AN AUTOMATED SYSTEM FOR REDUCING PREVENTABLE MEDICAL ERRORS

DiMed

(CASE STUDY: KAMPALA INTERNATIONAL UNIVERSITY CLINIC.)

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A Project Report Submitted to School of Computer Studies for a Project in Partial Fulfillment of the Requirements for the Award of Degree of Bachelor of Information Technology of Kampala International University.

Declaration

We hereby declare that the work in this project report is genuinely done by us and has never been submitted to this university or any other institution for the award of a degree or diploma.

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Approval

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

Signature ..... Date .....

24/10/2012

Mr. Kamulegeya Grace

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Dedication

I dedicate this Project most of all to the almighty God who has guided me throughout the entire project, and to my Mum, brothers and sisters, I thank for the patience and advice they gave me throughout my time in school.

To #14 I'm forever grateful.

Amukaga Mercy Ettyang' .....

To God and my family, you inspire me always.

Bihande Rodney .....

Acknowledgement

Special thanks and gratitude go to my supervisor Mr. Kamulegeya Grace for his always generous guidance and advice while working on this project and also throughout our study years at Kampala International University.

To our Head of Department, Ms. Margaret for her time and patience with us.

Finally, we also thank our friends and course mates who have stood by us throughout the years.

May God reward you all abundantly.

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CHAPTER ONE

INTRODUCTION

1.0 Background

Wikipedia defines a Medical error as "The failure of a planned action to be completed as Intended (error of execution) or the use of a wrong plan to achieve an aim (error of Planning)." In practice the term "medical errors" is often preceded by the modifier "preventable." Medical world accepts that there are some medical errors for which preventability is rarely questioned. The list includes medical errors such as wrong site surgery, administering the wrong medication when the correct one was ordered, or transplanting organs of the wrong blood type. On the other hand, there are less preventable medical errors such as case studies reported in journals, where one or more experts review the treatment decisions of a clinician's judgment was incorrect.

Two major categories of medical errors exist: 'mistakes' and 'slips'. Norman (2000) defines a mistake as "an error in the intention" and a slip as "an error in carrying out the intention". Even if lots of errors occur in medicine, they are still not always harmful. Those errors, which result in injury, are called preventable adverse events. An adverse event is an injury resulting from a medical intervention, in other words, it is not due to the underlying condition of the patient. While all adverse events result from medical management, not all are preventable (Byounggon and Basedow, 2001) [1].

Several studies have published in order to estimate the dimension of preventable medical errors. According to Corrigan et al. (1999) [2] in a report titled "To Err is Human: Building a Safer Health System" puts the number of preventable deaths in America due to preventable medical errors at 44,000 to 98,000 a year, and estimates the annual cost of preventable errors at $17-29 billion. A report of the Siemens Medical Solutions Health Services Corporation estimates that as much as 7000 of these preventable deaths are due to wrong medicines that are consumed. However, such a study has not been carried out in Uganda yet. In light of this, it is crucial that measures be taken to overcome such errors. The system to be developed provides an

Information Technology approach to creating a lasting solution to minimizing some common preventable errors in medicine.

1.1 Problem Statement

A good number of hospitals in Uganda have notably invested in accounting systems at the expense of computer based systems for medical error tracking and mitigation that directly improve medical services. Currently, the Kampala International University clinic, that treats mainly the university students, has only a manual system that caters mainly for patients' medical information. The system does not cater for medical error prevention. Information of a patient's record is only presented to other doctors when explicitly requested. It is common for patients to change doctors and medical centers frequently and therefore, they have to move with their medical documents if available or narrate their medical history.

It is also common for a patients' record to be mixed up leading to misidentification of the patient, which results into wrong diagnosis and hence failure to administer the right treatment. This is confirmed by (Kyhlback, 2005) [4] who reports that a doctor with several patients under anesthesia in an operating theatre can for example remove the kidney of someone who has just broken a leg thinking that the patient is someone else.

The general assumption is that patients will always go to the clinic whenever they fall sick or need to seek medical consult. This trend makes it very easy for doctors to access the patient's records and make proper follow ups if they are well kept and the information system in use is efficient.

This study is aimed at developing a medical system to overcome medical diagnosis errors as well as improve accessibility of patient records by pharmacists who may fail to read handwritten prescribed information.

1.2 Main Objective

The main objective of this project is to develop a computer-based Medical Diagnosis Information System, DiMed, for the Kampala International University Clinic.

1.2.1 Specific Objectives

To achieve the aim of this study, the following specific objectives will be addressed:

(i) Investigation of the causes of preventable medical diagnosis errors in the university clinic.

(ii) Design of a database for capturing patient Information.

(iii) Implementation of an interface in Visual Studio for the database in (ii) above.

(iv) Validation of DiMed using data from K.I.U clinic.

1.3 Scope

The Study will use data from Kampala International University clinic to validate the system. Data will be collected in relation to information that medical personnel record about their patients and the common preventable errors made by these personnel.

1.4 Significance

Currently the K.I.U clinic uses a manual system for keeping patients' records and which documents have to be moved from one department to another whenever needed. This poses an increase on the cost of hiring more non-medical staff to act as messengers and worse still, makes access to patients' information so difficult.

The anticipated contributions of DiMed are:

- Doctors will take knowledgeable decisions much more rapidly than before based on clear diagnosis information. Anytime straight access to emergency information for a patient will be possible and doctors will have easy access to a complete patient record.

- The computer-based Medical Diagnosis Information System that will support a quick and reliable diagnosis and provide the physician with diagnosis information with regard to the patients' symptoms.
- Encyclopedia and tutorial functions will be provided for doctors in order to help them during the diagnosis. A plausibility-checking feature to confirm the doctors' diagnosis and provide information of things that need to be considered for current illness will also included in the new system.

- Besides the actual treatment of a given patient, DiMed will also greatly help to improve medical research. The complete medical records of millions of patients are huge amount of information, which is very valuable and opens up totally new dimensions of research. Pharmaceutical companies can even be willing to pay significant amounts of money to get information from that new system, which was taken as an incentive for the implementation of the new Medical Information System. Protection of privacy is a big issue in all this and information may only be given out to identified individuals. Since the information in a medical record can be considered to be the corresponding patients' property, it may only be given away if the patient agrees to do so and may get some incentive for allowing the use of such medical information for research purposes.

As seen above, each patient has the ultimate control to decide, which information is stored in the database and how this information is used. Appropriate security measures restrict access to patient records to those who are allowed to and who need to get this information.

Other benefits of this new system to be realized will be in terms of:

- Streamlined operations like Reception, Inventory, Pharmacy, Purchasing (e-commerce), Warehousing.
- Enhance administration and control, realizing quicker and more precise decision making.
- Reduced paperwork

The aforementioned benefits shall improve the efficiency of the university health care system significantly.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The review is based on literature about preventable medical errors (section 2.1) and related medical systems (Section 2.2).

2.1 State of the art on preventable medical errors

Several studies have been published in relation to different categories of preventable medical errors. Corrigan et al. (1999) [2] in a report titled "To Err is Human: Building a Safer Health System" puts the number of preventable death in America due to medical errors at 44,000 to 98,000 a year and estimates the annual cost of preventable errors at $17-29 billion. A report of the Siemens Medical Solutions Health Services Corporation estimates that about $2 billion is annually spent on additional, wrong medicines that are consumed.

Krouwer (2004) [3] found out that there are some medical errors for which preventability is rarely questioned. These include medical errors such as wrong site surgery, administering the wrong drug when the correct drug was ordered, or transplanting organs of the wrong blood type. Less preventable medical errors include judgment type errors such as case studies reported in journal, where one or more experts review the treatment decisions of a physician and conclude that the judgment was incorrect.

According to Migdail (2000)[6], most people believe that medical errors usually involve drugs, such as a patient getting the wrong prescription or dosage, or mishandled surgeries, such as amputation of the wrong limb was earlier planned for amputation. However, there are many other types of medical errors, including:

- Diagnostic error, such as wrong diagnosis leading to an incorrect choice of therapy, failure to use an indicated diagnostic test, misinterpretation of test results, and failure to act on abnormal results where wrong diagnosis can be minimized by an integrated expert system.

- Equipment failure, such as defibrillators with dead batteries or intravenous pumps whose valves are easily dislodged or bumped, causing increased doses of medication over too short a period. This can be reduced by maintaining an inventory of medical equipment indicating when each of them is due for servicing.
- Infections, such as nosocomial and post-surgical wound infections.
- Blood transfusion-related injuries such as giving a patient the blood of the incorrect type which can be minimized by accessing the blood group from the patient's records in the system.
- Misinterpretation of other medical orders, such as failing to give a patient a salt-free meal, as ordered by a physician.

Two major categories of medical errors exist: 'mistakes' and 'slips'. Norman (2000) defines a mistake as "an error in the intention" and a slip as "an error in carrying out the intention". Even if lots of errors occur in medicine, they are still not always harmful. Those errors, which result in injury, are called preventable adverse events. An adverse event is an injury resulting from a medical intervention, in other words, it is not due to the underlying condition of the patient. While all adverse events result from medical management, not all are preventable (Byounggon and Basedow, 2001) [1].

Other errors include failure in communication. Medication errors in Uganda occur as a result of improper processing, flow and access of medical information. The information needed to make a correct decision is in most cases not obtained. Where it is obtained, it may not be available when the decision is being made. Sometimes information is obtained and available but not used in making the decision. At times it gets lost or garbled in transfer. In addition, less time is available to enable the use of this medical information during the treatment of a patient. It is also noted by medical personnel in K.I.U that process including information flows are not standardized for all hospitals and clinics in Uganda.

Schumer (2001) [8] found that while most medical errors are easily avoidable, the information technologies needed to eliminate them are too expensive for financially strapped hospitals to purchase. Computer physician entry systems (CPOEs), in which doctors enter prescription

information into a computer, cost roughly $2 million to buy and $500,000 annually to maintain. By instantly checking for potential problems, CPOEs can reduce overall error rates by 55-70% and serious medication errors up to 88%. Only 5% of hospitals nationwide in USA, however, have been actually able to purchase them.

2.2 Related Medical Systems

This section reviews literature on existing computer based medical systems.

Na (2004)[5] reports that, Electronic Medical Records Exchange (EMRX) system was launched in Singapore to enable the National Healthcare Group (NHG) and Singapore Health Services (Sing Health) share outpatient records, X-rays and laboratory reports via a centralized platform.

Linus Tham the Chief Information Officer at NHG said, "It is a crossover point where for example, a patient is discharged from an NHG hospital and follows up at a Sing Health polyclinic, we need to share information stored in NHG systems and vice versa." Further reports indicate that about 240,000 patients are referred between public healthcare institutions each year, with one quarter referred from one cluster to another.

Additional benefits of the EMRX system include:

- Better coordinated care for patients moving across different providers (for example, specialists from different disciplines), and improved levels of health care delivery (for instance, from the general practitioner to the hospital as well as the nursing home).
- Better clinic decisions, with access to complete and legible clinical histories, and updated test results at the providers' fingertips. The risks of transcription errors and missing records are reduced.
- Cost savings through the avoidance of unnecessary repeat tests and investigations.
- Better distribution of care, for example, patients with conditions which can effectively be managed in a community setting can be discharged from the hospital specialist outpatient clinic, and followed up by the general practitioner.
- Facilitation and follow up of other I.T based applications, such as electronic prescriptions and clinical decision support systems.

- Potential for 24-hour access to real-time data for up-to-date results reporting.
- Provision for data security and audit features built into the system.

Tamar (2000) [9], In the Federal Drug Authority (FDA) consumer magazine "Make No Mistake: Medical Errors Can Be Deadly Serious", says the Veterans Affairs (VA) healthcare system is held up in the institute of medicine report of medical errors as shinning success story. The VA has the largest healthcare system in the USA by one estimate serving more than three million veterans a year at 172 hospitals and 1000-plus outpatient clinics, nursing homes, counseling centers and other health programs. The VA counted almost 3000 errors, some 700 deaths among them within its health network between January 1997 and December 1998. Among the major steps the VA has taken to improve its safety, is a new bar-coding system to prevent and track medical errors. Generally the bar-coding system works this way; ID strips are worn by nurses, patients and are attached to medications. Before giving a patient a drug, a nurse scans all the three Id strips into a computer, which verifies that the drug is being given correctly and will not cause drug interactions. If the program identifies a potential problem, it flashes a warning. Otherwise it just keeps a record of activity. In a test of the bar-coding technology at two VA hospitals in Kansas, the medication error rate dropped at 70 percent over a 5 year period.

Milwaukee and Saskatoon (2002)[7], General Electric company in Canada announced on 16th December that it had acquired BDM Information System Ltd to provide clinicians with an advanced pharmacy information system to enable more accurate medication orderly. With BDM's premier pharmacy Information system, ("pharmacy for 21st Century"), General Electric (GE) is better positioned to create and deliver it's "next generation" medical orderly technology, a Computerized Physician Order Entry (CPOE) system, so clinicians can provide safer patients care through a paperless process that eliminates hand written documents.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter describes the various methods that will be used to collect and analyze data required for the development of the Medical system as well as the different techniques to be used in system design. Data collection will be done through the use of techniques such as interviews, literature review, observation and questionnaires. These techniques are to be employed in studying the existing system, in understanding the problems and addressing the objectives in this study.

3.1 Data Collection

The following techniques shall be used for gathering data required for the project.

3.1.1 Interviews

Structured setup questions are used as a guide during the interview sessions with different medical personnel at Kampala International University Clinic. These questions are aimed at finding out the common preventable errors that occur regularly by the clinic staff.

3.1.2 Reading existing documents

Several literatures related to the Medical Information systems and preventable medical errors will be reviewed so as to get better understanding of the system in use.

3.1.3 Observation

Observations will be made on how the patients' records are handled by K. I. U. clinic using the existing system. This technique is easy and cheap to use.

3.1.4 Questionnaire

A structured questionnaire will be distributed to the different medical personnel at K.I.U clinic. The questionnaires are aimed at finding out information about the existing system as well as the common preventable medical errors made by personnel at the clinic.

3.2 System Design

The following is done during system design:

Analysis and Design are used to get the requirements of the proposed system using Entity Relationship Modeling.

3.3 System Implementation

The output from the system design is used for actual coding of the modules using the top down approach. This approach begins by examining the major problem and breaking it into smaller problems.

- The system interface is developed using C# which is an object oriented programming language, php and html for its web component.
- The application links to a database on an SQL Server 2000.

3.4 System testing and Verification

The system is tested to determine whether it meets user, system and functional and non-functional requirements using Unit testing, system/ acceptance testing and integrated testing.

CHAPTER FOUR

SYSTEM STUDY, ANALYSIS AND DESIGN

4.0 System Study and Investigation

DiMed is a computerized medical diagnosis system that will help medical personnel in providing efficient and effective medical care and services to their patients.

The need to develop the system arose after finding out that most medical institutions, and in particular The K.I.U Clinic, are not up to standard in providing proper diagnosis services to their patients, leaving them suffering as a result of an error that was made during diagnosis and consequently treatment. This chapter involves a detailed study of the existing system and its weaknesses.

4.1 System Analysis

4.1.1 Introduction

This is concerned with analyzing the current situation. The data collected from the questionnaires will be analyzed using the formula below to calculate the percentages of respondents who answered a particular question.

Number of respondents who answered a particular question * 100

Total number of questionnaire distributed

The interview questions will be compared with the results got from the questionnaires and conclusions drawn.

4.1.2 Current system

Through the questionnaires survey, interviews and observations, the following analysis of the existing situation in the University Clinic was obtained.

- Most people came out that all medical institutions in Uganda use a manual method in capturing and storing their patient's information.
- Above 75% of the sample population (30 respondents) indicated that they have at least experienced a medical error related event. The most common medical errors indicated by the respondents include prescription errors as a result of wrong diagnosis as a result of lack of appropriate patient information, wrong administering of drugs as a result of unavailability of the appropriate drugs.
- Most respondents indicated that currently nothing is being done to minimize on the existing medical errors.
- Some of the respondents indicated optimism that a computerized system will help in eliminating some of the medical errors.

4.1.3 Weakness of the current system

- The current system does not provide doctors with access to patient's medical history and hence making it difficult for doctors to make accurate decision that requires knowledge of a patient's medical history.
- The current system requires a lot of resources to maintain the man power, stationery and stores for the files.
- The current system provides room for data redundancy as a result of recapturing patient's information over and over.
- The current system does not support medical error prevention to a satisfying extent which therefore justifies this study.

4.2 Requirements

4.2.1 Introduction

This is concerned with analyzing expectations the users have for the proposed system.

4.2.2 User Requirements

The design of the proposed system must conform to the following requirements if it is to enable easy interaction with the users:

- Display an appropriate level of consistency i.e. the menus must have the same format.
- The system must provide some resilience to the user errors and allow the user to recover from errors.
- Enable easy input of data in the system.

4.2.3 Functional Requirements

Functional requirements are the services the system provides i.e. how it reacts to particular inputs. DiMed is designed to meet the following functional requirements:

- The system captures the patient's, in this case, student's college identification card number, which upon a visit to the clinic the patient presents it to the doctor who then keys it into the system. This will be used to uniquely identify ever patient who comes for treatment at the clinic.
- The system will generate prescription and treatment reports made by the doctor(s) who worked for the day and the patents they treated and the date of prescription. This minimizes the errors resulting from poor handwriting by doctors.
- The system can generate a report on a particular patient basing on criteria like patient name, gender (male and female), blood group to create a better view of the patients' records.
- The system should accept data from the user through the user interface and interactive forms and capture their details.

- The system keeps track of all users that have had access to the system at a particular time, this helps in securing the system from malicious intruders and hence ensuring privacy of patients records.
- The system can keep records of the various illnesses, their symptoms, and recommended level of treatment from which doctors can make reference during prescription and come up with the right diagnosis and treatment.
- The system notifies users of any invalid inputs and prompts to make corrections.
- The system provides a functionality of locking the machine in case an intruder fails to log in five times. This improves on security of the system.

4.2.4 Non-functional requirements

These are constraints on the services of the functions of the system such as response time. The system is therefore designed to fulfill the non-functional requirements.

- The system should be completed within the time allocated for this project.
- The system should be capable of running on the existing machines used in the University clinic and should also run on Linux platform.
- The system should access a centralized database that can eliminate inconsistencies and redundancy of data.

4.2.5 System Requirements

The following sections describe the system specifications for hardware and software, security and operations required for the proposed system to perform as expected.

Hardware Acquisition

The proposed system is designed to run on an ordinary desktop computer with the following minimum specifications:

- Intel Pentium III (or IV) processor
- 512 MB RAM

- 40 GB HDD
- High resolution VDU,15"
- Uninterruptible power supply (UPS)

Software Acquisitions

The usefulness of computer hardware to a greater extent depends on the available software and the ability of management to evaluate and control utilization of the software. In order to run the application software the following software must be present on the computer onto which the application is to be installed.

- Windows 98/ 2000/ XP Operating system
- Microsoft Visual Studio.NET
- Microsoft application office suite.

4.3 Design of the new system

4.3.1 Introduction

As a result of the manual system's limitations, there was a need to design a new system that can help to improve on the existing system. DiMed is designed to help minimize preventable medical errors in the clinic. The new system is basically an application with a database to store all the necessary medical information required to minimize preventable medical errors. The section shows the design of the new system. A relational database model is identified for that purpose so that both the data and programs are mutually independent i.e. data can be moved or restructured without the need to make modifications to the programs. The relational database model also includes all the necessary interrelations of data and has a common approach to retrieval, insertion, update and searching of data.

4.3.2 System Design Objectives

The system design is developed to address the following areas.

- The system should help the doctors in making the right diagnosis and prescriptions.
- The system should help the doctors to properly identify the patients individually.
- The system output should be accurate, complete and comprehensive.
- The system being secure and having access control in order to prevent unauthorized users from accessing it. This is through use of user IDs and passwords.

4.3.3 Architectural design of the system

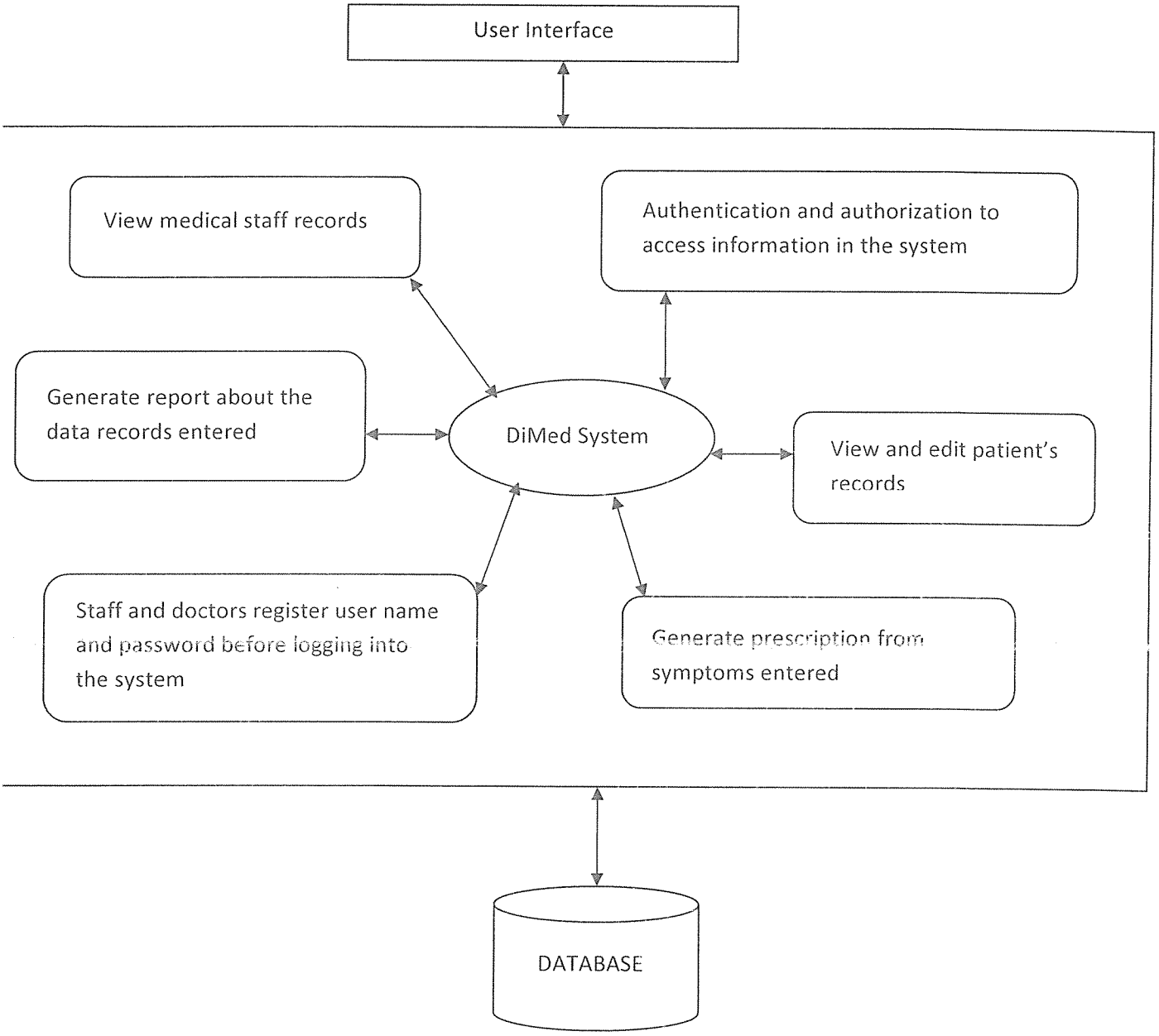


Figure 4.1: Architectural Design of the System

4.3.4 Design features of the Database

The first stage is to define tables and fields contained therein. The data types such as varchar, int, date time, text, to be stored in each field are defined. This determines the type and the range of values entered. Through linking fields in different tables of the same data type size, relationships are identified for instance one to one, one-to-many and many-to-many. On creating relationship between any two tables, referential integrity will be enforced. In order to preserve the validity and integrity of the database, the following measures are taken:

- Uniqueness achieved through the use of a primary key which uniquely identifies each record in the table. Each table of the database is structured in such a way that at least one field is defined as the primary key.
- Fields defined as primary key do not accept null values and that only one value of the primary key for each record exists in the table.
- Incorrect input and duplicate data in certain fields, especially the primary key field, must be rejected by the user interface. Where possible an error message will be sent to the user.

4.3.5 System Design with Data Flow Diagram

The design of the System database was done using the following symbols

Data store

External entity

Data flow

Process

Figure 4.2: Data flow diagram symbols

4.3.6 Context diagram

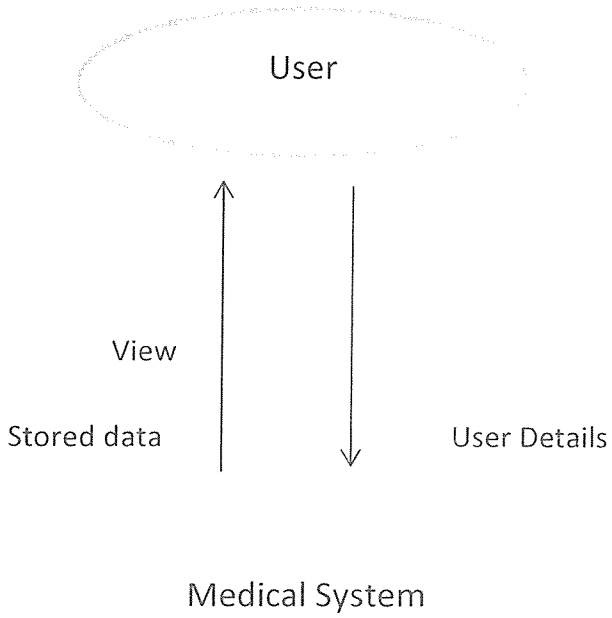


Figure 4.3: Context diagram

4.3.7 Level 0 Dataflow diagram

This figure shows the system, the external system users and data stores.

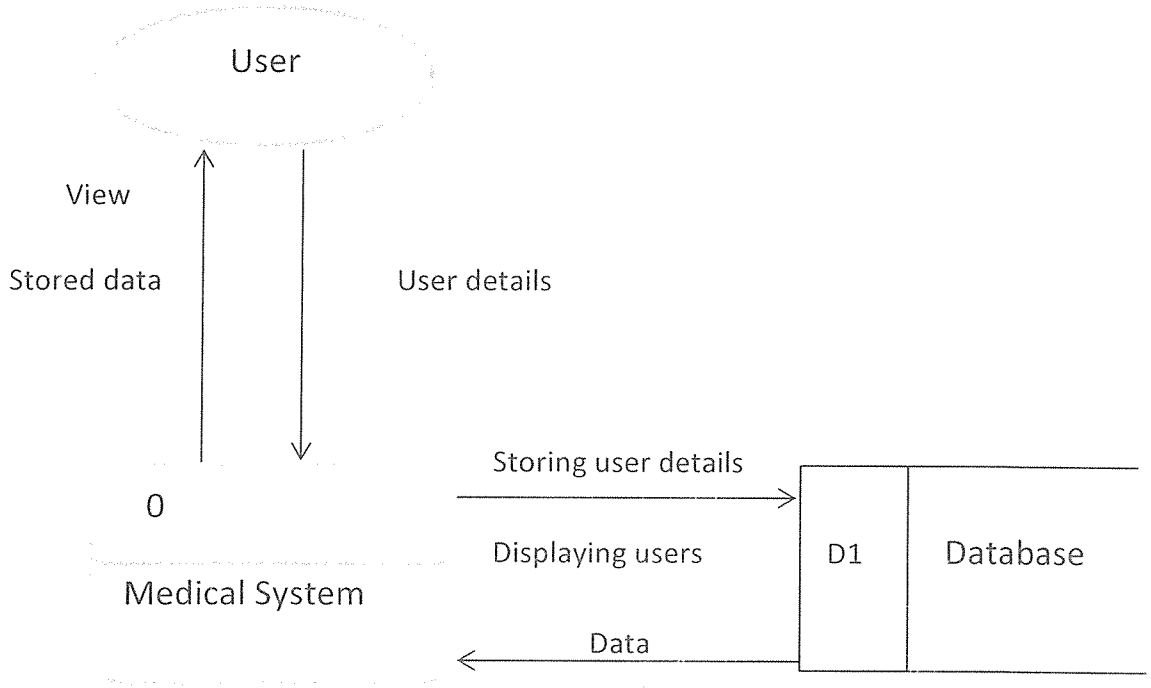


Figure 4.5: Level 0 dataflow diagram

4.3.8 Level 1 data flow diagram

This process shows the different processes of the system

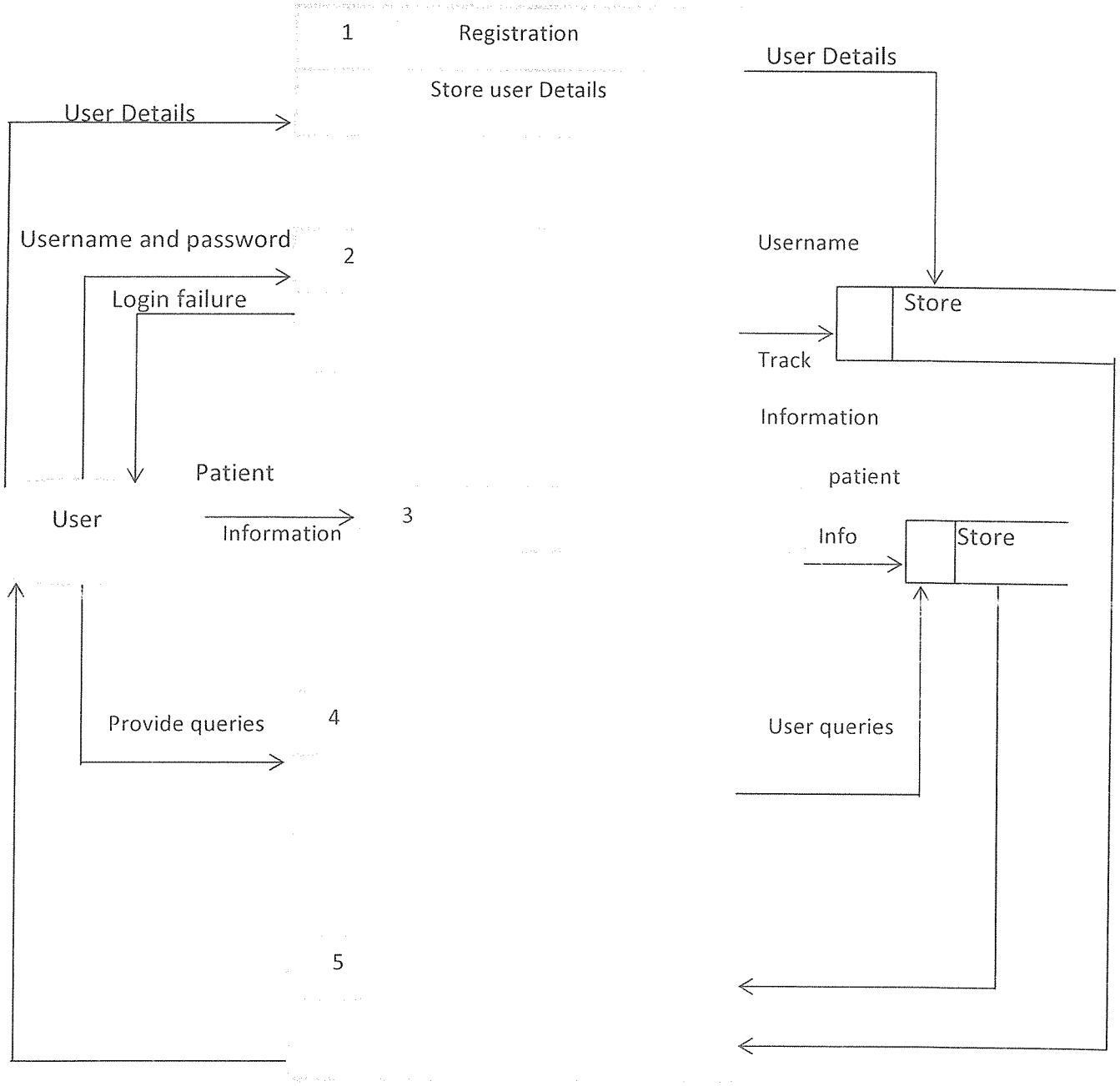


Figure 4.6: level 1 dataflow diagram

4.3.9 Conceptual database design

This involves data modeling that creates abstract data structure to represent real world items. Therefore after the investigation and analysis, the concept of the new system will be designed and all the relevant entities involved in the system identified. The medical database is designed to maintain the following:

- Patients information
- Doctors information
- Prescription information
- Other staff information

4.3.10 Entity types of the database

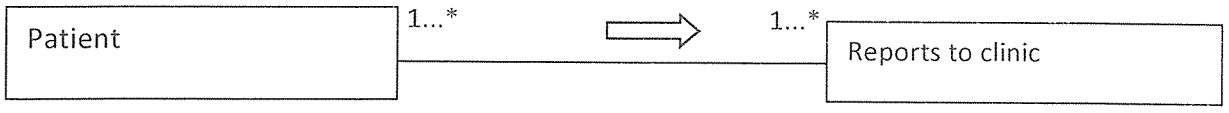
In order for the database to store its information, it is designed to maintain the following entities:

- Patient
- Doctor
- Login Detail
- Prescription/medication information

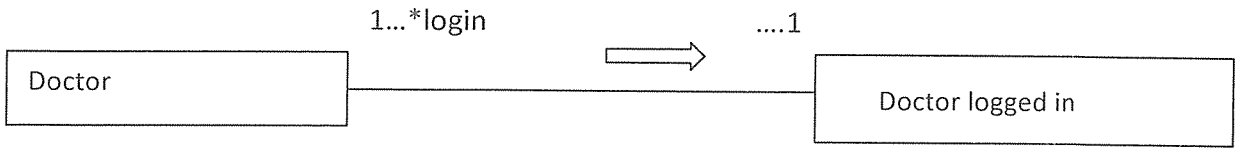
4.3.11 Relationships and cardinalities

This involves relationships among the different entities

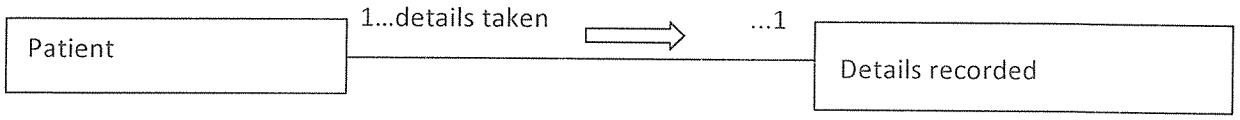
1. Patient seeks treatment



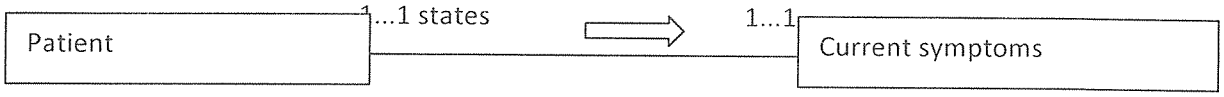
2. Doctor log into the system



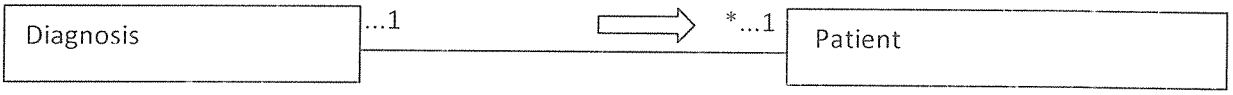
3. Patient entered to the system



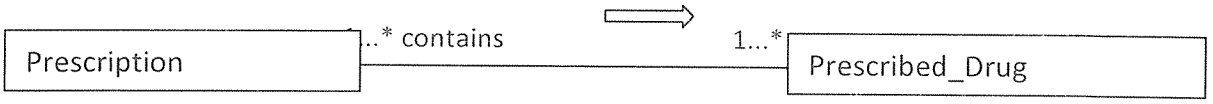
4. Patient states current symptoms



5. Diagnosis is done



6. Treatment is stated



7. Patient's records are saved

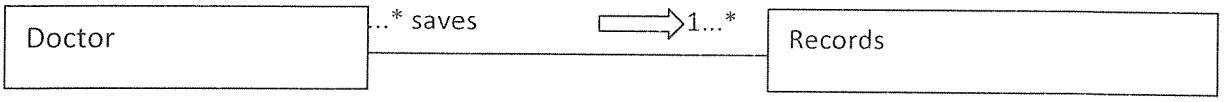


Figure 4.6: relationships and cardinalities

4.3.12 Entity Relationship Diagram

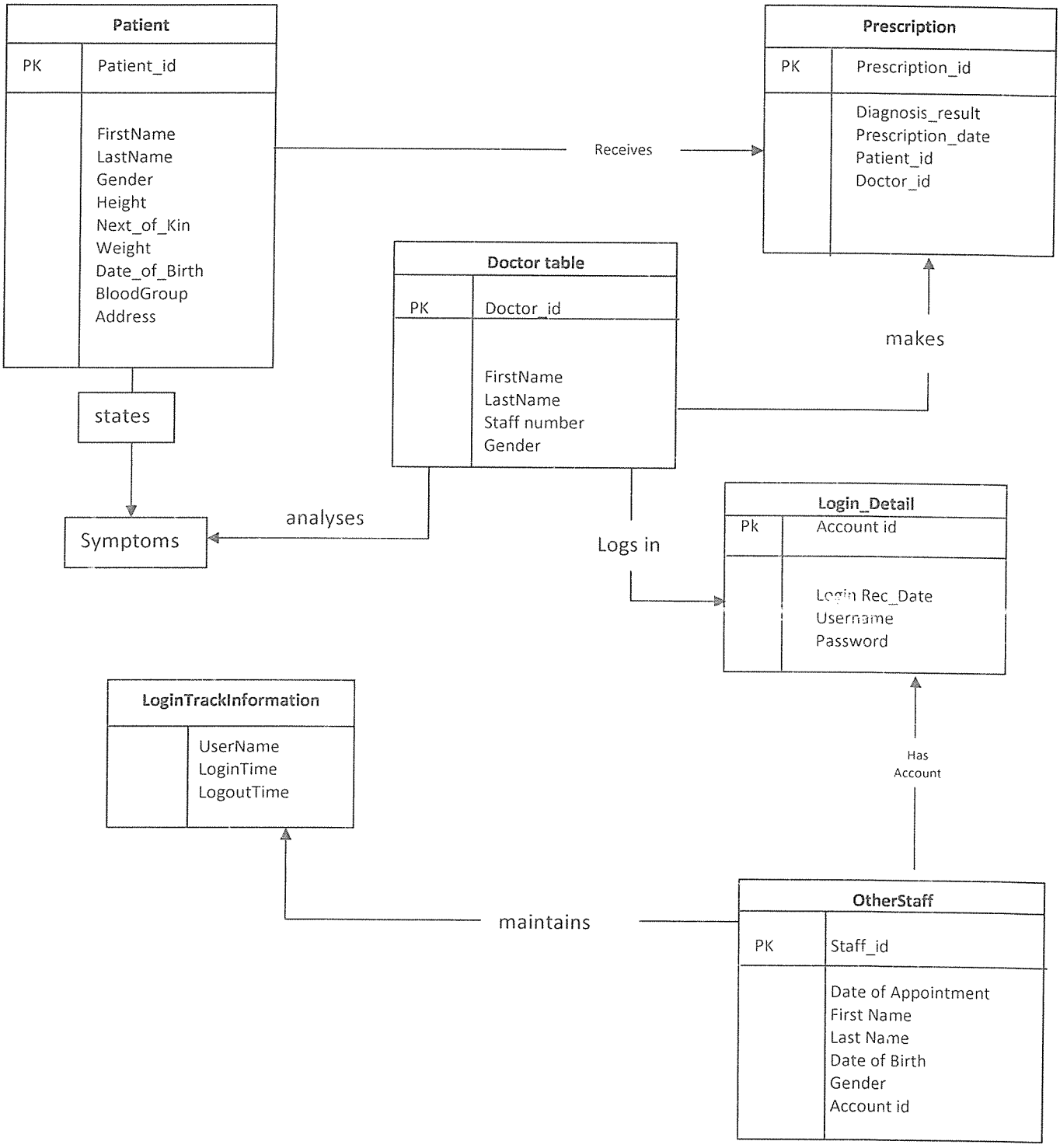


Figure 4.7: Entity Relationship Diagram

4.3.13 Database Relations

Relation	Attribute	Data type	Modifier	Description	key
Patient	Patient_id	int	Not Null	Uniquely identifies patient	PK
	FirstName	Varchar(25)	Not Null	Patients first name	
	Last Name	Varchar(25)	Not Null	Patients last name	
	Gender	VarChar(1)	Not Null	Patients sex	
	Height	Int	Nill	Patients height	
	Next of Kin	Varchar(50)	Null	Closest relative	
	Weight	int	Null	Patients weight	
	Date of Birth	Date&Time	Not Null	Date when patient was born	
	Blood Group	Varchar(20)	Null	Patients blood group	
	Telephone contact	Text	Null	Patient's phone number	
	Address	Text	Null	Patients address	

Table4.1: Patients table

Doctors Table	Doctor_id	Int	Not Null	Uniquely identifies each doctor	PK
	First_Name	Varchar(25)	Not Null	First name of the doctor	
	Last_Name	Varchar(25)	Not Null	Last name of the doctor	
	Password	Varchar	Not Null	Sex of the doctor	

Table4.2: Doctors table

CHAPTER FIVE
SYSTEM IMPLEMENTATION

5.0 Introduction

The output from the system design was used for the actual coding of the modules using the top down approach. This approach begins by examining the major problem and breaking it into smaller problems.

Visual Basic which is an event-driven programming language was used to implement this design. Databases that contain tables with all the information required for the medical system were designed using Microsoft Access because:

It is easy to use, takes a few resources to maintain and performance tune than other comparable database platforms.

It is compatible with the VB environment.

5.1 System platform

The system implementation was based on the 3-tier architecture, which includes the backend (database), system tools and the front end. Microsoft Access was used for the database management system, Visual Basic was used for the front end and the system tools like the login component.

5.2 Login component

This module protects the system from unauthorized users; it accepts username and password input from the user and crosschecks with the database to confirm the existence of such details in the backend database.

5.3 Testing and Verification

5.3.1 Introduction

These involve execution of the medical system to determine whether it meets the user, system, functional and non-functional requirements. In order to correct the errors in the system, the following types of testing were carried out:

5.3.2 Unit Testing

Various modules of the system were tested and errors got were corrected. Sample data was used in different modules. Insertions, updates and deletions were also done. Results got at this stage gave the research more insight about the functionality- of the system.

5.3.3 System/Acceptance testing

Actual sample data was used during the test. The entire system was repeatedly tested in the presence of the users so as to help the users gain confidence in the flexibility and correctness of the system.

5.3.4 Integrated testing

For the system to work as required different modules of the system that had been tested separately during the unit testing were tested together. The testing was aimed at correcting the errors in the entire system.

5.4 User Interface for the System

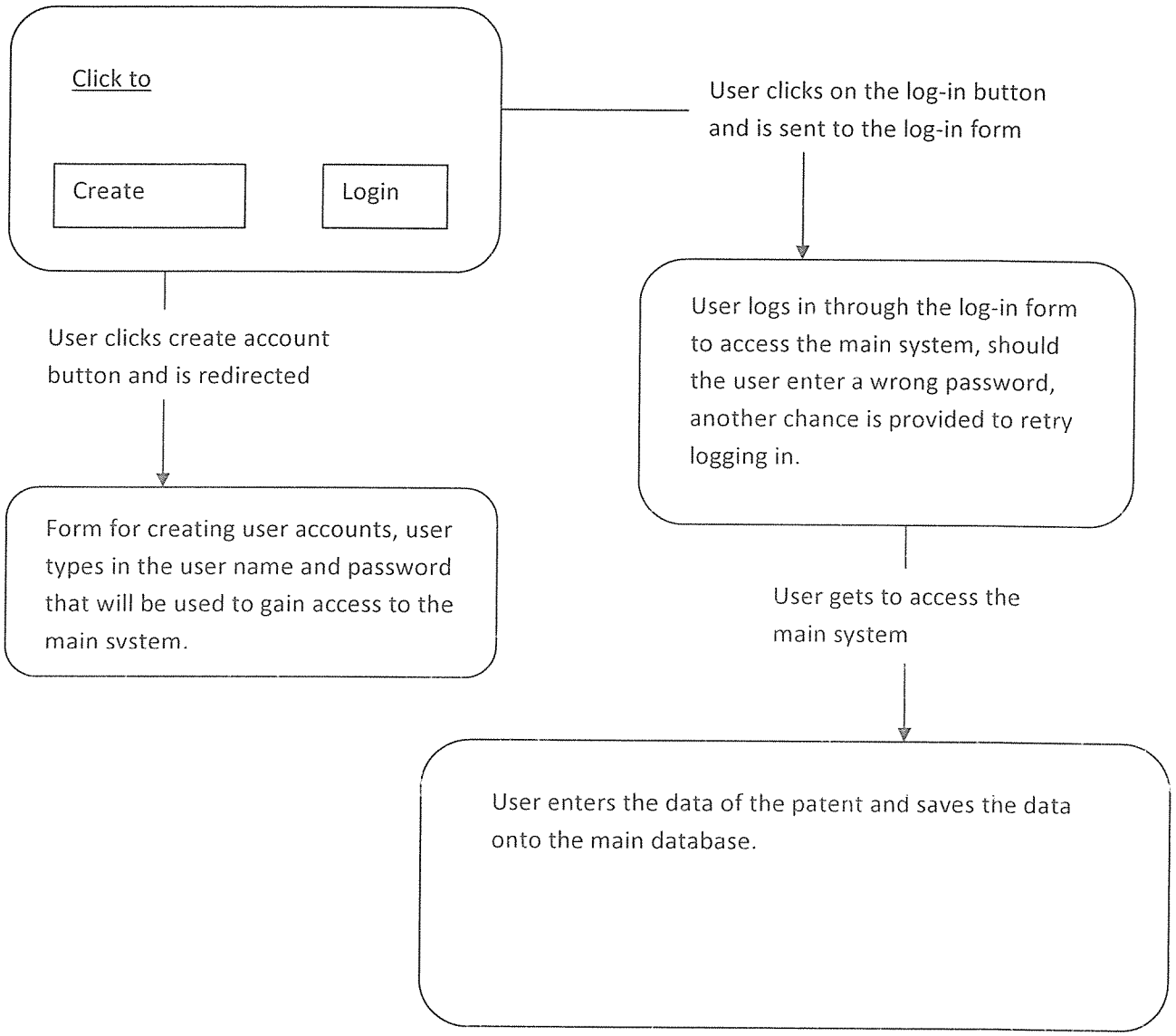


Figure 5.1: User interface

5.4.1 Doctor's registration form

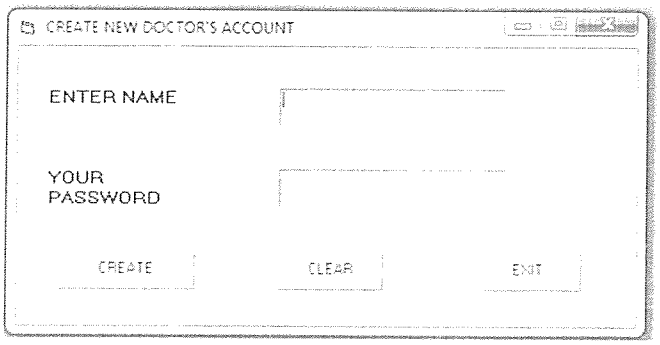


Figure 5.2: Registration form.

The form is used to create new account that will enable them to login into the system. Each doctor, before accessing the system has to provide their names and password that will be captured onto a table on the database. Once the user account has been created, the doctor can gain access to the main form by logging in through the log-in form

Code for the form.

```
Private Sub Command1_Click()
Adodc1.Recordset.Fields("Username") = txtname.Text
Adodc1.Recordset.Fields("password") = txtpass.Text
Adodc1.Recordset.Update
Form4.Show
Form1.Hide
End Sub

Private Sub Command2_Click()
txtname.Text = ""
txtpass.Text = ""
End Sub
Private Sub Command3_Click()
frmLogin.Show
End
End Sub
Private Sub Form_Load()
```

```
Adodc1.Recordset.AddNew
End Sub
```

5.4.2 Doctor's login form

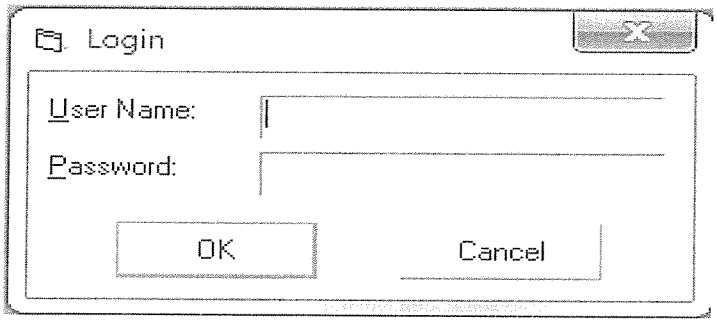


Figure 5.3: Login form

The form allows the doctors to access the main DiMed form. For a user to gain access to the main for, he has to have an account already created else access will not be granted. If a wrong password is entered, access to the system is not granted and the user is given the option of either trying to login again or exiting the system.

Code for the form

```
Option Explicit
Public LoginSucceeded As Boolean
Private Sub cmdCancel_Click()
    LoginSucceeded = False
  End
End Sub

Private Sub cmdOK_Click()
Dim response As String
Dim Username As String
Dim Password As String

  Form4.Adodc1.Refresh
  Username = txtUserName.Text
  Password = txtPassword.Text
```

```
    Do Until Form4.Adodc1.Recordset.EOF
    If Form4.Adodc1.Recordset.Fields("Username").Value = Username And
Form4.Adodc1.Recordset.Fields("Password").Value = Password Then
    frmLogin.Hide
    Form3.Show
    Exit Sub
    Else
    Form4.Adodc1.Recordset.MoveNext
    End If
    Loop
    response = MsgBox("Password Invalid, try again!", vbOKCancel)
    If (response = 1) Then
    frmLogin.Show
    txtUserName = ""
    txtPassword = ""
    Else
    End
    End If

End Sub
```

5.4.3 The main form

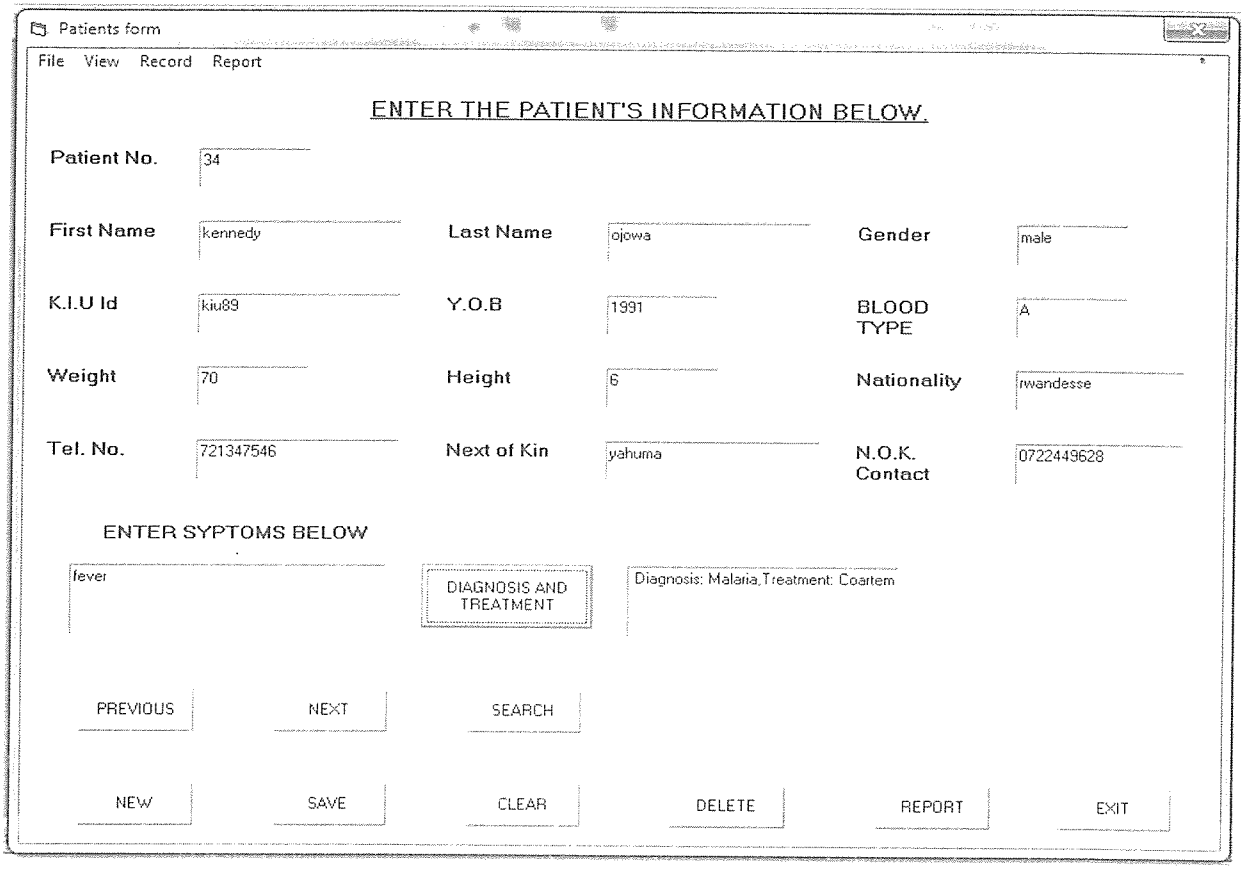


Figure 5.4: Main form

Once logged in, the doctor has to fill in the form above with the patient's details, which will be saved onto the database on the back-end of the system.

The diagnosis is made with reference to the symptoms entered and then displayed on the form along with the recommended treatment for the ailment.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

The goals of the project stated in chapter one of this report were successfully achieved. The medical system helps the KIU Clinic to minimize preventable medical errors.

6.1 Achievements

Through this study a lot of achievements were made, namely:

- Skills of using VB were acquired.
- Chance of applying the System Analysis and Design concepts most especially in the System Development Life Cycle was got.

6.2 Advantages of the medical system

- The system provides easy identification of a patient using the university identity card, whose number is captured and stored into the system.
- It reduces the problem of inaccessibility of patient records by nurses who may fail to read handwritten prescriptions by the doctors.
- Provides doctors with easy access to patient's medical history and hence making it easy for doctors to make accurate decision that requires knowledge of a patient's medical history
- The system keeps track of all users that have had access to the system at a particular time, this helps in securing the system from malicious intruders and hence ensuring privacy of patients records.

6.3 Conclusions

This project was about developing an automated system for minimizing preventable medical errors. This problem arose after a realization of the prevalent number of medical errors in the health care system of the university clinic.

The system was successfully designed and implemented to minimize preventable medical errors which are the main strength of the system. The project work was found rewarding as it enabled

the researchers to directly apply the theoretical information obtained from class and personal studies to a real world software project. It has exposed some of the real life challenges of developing a system and created more confidence for the researchers to take up more software projects in future.

6.4 Recommendations

The system has some deficiencies that can be improved upon in future versions, In particular:

- The system does not yet have the capability to notify the user automatically when the date for servicing of a machine is due;
- Upon login failure by an ordinary user, the future version could have functionality added to enable automatic notification to the currently logged in administrator informing him of the failure;
- The system could also be scaled further to accommodate a billing functionality,
- The online site could be developed to allow more interaction by remote users with the information in the system;
- An expert system could be included in the system to further help doctors in diagnosis of patients' with critical ailments
- Discussion forum could be integrated to enable medical personnel to share ideas related to medical error prevention.
- Some encyclopedia and tutorial functions could be provided for doctors in order to help them during the diagnosis.

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APPENDIX A: Questionnaire Design

A STUDY TO EVALUATE DATA HANDLING AT THE K.I.U CLINIC

The aim of the study is to evaluate data handling at the K.I.U Clinic and make recommendations and improve on the current system.

This research is meant for study purposes and the information obtained will be kept confidential.

INSTRUCTIONS

1. Do not write your name on the questionnaires for the purpose of confidentiality
2. Use the spaces provided against to record your answer.
3. For questions provided with answers tick in the box corresponding to the answer of your choice.

1. How is data captured and stored at the clinic?

a) Computerized ☐

b) Manual ☐

c) Both ☐

2. Are there any weaknesses with the system in use?

a) Yes ☐

b) No ☐

If yes, what are they?

_____

_____

_____

7. How do you think some of these errors can be prevented?

_____

_____

_____

8. What is the clinic doing to prevent medical errors?

_____

_____

_____