RESPONSIVE REAL-TIME INFORMATION SYSTEM FOR MANAGING PATIENT'S MEDICAL RECORDS CASE STUDY: JUBA TEACHING HOSPITAL

BY

MONYJOK ELIJAH MALUAL

BIT/20008/82/DF

AND

MAYEN MAKER THIONG

BIT/20010/82/DF

SUPERVISOR

MR. LAWRENCE MUYANJA

A GRADUATION PROJECT REPORT SUBMITTED TO THE SCHOOL OF COMPUTER STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY OF KAMPALA INTERNATIONAL UNIVERSITY

FEBRUARY 2012.

DECLARATION

We do hereby declare to the best of our knowledge that this graduation project is our original work and that it has never been submitted to any university or any other institution.

MONYJOK ELIJAH MALUAL

BIT/20008/82/DF

Student

Date 02/03/2012

Signed:

MAYEN MAKER THIONG

BIT/20010/82/DF

Student

Date 02/3/2012

Signed:

APPROVAL

This Graduation project has been submitted with the approval of the following supervisor

MR. LAWRENCE MUYANJA

Supervisor

Signed.....

Date.....02/03/2012

DEDICATION

This project is dedicated to our parents, and to our beloved brothers and sisters (siblings) who have fully contributed to the success of our education. For all the love, understanding, encouragement, material and moral support, we appreciate. To our dear friends, God Bless you.

ACKNOWLEGEMENTS

First, we would like to acknowledge the divine presence of the Almighty God with whom this research study have been successful. His loves, care, protection, comfort, guidance, support and provision is just overwhelming. All the Glory belongs to Him.

We would like to thank every student who has played a role in one way or the other to the completion and success of this project. Thanks for every support and encouragement.

Our sincere appreciation goes to our dear parents for all the support they have shown us through all hardships and struggles till this far. May the Almighty grant you more strength move on

To Mr. Asiimwe John Patrick, Head of department Information Technology and System Kampala International University. We appreciate your vision in leadership and sustaining an effective and focused academic environment.

Finally, we give special thanks to our supervisor, Mr. Lawrence Muyanja. Your support, guidance and encouragements were effective for the completion and shaping of this edition. Thank you for your patience and bearing with us in the wake of deadlines.

ACRONYMS/ABBREVIATIONS

DBMS	Database Management system
DBA	Database Administration
MIS	Management Information System
DB	Database
VB	Visual Basic
DFD	Data Flow Diagram
E-R Model	Entity-Relationship Model
1NF	First Normal Form
2NF	Second Normal Form
3NF	Third Normal Form
ICT	Information Communication Technology
IT	Information Technology
CASE	Computer-aided Software Engineering
GUI	Graphical User Interface
DDL	Data Definition Language
DML	Data Manipulation Language
SDLC	System Development Life Cycle
RAM	Random Access Memory
MB	Megabyte
GB	Gigabyte

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

DEFINITIONS AND TERMS

Computer: It's an electronic device that accepts / receives input, processes it, analyzes it, stores it, interprets it and outputs the information.

Software: It's a set of programs that facilitates the use of the entire computer systems.

A system: Refers to the group of interrelated components, working together to achieve specific objectives.

Database Management System (DBMS): Thomas Connolly and Carolynn Begg (2000) define DBMS as a software system that enables users to define, create, maintain the database and it provides controlled access to the database.

Database (DB): defined as a shared collection of logically related data designed to meet the information needed in an organization.

Data: It refers to the unprocessed facts or raw facts.

Information: Refers to the processed data, which is useful in decision making.

Administration: It refers to the setting of tasks or polices or overall objectives of an organization (where organizations refers to a group of two or more people who have come together for a purpose). It involves planning, organizing, assembling, supervision, controlling, budgeting, decision making, evaluation, co-coordinating, and innovating

Abstract

Information is a very important aspect in our day-to-day activities to ensure effective communication. As result of this, Information Communication Technology plays a great role to guarantee efficient and effective communication within and among different institutions and organizations. In response to this, each organization/institution strives to make sure that there is a secure means of disseminating, storing and retrieving of information within their boundaries. This calls for an information system that is capable of handling all these tasks without fail. The outpatient department of Juba Teaching Hospital has been used as a case study.

With the use of computer database systems, it becomes easier to run and effectively coordinate the operations of the department bearing in mind the environment under which it operates (vast inhabited national referral hospital). Consequently, in this project, we have displayed database development using the system development lifecycle to come up with a good database design for ease of operations within the department, using Microsoft Access and Microsoft Visual Studio (VB.Net).

CHAPTER ONE

1.0 Introduction

Information and Communication Technology (ICT) has proved to be a very important aspect of society today such any organization intending to progress cannot ignore it. Increased workload, integration of various activities and economies of scale are some of the key factors that organizations feel the Input of ICT is of great importance.

An article by Mugisha R. (2005) in the Uganda investment magazine indicates how local banks have doubled their efficiency and profits after having their systems computerized. Institutions of learning, businesses, hospitals, hotels and all other spheres of influence have not been left out by the wave of technology.

It is in this regard that this study has been carried out to further rubber-stamp the notion that ICT is a key factor contributing to the success of any venture. The outpatient department of Juba Teaching Hospital has been used as a case study.

Hospital responsive real-time Information System is a system which maintains and retrieves detailed clinical data for a patient. This system stores detailed medical record of a particular patient like his/her background information, height, weight, blood pressure conditions, previous treatments and other medical history of the patient. This system also gives details about their previous laboratory records, their prescribed drug usage based on the patient's medical condition, and billing. All the departments of the hospital like, outpatient, inpatient, reception, pharmacy, laboratories are linked to the main system so that professionals working in these particular departments may perform a query, extract the data, and upload/download details about the condition of a patient depending on the access privilege of each individual.

1.1 Background to the study

Juba Teaching hospital (JTH) is a government hospital in the category of regional hospitals started up in the early 1990's as a health center by the town council of Juba that was to handle. It was started up as a treatment center that handled minor illnesses that needed not serious attention and incase of any emergencies, they offer first aid and then have the patient referred to an advanced big hospital. With a population of 20,000 persons, it was realized that there was an increase in the inflow of patients both from within and outside the town as well as a rise in the malaria cases and other health cases that was claiming a lot of lives. Due to this, the government of Sudan through the township council of Juba saw the need of having the health

center expanded so that it could handle a bigger number of patients and offer advanced medical services that cater for other serious cases. This expansion therefore took some time for it to be completed and by 1993, Juba teaching hospital was in place fully furnished with all the facilities and qualified personnel's to handle any health related cases.

Being the regional largest hospital, the hospital realized an annual average of about 10,000 in-patients and attends to over 9,000 out-patients in the assessment centre, general out-patients clinics, specialist's clinics, the accidents and emergency departments annually and delivers about 8,000 mothers per year. The bed capacity is 3,500. It provides specialists' and super specialists' services in surgery, internal medicine, pediatrics, obstetrics and gynecology.

For purposes of this study, attention was focused on the hospital's outpatient department. The outpatient department is the most active department in the hospital and it serves the hospital with services of capturing the patient's information, diagnosing, and offering first aid to emergencies and offers the rightful medication as per the doctor's prescription.

Faced with these, rather unpredictable trends of events, there's need to invest money and resources in order to establish and develop the rapidly emerging and changing technology that is to help in addressing the challenges posed by increased activities in the department.

The outpatient department being in such a big hospital attends to a vast number of patients thereby indicating a need for an information system that is efficient in storage, retrieval and management of the data concerning the patients attended to. The current information system is mainly paper-based and hence not able to accurately maintain up-to-date track of the department's information as tracked down.

The proposed information system was to provide important and useful tools for better planning, management, accurate reporting, improved performance and productivity. This project was aimed at finding better solutions to address problems resulting from increased activities in the department and seeks to show how these can be achieved by use of database management systems and easy to use interfaces.

1.2 Statement of the problem

Medical data have always been exchanged between care providers and the patients. Traditions methods checking in the files which are kept in drawers and partially automated system which is not reliable to handle the number of patients who visit the hospital. This method is inferior to fully computerized communication methods in ease of use, speed of access, cost, improved data security, provision of backup and recovery, provision of reports and reliability. The development of computer-based systems has made medical data exchange simple and quick.

1.3 Justification of the project

Due to changes in technology on both the local and global scale, the health check field is becoming more and more reliant on ICT. ICT has played a very significant role to many companies on lying down their strategies and in their quest to acquire modern technology. This has proved to be a great investment that results in quick financial returns and enhance better performance geared towards efficient communication technology.

A well-designed and implemented database and information system enables information to be quickly retrieved and processed, and has provided a one stop system in which important information resides and is shared.

1.4 Objectives

1.4.1 General (main) objective

The main objective of this study was to design a computer-based information system that help to record and store patient's medical records so as to ease use, speed of access, cost, improve data security, provide backup and recovery, as well as issuing reports and reliability, Minimize the cost, manual effort and amount of processing time.

1.4.2 Specific objectives

Specifically, the objectives of the study were;

a) Carry out a detailed study of the case study with an aim of learning how the current system runs, identify weaknesses and strengths.
b) Analyze data gathered and develop a design document to which a customized application suiting the case study will be developed to tackle most if not all the problems mentioned

c) Implement the developed system using Visual basic as the application and Microsoft access as the backend.
d) Ensure security of the new implemented system is in place.

1.5 Scope of the project

The project has covered the JTH's outpatient department. The project dealt with patient's records which is stored in a central database for reference whenever a patient visits a hospital. The details of the patient are then retrieved per visit for medication and administration of treatment. The project has also incorporated the community, patients and doctors.

1.6 Conclusion

This chapter provided the background of the area under study, the problem statement, the scope of the study, objectives and the limitations to this research. The next chapter will delve into what other scholars have said or discovered about the field under study.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

This chapter covers what other scholars have said about the study title. This involved reading what other studies in the same field have revealed and in addition identifies a case that is implemented in reference to the revealed knowledge by previous authors. It also includes the tools that were used in the research and the system development methodology.

Literature review brings into the researchers' awareness that their study is in line with what other scholars have discovered about the subject under study.

2.1 Issues related to the study title

To ensure the success of a given organization, there is need of an information system that will handle all the needs of the users efficiently and effectively.

2.1.1 Information systems.

According to James (2004) information system refers to any organized combination of people, hardware, software, communication and data sources that disseminate information in an organization. According to Effy (2002) information system refers to all components that work together to process data and produce information.

Information system is the arrangement of people, data, processes and interfaces that interact to support and improve day-to-day operation in business as well as problem solving and decision making needs of management and users (Whitten, 2001).

Conclusively, information system refers to a situation which all the components and resources like: - people, hardware, software and communication are organized together in order to produce expected output of a system for a decision making.

According to Kroenke, D (2000), A**n information system** is an arrangement of people, data, processes, information presentation and information technology that interact to support and improve day to day operations in a business as well as support the problem solving and decision making needs of management and users.

The following are classes of information system applications.

- Transaction processing systems.
- Management information systems.
- Decision support systems.
- Expert systems.

- Office automation and workgroup systems.

2.1.2 Information Technology.

The term IT represents the various types of hardware and software used in an information system including computer and networking equipments (Gerald 2000). It is a contemporary term that describes the combination of computer technology with telecommunications technology. It significantly expands the power and potential of most information systems.
According to Whitten (2001), IT refers to the contemporary terms that describe the combination of computer technology (data, image and voice network).
Inclusion, the term IT refers to the computer technology like printer, plotters, CR ROM cables and software like office applications like Ms word, Ms Excel, and network operation system, window 2000 that are use to transfer data in a network.

2.1.3 Management information system

Management information system is an information system application that provides management-oriented reporting.
According to Effy (2002), MIS refers to the use of computer for planning, controlling decision making and problem solving, rather than just reporting transactions MIS is a strategy that provides periodic information about such a topic and operational corporate database and processing it according to (Turban etal...2002),Therefore in conclusion, MIS refers to a computer based information system that is use to provide information for planning, controlling decision by extracting it from a cooperate database and processing according to user's interests.

Information sharing is a key factor to successful communication and development in an organization as it enhances effective communication among different departments. Every organization whether small or large, must be in a position to manage its data. Without an information system, this cannot be effectively achieved. Thus, emphasizing the importance of an information system. Some organizations might use file cabinets to manage their data but most use computerized database management systems that effectively store, retrieve and manage large amounts of data.

2.2 Database

According to Date (2002), a database system is basically a computerized record keeping system. The database itself can be regarded as a kind of electronic filing cabinet that is, a repository or container for a collection of computerized data files.

According to Turban et al (2001), database refers to the collection of interrelated data organized to meet the need and structure of an organization and can be used by more than one person for more than one application like; ORACLE, VB.Net and VB 6.0.

In relation to the two definitions, database refers to the collection of a computerized interrelated data organized to meet the need of an organization.

2.3 Terminologies in database

E-R modeling (Entity-Relationship modeling).

E-R model is based on the perception of the real world which consists of sets of objects called entities and the relationship among those objects.

2.3.1 Entities

An entity is a "thing" or "object" in the real world that is distinguishable from the other objects (Silberscharz et al, 2002).

2.3.2 Attributes

It's a descriptive elements or properties possessed by each number of an entity set (Silberscharz et al, 2002).

2.3.3 Entity Integrity

Entity integrity rules state that no components of the primary key are allowed to accept a null value or null values (Date 2000)

2.3.4 Referential Integrity

It's a rule which state the database must not contain any unmatched foreign key values (Date, 2000)

2.3 Database management system-DBMS

According to Date (2000), DBMS is software that handles all access to the database. DBMS is software application system that is used to create, maintain, and provides a controlled access to the user database (Mc Fadden, 1994).

According to Whitten et al (2001), DBMS is specialized computer software available from computers venders that is used to create, access, control and managed the DB.

In conclusion, DBMS is a software program for adding information to a DB and updating, deleting, manipulating, storing, and retrieving information.

2.3.1 Function of a database management system.

According to (2002) **Date definition**: The DBMS must be able to accept data definition (external schemas, the conceptual , the internal, and all associated mappings) in source from and convert them to appropriate object form.

b) **Data manipulation**. It must be able to handle requests to retrieve, update, delete existing data in the database, or add new data to the new database.

c) **Optimization of the execution**. DML request, planned and unplanned, must be processed by the optimizer components whose purpose is to determine an efficient way of implementing the request. Optimized request are then executed under the control of run-time managers.

d) **Data security and integrity.** The DBMS must monitor user request and reject any attempt to violate the security and integrity constraints defined by the DBA. This task can be carried out at compiling or run time or both.

e) **Performance**. A database provides user interface to the database efficiently and effectively.

2.3.2 Advantages of Database management systems

According to Ramakrishna (2002), DBMS has the following advantages:

1. **Data independence**: application programs should be as independent as possible from details of data representation and storage. The DBMS can provide an abstract view of the data to insulate application codes such from details.
2. **Data security and integrity**: if data is always access through the DBMS, the DBMS can enforce integrity constraints on the data. Example, before inserting certain information for an employee the DBMS can check that the department budget is not exceeded. Also the DBMS can enforce access controls that govern what data is visible to different class of users.
3. **Efficient Data Access**: a DBMS utilizes a variety of sophisticated techniques to store and retrieve data efficiently and effective. The feature is important if data is stored in an extended device.

4. **Data Administration:** when several users share the data, centralizing the administration of data can offer significant improvement. Experience professionals who can understand the nature of data being managed and how different user uses it, can be responsible for organizing the data representation to minimize redundancy and for fine tuning the storage of data to make the retrieval efficient.
5. **Concurrent Access and Crash Recovery:** A DBMS schedules concurrent access to the data in such a manner that users can think of the data as being accessed by only one user at a time. Further, protects the user from effects of system failures.
6. **Reduced Application Development Time:** clearly, the DBMS supports many important functions that are common to many applications accessing data stored.

2.3.3 Disadvantages of Database management system

i. **Complexity:** The provision of functionality we expect of a good DBMS makes the DBMS makes the DBMS an extremely complicated piece of software.
ii. **Size:** The complexity and breath of functionality makes the DBMS an extremely large piece of software, occupying many MB or GB of disk space and requiring substantial amount of memory to run efficiently.
iii. **Cost of DBMS:** The cost of the DBMS varies significantly, depending on the environment and functional provided.
iv. **Additional Hardware Cost:** The disk storage requirement for the DBMS and the DB may necessitate the purchase of additional space to adhere required performance, it may be necessary to buy a large machine.
v. **Cost of Conversion:** This cost may also include; cost of training staff to use the new system, employing specialist staff to help with the conversion and running of the system.
vi. **Performance:** DBMS is written to be more general to carter for more application rather than just one. The effect is that some application may not run as fast as any other.
vii. **Higher Impact of Failure:** The centralization OF resources increases the vulnerability of the system since all users and applications rely on the availability of the DBMS.

The DBMS must produce the following

1. Forms: These are the screen display of the DBMS of the computer form that someone fills in for a particular entity.
2. Reports: It is a printed document, output for the system in a paper. It's especially applicable in VB.

Characteristics of Database management systems

According to Elmasri (2000); a number of characteristics distinguish the DB approach from programming of files.

1. Self-Describing Nature of DBS: The DB system contains not only the DB itself but also a complete definition of the DB structure and constraints.
2. Insulation between programs and Data abstraction: In files system, the structure of the file may require changing all the programs that access the file. By contrast, DBMS, access program do not require such changes. The structure of data file is stored in the DBMS catalog separately from the access programs.
3. Support of Multiple Views of the data: A database typically has many users of who may require a different perspective or view of the DB. A view may be a subset of the DB or it may contain virtual data i.e. desired from the database file but not explicitly stored.
4. Multiple users to access the database at the same time. The DBMS include; concurrent control software to ensure that several users are trying to update the same data that the result is correct.

Database Administrator: In a database environment, the primary resources it the database itself and the secondary resources are the DBMS and related software

2.3.4 Components of the database or DBMS environment

In reference to Kroenke, D (2000) major components of the database environment are:

- **Computer-aided software engineering (CASE) tools**: -Automated tools used to design databases and application programs.
- **Repository**: - Centralized knowledge base containing all data definitions, screen and report formats and definitions of other organizations and system components
- **Database management system**: - Commercial software system used to create, maintain and provide controlled access to the database and also to the repository.
- **Database**: - A shared collection of logically related data, designed to meet the information needs of multiple users in an organization.
- **Application programs**: - Computer programs that is used to create and maintain the database and provides information to the users.
- **User interface**: - Languages, menus, and other facilities by which users interact with various system components such as CASE tools, application programs, the DBMS and the repository.

- **Data administration**: - Persons who are responsible for the overall information resources of an organization. They use CASE tools to improve the productivity of database planning and designing.
- **System developers**: - Persons such as systems analysts and programmers who design new application programs.
- **End users:** - Persons throughout the organization who add delete and modify data in the database and who request or receive information from it. All user interactions with the database must be routed through the DBMS. Examples of end users are:;
    i. Naive users.
    ii. Application programmers.
    iii. Sophisticated users.
    iv. Specialized users.

The users interact with the system through the application programs, graphical programs and the GUI provided by the operating system. The end users are the clients of the database.

View of data

A major purpose of the database is to provide users with an abstract view of the data as observed by Date, J (2000). That is, the system hides details of how the data are stored and maintained.

For the system to be usable, it must retrieve data efficiently. The need for efficiency has led designers to use complex data structures to represent data in the database. Since many database users are not computer trained, developers hide the complexity from users through several levels of abstraction to simplify users' interactions with the system as described below:-

❖ ***Physical level***: - Also known as the internal level. This is the lowest level of abstraction. It describes how the data are actually stored. It also describes complex low-level data structures in detail.

❖ ***Logical level***: - Also known as the conceptual level. It describes what data are stored in the database and what relationships exist among those data. The logical level thus describes the entire database in terms of a small number of relatively simple structures.

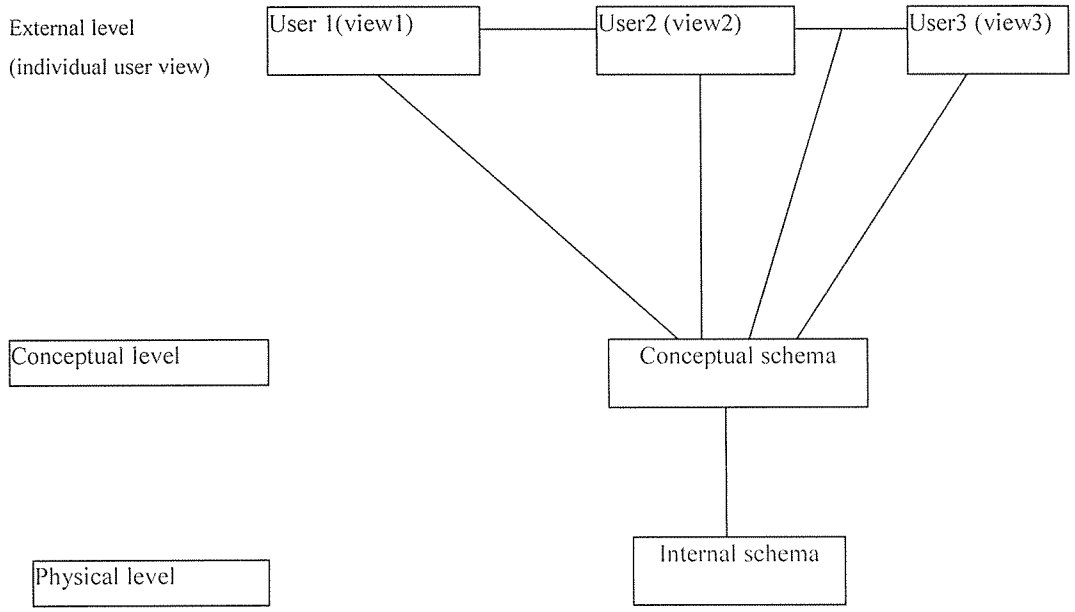
❖ ***View level***: - Also known as the external level. This is the highest level of abstraction. It describes only part of the entire database, the part that is important to the users.

Database systems have several schemas partitioned according to the levels of abstraction in reference to Date, J (2000).

- ***Physical schema:*** - Describes the database design at the physical level.
- ***Logical schema:*** - Describes the database design at the logical level.
- ***Sub-schemas:*** - Describes different views of the database.

At the external level, we have Data Definition Language (DDL) which supports the definition or declaration of database objects and Data Manipulation Language (DML) which supports the manipulation or processing of such objects.

Figure 1: Different level of viewing data in the database.



2.3.5 Advantages of DB systems

- *Data can be shared:* - Different users can share data from the same database as well as new applications can be developed to operate against that same data.
- *Redundancy reduction:* - In non-database systems, each application has its own files. This leads to the redundancy in stored data resulting to wastage of storage space. This is done away by the use of DB approach.
- *Inconsistency avoided:* - Redundancy is controlled by ensuring that given data is represented by a single entry. DB systems ensure propagating updates in that incase there is data duplication; the DBMS is made aware such that any change made in either of the two entries is automatically applied to the other one as well.

- *Transaction support:* - A transaction is a logical unit of work typically involving several database operations (update operations). This involves the transfer of cash amount from account A to account B. Here we need two updates, one to withdraw cash from account A and the other to deposit cash to account B.
- *Data integrity is maintained:* - An integrity constraint is a rule that data in the database must follow. A database has integrity if the data in the database satisfies all integrity constraints that have been established. In DB approach, (Database Administration) DBA can define validation procedures that will ensure the integrity of the database.
- *Security:* - Security is the prevention of access to the database by authorized users. Since DBA has control over the operational data, it can define authorization procedures to ensure that only legitimate users access the data.
- *Flexibility and responsiveness:* - Flexibility furnished by the DBMS to locate and access data in a number of different ways aids programmers in developing new programs to satisfy user requests.
- *Economy of scale*: - The concentration of applications in one location allows for the possibility of smaller numbers of large and more powerful computers which usually result in an economy of scale. The same economy of scale can be realized by concentration of expertise.
- *Balancing conflicting requirements:* - By keeping the overall needs in mind, the DBA can structure the database to the benefit of the entire organization not just a single user group.
- *Data independence:* - This occurs when the structure of the database can change without requiring the programs that access the database to change. This is achieved in database environment through the use of external views or sub schemas.
- *Improved program maintenance:* - When interacting with a DBMS, programs are relatively independent of the actual data in the database. This means that many changes to the structure of the data itself may not require maintenance to existing application programs.
- *Increased programmer productivity:* - Since programmers accessing a database do not have to worry about mundane data manipulation activities, as they would when accessing file, they will be more productive.

Patient's records are vital and it is reviewed in order to offer effective treatment and this research reviews this by giving the inconsistencies in handling this records which include;

i. Duplication of data

ii. Restriction to only single user

iii. Restriction to single way of interfacing to the system.

iv. Manual filing system.

2.3.6 Disadvantages of DB systems

- **Size**: - To support all the complex functions that it must provide to users, database management system must be a very large program occupying megabytes of disk space as well as substantial amount of internal memory.
- **Complexity**: - The complexity and breathe of the functions furnished by a DBMS make it a complex product.
- **Cost**: - A good DBMS is an expensive product buying/ purchasing and maintaining.
- **Additional hardware requirements**: - Because of the size and complexity of a DBMS, greater hardware resources are required than would be necessary without the DBMS.
- **Higher impact of a failure**: - Since many of the data processing resources are now concentrated in the database, a failure of any component has a much more far-reaching effect than in a non-database environment.
- **Recovery more difficult**: - Because of the added complexity, the process of recovering the database in the event of a catastrophe is a more complicated one, particularly if the database is being updated by a large number of users concurrently.

The foundation of information systems came as a result of hardware, software, storage and telecommunication technologies. In today's new information architecture the computer itself is considered as one of the many information technologies that permit modern information systems to function. Therefore, to build effective information systems, one must understand how these technologies can work together.

A computer system consists of a central processing unit, primary storage, secondary storage, input devices, output devices and communication devices according to Kroenke, D (2000).

- The central processing unit manipulates raw data into more useful information and controls other parts of the computer system.
- Primary storage temporarily stores data and program instructions during processing while secondary storage devices store data and programs when they are not being used in processing.

- Input devices such as keyboards and mouse convert data and instructions into electronic form for input into the computer whereas output devices such as printers and video display convert it into a form that people can understand.
- Communication devices provide connections between the computer and communication networks.

2.4 Conclusion

This chapter mainly dealt with issues related to the subject under study and the tools that were used. The next chapter will mainly cover the analysis of the current system and the proposed system. It will answer the questions on how the problem was solved.

CHAPTER THREE
METHODOLOGY

3.0 Introduction

This chapter deals with the analysis of the data that has been collected from the research carried out. It also includes the procedures that were used to carry out the study, the methods of data collection, analysis of the strengths and weaknesses of the current system, system specifications and requirements, user requirements, functional and non functional requirements.

3.1 Procedure of the study

The research entailed seeking permission from the case study's management to carry out the research at their premises. Granted, the researchers went ahead and implemented questionnaire and interview methods as data collection tools that would hence lead to eventual analysis.

3.2 Research Methodology

Research methodology refers to the methods applied to collect data. Under this category, the researchers concentrated much on issues concerning the area of study.

3.3 Research technique

The research techniques which were employed were both quantitative and qualitative methods. The quantitative technique was based on numbers and used statistical measures. On the other hand a qualitative technique used explanations and was used to answer questions such as "how effective is an application for creating a database and automating records at the outpatient department of JTH affects the institution's performance"?

3.4 Target population

The target population was all the staffs of the subordinate workers, who have close dealings in the automation and the creation of the department's database. Apart from the staff of the outpatient department, other target populations were the patients visiting the hospital.

3.5 Units of inquiry

These were the members and non-members of the institution who participated in the research process. The researcher took the whole staff members of the outpatient department of JTH who had close dealings with the creation of the department's database and the automation of the

documents. Also the researcher took the non-members of the department. These non-members were the patients visiting the hospital from different parts of the county and beyond.

3.6 Sampling techniques

Simple probability sampling method was employed to get the people interviewed. Under this method each member of the population who had close link with the outpatient department of JTH and its patients had an equal chance of being selected.

3.7 Data collection methods.

The following methods were applied in the collection of the data namely: Interview, questionnaire, Observation, and document examination and analysis.

3.7.1 Primary methods

The primary methods were used to obtain first hand information from the staff members of the pharmacy department and non- members. The following are some of the primary methods used:-

Observation

This method was very useful especially where the required information was not easy to obtain due to restrictions imposed on the obtaining of such information that proved to be relevant to this research. Observation involved visiting the offices where the information is kept and taking note of what was going on and then come up with a conclusion. It included where the relevant staff will go and pick bits of information they required. By observing this pattern, it was possible to define from the information they picked their role and as such came up with an analysis that helped in developing a better system.

Face-to-face interview

This involved physical contact with direct questions posed to the people being interviewed. It proved to be useful in obtaining first-hand information on the topic being investigated and therefore identifying requirements and gathering ideas and opinions. The interviews were mainly structured type with specific questions asked.

Questionnaires

This method involved written questions sent to the targeted group to acquire information that may not be obtained from the above research methods. It was very crucial as it provided ample time for the respondents to collect relevant information and send the feedback at their convenient time.

3.7.2 Secondary methods

i. Document examination and analysis.

The researcher examined and analyzed the patient's records for more information which was rather difficult to obtain from the above mentioned methods.

ii. Research.

This was a very instrumental fact finding technique to research the application and problem. Documents such as journals, magazines, lecture notes, reference books, other people's research work and the internet including user groups and bulletin boards provided good sources of relevant information.

3.8 Development Tools

The development tools in the research that were used to implement the system are as follows:

3.8.1 Microsoft Visual Basic Programming Language (VB)

A computer program is an organized list of instructions that, when executed, causes the computer to behave in a predetermined manner. Without programs, computers are useless. Programming is designing or creating a set of instructions to ask the computer to carry out certain jobs which normally are very much faster than human beings can do. In order to do programming, we need to use certain computer language to communicate with the computer. There are many computer languages, some of the examples are Visual Basic, VB.Net, Java, C++, C, and so on.

According to the website *http://www.webopedia.com/TERM/V/visualbasic.html* Visual basic is an event driven language that responds to users' actions. The language interfaces between the user and the database. Patient's records are to be stored in database and accessed through visual basic interface.

Visual basic has in-built function and code fragments that assist the programmer to write the codes effectively as objects independently and then called to form a complete project.

The following are the reasons to the use of Microsoft Visual Studio (VB.Net).

- *Capability:* - VB.Net is capable of producing software as sophisticated as any other data access techniques available.
- *Flexibility:* - You do not have to use VB.Net for database access; you can use it to write a text processor, an e-mail listener or other tasks.
- *Familiarity:* - Being the most popular programming language in the world means there is a steady supply of talented staff for you to add your development teams. When the general supply is short, you will still be more likely to find development staff than for other languages.
- *Popularity:* - The popularity of a product is important for you to become familiar with because you will see more magazine articles and books as well have a better supply of third-party products from companies who will devote their resources in which there is a payback.
- *User friendly:* - VB.Net is user friendly.

3.8.2 Operating systems

Windows 7, NT or XP operating system is the most widely used and most versant with users than any other operating system and therefore it is most appropriate operating system to use for this system to work

3.8.3 Database management system (DBMS)

This is a program that enables the user to create, manipulate and maintain records in an organization. It enables tables and relationship to be set up on the computer and allows you to enter information into those tables. From "database management systems, designing and building business applications, by Gerald V. Post 2nd edition", "and principles of database management by James Martin", they state how the database can be set up using specific application programs, for instance the software used is Microsoft Visual Studio (VB.Net) application to interface main database system created in Ms Access. Different operations can be performed on the information stored in the database which includes:

- Information can be printed to give reports and issue statements.
- Information can be deleted, added or edited to update the database.
- Organize records (data) in different orders for example; ascending, descending, random, payment made by patients, admitted, treated, and so on.

In reference to *Timothy J. (2000),* Microsoft Access is a relational database management system. In relational database systems, data is organized in tables that are related or linked to one another. Each table consists of rows called records and columns called fields.

Access is a powerful program with numerous easy-to-use features including the ability to quickly locate information, add, delete and modify records, sort records, analyze records and produces professional looking reports.

The database management system maintains the records of patients by performing the following tasks;

- data redundancy control
- data abstraction
- support for multiple users
- multiple way of interfacing
- restricting unauthorized access
- enforcing integrity rules
- Back up and data recovery.

3.9 Conclusion

This chapter mainly dealt with the fact finding methods and the scope at which the research was concentrated on. The user, system, functional and non-functional requirements were as well identified. The next chapter will mainly cover the design of the proposed system.

CHAPTER FOUR
SYSTEM DESIGN

4.0 Introduction

This chapter explains the current system, analyzing its Objectives, and the new system design; which will include; functional design, logical and physical design, database planning and Implementation. The design of the system produces the details that state how the system will meet the requirements identified during system analysis.

4.1 Analysis of the current system

According to the research, the outpatient department of JTH information system is mainly paper-based. There are several computers in the department spread over the different units. Two at the ICT unit, one at the senior nursing superintendent, one at the nursing staff chambers, the other in the treatment chambers. The computers are used for data entry and information storage.

When data is received (data concerning the patient and the treatment measures taken), it is recorded in the computer to ensure easiness in the retrieval of data (information). This is done by the nurses in charge and the subordinate staff under the direction of the doctor. The concerned nurses and the subordinate staff encounter difficulties with following up all the required information since at times the information is incomplete. Thus, it may take them a number of days to capture all the required information concerning the patient and the treatment measures taken. On the other hand more copies of the same item may be recorded on different computers thus, causing data inconsistency when the records are being updated. This is because one copy might be updated while the rest may not. In such a case, contradiction crops up.

Due to lack of enough computers, there is lack of co-operation among the staff in the concerned units when it comes to the use of the data stored at the various units. One unit might be in need of data available in another unit. This will mean checking with the concerned unit in order to retrieve the information. A lot of time could be saved especially in collecting the same information that may already be available in another unit. This occurs as a result of doubts cast on the accuracy of figures. It will be important if relevant information was only available to relevant people.

4.1.1 Strengths of the current system

Despite the system being paper-based, the following was achieved.

- Data retrieval by the staff.
- Storage of the data received.
- Security was maintained even though at a low standard.
- Data was shared by the different units.
- Data was updated quarterly (once every three months).

4.1.2 Weaknesses of the current system

- There was demand for storage space for paper work. This space could be utilized to accommodate other activities such as offices or for expansion of the hospital.
- Inaccurate data capture and recording resulting from the collecting of incomplete manifests and other relevant data hence unreliable data which may result in processing of wrong information.
- Loss in productivity because staff members spend valuable time moving from place to place in search of data to be analyzed.
- Too much reliance on clients who may at their own discretion deliberately or unknowingly conceal vital information.
- A lot of paper work involved which can result to errors and inconsistent results.
- The paper-based system used gives little opportunity to share data across the units in the department. This is because each unit has its own files with contents relevant to it.
- Same data kept on the subject in different files may be inconsistent and therefore lacks integrity and may be unreliable.
- Retrieval of information is tedious and time wasting. It is therefore necessary to automate the system so as to overcome the various shortcomings associated with the current system.

4.2 Desired system

4.2.1 Functional requirements

These are the statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. They explain what the system should do and what it entails:

- Produce reports on the most commonly diagnosed disease in a given period of time.

- Produce reports on the percentage of patients that were diagnosed with a common disease in a given period of time.
- Retrieve patients recorded information on request.
- Query the data in the database.
- Update, delete, refresh, exit and add are some of the functionalities that the system will have.
- The system shall provide appropriate views for the user to read documents in the document store.
- There is need for sufficient hard disk space to manage the system, at least 60GB.
- Enough memory (RAM) is needed to ensure quicker and better responsiveness, at least 512MB.
- There will be need for a medium that offers fast and efficient communication transmission that has a minimum error performance

4.2.2 Non-Functional requirements

These are systematic qualities that defined the system properties and constraints. They include the following,

Performance: The system will be expected to have good response time in order to successfully perform data manipulation.

Security: The system will be expected to have security functionalities like the user name and password to avoid unauthorized users from accessing the system.

Accessibility: Efficiency, reliability, speed and retrieval of information needed will be made easier for the system users.

User friendly: The system uses commands, for system navigation that the user will find it easy to learn, because of reduced complexity.

Versatility: The system will be designed to fit on other types of operating systems such as window 7 vista, XP, Linux, etc.

Availability: Access to the system is a bit simplified to allow users to be able to start work as smoothly as possible. Maintenance by system administrator should be done regularly to keep the system available to the users

4.2.3 System specification

This specifies the functionality of the system and the constraints in its operation. System specifications are intended to establish what services are required from the system and the

constraints on the system's operation and development. This stage is very delicate because errors at this point inevitably lead to later problems in the system design and implementation.

In this research study, the researcher observed the following on system specification:

- An estimate of whether the identified user needs may be satisfied using the current software and hardware technologies and whether the proposed system is cost effective.
- Deriving system requirements through observing the existing system, discussing with potential users and procurers.
- Defining a set of requirements and recording it to produce a requirements document.
- Checking the requirements for realism, consistency and completeness. Errors in the requirements document are inevitably discovered thus correcting them. The systems requirements document, also known as the functional specification, should be precise. It may serve as a contract between the system buyer and software developer.

4.2.4 System requirements.

These are the requirements for the system as a whole rather than of its components. To obtain the system requirements, the researcher consulted the department's staff in order to obtain the actual requirements. They include properties such as:

i. Performance.
ii. Reliability.
iii. Usability.
iv. Safety.
v. Security.

The success or failure of a system is often dependent on the system requirements.

4.2.5 User requirements of the new system

These are the statements in natural language plus diagrams of what services the system is expected to provide and the constraints under which it must operate.

Readers of the user requirements are: - client manager (ICT manager), staff members (end-users) and system developers (researchers).

The system performed the following user requirements.

- Update records.
- Delete any records.

- Edit and refresh records.
- Add records that will need to be added into the system's database.
- Search for relevant records.
- Generate reports.

4.2.6 Security requirements

These specify system behavior that is disallowed rather than the behavior that is expected of the system. The following security checks will be observed:

- Unauthorized users should not be allowed to access the database. This can be enhanced by use of passwords and user names.
- Relevant information should be made available to the relevant people.
- Use of security measure such as firewalls and anti-virus to trap unwanted information that might harm the system.

4.2.7 Organizational Requirements

With the new system in place, there is a need to maintain the database. Therefore some cost would need to be budgeted for in terms of operational and maintenance cost.

4.2.8 User requirements

An agreement was reached upon with the help of the system administrator and the general manager that user requirements and system constraints shall define the system services and functionality. They included the functional and non-functional requirements of the system.

4.2.9 System administrator

The System administrator does manage the system in the Organization in case of any breakdown or failure.

4.3 Technical user

Database/system administrator

- Monitor the progress of the system.
- Manage the system in case of breakdown.
- Protect the entire system from external threats.
- Maintenance and Repair.
- Provision of new types of security features for the system.

4.4 System Development Methodology

This part of the research will focus on the development tools and techniques the researcher used for the design, development and implementation of the Automated Client loan management system.

4.4.1 Systems Development Life Cycle (SDLC)

This is a traditional methodology used by many organizations to develop and design a system. It features several phases that mark the progress of the system analysis and design effort. The researcher chose this methodology because it is accepted universally.

- **Planning** This is the first phase in SDLC, all the information the system needs are identified, analyzed, prioritized and arranged so that the needs of the project are identified.
- **Analysis.** This is the second phase in SDLC, during this phase; the system requirements are studied and structured. During this process, a careful study of any current system, manual and computerized systems that might be replaced or enhanced as part of the project.
- **Design.** During this phase of SDLC, the descriptions of the recommended solution is converted into logical and the physical system specifications.
- **Logic design** (all the functional features of the system are chosen for development is analyzed and described independently of any computer platform.)
- **Physical design** (logical specifications of the system from logical design are transformed in to technology specific details.)
- **Implementation:** This is the fourth phase in SDLC, during this phase, the database or system is coded, tested, installed, that is to say put into use.
- **Maintenance,** The system is systematically repaired and improved

System development Life Cycle

This is the process that provides software developers with the required information and guidelines on how to develop systems software. In this research, we considered System Development Life Cycle (SDLC) as the choice for this study. Different models provide useful abstractions which can be used to explain different approaches to software development. SDLC is the oldest methodology for building an information system. Every system goes through a process of birth, growth, maturity and decline. The following diagram illustrates the steps which must be followed in system development life cycle

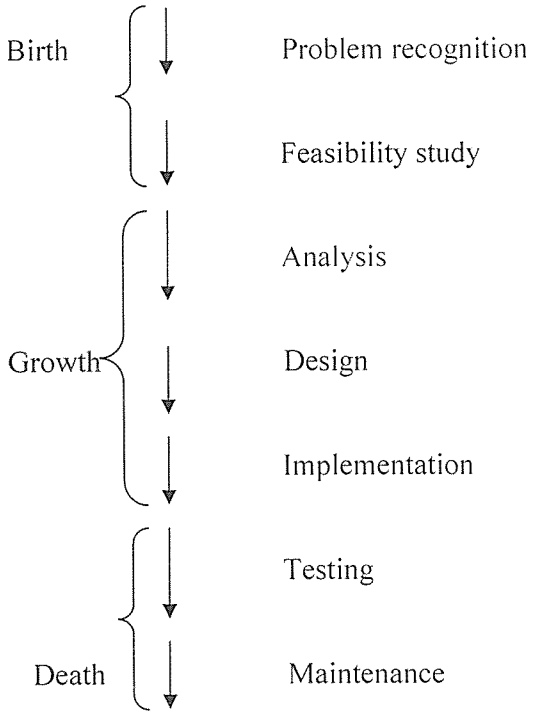


Figure 2: System Development life cycle

1. Problem recognition

This is the initial stage. It involves identifying the exact problem and the system to be developed out of all the new systems that could be developed. Once the problem has been recognized and acknowledged by the management, the users and the system analyst (in this case the researchers), the work of implementing a new system is assigned to the system analyst.

2. Feasibility study

Here the problem definition is brought into a sharper focus. Feasibility study is also known as preliminary investigation. The specific system objectives are set and aspects of the problem that will be excluded from the system clearly noted. The analyst ought to estimate the costs and benefits of the system with greater accuracy. This calls for a cost-benefit analysis study of the proposed system. The cost analysis indicates whether the proposed system is feasible or not.

Feasibility study contains these aspects.

- *Technical feasibility:* This is a measure of the practicality of a specific technical solution and the availability of technical resources and expertise.
- *Economical feasibility:* This is a measure of the cost effectiveness of a project or solution. This is often called *cost-benefit analysis.*

- *Operational feasibility:* This is a measure of how well the solution will work in the organization. It is also a measure of how people feel about the system/project.
- *Schedule feasibility:* This is a measure of how reasonable the project timetable is.

3. Analysis

After the feasibility study is approved, the system analyst works in conjunction with the user to develop a logical model of the system. There must be understanding between the user and the analyst to avoid failure of the project. Use of technical language is avoided so that the user can comprehend and in return contribute as well. This can be done by use of diagrams, elementary data dictionary and rough descriptions of the relevant diagrams which must be revised by both the user and the management.

4. Design stage

Here the analyst answers the question, how is the problem going to be solved? Logical design is incorporated to ensure that everything runs smoothly. It also ensures that premature termination does not occur. Then we have the detailed design where programs are coded to solve the problem. This answers the question, how should the system be implemented?

5. Implementation

Here the new system is put into use. When implementing a new system various ways can be adopted. These include:

- *Direct change over:* - this is a complete replacement of the old system by the new system in one bold move.
- *Parallel running:* - this involves processing of current data on both old and new systems in order to cross-check the results.
- *Pilot running:* - data from one or more previous periods is first run on the old system and then on the new system. The new results are then compared.
- *Phased change over:* - this is where the system is introduced piece by piece.

6. Testing

Before any system is brought into use, it is essential to ensure that it carries out all its intended functions within the established limits. On both logical and physical designs, the computer system and its environment must be tested to the satisfaction of the analyst and the user.

7. Maintenance

The main objective of maintenance is to keep the system functioning at an acceptable level.

Maintenance functions mainly include:-

- Correcting errors due to problem bugs
- Changing parameters and algorithms used to develop the original programs.
- Changing procedures
- Hardware and software maintenance
- Making any enhancements as new technology comes.

The SDLC also known as the software life cycle employs a software model known as waterfall model. The waterfall model cascades from one phase to the next. The principal stages of the model map onto fundamental development activities. The next phase should not start until the previous phase has been completed and produces one or more documents as its result. The software process is not a simple linear model but involves a sequence of iterations of the development activities.

The problem with the waterfall method is its inflexible partitioning of the project into these distinct stages. It should be used when the requirements are well understood.

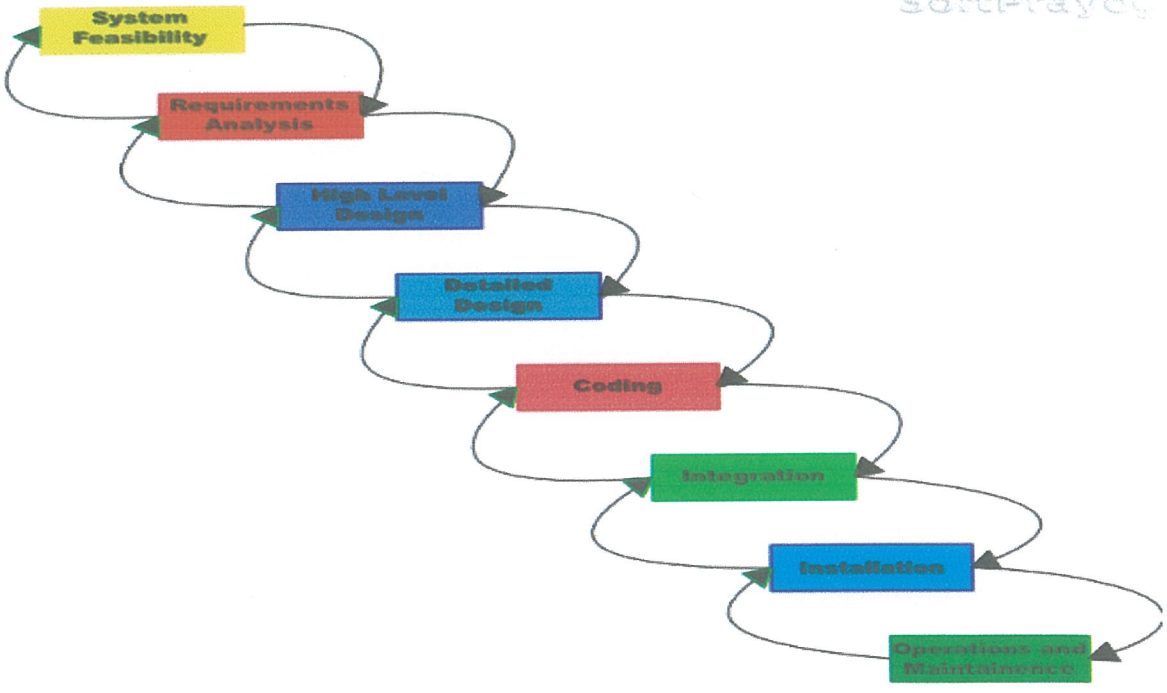


Figure 3: The water fall model for the software development life cycle

1. *Requirements analysis and definition.*

All the system's services, constraints and goals were established by consulting the system users. The researcher then defined them in detail to serve as a system specification.

2. *System and software design.*

The system's design process partitions the requirements to either hardware or software systems. Overall system architecture is established. Software design involves identifying and describing fundamental software system abstractions and their relationships.

3. *Implementation and unit testing.*

During this stage the software design is realized as a set of programs or program units. Unit testing involves verifying that each unit meets its specification.

4. *Integration and system testing.*

The individual program units or programs are integrated and tested as a complete system to ensure that the software requirements have been met. After testing, the software system is delivered to the customer/user.

5. *Operation and maintenance.*

Normally, this is the longest lifecycle phase. The system is installed and put into practical use. Maintenance involves correcting errors which were not discovered in earlier stages of the life cycle, improving implementation of the system units and enhancing the system's services as new requirements are discovered.

A part from the waterfall model employed by the SDLC, there are other models which include:

- *Evolutionary development:* - This approach interleaves the activities of specification, development and validation. An initial system is rapidly developed from abstract specifications. This is then refined with customer input to produce a system which satisfies the customer's needs.
- *Formal systems:* - This approach is based on producing a formal mathematical system specification and transforming this specification using mathematical methods to construct a program. Verification of system components is carried out by making mathematical arguments that they conform to their specification.
- *Re-use based development:* - This approach is based on the existence of a significant number integrating these components into a system rather than developing them from scratch.

4.5 Final system

From the research and documentation that was done in this chapter the researcher was able to develop the proposed system.

4.5.1 Detailed analysis and Design

It's also known as the logical or physical design. Here the researcher looks at how the proposed system:-Responsive real-time record management system shall deliver the general capabilities in the problem definition.

4.5.2 Conceptual Design

This includes a conceptual data model which is a detailed model that captures overall structure of organizational data, while being independent of any data base management system or other implementation consideration. A conceptual data model includes the relevant entities, relationships and attributes as well as rules and constraints that define how data are used. The conceptual data model may be expressed in one of the several forms: - the most common are detailed entity relationship diagrams or object oriented models. In this research, the researchers considered the Entity Relationship Model (E-R Model) which is described below.

The key elements of the Entity Relationship Model (E-R Model)

These are entities, attributes, identifiers and relationships.

Entity

In reference to Kroenke, D (2000), an entity is something that can be identified in the users' work environment, something that the users want to track. In this case the following are the entities.

- Examination
- Patient's
- Staff

Attributes

Entities have attributes, also called properties that describe the entity's characteristics. Examples of attributes are Patient's name, Patient's id and so on. They are printed on both capital and small letters.

Identifiers

Entity instances have identifiers which are attributes that name or identify entity instances. Examples, patient's instances could be identified by Patient's name or Patient's id the identifier of an entity consists of one or more of the entity's attributes. An identifier may either be *unique* or *non-unique* whereby the value of a unique identifier will identify one and only one entity instance while that of a non-unique identifier will identify a set of instances. Identifiers that consist of two or more attributes are called composite identifiers.

Relationships

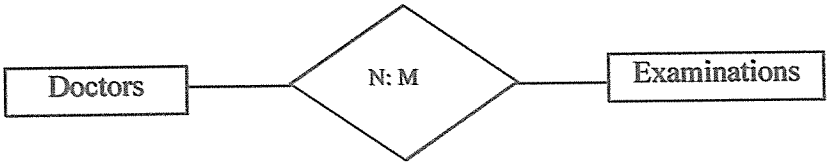
A relationship is an association between entities according to Kroenke, D (2000). An E-R Model consists of both relationship classes and relationship instances. Relationship classes are associations among entity classes and relationship instances are associations among entity instances.

A relationship can include a number of entities; the number of entities in a relationship is the *degree* of the relationship.

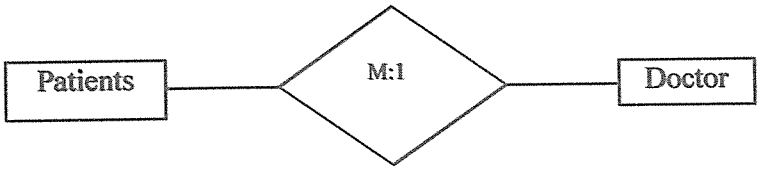
Types of relationships

i. *One-to-one relationship:* - A single entity instance of one type is related to a single entity instance of another type.
ii. *One-to-many relationship:* - A single instance of one type is related to or relates to many instances of another type.
iii. *Many-to-many relationship (N: M)*: - Many instances of one type relate to many instances of the other type.

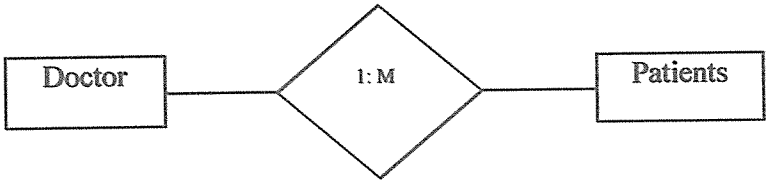
The numbers between the relationships diamonds show the maximum number of entities that can occur on one side of the relationship such as constraints are called the relationship's maximum cardinality as observed by Kroenke, D (2000).



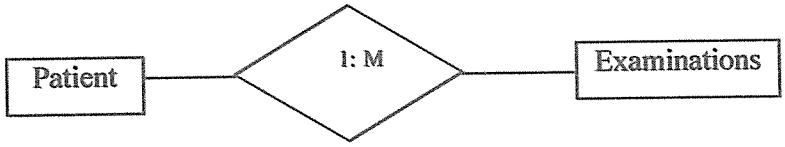
This is a many –to –many relationship. Many doctors can carry out many examinations.



This is a one – to – many relationships: - Many patients' can see one doctor.



This is a one – to-many relationship: - a patient can visit many doctors.



This is a one – to- many relationships: - a patient can carry out many examination tests.

Figure 4: Relationships and Cardinality

Figure 5: E-R Diagram for the new system

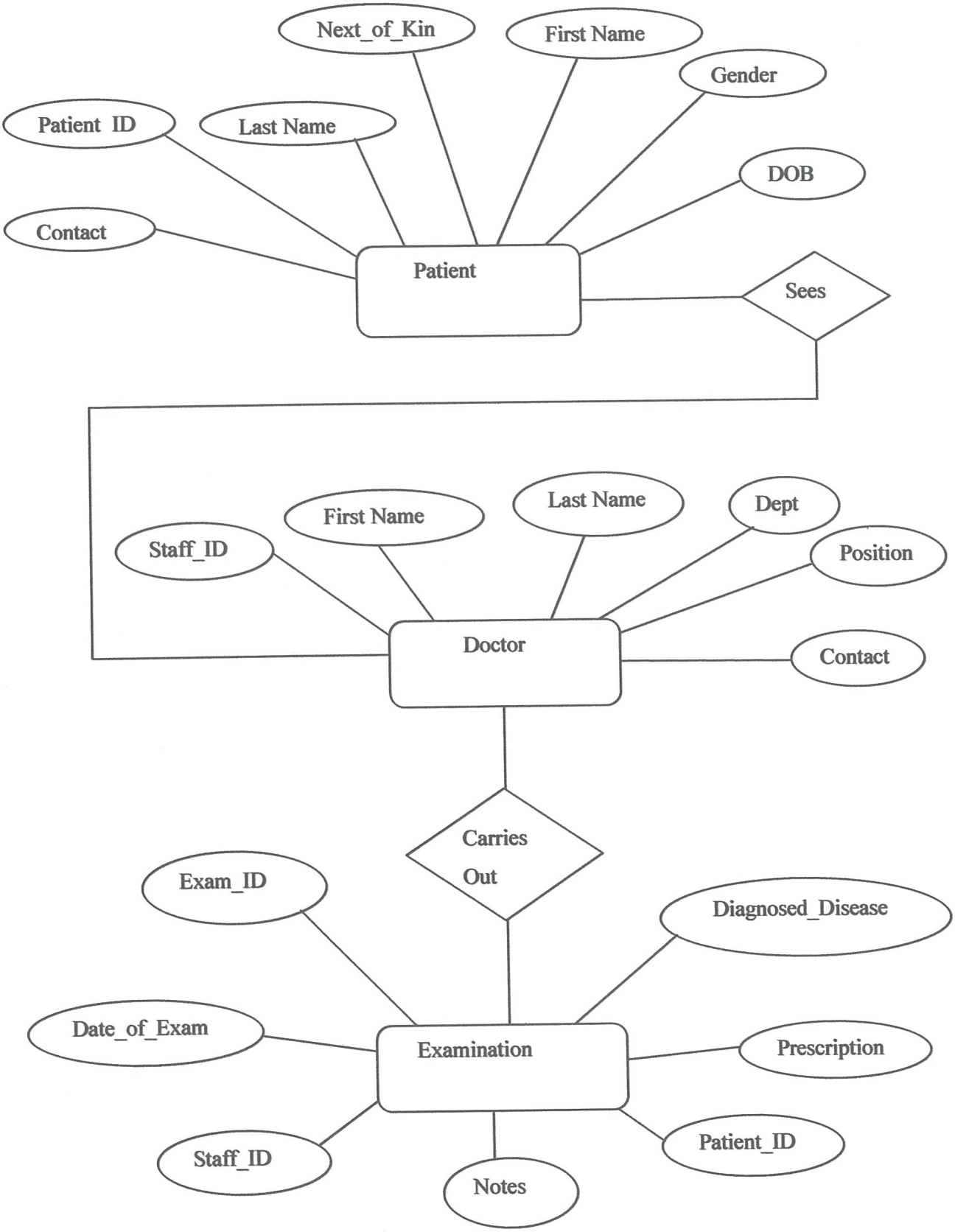
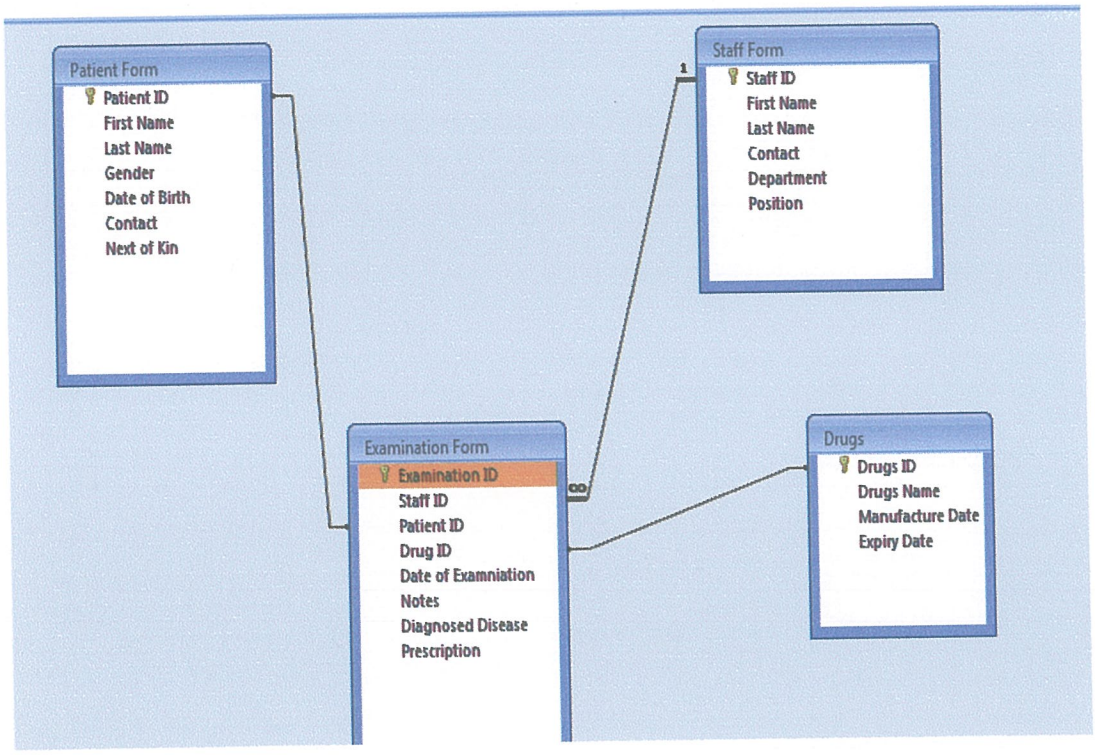


Figure 6: Relationship among entities



4.5.3 Logical design

This is the process of mapping the conceptual data model to the structures that are specific to the target DBMS. If the target environment is relational DBMS, then the conceptual data models are mapped to normalized forms.

The logical design process is concerned with transforming the conceptual data model (in this case the E-R Model) to a logical data model (Relational Data Model). It includes the following steps.

- *Represent entities:* - Each entity type in the E-R diagram is represented as a relation in the Relational Data Model. The identifier of the entity becomes the primary key of the relation and other attributes of the entity type become non-key attributes of the relation

Table 1: Examination Table

This captures the examination tests conducted on a patient

Field name	Data type	Size	Constraints	Key
Exam-ID	Text	10	Not null	Primary key
Patients-ID	Text	10	Not null	Foreign key
Staff-ID	Text	10	Not null	Foreign key
Drug-ID	Text	10	Not null	Foreign key
Date-of-Exam	Date/time	Short Date	Not null	
Notes	Memo	50	Not null	
Diagnosed-disease	Text	20	Not null	
Prescription	Memo	50	Not null	

Table 1: Patient's Table

This captures the patient's details.

Field Name	Data Type	Size	Constraints	Key
Patient-ID	Text	10	Not null	Primary key
First Name	Text	10	Not null	
Last Name	Text	10	Not null	
Gender	Text	8	Not null	
Date of Birth	Text	10	Not null	
Contact	Text	10		
Next of Kin	Text	20	Not null	

Table 2: Staff Table

This table shows details concerning the staff members of the department.

Field name	Data type	Size	Constraints	Key
Staff-ID	Text	10	Not null	Primary key
First Name	Text	10	Not null	
Last Name	Text	10	Not null	
Department	Text	20	Not null	
Position	Text	20	Not null	
Contact	Text	10		

Table 4: Drug Table

This table shows details concerning the drugs.

Field name	Data type	Size	Constraints	Key
Drug-ID	Text	10	Not null	Primary key
Drug name	Text	10	Not null	
Manufacturer Date	Text	10	Not null	
Expiry Date	Text	10	Not null	

According to Kroenke, D (2000), a relational data model is a data model that represents data in the form of tables or relations.

A relation is a named, two dimensional table of data. Each relation consists of a set of named columns and an arbitrary number of unnamed rows.

4.5.4 Physical design

This is the last stage of the design process. Its major objective is to implement the database as a set of stored records, files, indexes and other data structures that will provide adequate performance and ensure database integrity, security and recoverability. Physical database design must be performed carefully since decisions made during this stage have a major impact on data accessibility, response time, security, user friendliness and similar factors. The following are the major inputs to physical design.

- ❖ Logical data structures that were developed during the logical design like the relational data models.
- ❖ User processing requirements that were identified during requirements definition including size and frequency of use of the database.
- ❖ Characteristics of the database management system (DBMS) and other components of the computer operating environment.

Components of the physical database design

- **Data volume and usage analysis**: - The size and usage patterns of the database are estimated. Estimates of the database size are used to select physical storage devices and estimate the storage costs. Estimates of usage paths or patterns are used to select file organizations and access methods to plan for the use of indexes and plan a strategy for data distribution.
- **Data distribution strategy**: - There are different distribution strategies. In this research *hybrid data distribution strategy* was considered. In this strategy, the database is portioned into critical and non-critical fragments. Non-critical fragments are stored at one site while critical fragments are stored at multiple sites.
- **File organization**: - This is a technique for physically arranging the record of files on secondary storage devices. The following were put into consideration: - constraints including physical characteristics of the secondary storage devices, available operating system and file management software and user needs for storing and accessing data. Indexed non-sequential method whereby records are stored non-sequentially and full index required is the selected file organization technique.

The selected file organization for the new system is expected to provide the following:

- o Fast access for retrieval.
- o High throughput for processing transactions.
- o Efficient use of storage space.
- o Protection from failures or data loss.
- o Minimizing need for reorganization.
- o Accommodating growth.
- o Security from unauthorized use.

Indexes: - Most database manipulations require locating a row that satisfies some condition. An index is a table or other data structures that are used to determine the location of rows in a table that satisfy some condition. Indexes may be defined on both primary key values and non-key attribute values.

Integrity constraints: - These are specifications that preserve the integrity of the database. Referential constraints as such are business rules in a database to some other objects in the database.

4.6 Conclusion

The chapter basically has exhausted the design process with all the diagrams that support each design level. The next chapter will look into the implementation of the new system

CHAPTER FIVE

SYSTEM IMPLEMENTATION

5.0 Introduction

This chapter deals with how the new system will be implemented. It includes how the system operates and supports the users. The program is tested, if it delivers the solution to the department, it can be fully used to replace the shortcomings of the old system. The chapter also covers the different ways in which the old system is converted to embrace changes brought by the new system developed.

5.1 Project implementation

Project implementation is putting into effect a piece of research work.

To implement the system the following were done:

- Acquire the installation of requirements e.g. hardware, software.
- Data collection.
- Planning analysis and project writing
- System design and user training
- System testing and review
- System implementation and report writing

5.1.1 System implementation

Systems implementation is the delivery of that system into production (meaning day to day implementation). The implementation phase delivered the production system into operation. The functional system from the construction phase was the key input to the implementation phase of the system. The deliverable of the implementation phase was the operational system, the operation and support stage of the life cycle.

System implementation involves:

a) Conduct a system test

The system was tested to ensure that it operates as required to avoid inconveniences while under operation by the users. Different tests were carried out as explained below under program testing.

b) Prepare a conversion plan

Once a successful system test was completed, the developers began preparations to place the new system into operation. Using the design specifications, the researchers developed a detailed conversion plan for the new system.

c) Install the database

To place the system into operation, the researchers loaded the database. The purpose of installing the database was to populate the new system's database with existing data from the old system. Each record loaded must be input, edited and confirmed before the database table was ready to be placed into operation. The researchers calculated the database size and estimated the time required to perform the installation. Data entry then kicked off. This task was crowned with a restructured existing data that has been populated in the database for the new system.

The new system was now put into operation. The functional system from the construction phase was the key input to system implementation. The users were trained using various manuals, files and the database was loaded and the final testing was performed. System users provide continuous feedback as new problems and issues arise.

To provide a smooth transition to the new system, a conversion plan must be prepared. This plan may call for an abrupt switch where the old system is terminated and replaced by the new system. Alternatively the old system may run in parallel with the new system until the new system has been deemed acceptable to replace the old system.

The system begins by loading a splash screen that is indicated below then loads the login page.

Figure 5: Splash Form

Security Requirement

All the users have to first log in with a correct username and password to gain access as shown below.

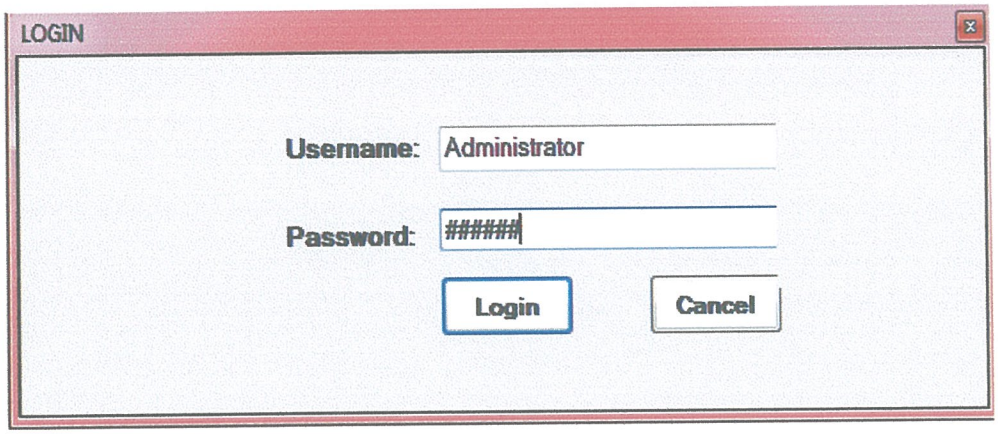


Figure 6: The Login Form

If the user enters the wrong password, a message box appears informing the user that the password is invalid as shown below.

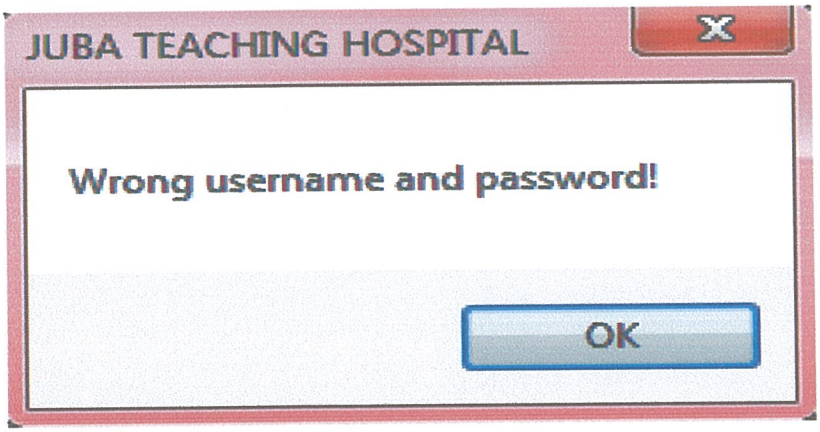


Figure 7: Invalid Password Entered.

Sample form designs

Some forms used in the system for data entry are indicated below.

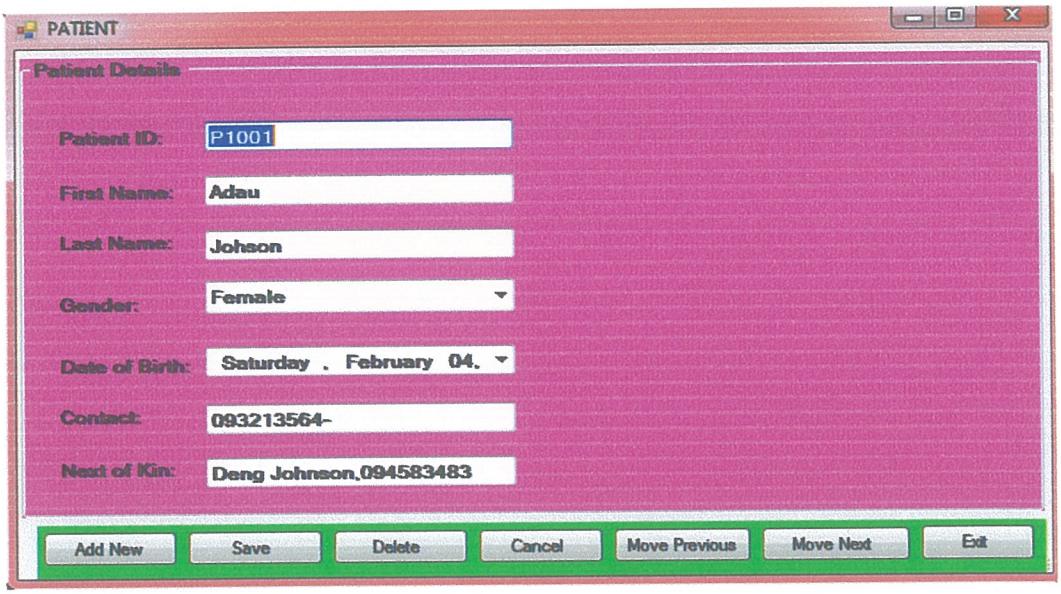


Figure 10: Patients Form

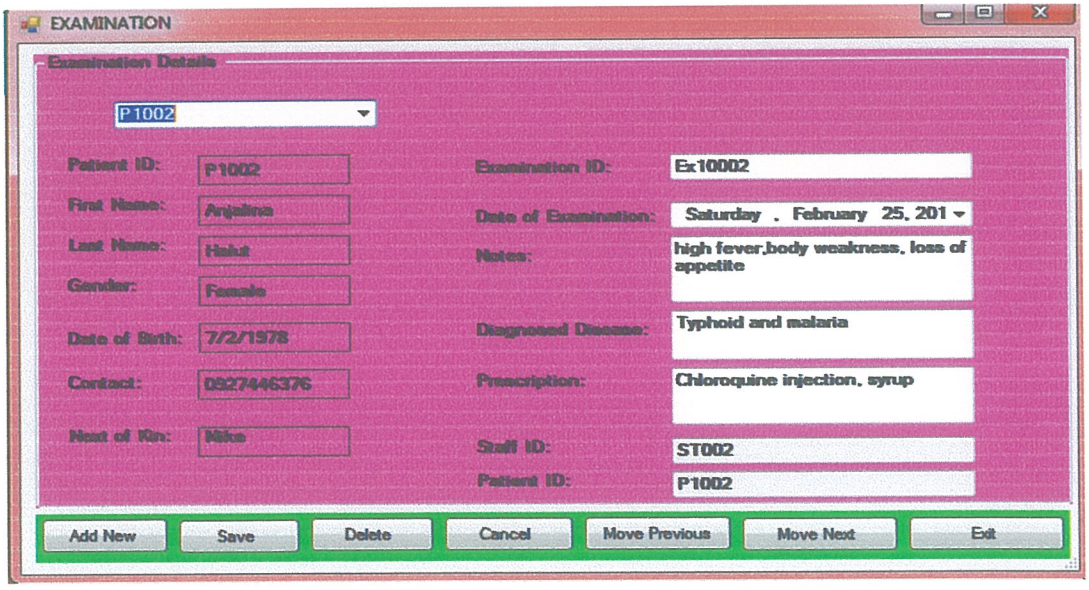


Figure 11: Examination Form

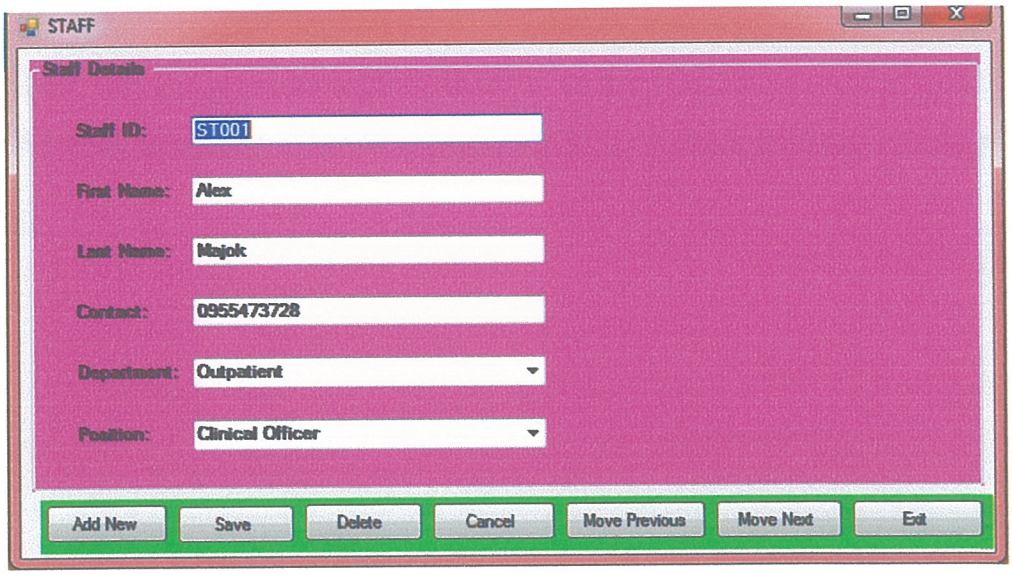


Figure 8: Staff Form

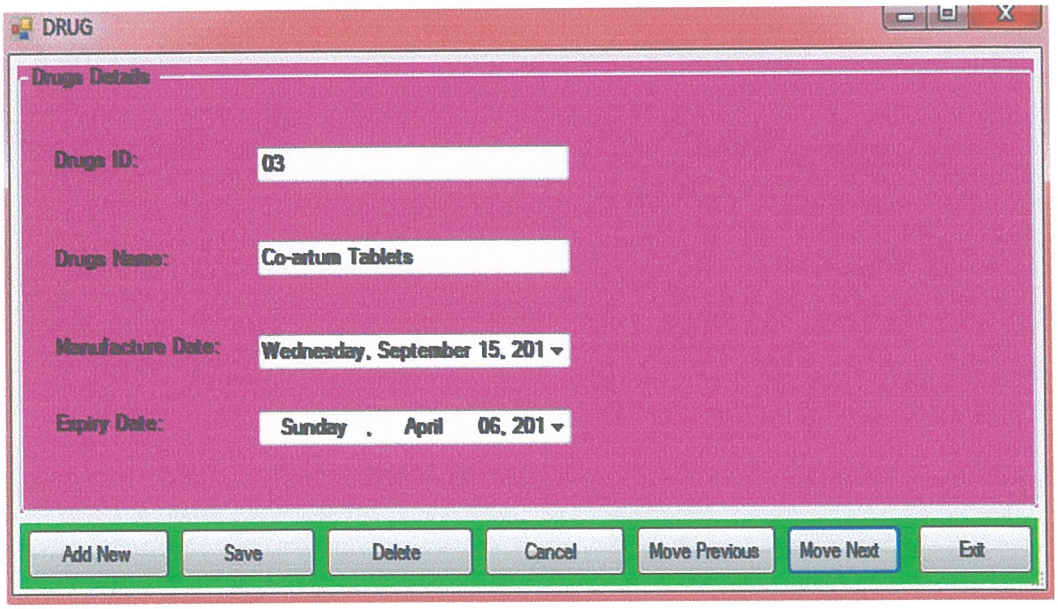


Figure 13: Drug Form

In the above forms, the user can add, delete, and update the data in the database. The user can as well view the previous and the next records in the database. A report can be generated to give a detailed report of the transactions that have taken place within a given period of time.

Sample reports

Some reports produced by the system are described below.

`Displays the list of the staff members

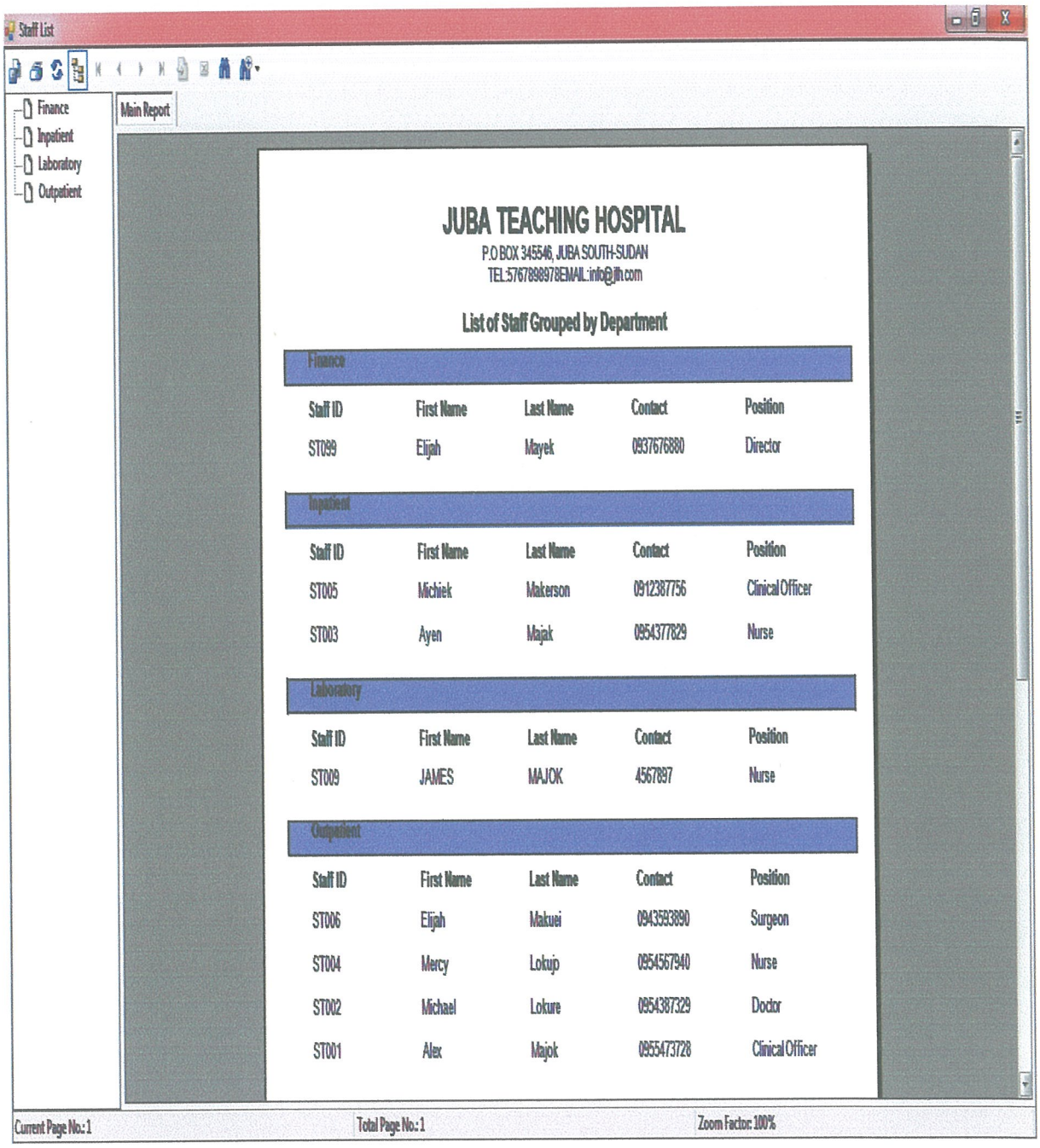


Figure 14: Staff Report

Displays the patient's general Examination details report

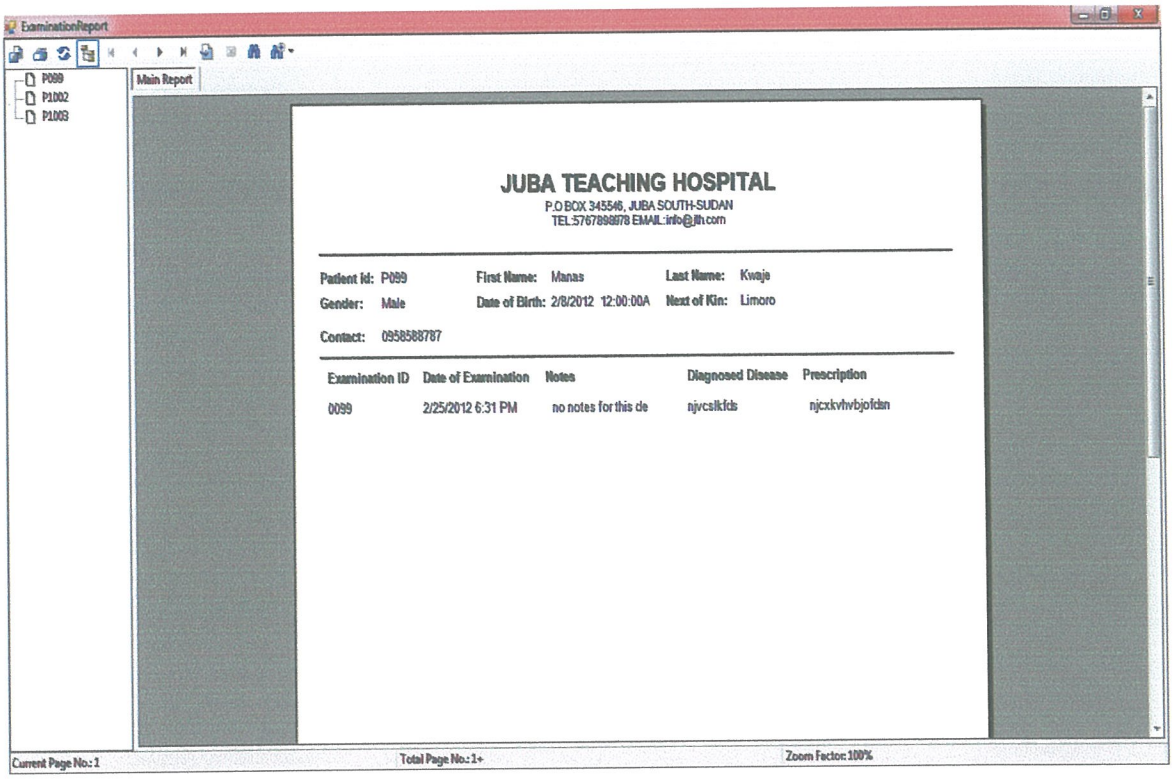


Figure 15: Exam Report

5.2 Program testing

This was intended to ensure that the system conforms to its specification and that the system meets the expectations of the users. Large systems, as the new system, are built out of sub-systems which are built out of modules which are composed of procedures and functions. The testing process proceeded in stages where testing was carried out incrementally with system implementation. The following were the stages followed:-

- *Unit testing*: - Individual components were tested to ensure that they operate correctly. Each component was tested independently without other system components.
- *Module testing:* - A module encapsulates related components, thus tested without other system modules. Examples of modules are object class, abstract data types and collection of functions and procedures.
- *Sub-system testing:* - A collection of modules were integrated into sub-systems and then tested. This concentrated on the detection of module interface errors by rigorous exercising these interfaces.
- *System testing:* - The sub-systems were integrated to make up the system. This process was concerned with finding errors that result from manipulated interactions between sub-systems

and sub-system interface problems. It was concerned with validating the system so that it would meet its functional and non-functional requirements and testing the emergent system properties.

- *Acceptance testing:* - This was the final stage in the testing process before the system was accepted for operational use. The system was tested with data supplied by the system customer rather than simulated test data. Acceptance test revealed errors and omissions in the system requirements definition because the real data exercise the system in different ways from the test data. It also revealed requirements problems where the system facilitations do not really meet the users' needs or the system performance was unacceptable.

5.3 System Specification

The system specification states the features of the computers that will be used to run or interact with the application that is, input, output, and processing and control specification

5.3.1 Software Specification

The software to be used in system implementation is:

Visual Basic for developing the User Interface and Microsoft Access will be used to develop the database application. Both form the Database Management System.

The choice of software was used because of some reasons not limited to, but including;

- Capability
- Flexibility
- Familiarity
- Popularity
- User friendliness

All the above explained in chapter 2.

5.3.2 Hardware Specifications

The hardware components necessary for implementing the application should be in position of being easily replaceable if need arises.

The computer that the database sits on should have the following features;

- At least 80 GB of hard disk space
- At least 1024 MB of RAM

- At least 2.4 GHz of processing power
- At least 533 MHz of front side bus (FSB)
- A gigabit Ethernet adapter
- A laser jet printer for printing reports
- A 17' LCD or CRT monitor,

However, all this can be foregone by having an Internet Service Provider (ISP) to provide the service of data storage and backup

For the users, a computer with the following minimum specifications;

- At least 1.5 GB of hard disk capacity
- At least 256 MB of RAM
- At least 200 MHz of processing power
- At least 133 MHz FSB
- A standard NIC
- An internet connection
- A standard printer
- A monitor of choice
- If running Windows operating systems, Windows 98 and above, if Linux, any distribution that uses GUI, if Macintosh, at least Mac 5.X.

System Evaluation and User Training

5.3.3 System Testing and Limitations

The system was tested during the design stage and during the implementation. The main users were involved all through the development.

5.4 Social and Ethical Issues

This section looks at the social, ethical and moral issues concerning Information Technology/Information System in general and the impact of the new designed system on the community in particular.

5.4.1 Ethical and Social Issues Concerning IT

Ethical and social issues are very important to businesses, and the use of information systems has caused new issues to arise. Ethics is generally defined as having to do with right and wrong

behavior, and it is not limited to topics governed by laws. It requires from people not only to base their actions on the laws but to also question their conscience to find out what is good to be done and what is wrong to avoided.

"Ethical behavior in business includes personal integrity, honesty, fairness, and respect for the rights of others.

It is very difficult to train people on ethical behavior than to train them to perform job tasks. Businesses sometimes provide written policies for their employees-indication that unethical behavior will be treated as justification for dismissal. Organizations may have Codes of Ethics for their employees; however, such codes often are fairly general and may not provide specific guidelines for some situations, such as proper uses of information technology. Numerous ethical issues have developed in recent years that are specifically concerned with the use of information technology (Simon, 1996)"

Some major issues, that may arise, are as follows:

- *Privacy*

Privacy includes keeping confidential information confidential by its owner (holder). Employees must be aware of regulations and must be trained in proper procedures to ensure confidentiality. This requires from him/her to be a responsible and trustful employee.

- *Security*

Security issues include security of data, hardware, and software. Security of data is also related to privacy of access in that increased protection of data reduces the likelihood of private information becoming public. Security of hardware involves making sure that all equipments remain in the desired locations, in undamaged condition, and is only accessed by authorized personnel.

Considering software, security of the software, is a responsibility of the client (in this case, the outpatient department of Juba teaching hospital). The client ensures that its employees or any other person does not make unauthorized copies of copyrighted software.

- *Accuracy*

Accuracy of data implies ensuring that the stored information remains the same location and preventing unauthorized personnel accessing and/or interfering with it. Also, inaccuracy can be achieved by entering the right information in the wrong way and place. Measures have to be taken to ensure that right information is stored in the right way and place by training the personnel as well as including possible measures in the design of the system that can help the user to enter the right information.

- *Other Issues*

Many other ethical issues exist. Interestingly, information technology can be used to perform someone's duty or as the means of performing some unethical activity. For example, persons could attempt to change or delete data stored about them, they could perform unauthorized searches within sets of data to obtain confidential information other persons, or they change some information for their profit.

In summary, new ethical and social issues have arisen because of the use of information technology in our business and personal lives, including concerns about confidentiality of data and working conditions. New global issues have also surfaced, primarily because of the capabilities of transmitting data and messages worldwide. Hence, we can say that the outpatient department of JTH, which is still in the process of incorporating technology in its activities, must bear these ethical issues in its mind so that it may build a sustainable code of conduct in relation to the use of the new technology.

5.4.2 User training

The implementation of the new system will also involve training individuals that will use the final system and developing a documentation to aid the system users. It includes an audit to gauge the success of the completed project.

The deliverable of the system implementation and project implementation is the operational system that will enter the operation and support stage.

The operation and support stage comes in once the system is operating. It delivers the outpatient department of JTH, with a solution to the user community. It will require ongoing system support. System support is the ongoing technical support for users as well as the maintenance required to fix any errors, omissions or new requirements that may arise. System support consists of the following ongoing activities.

- *Assisting the users:* - Regardless of how well the users have been trained and how good the end-user documentation is, users will eventually require additional assistance unanticipated problems may arise, new users added and so forth.
- *Fixing software defects (bugs):* - Software defects are errors that slipped through the software testing.
- *Recovering the system:* - A system failure may result in a program "crash" or loss of data. Human error or hardware or software failure may have caused this. Researchers may then be called to recover the system. That is, to restore the system's files and databases and to restart the system.

- *Adapting the system to new requirements:* - New requirements may include business problems, new user requirements, new technical problems or new technology requirements which will need to be adopted into the new system.

5.5 System conversion

Conversion of the new system from the old system is a significant milestone. A conversion plan was needed to begin preparations to place the new system into operation. Using the design specification, the researchers came up with a conversion plan. This included a strategy for converting from the old system to the new system. The following were some of the strategies that the researchers came across:-

- *Direct changeover*

This is a complete replacement of the old system in one bold move. This is only done when the users have a very high level of confidence with the system. System tests and training must be comprehensive and the changeover carefully planned. It is the least expensive method but most risky. Direct changeover is likely to be used for most terminal /online systems: where the new system bears little resemblance to the old; where the system is relatively small; where personnel resources are unavailable for any other method.

- *Parallel running*

This is the most used method, involving processing of the current data on both the old and the new systems in order to cross-check the results. This keeps the old system alive until the new system has been proved for at least one processing cycle. In fact it promotes user confidence since it allows the results of the old and new system to be compiled side by side. Also they have given time to familiarize themselves with the new system. It has the disadvantage of being costly and difficult for the staff out clerical operations for two systems during the time available which is just enough for one system.

- *Pilot running*

It is similar in concept to the parallel running. Data from one or more previous periods is first run on the old system and then on the new system. The new results are then compared with the old. It is less descriptive than parallel running since things are less critical, although runs still have to cope with clerical procedures for both systems.

- *Phased changeover*

This is where the new system is introduced piece by piece for example one unit of the department after the other, whilst the other units are still processed by the old system. When each new system is proved satisfactory, another one is brought in. this method reduces the

risk inherent in the direct changeover. In this case, users and researchers learn from their mistakes. It ends to prolong the implementation period.

5.6 Conclusion

Conversion to the new system is a significant milestone. After conversion, the ownership of the system officially transfers from the developers to the end-users. The developers completed this task by carefully carrying out the conversion plan. The task involved the system owners, users and developers. The developers who oversaw the conversion process facilitated it. The system owners provided feedback regarding the new system that has been placed into operation. The system users provided valuable feedback concerning the actual use of the new system. They were the source of the majority of the feedback used to measure the system's acceptance. The developers assessed the feedback received from the system owners and users once the system was in operation. The feedback may stimulate actions to correct identified short comings. Regardless, the feedback was used to help benchmark new systems projects down the road. The key input to this activity was the conversion plan and the principal deliverable was the operational system that was placed into production in the department.

The next chapter will summarize the research work. It will include the limitations of the study, the recommendations and finally the conclusion.

CHAPTER SIX
RECOMMENDATIONS AND CONCLUSION

6.0 Introduction

From the research conducted, the researchers came up with the following conclusions and recommendations based on the research objectives for this study, which are restated here below:

- Carry out a detailed study of the outpatient department of Juba Teaching hospital with an aim of learning how the current system runs, identify weaknesses and strengths.
- Analyze data gathered and develop a design document to which a customized application suiting the case study will be developed to tackle most if not all the problems mentioned
- Implement the developed system using Visual basic as the application and Microsoft access as the backend.
- Ensure security of the new implemented system is in place.

The outpatient department of Juba Teaching hospital, being in a vast inhabited hospital needed an information system that was capable of handling all the information regarding the transactions that took place in the outpatient department. Despite having a paper-based information system, it was able to accomplish the following:

- Data retrieval by the staff.
- Storage of the data received.
- Security was maintained even though at a low standard.
- Data was shared by the different units.
- Data was updated quarterly (once every three months.

However, the existing system had several weaknesses which were well explained in chapter three of this research study. The preliminary chapters stated the background, problem statement and the objectives of carrying out this research study. They also brought to awareness what other scholars and authorities have said, observed and commented about the study title. These established the basic foundation of this research and with the unfolding of the chapters, analysis, design and implementation phases of the proposed system were broadly discussed.

6.1 Conclusion

The patients record based management system was designed to respond to the needs of the outpatient department of JTH and provide adequate information and reports to monitor and review the progress of the hospital from time to time with respect to the patient's that visit and are attended to.

The system has been developed with scalability in mind and can be re-developed or updated to new requirements. This system can be updated to include other requirements that may come up as the system requirements expand.

This system has not been pre-tested sufficiently to remove all the bugs that may not have been recognized at the time of developing this application. Exhaustive testing needs to be carried out to isolate these bugs and to make the system more robust.

6.1.1 Project limitations

The researcher did not analyze all documents that would be used in the system investigation. Samples of several of these documents were used to give reasonable insight into the various aspects of the system under study considering the time constraints, which had to complete the project.

To enable a reasonable deduction to be made in the analysis, aspects that required further detailed analysis were observed though it would have been better to carry the investigation to its logical conclusion.

The success of the project to a large extent depended on the cooperation of between the researchers and the system users in order to provide conducive environment for those approached to avail the required documentation of which some were reluctant to provide detailed information.

Some of the documents for analysis provided were official and did not permit external analysis but rather be studied and analyzed in their office.

The system could have been developed further to incorporate other activities within JTH, which have different requirements. Due to time constraints, this could not be achieved.

6.2 Recommendations

Since the system is under operation for it to be implemented with fewer problems, it is recommended for it to be run on Windows 7 operating system, hard disk size of at least 60GB and RAM size of at least 1024MB.

Functionality such as those that allow multiple access of the system can be implemented at a later stage to further enhance usability.

The researcher recommends that before the application is put into full use, it should be tested in a sample field to estimate any bugs that may not have been identified at the time of development.

Password levels may be increased to higher levels depending on the confidentiality of the stored data. The current system password level is basically low-level.

Since the system is in use, it should be run alongside manual files in order to prevent unexpected embarrassments, that is, parallel conversion should be adopted for the system.

Once in conversion stage, it is recommended for other departments to adopt the same system to ensure efficiency and effectiveness in data sharing, storage and retrieval.

6.3 Areas for Further Work

Since the system is under operation, the researcher will have to be involved in system support which includes the following activities:

i. Program maintenance
ii. System recovery
iii. Technical support
iv. System enhancement

If opportunity allows, the researcher hopes that the features that have not been implemented in this application but were originally desired features will be taken into consideration in order to improve on the efficiency, reliability and user friendliness of this system.

Bibliography

C. J. Date (2000) *an Introduction to Database Systems* Seventh Edition, Pearson Education Asia.

Carlo Ghezzi, Mehdi Jazayeri, Dino Mandridi (2002) *Fundamentals of software Engineering* Eastern Economy Edition; Prentice Hall of India – Private Limited New Delhi- 110001.

David M. Kroenke (2000) *Database Processing – Fundamentals, Design and Implementation* Seventh Edition, Prentice Hall (Upper Saddle River, NJ 07458).

Geraldv (2002) Database Managements of Database Systems Boston.

Hectorgarcia (2000) Database System Implementation.

Ian Sommerville (2001) *Software Engineering* 6th Edition; Pearson Education – Asia.

Irwin- McGraw Hill, Gerald V. Post (2002) *Database Management Systems – Designing and Building Business Application* Second Edition.

Irwin McGraw Hill, Jeffrey L. Whitten, Lonnie D. Bentley and Kevin C. Dittman (2001) *Systems Analysis and Design Methods* Fifth Edition.

Irwin McGraw Hill, Timothy J O'Leary (Arizona State University), and Linda I O'Leary (2000) Microsoft *Access 2000* Brief Edition.

Julia Case Bradley, Anita C. Millspaugh (1999), Tata McGraw-Hill Edition (2000) *Programming in Visual Basic 6.0.*

Mcfadden (1994) Modern Database Management.

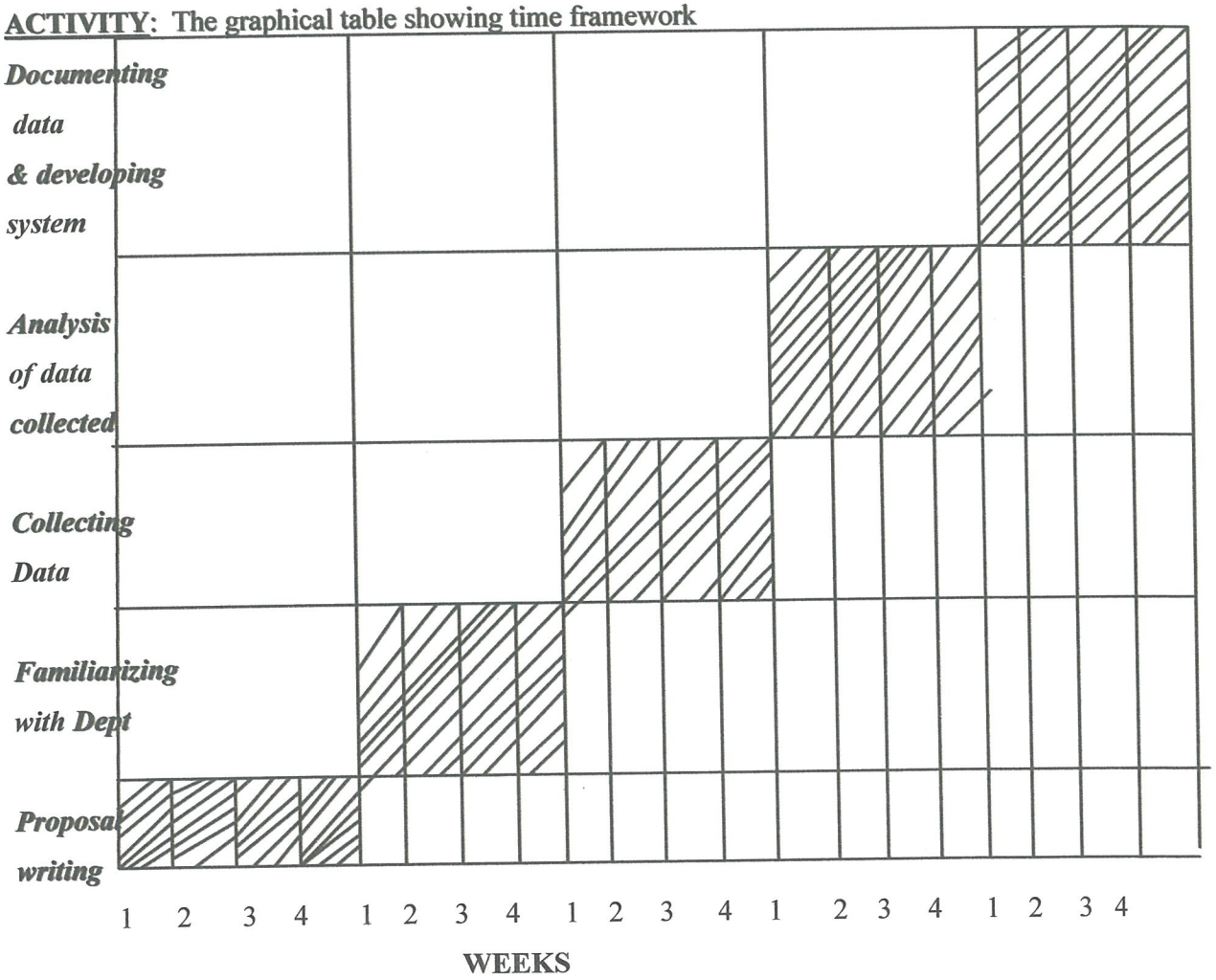
McGraw Hill, Abraham Silberschatz, Henry F. Korth and S. Sudarshan (2002) *Database Systems Concepts* Fourth Edition.

Appendix A: Budget

Table 3: Budget Table

Items	Equivalent Amount	Total Amount
Computer	1500 SSP	950,000/=
Typing and Printing	50 SSP	31,000/=
Transport	35 SSP	21,700/=
Research Assistant	40 SSP	24,800/=
Internet Service	70 SSP	43,400/=
Photocopy	25 SSP	15,500/=
Flash disk	80 SSP	49,600/=
Lunch	45 SSP	28,000/=
Total	1,845 SSP	1,164,000/=

ACTIVITY: The graphical table showing time framework



Appendix B : Questionnaire

Dear répondent,

We are students of Kampala International University, carrying out a research concerning the outpatient department of Juba Teaching hospital. We kindly request you to fill the questionnaire below to facilitate this research study to the success and of help to the society. Your information will be treated with confidentiality and will be highly appreciated.

Much regards,

Monyjok Elijah Malual

And

Mayen Maker Thiong

1. When and by whom was the hospital founded?

   .....

   .....

   .....

2. What is the hierarchy of this department?

   .....

   .....

   .....

   .....

   .....

3. With which methodology do you use to capture and store information?

   ☐ Manual ☐ Computerized (*Tick where appropriate*)

4. What are some of the challenges that you face while undertaking these procedures?

.....

.....

.....

.....

.....

5. Is there any step that has been taken as a remedy to the challenges faced?

☐ Yes ☐ No *(Tick where appropriate)*

If yes, please state it (them).

.....

.....

.....

.....

.....

6. What are the fields that make up your records?

.....

.....

.....

.....

.....

7. Do you have back-up copies for your records?

☐ Yes ☐ No *(Tick where appropriate)*

If yes, state the kind of information you back up.

.....

.....

.....

.....

8. How often do you have your records updated?

☐ After an year ☐ After six months

(Tick where appropriate)

☐ After one month ☐ Regularly

9. Do you have specialized record keeping staff?

☐ Yes ☐ No

If yes what are some of the activities they perform and how do you ensure that every record is where it is supposed to be?

.....

.....

.....

.....

.....

Your support is highly appreciated. Thank you.