only showing only possible email and phone numbers characters

Programmable Security



Validating the input programmatically

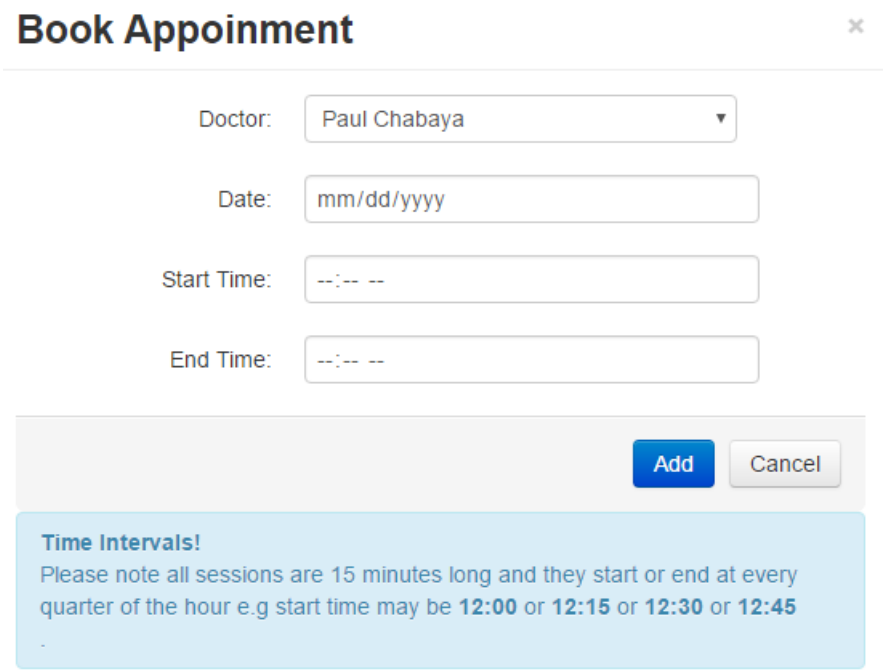
Third Party Security

The licence that are needed to encrypt the channel of communication are preinstalled on the remote server to be used.

5.4 SYSTEM AGAINST OBJECTIVES

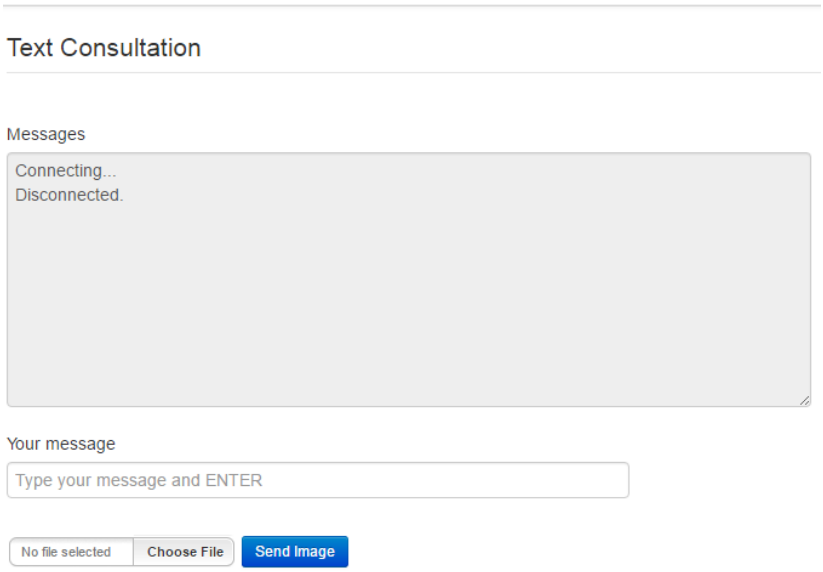
5.4.1 APPOINTMENT BOOKING

To enable a patient took a doctor's appointment remotely without the need to travel and consult with the offices for available slots.



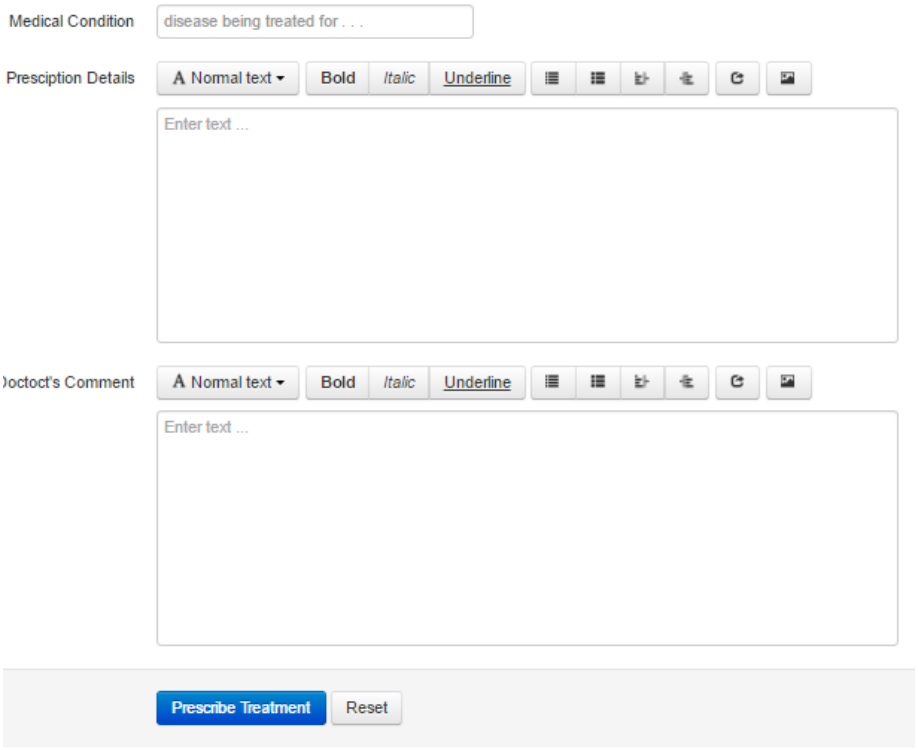
5.4.2 REMOTE DOCTOR CONSULTATION

To do a one on one consultation session with the doctor in the form of text, audio and or video via both mobile and web.



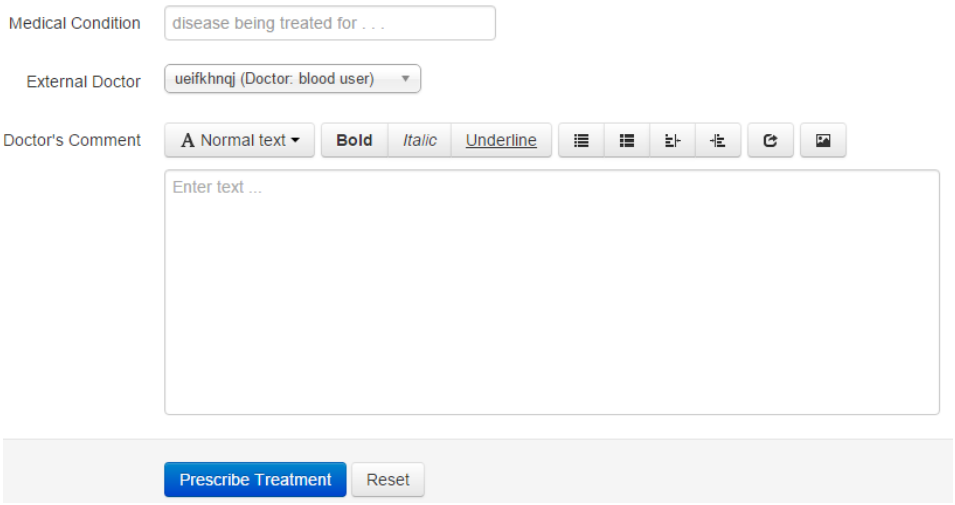
5.4.3 PRESCRIBE TREATMENT REMOTELY

To facilitate the doctor to prescribe and send a prescription to the patient after a consultation session.



5.4.4 PATIENT REFERAL

A doctor can refer a patient to a specialist (specialist) after a session when he / she considers the need to do so.



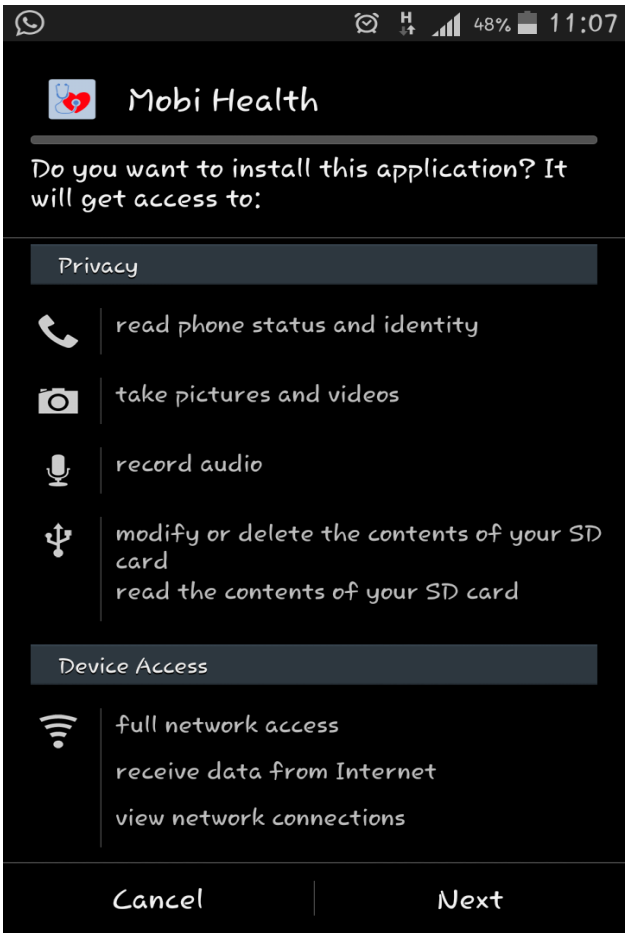
5.5 INSTALLATION

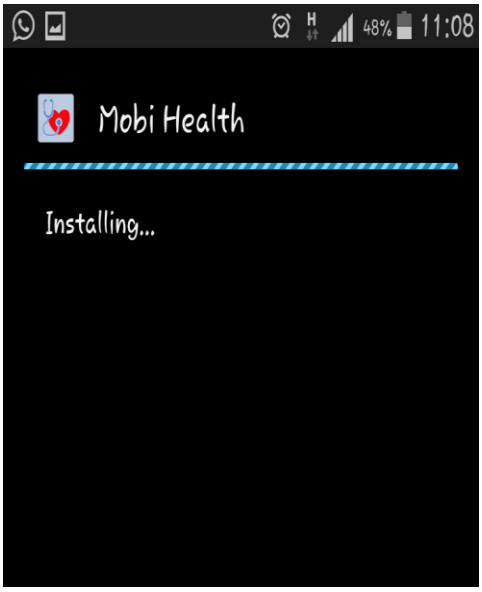
Installation is the procedure of succeeding an old framework with another one or the presentation of another framework (Dennis et al 2012). The establishment stage will just emerge at a later phase of improvement as it is done when the framework has been regarded fit for use. Moreover Connolly (2005) characterized the procedure as a strategy for making a system prepared for execution.

5.5.1 INSTALLATION STEPS

To install the application on an android device:

i. *Select the application APK and Run the installer*
ii. *Accept security questions and access permission and Install the application*





iii. *Open the installed application.*

5.5.2 DATA MIGRATION

All the local data will be baked up and moved to the remote site and properly synced to make sure there are dependency errors. This will enable end users to connect to the live application and interact with it as per user training.

5.5.3 TRAINING PLAN

The stakeholders who are going to use the application are to be trained as per following table:

Task	Duration (Days)
Sign up and sign in	1
Appointment booking (web and mobile)	1
Accessing reports (web and mobile)	1
Sharing reports(mobile)	1
Offline capabilities(mobile)	1
TOTAL	5

5.5.4 SYSTEM CHANGE OVER STRATEGIES

System changeover or conversion is concerned with the even change from one way of doing things or one system to another and the justification of interruption of business proceedings and activities during the system conversion (Myers, 2009). The whole conversion strategy should be done in a more cautious manner as during migration system data might be lost and business proceedings might be disturbed affecting the company profits. System configurations must be done perfectly, thus it is important to select a suitable change over strategy to safeguard the organization from system failure (Yeates and Wakefield 2004). There are three main change over strategies that an organization might be employ, namely pilot, direct and phased system changeover.

5.5.4.1 DIRECT CHANGE OVER

During the direct system change over the old system is completely phased out and a new system is immediately employed (Whitman and Mattord 2011). Doyle (2009) further on mentioned that

the old system is completely phased out in less than 24hrs and is replaced by a completely new system the following day. The whole process is in actual fact done in one instance. The system from the past is considered obsolete and all the organizations' departments exhausting the old system will commence to their daily activities or tasks under the newly introduced system.

Advantage

- It is a sudden change and could be exasperating if the changes are huge.
- Since only one system will be in use the direct changeover strategy can be cheap in terms of system implementation costs.

Disadvantage

- However the change might cost the organization dearly if there is no back up data as in the event of failure all the data might be lost.

5.5.4.2 PILOT CONVERSION

Pilot conversion is the changeover strategy that involves the use of the two system that is the old system and the new system with the majority of the system using the old system (Godfrey 1999). Lancaster (2001) elaborated by saying that the pilot a small scale execution of the new system.

Advantage

- This method is less expensive

Disadvantage

- It is attributed to high risks as compared to the parallel means that it is less expensive

5.5.4.3 PHASED CHANGEOVER

The continual and segmental replacement of the old system with the new system is what's referred to as phased changeover (Lancaster 2001). During the phased changeover the new system is introduced in phases and segments. This means that as the system is being introduced the system users will gradually get accustomed to the system at the same time the old system will

be phased out gradually. Shelly and Vermaat (2010) went on to mention that with phased changeover each location is associated with a different phase at a separate time.

Advantage

- The cost accompanied with the phased changeover is relatively low because the system is introduced in phases.
- System failure risks are low and in the event they occur they will be easily identified and controlled.

Disadvantage

- It takes a long time for stakeholders to fully gain the value of the whole system

5.5.4.4 PARALLEL CHANGEOVER

Ghezzi (2004) stipulated that parallel conversion is the changeover method in which the old system will run in parallel at the same time with the new system. As both systems are run the old system will eventually stop functioning and is phased out. The whole process of running both systems is to accommodate failures and reduce risks. The system data is transferred smoothly and efficiently. The parallel changeover is the safest and the one recommended for change overs.

Advantage

- The strategy is designed to reduce failures and risks

Disadvantage

- Can be costly to implement as the both systems will be running at the same time

5.5.4.5 CHOOSEN OPTION

After consideration of the above change over strategies, a parallel strategy was used due to the impact it can have on the overall project. As the system is still new it needed some time for testing and validation in the real world so this strategy makes it possible to improve any glitches whilst making sure that the usual business processes are continuing.

5.6 MAINTANANCE

Maintenance is the procedure of framework observing, framework assessment and framework alteration to make the important upgrades amid the full life range of the framework. Data frameworks ought to be kept up in order to guarantee that framework is complying with the framework specifics. Framework surveys ought to likewise be directed frequently and occasionally and in the occasion that the environment has changed the framework is ought to be moved up to meet the progressions in the surroundings. Framework support is a stage that is consistent and it never closes (Valacich et al 2012).

5.6.1 CORRECTIVE MAINTANANCE

As indicated by Valacich et al (2012) corrective maintenance are individualities made to a framework in order to settle bugs in the framework plan, usage even coding. Krugman (2009) characterizes corrective maintenance as acquainting a system to various working environments. Coding flaws are normally low valued to be balanced yet mistakes in planning are expensive as they may take in adjusting countless modules. After the adjustment of errors have been made checking should be directed to ensure that the entire framework is free of bugs.

5.6.2 ADAPTIVE MAINATANANCE

The technological environment is perpetually changing and the framework is ought to have the capacity to adjust to the evolving environment. In the occasion of environment changing the framework ought to be adjusted as needs be. Sommervile (2004) implied that versatile upkeep includes the procedure of embracing a product to an assorted working environment. Additionally in support Valacich et al (2012) declares that these are contrasts made to a framework to propel its usefulness to fluctuating business needs and goals. All movement changes relating the versatile maintenance stage ought to be all around archived.

5.6.3 PERFECTIVE MAINTANANCE

Krugman (2009) characterized perfective maintenance (support) as a procedure that includes executing an enhanced version in reference to the present framework adding precluded functionalities to the framework. Valacich (2012) states that perfective support includes the

changing of the framework by counting new elements and enhancing the entire framework execution.

MAINTANANCE RECOMENDATIONS

One would recommend the university to hire an external consultation company that will manage the maintenance process and ensure that the applications and all its dependencies are up and running.

5.7 RECOMMENDATIONS FOR FUTURE DEVELOPMENTS

The following list highlight the recommendation for future projects:

- The overall duration of the project should be long enough in order to cover all the test cases needed to build a robust system.
- More than 1 member should be available in the development team.
- Proper hardware and software should be available for data to sync smoothly between platforms without third party API.

5.8 CONCLUSION

This being the last part in the system (framework) advancement lifecycle, the framework will realize the most required compelling and effective smooth stream of data among patients and the specialists included. Usage was completed effectively and the deliverable is working and completely useful. The framework experienced cautious testing and it was a win. All the investigation, exertion that was utilized for the improvement of Gweru MobiHealth Android application is archived in this paper.

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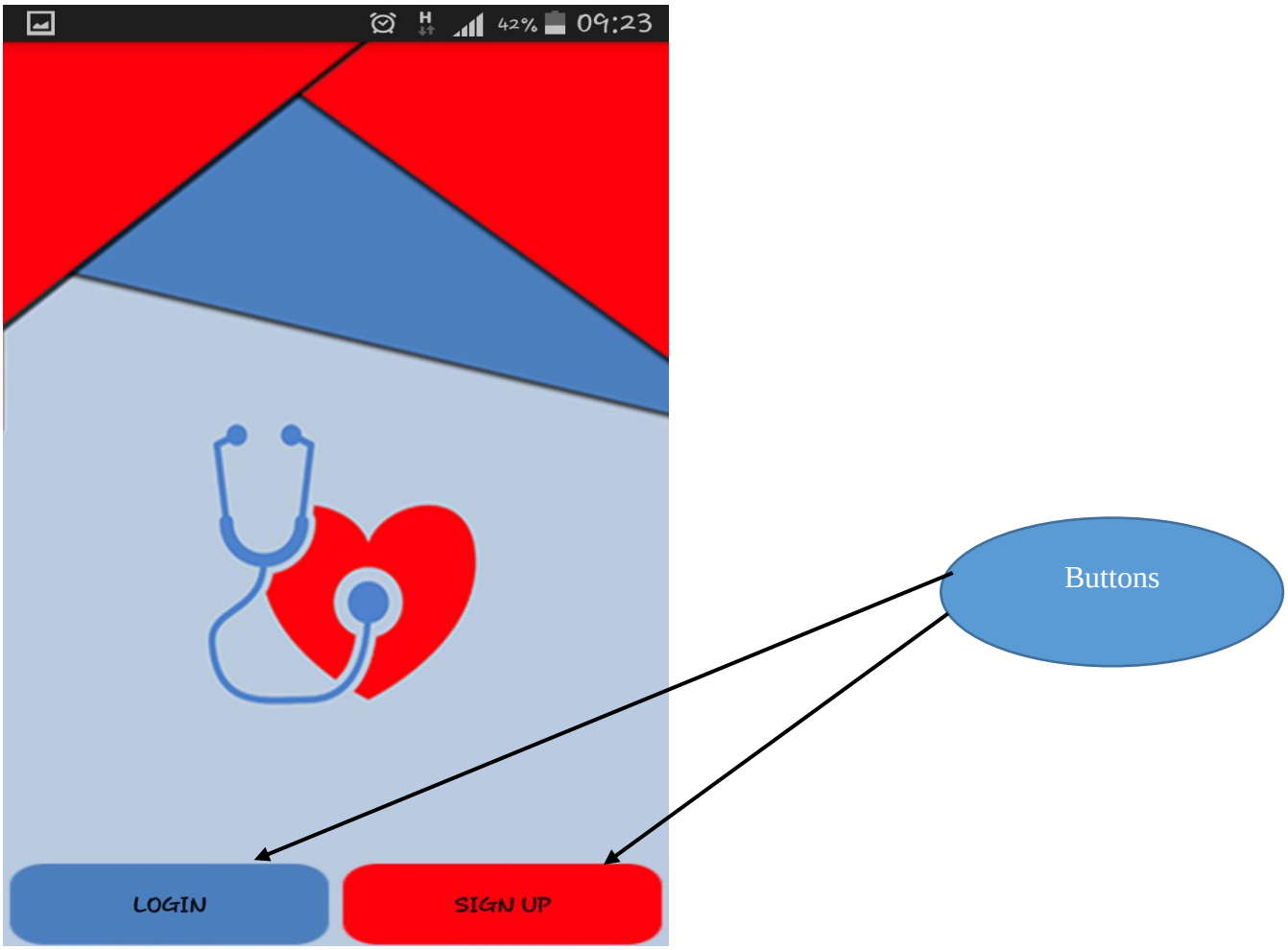
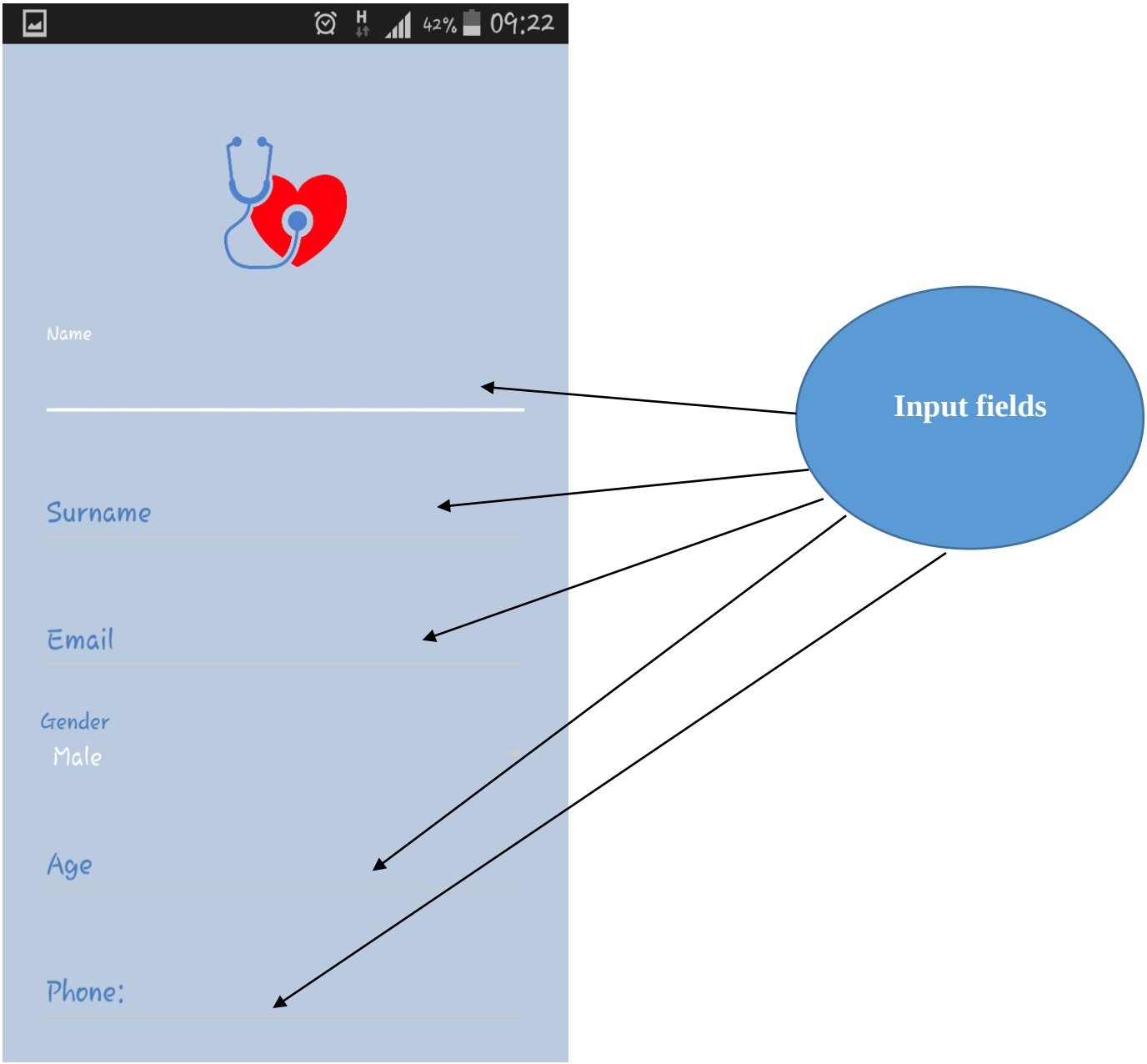
Yeates, D. and Wakefield, T.(2004) Systems Analysis And Design 2nd ED, Prentice Hall England

APPENDIX A: USER MANUAL

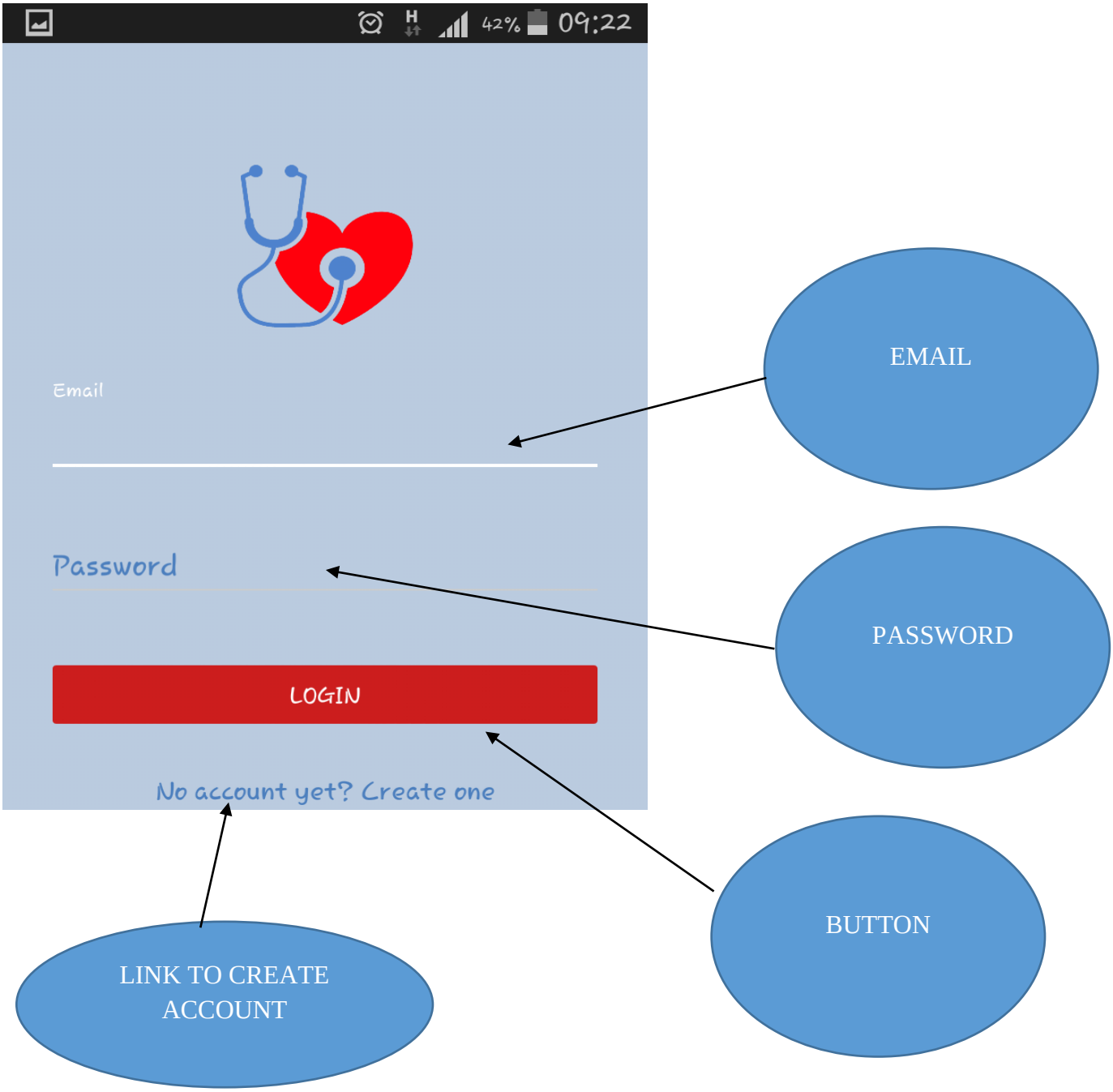
Launcher Screen



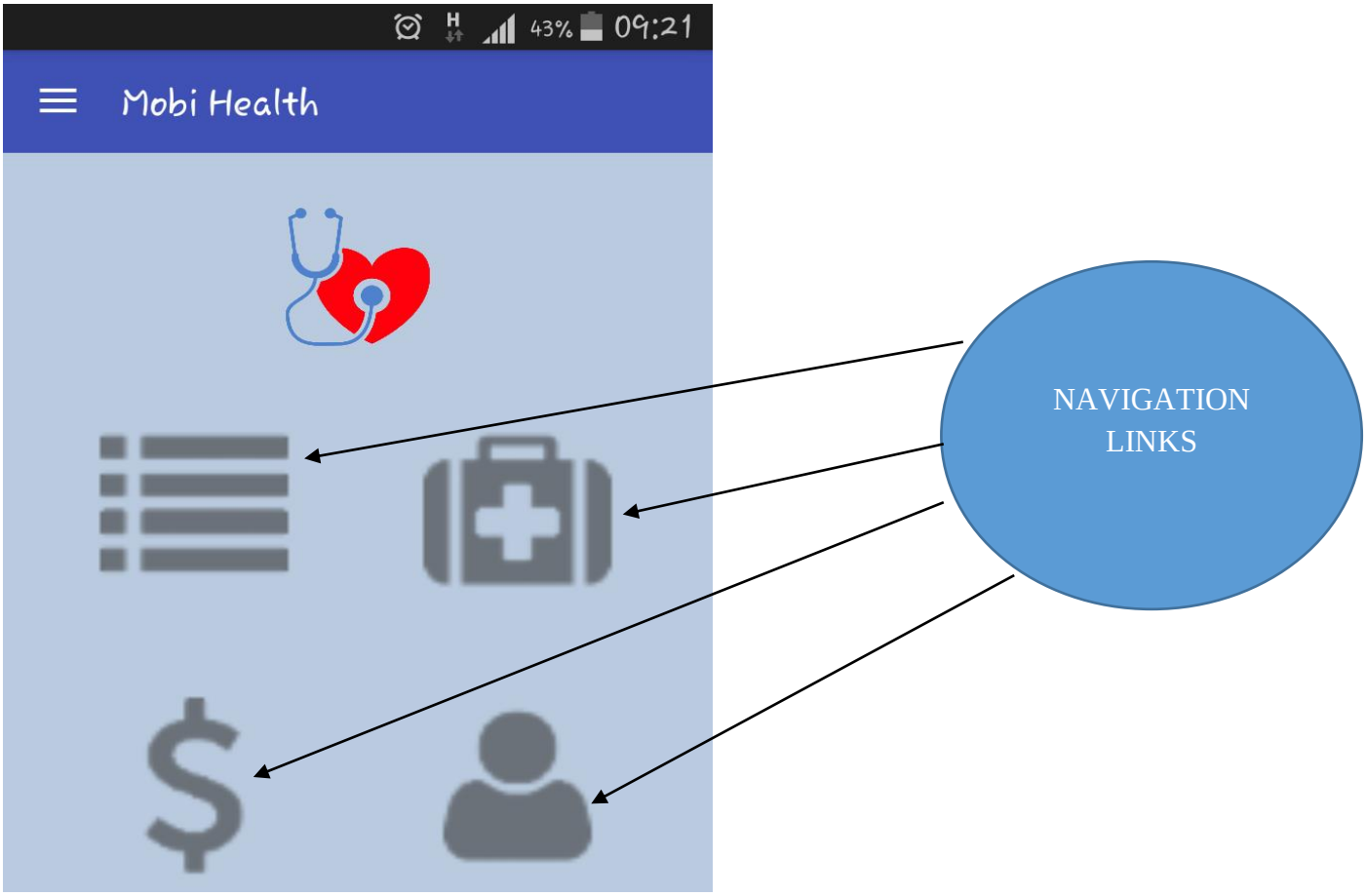
Create Account:



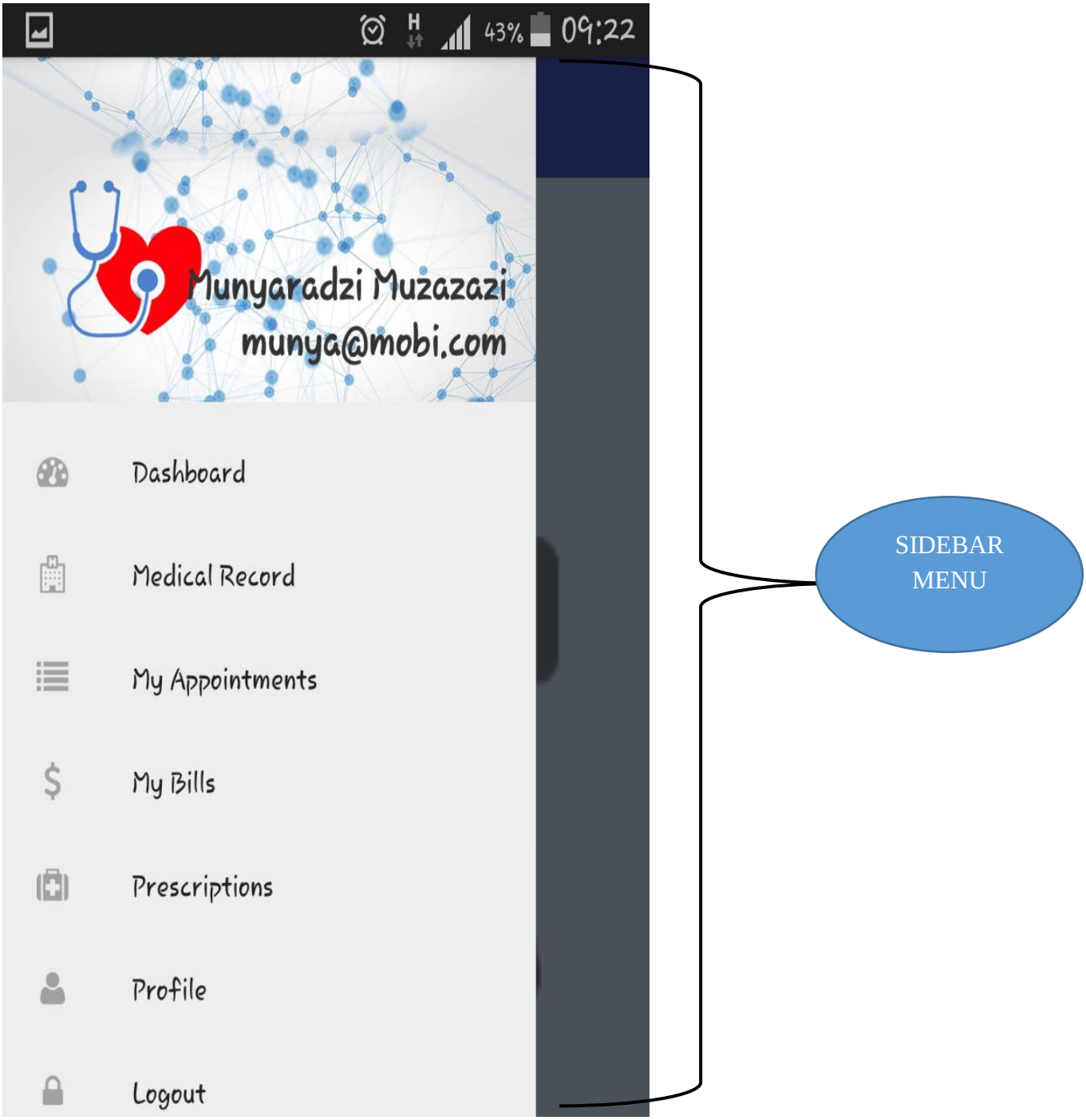
Login


42% 09:22
Email
Password
LOGIN
No account yet? Create one
EMAIL
PASSWORD
BUTTON
LINK TO CREATE ACCOUNT

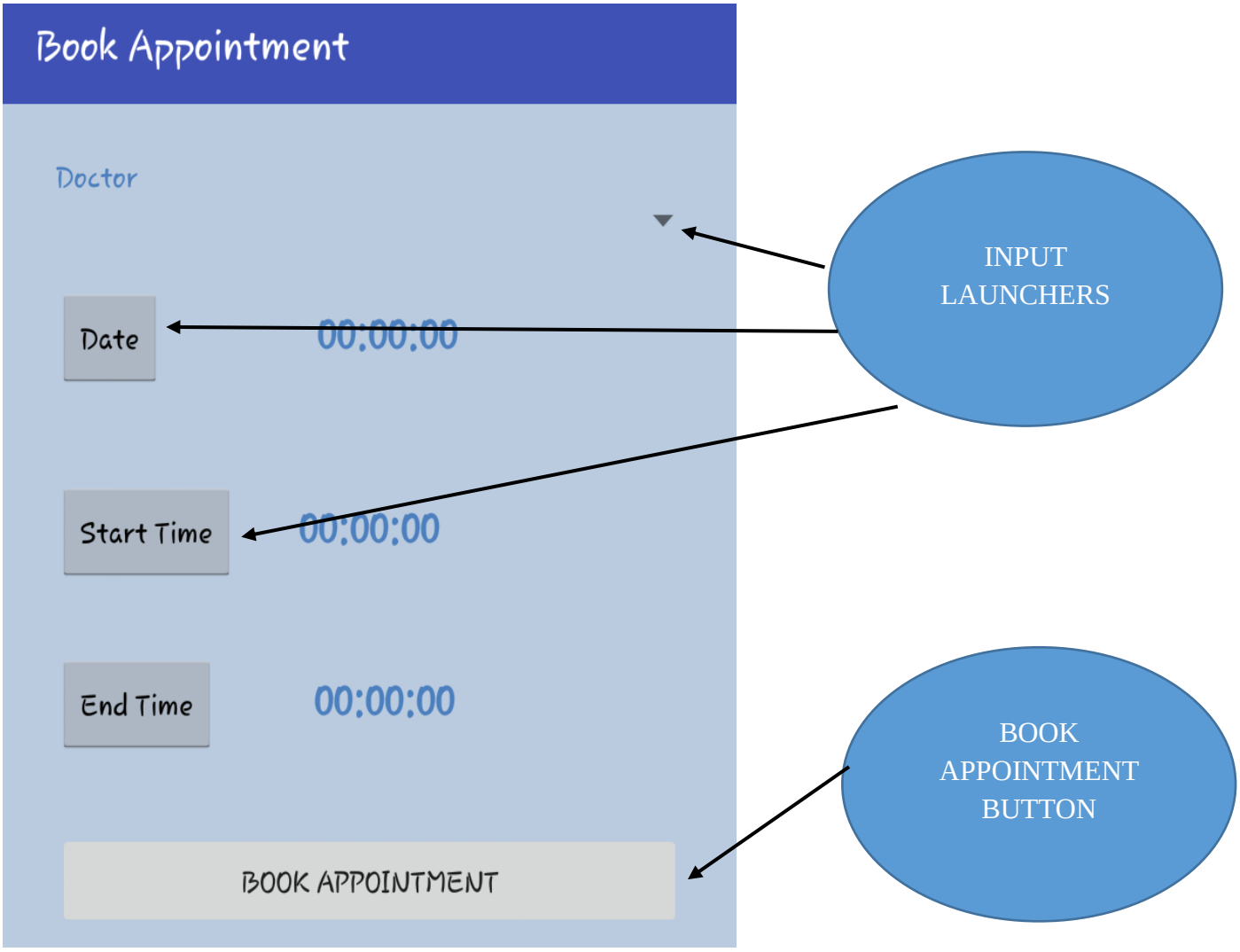
Dashboard



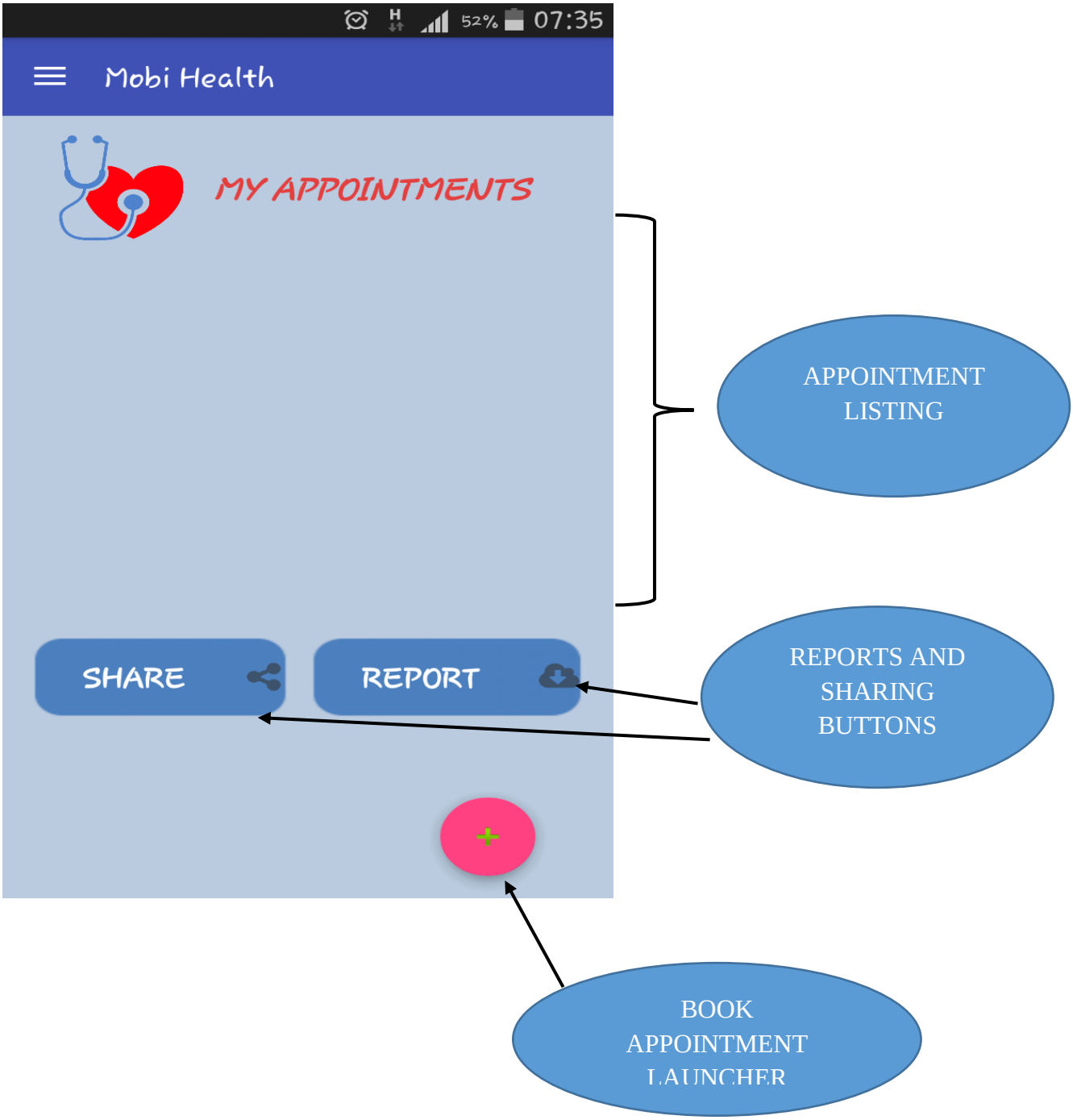
Menu


09:22
43%
Munyaradzi Muzazazi
munya@mobi.com
Dashboard
Medical Record
My Appointments
My Bills
Prescriptions
Profile
Logout
SIDEBAR MENU

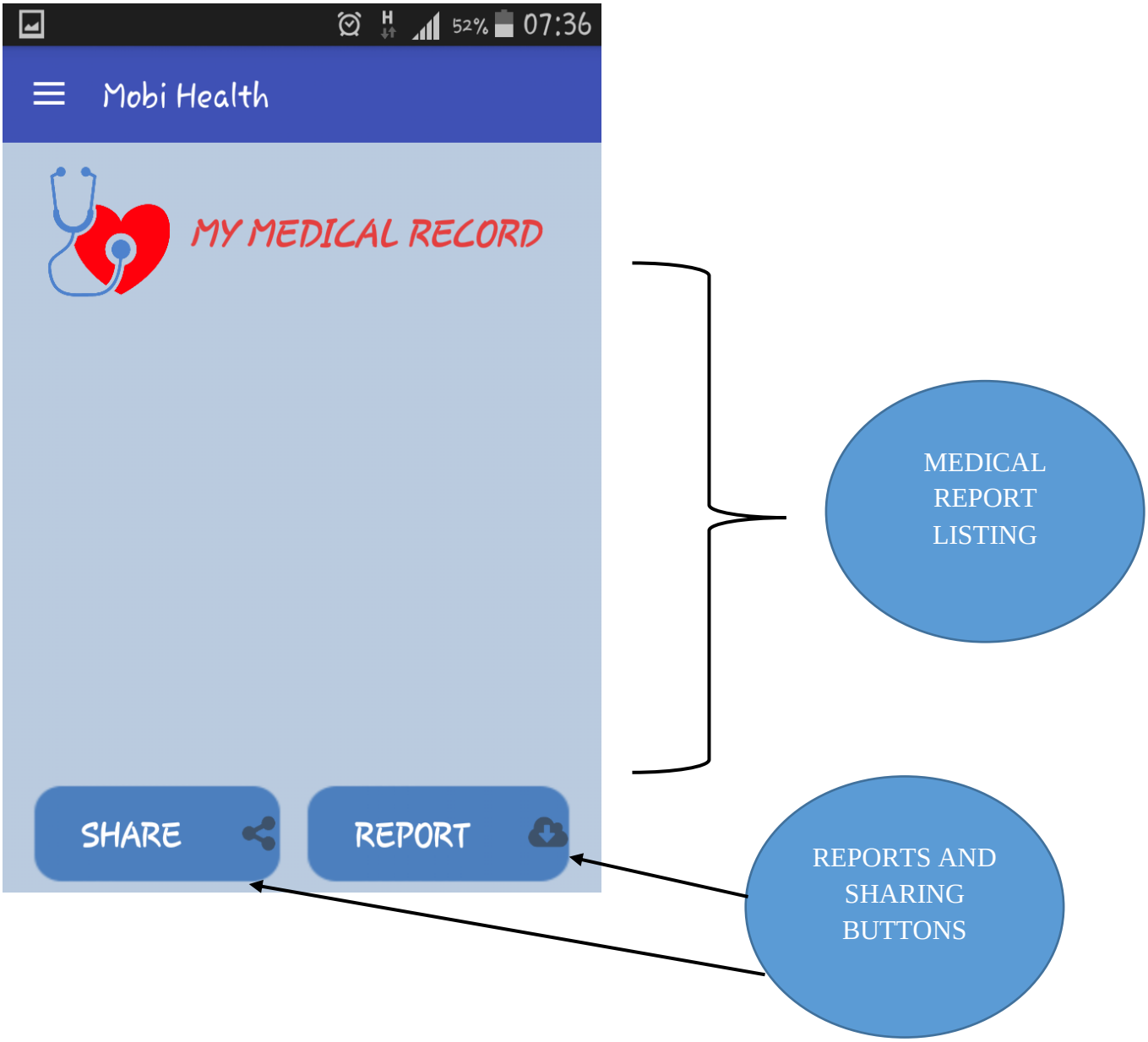
Book Appointment



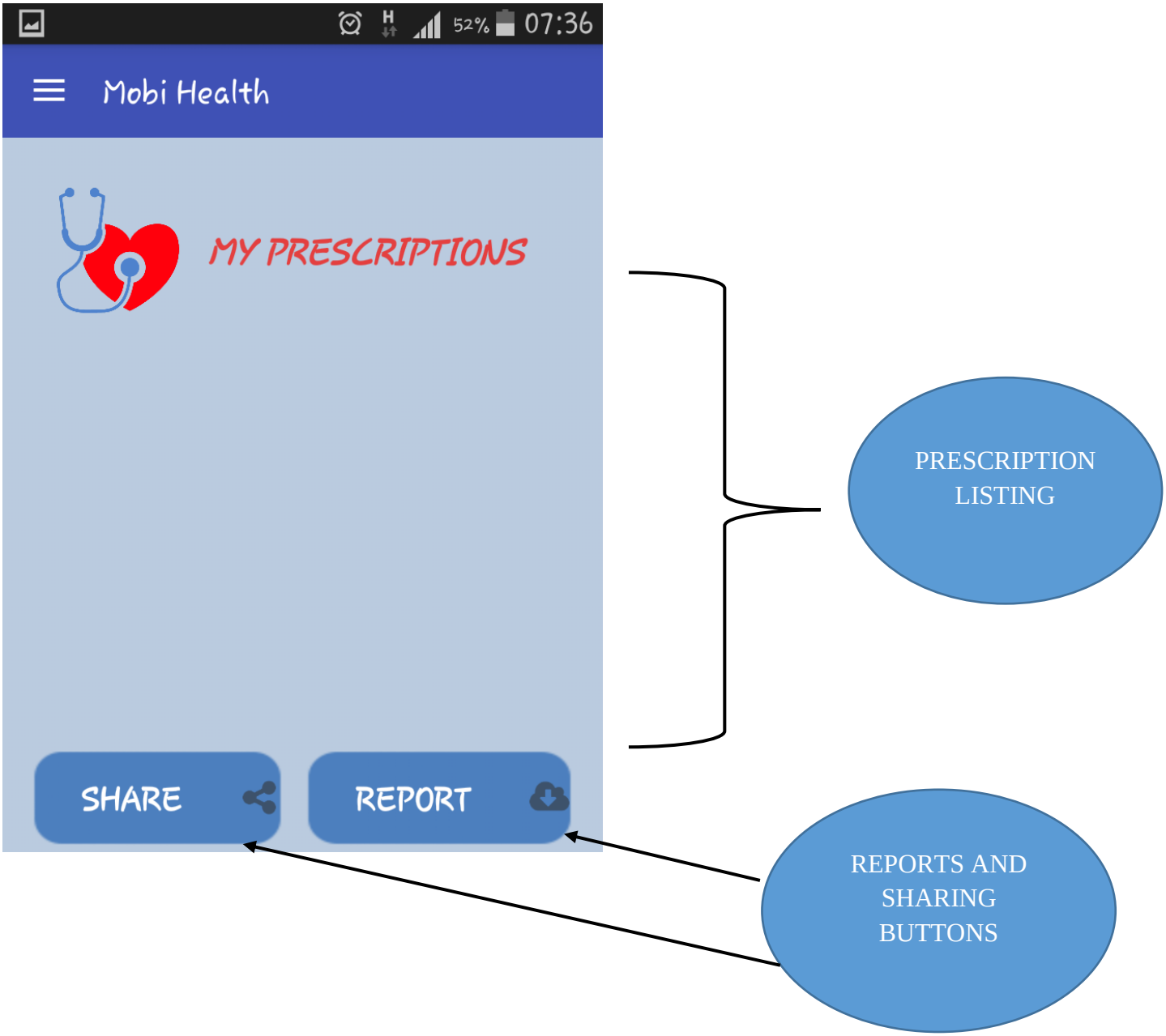
My Appointments



Medical Record



My Prescriptions



APPENDIX B: QUESTIONNAIRES SAMPLE

Questionnaires to Patients

For each of the questions listed below kindly fill in or tick your response in the spaces provided. Information gathered will be used with the highest degree of confidentiality.

2. How many times do you visit a hospital to see doctor in a month? ……

1. Kindly indicate the nature of your visit

Therapy ☐

Follow Up ☐

Prescription basis ☐

Referral basis ☐

3. Please indicate the time you waste in the process?

Short Time ☐

Normal Time ☐

Long time ☐

Other (specify) ……

4. How do you view the current operations of Telemedicine in view of patients support?

……
……

5. What would you want the mobile application to incorporate?

……
……

6. Any recommendations or suggestions to the system?

……
……

7. What functionalities would you like the application to have?

……
……

8 How would you rate the mobile application?

Reliable ☐ Unreliable ☐

APPENDIX C: INTERVIEW CHECK LIST

Interview Guide Script

The interview guide comprises of the broad areas that were covered in the interview. These areas are broken down into the following questions;

Which components do you consider a must for an effective mobile application?

What factors should be considered in creating the mobile application?

How many times do you visit the hospital to acquire the services of a health worker?

On average how much time do you waste or you are delayed in the process?

Is the doctor always available for a scheduled visit you would have made earlier?

Would the intervention of a mobile application simplify the operation of the hospital?

Do you have any suggestions for the introduction and improvement of the mobile application?

Are you willing to try the new application?

APPENDIX D: OBSERVATION SCORE SHEET

Aim of the observation……

……

Short description of the system:

……

……

Areas of strength:

……

……

Areas of that need improvement:

……

……

Work ethics shown by staff:

……

……

APPENDIX E: CODE SNIPPET

MAIN ACTIVITY

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    android:orientation="vertical"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingBottom="@dimen/activity_vertical_margin"
    android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    app:layout_behavior="@string/appbar_scrolling_view_behavior">

    <LinearLayout
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:layout_marginBottom="5dp"
        android:layout_marginTop="10dp"
        android:orientation="horizontal">

        <ImageView
            android:layout_width="match_parent"
            android:layout_height="75dp"
            android:layout_gravity="center|left"
```

```
        android:src="@drawable/logo" />

</LinearLayout>

<LinearLayout
    android:orientation="horizontal"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:weightSum="2"
    android:layout_marginTop="20dp">
    <ImageView
        android:layout_width="match_parent"
        android:layout_height="130dp"
        android:layout_gravity="center|left"
        android:src="@drawable/ic_fa_list"
        android:layout_weight="1" />
    <ImageView
        android:layout_width="match_parent"
        android:layout_height="130dp"
        android:layout_gravity="center|left"
        android:src="@drawable/ic_fa_medkit"
        android:layout_weight="1" />
</LinearLayout>

<LinearLayout
```

```
        android:orientation="horizontal"
        android:layout_width="match_parent"
        android:layout_height="wrap_content"
        android:weightSum="2"
        android:layout_marginTop="20dp" >

        <ImageView
            android:layout_width="match_parent"
            android:layout_height="130dp"
            android:layout_gravity="center|left"
            android:src="@drawable/ic_fa_usd"
            android:layout_weight="1" />

        <ImageView
            android:layout_width="match_parent"
            android:layout_height="130dp"
            android:layout_gravity="center|left"
            android:src="@drawable/ic_fa_user"
            android:layout_weight="1" />
    </LinearLayout>

</LinearLayout>
```

BOOK APPOINTMENT

```
package com.mperrence.mobihealth;
```

```
import android.annotation.TargetApi;
import android.app.DatePickerDialog;
import android.app.Dialog;
import android.app.ProgressDialog;
import android.app.TimePickerDialog;
import android.content.Context;
import android.content.DialogInterface;
import android.content.Intent;
import android.os.AsyncTask;
import android.os.Build;
import android.os.Bundle;
import android.support.design.widget.FloatingActionButton;
import android.support.design.widget.Snackbar;
import android.support.v4.app.DialogFragment;
import android.support.v7.app.AppCompatActivity;
import android.support.v7.widget.Toolbar;
import android.text.format.DateFormat;
import android.view.View;
import android.widget.ArrayAdapter;
import android.widget.Button;
import android.widget.DatePicker;
import android.widget.Spinner;
import android.widget.TextView;
import android.widget.TimePicker;
```

```
import android.widget.Toast;

import com.mperrence.mobihealth.library.SessionManager;
import com.mperrence.mobihealth.library.UserFunctions;
import com.mperrence.mobihealth.models.Appointments;

import org.json.JSONArray;
import org.json.JSONException;
import org.json.JSONObject;

import java.text.ParseException;
import java.text.SimpleDateFormat;
import java.util.ArrayList;
import java.util.Calendar;
import java.util.Date;
import java.util.HashMap;
import java.util.List;
import java.util.Locale;

public class BookAppointmentActivity extends AppCompatActivity {
    private static final String KEY_NAME = "name";
    private static final String KEY_SURNAME = "surname";
    private static final String KEY_DOCTOR_ID = "doctor_id";
    Button date, bookAppointment;
    static TextView startTime;
```

```
static TextView endTime;
static TextView dateText;
String bookDoctor, bookDate, bookStartTime, bookEndTime;
ProgressDialog progressDialog;
Spinner doctorSpinner;
private static SimpleDateFormat dateFormatter;

private static String KEY_SUCCESS = "success";
private static String KEY_ERROR = "error_msg";

UserFunctions userFunction;

// Session Manager Class
SessionManager session;
String patient_id;

@Override
protected void onCreate(Bundle savedInstanceState) {
   super.onCreate(savedInstanceState);
   setContentView(R.layout.activity_book_appointment);
   Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar);
   setSupportActionBar(toolbar);

   GetDoctorsTask getDoctorsTask = new GetDoctorsTask();
   getDoctorsTask.execute("Get the active doctors");
```

```
    date = (Button) findViewById(R.id.btnSetDate);
    dateText = (TextView) findViewById(R.id.showDate);
    dateFormatter = new SimpleDateFormat("dd-MM-yyyy", Locale.US);

    startTime = (TextView) findViewById(R.id.showStartTime);
    endTime = (TextView) findViewById(R.id.showEndTime);

    bookAppointment = (Button) findViewById(R.id.btn_save_appointment);
    doctorSpinner = (Spinner) findViewById(R.id.input_doctor);

    // Session Manager
    session = new SessionManager(getApplicationContext());

    // get user data from session
    HashMap<String, String> user = session.getUserDetails();

    // Set the userName and userSurname in the navigation bar
    patient_id =  user.get(SessionManager.KEY_PATIENT_ID);
}

public void setDate(View view) {
    DialogFragment newFragment = new DatePickerFragment();
    newFragment.show(getSupportFragmentManager(), "datePicker");
}
```

```
    public void pickTime(View view) {
        CustomTimePickerDialog timePickerDialog = new
CustomTimePickerDialog(BookAppointmentActivity.this, timeSetListener,
                Calendar.getInstance().get(Calendar.HOUR),
CustomTimePickerDialog.getRoundedMinute(Calendar.getInstance().get(Calendar.MINU
TE) + CustomTimePickerDialog.TIME_PICKER_INTERVAL), true);
        timePickerDialog.setTitle("Set your appointment time");
        timePickerDialog.show();
//        DialogFragment newFragment = new TimePickerFragment();
//        newFragment.show(getSupportFragmentManager(), "timePicker");
    }

    public void doBookAppointment(View view) {
        bookDate = dateText.getText().toString();
        bookStartTime = startTime.getText().toString();
        bookEndTime = endTime.getText().toString();
        bookDoctor = doctorSpinner.getSelectedItem().toString();

        if (!validate()){
            onBookAppointmentFailed("Failed Validation");
            return;
        }

        bookAppointment.setEnabled(false);
```

```
        progressDialog = new ProgressDialog(BookAppointmentActivity.this,
                R.style.AppTheme_Dark_Dialog);
        progressDialog.setIndeterminate(true);
        progressDialog.setMessage("Processing Request...");
        progressDialog.show();

        MyTask myTask = new MyTask();
        myTask.execute("Book Appointment");
    }

    private void onBookAppointmentFailed(String responce) {
        Toast.makeText(getApplicationContext(), responce, Toast.LENGTH_LONG).show();
    }

    private void onBookAppointmentSuccess() {
        Toast.makeText(getApplicationContext(), "The booking has been saved.",
Toast.LENGTH_LONG).show();
        Intent intent = new Intent(getApplicationContext(),MainActivity.class );
        startActivity(intent);
    }

    private boolean validate() {
        if (bookDate.isEmpty()){
            Toast.makeText(getApplicationContext(), "Enter a valid date",
Toast.LENGTH_LONG).show();
```

```
            return false;
        }
        return true;
    }


    public static class CustomTimePickerDialog extends TimePickerDialog{
        public static final int TIME_PICKER_INTERVAL=15;
        private boolean mIgnoreEvent=false;

        public CustomTimePickerDialog(Context context, OnTimeSetListener callBack, int hourOfDay, int minute, boolean is24HourView) {
            super(context, callBack, hourOfDay, minute, is24HourView);
        }

        @Override
        public void onTimeChanged(TimePicker timePicker, int hourOfDay, int minute) {
            super.onTimeChanged(timePicker, hourOfDay, minute);
            if (!mIgnoreEvent){
                minute = getRoundedMinute(minute);
                mIgnoreEvent=true;
                timePicker.setCurrentMinute(minute);
                mIgnoreEvent=false;
            }
        }
```

```
    public static  int getRoundedMinute(int minute){
        if(minute % TIME_PICKER_INTERVAL != 0){
            int minuteFloor = minute - (minute % TIME_PICKER_INTERVAL);
            minute = minuteFloor + (minute == minuteFloor + 1 ? TIME_PICKER_INTERVAL : 0);
            if (minute == 60)  minute=0;
        }

        return minute;
    }
  }

  private CustomTimePickerDialog.OnTimeSetListener timeSetListener = new CustomTimePickerDialog.OnTimeSetListener() {
    @Override
    public void onTimeSet(TimePicker view, int hourOfDay, int minute) {
//          startTime.setText(hourOfDay + ":" + minute);
        startTime.setText(String.format("%02d", hourOfDay) + ":" + String.format("%02d", minute));
        minute += 15;

        endTime.setText(hourOfDay + ":" + minute);
    }
  };
```

```
public static class DatePickerFragment extends DialogFragment
        implements DatePickerDialog.OnDateSetListener {

    @Override
    public Dialog onCreateDialog(Bundle savedInstanceState) {
        // Use the current date as the default date in the picker
        final Calendar c = Calendar.getInstance();
        int year = c.get(Calendar.YEAR);
        int month = c.get(Calendar.MONTH);
        int day = c.get(Calendar.DAY_OF_MONTH);

        // Create a new instance of DatePickerDialog and return it
        return new DatePickerDialog(getActivity(), this, year, month, day);
    }

    public void onDateSet(DatePicker view, int year, int month, int day) {
        dateText.setText(year + "-" + (month)  + "-" + day);
    }
}

private class MyTask extends AsyncTask<String, String, JSONObject> {

    @Override
    protected void onPreExecute() {
```

```
}

@Override
protected JSONObject doInBackground(String... params) {

    userFunction = new UserFunctions();

    //Converting the value to mysql freindly version
    String bookDateSource = bookDate.toString();
    Date newDate = null;
    try {
        newDate = new SimpleDateFormat("yyyy-MM-dd").parse(bookDateSource);
    } catch (ParseException e) {
        e.printStackTrace();
    }
    String bookMysqlDate = new SimpleDateFormat("yyyy-MM-dd").format(newDate);

    JSONObject json = userFunction.bookAppointment(patient_id, bookDoctor, bookMysqlDate, bookStartTime, bookEndTime);
    return json;
}
@Override
protected void onPostExecute(JSONObject json) {

    if (json != null) {
```

```
    // check for sign up responce response
    try {
        if (json.getString(KEY_SUCCESS) != null) {

            String res = json.getString(KEY_SUCCESS);

            if(Integer.parseInt(res) == 1){

                bookAppointment.setEnabled(true);
                progressDialog.dismiss();
                onBookAppointmentSuccess();

            }else{
                String responce = json.getString(KEY_ERROR);
                bookAppointment.setEnabled(true);
                progressDialog.dismiss();
                onBookAppointmentFailed(responce);
            }
        }
    } catch (JSONException e) {
        e.printStackTrace();
    }
} else {
    bookAppointment.setEnabled(true);
    progressDialog.dismiss();
```

```
            Toast.makeText(getApplicationContext(), "Failed to connect to server.", Toast.LENGTH_LONG).show();
        }
    }
}

private class GetDoctorsTask extends AsyncTask<String, String, String> {

    @Override
    protected void onPreExecute() {
    }

    @Override
    protected String doInBackground(String... params) {

        userFunction = new UserFunctions();

        String json = userFunction.getDoctors();
        return json;
    }

    @TargetApi(Build.VERSION_CODES.KITKAT)
    @Override
    protected void onPostExecute(String json) {
```

```
if (json != null) {
    try {
        if (!json.isEmpty()) {

            JSONArray ja = new JSONArray(json.toString());
            JSONObject jo = null;

            List<String> doctorsList = new ArrayList<>();
            for (int i = 0; i < ja.length(); i++) {
                JSONObject jsonObject = ja.getJSONObject(i);

                String doctor = jsonObject.getString(KEY_NAME) + " " +
jsonObject.getString(KEY_SURNAME);
                int doctor_id =
Integer.parseInt(jsonObject.getString(KEY_DOCTOR_ID));

                doctorsList.add(doctor_id, doctor);
            }

            ArrayAdapter<String> doctorsArrayAdapter = new ArrayAdapter<String>
                (getApplicationContext(), R.layout.spinner_item, doctorsList);
            doctorSpinner.setAdapter(doctorsArrayAdapter);

        }else{
        }
    } catch (JSONException e) {
```

```
                e.printStackTrace();
            }
        } else {
            Toast.makeText(getApplicationContext(), "Failed to connect to server.", Toast.LENGTH_LONG).show();
        }
    }
}
```