

**A COMPUTERIZED PATIENT RECORDS MANAGEMENT SYSTEM
AT KANSANGA MEDICAL CENTRE**

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**A PROJECT REPORT SUBMITTED TO THE COLLEGE OF APPLIED
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DECLARATION

I, Okot Samuel hereby declare that this work is original and has not been submitted to any University or any other institution of higher learning before for an academic award and should not be reproduced without my consent.

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SUPERVISOR'S APPROVAL

This work has been done under my supervision as the University supervisor and submitted with my approval.

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Date. *15th Sept 2012*

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DEDICATION

This book is dedicated to my parents Mr. Omona Johnson and Mrs. Lucy Omona, to my aunt Mrs. Atoo Nighty Olwoch, my uncle Mr. Oyet Bosco, Mr. Oryem John. and finally to my girlfriend Matwale Zeridah for their love and supports they have given me during my studies especially in my final semester. This work is a manifestation of your prayers and hard work!!

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TABLE OF CONTENTS

DECLARATION	i
SUPERVISOR'S APPROVAL.....	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	v
LIST OF ACRONYMS.....	viii
LIST OF TABLES	ix
LIST OF FIGURES.....	x
ABSTRACT	xi
CHAPTER ONE.....	1
INTRODUCTION.....	1
1.1 Introduction	1
1.2 Study Background.....	2
1.3 Statement of the Problem	2
1.4 Objectives.....	3
1.4.1 General Objective.....	3
1.4.2 Specific Objectives.....	3
1.5 Research Questions	3
1.6 Scope	4
1.7 Significance of the Study	4
CHAPTER TWO.....	6
LITERATURE REVIEW.....	6
2.1 Introduction	6
2.2 Record Management	6
2.2.1 Information System	6
2.3 Application of Information Management Systems in a health Care on a Global view.....	6
2.4 Application of Information Management Systems in health Care sectors of developing countries..	8
2.5 Keys to Successfully Adopting Electronic Health Records (EHR)	8
2.6 Push for Medical Record Computerization.....	9
2.7 The Role of IT in Improving Health care Delivery.....	9
2.8 Data Overload and out dated Technology.....	9
2.9 Health care Challenges Solved through Networking	10
2.10 Conclusion.....	11
CHAPTER THREE	13
METHODOLOGY.....	13
3.1 Introduction	13
3.2 Data collection techniques	13
3.2.1 Questionnaire	13

3.2.2 Interview.....	14
3.2.3 Observation	14
3.2.4 Document Review	15
3.3 Area of study	16
3.4 Research design.....	16
3.5 Sampling procedures	16
3.6 Data analysis and Design	17
3.6.1 Using the Qualitative Data Analysis Tool.....	17
3.6.2 Requirements Specification Document.....	17
3.7 Conclusion.....	17
CHAPTER FOUR.....	18
SYSTEM DESIGN AND IMPLEMENTATION	18
4.1 Introduction	18
4.2 System Study.....	18
4.2.1 Current System Study.....	18
4.2.2 Weaknesses of the Existing System	19
4.3. Requirements Analysis.....	19
4.3.1 Functional requirements.....	21
4.3.2 Non-Functional Requirements	21
4.2.3 Flow chart showing the flow of information at the Patient Monitoring System login.....	22
4.4 System Specification	23
4.5 System Design.....	23
4.5.1 Patient Monitoring System Activity Diagram.....	24
4.6 The Proposed System	25
4.6.1 Strengths of the System.....	25
4.7 System Architecture of the Proposed System	27
4.8 Process Modeling	28
4.8.1 Data Flow Diagrams (DFDs)	28
4.8.2 Context Diagram	28
4.9 Data Modeling.....	29
4.9.1 Enhanced Entity Relationship Modeling Concepts.....	29
4.9.2 Relationship Modeling	31
4.9.3 Enhanced Entity Relationship Modeling.....	32
4.10 System Implementation.....	33
4.10.1 Implementation Tools	33
4.11 Testing and Validation	35
4.11.1 Testing.....	35
4.11.2 Validation	36

CHAPTER FIVE.....	37
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.....	37
5.1 Introduction.....	37
5.2 Summary.....	37
5.3 Problems / Constraints Encountered.....	37
5.3.1. Financial constraints:.....	37
5.3.2. Time constraints:.....	38
5.3.3. Busy schedules:.....	38
5.3.4. Fear for retrenchment:.....	38
5.3.5. Power problem:.....	38
5.4 Recommendations.....	38
5.4.1 Train both staff and users on how to use the mobile phone application.....	38
5.4.2 Ensure timely sending of notifications to patients.....	39
5.4.3 Expand on the hospital premises.....	39
5.5 Conclusion.....	39
References.....	40
APPENDIX I: DATA COLLECTION TOOL (QUESTIONNAIRE).....	42

LIST OF ACRONYMS

HMIS	Health Management Information System
HTML	Hypertext Markup Language
EHR	Electronic Health Records
HPCS	Hospital Patient Care Services
EPR	Electronic Patient Records
IT	Information Technology
NPfIT	National Programme for Information Technology
SCR	Summary Care Record
DCRs	Detailed Care Records
SUS	Secondary Uses Service
ALM	Application Life-cycle Management
IDE	Integrated Development Environment
DFD	Data Flow Diagram

LIST OF TABLES

Table 4. 1: Showing System Users and their Respective Requirements	20
Table 4.2: Showing Hardware Requirements for the System.....	23
Table 4.3: Showing Software Requirements for the System	23
Table 4.4: patient	30
Table 4.5: prescription	30
Table 4.6: staff	30
Table 4.7: treatment	30
Table 4.8: users	30
Table 4.9: ward	31

LIST OF FIGURES

Figure 4. 1: Flow chart showing the flow of information at level one by users	23
Figure 4. 2: Activity Diagram	25
Figure 4. 3 :showing the architecture of the proposed system	28
Figure 4. 4: Context diagram showing the system users.....	30
Figure 4. 5: Showing Database Design Showing the Tables their Entities and Relationships	31
Figure 4. 6: Enhanced Entity Relationship Diagram.....	34

ABSTRACT

This is a report of a project study that was carried out at Kansanga Medical Center in Kampala (Kampala District). It is a Computerized Patient Records Management System with an objective of managing and monitoring patients through proper keeping of their medical records. It also sends out alerts and reminders to patient's phones reminding them of things like their next visits to the doctor and also gives doctors a chance to access the system from anywhere at any time using their mobile phones. This solves problems like inefficiency in record keeping and error prone cost distribution among others. To come up with the system, data was collected through interviewing of the doctors, patients and nurses. Questionnaires were also used to identify activities at the Medical center as well as observations. The information collected was analyzed then used to design and implement the system.

The system was developed using HTML language to develop the front end of the program, SQL to create the backend and PHP to connect to the database. It has a database that stores information about the patients and doctors associated with them, nurses, wards among others. On top of that, a mobile module is also included to enable doctors and other system users to update, edit and offer mobile prescription to patients' inquiries and prescriptions via mobile devices configured with the system. This was archived by using Java 2 Micro Edition (J2ME) developed in Net Beans and internetworked by a Global System for Mobile Communication (GSM) as a network framework.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Patient records management is one of the most important area in health centres because without proper records, planning will cause difficulties. Most decisions in hospitals and health units are based on records to know which drugs to stock and which services to prioritize. It is therefore important to give due attention to health records management to ensure that the right information is available at the right time.

In the Global view Computerized Patient Management System has been appreciated most in the developed countries and this explains the reason for the strong business foundation and the competition in the entrepreneurial environment in the world today. Despite the success of computerized management systems in the health sectors in developed countries for example online medication, powerful equipments, many of these systems in the developing countries have failed to match to the standards of those in the developed ones which is explained by poor system analysis, lack of evaluation, resources and capacity.

In Uganda, there is lack of a computerized record system. For example Mulago Hospital has filed based systems which has affected the security and confidentiality of patients' records management and has resulted into delays in clinical cross-checking, fast response to laboratory results and safe drug administration.

The aim of this study was to build a computerized record management system that would be more effective and efficient than the existing file based system at Kansanga Medical Centre. This was done by looking at the existing health records management system, analyzing its strong and weak points design and implementation of a new system.

1.2 Study Background

The current patient monitoring system used at Kansanga Medical Center is a file-based system that was introduced by the hospital management in 1999 when the hospital commenced its operations. With this system, patient's records are kept in their respective individual files. As a patient arrives at the hospital for treatment, a nurse notes his/her credentials that are recorded on paper and enclosed in a file. The patient then takes this file to the doctor who checks out what the nurse has recorded down concerning the patient and then gives out the required medication. This file is given to the patient which then becomes his/her sole responsibility to keep the file well and present it at the hospital the next time he/she reports for any other treatment.

The system has had several challenges like keeping patient records which has been hard since the patients keep their own files and at times these files are misplaced which has caused severe problems like wrong medication and wastage of time trying to locate the missing files, long queues is also formed by patients because the health workers will spend more time looking for information than they spend on caring for the patients which makes patients to wait for a long time. The clinicians also have difficulties to make right decisions leading to prescription mistakes or mistreatment since there is a lot of paper work which is kept in the records centre. Therefore, the project aimed at creating a computerized system that would handle the huge records, quicken the generation of reports, solve issue of long queues, and store huge amount of data more efficiently and effectively needed to replace the current manual system.

1.3 Statement of the Problem

Kansanga Medical Centre generates huge amount of paper work which is difficult to deal with in terms of storage, retrieval, maintenance and sharing among the medical personnel which consume a lot of time looking for information. Duplication of records resulting from multiple registration and misplacement of some of them makes the situation worse which does not favor

generation of reports in time. Some of the patients usually lose their medical form and when they return to the hospital, doctors get difficulties in tracing their disease details.

1.4 Objectives

1.4.1 General Objective

To build a computerizing patient management records system that will replace the current manual records management and track the medical progress of different patients, solve long queues created by patients at Kansanga medical center and send out alerts and reminders to the patients.

1.4.2 Specific Objectives

- To investigate issues related to patient's demographic data, medical history, diagnosis, prescriptions, and treatment.
- To collect and analyze the system requirements that will be used to design the Patient Monitoring system.
- To solve the problem of long queues created by patients on their arrival at the hospital medical treatment.
- To design the Patient Monitoring system that will simulate periodic alerts to patients reminding them when to take their medicine and appointment dates.

1.5 Research Questions

This research was guided by the following questions.

- What is a computerized management information system?
- How does the introduction of a computerized record management affect the health centre?
- Which issues and factors influence the successful integration of a computerized record management in existing work process in hospitals?

- Suppose the existing system was replaced with a computerized one, how would this help to improve health records management?
- What would you expect from the new system (if introduced) as a person going to use it?

1.6 Scope

This research was done at Kansanga Medical Centre in Kampala District to create a computerized patient records management system which could be upgraded to serve other Medical Centre elsewhere. The study will cover the departments that directly deal with clinical services and only medical records will be considered and these include; Patient personal information, Laboratory examinations, Diagnosis, Prescriptions and Treatment, and follow up of the patient. It will have the functionalities like; patient registration by the nurses as they report for treatment, logging in of doctors who will be able to see patients assigned to them and medical records will be considered to the departments that deal with clinical services which include: Patient personal information, Laboratory examinations, Diagnosis, Prescriptions and Treatment, and Follow up of the patient.

1.7 Significance of the Study

- Patients records can be accessed anywhere in the departments of the hospital on a computer screen which has reduced the problem of moving from department to department to get some records.
- Problem of long queues created by patients at hospital can now be reduced since the medical personnel will not waste time look for the patient's information.
- Delay or missing paperwork used to add time to patient hospital stays and could lead to unnecessary or duplicate clinical tests can be solved.
- Lose of medical form by some careless patient can be reduced since all their information will be kept in a computer.

- The project also reduce costs that would have been incurred by the hospital management on hiring different people to record and keep track of patient's details.
- The project helps in cost benefit analysis for other projects on completion of the project other people intending to develop similar or related projects will be able to estimate costs to be incurred.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the rationale of other enthusiastic authors about Management Information Systems and the concepts that entail to it. It lays out a descriptive overview of how these systems have been managed in a broader perspective. It further explains how the management information systems have impacted the health sector both in developed and developing countries all over the world.

2.2 Record Management

According to (ISO, 2001), Records Management is the practice of identifying, classifying, archiving, preserving, and sometimes destroying records.

2.2.1 Information System

According to Loudon, K.C. and Loudon, J.P. (1997) [1], an information system is a set of interrelated components working together to collect, retrieve, process, store, and disseminate information for the purpose of facilitating planning, controlling, coordination, analysis, and decision making in businesses and other organizations. They further look at information systems as a set of people, procedures and resources that collect, transform and disseminate information in an organization.

2.3 Application of Information Management Systems in a health Care on a Global view.

Mogli G.D. (2003) [3] notes that in the growth of scientific medicine, medical records have played an important role as a tool and basis for planning patient care besides medical education, research and legal protection. Having served at the National level as Senior Medical Record Consultant Adviser and visiting World Health Organization Consultant in a number of countries like Kuwait, Saudi Arabia, Bahrain Afghanistan and India, Dr. Mogli wishes to share his

experience and findings with the society. The blueprint for the development of medical records included three phases.

- The first phase surveyed the existing status of medical records.
- The second phase suggested appropriate systems, policies and procedures, trained personnel, and organized the medical record departments.
- The third phase is about the implementation of Electronic Health Records (EHR), education, training, and monitoring.

During these phases, Dr. Mogli undertook the study of importance of medical records and the Problems of Medical Records but there was no clear concept of Medical Record System earlier. In some hospitals Medical Records Departments were so poorly organized, missing patient's records, non-availability of laboratory and radiology reports which resulted into the creation of new records and new investigation orders on each visit by the patient and there was no continuity in patient care. There was repetition of doctor's work like history documentation, physical examination, investigations and prescribing drugs, the hospital patient care services (HPCS) were chaotic with much confusion and duplication of work. While developing the Patient Monitoring System, the most important aspect is meticulous preparation of domain of all functions, classification of diseases lists, alerts, reminders, and clinical decision support systems for quality improvement, have to be incorporated.

Stewart Jackson (2007)[4] Electronic Patient Records Management: House of Commons Health Committee, In England, implementation of Electronic Patient Records (EPR) systems was one of the main aims of the National Programme for Information Technology (NPfIT) which was launched in 2002, building on earlier initiatives. The main plank of the NPfIT programme was the NHS Care Records Service (NCRS) which would create two separate Electronic Patient Records systems: a national Summary Care Record (SCR), containing basic information, and

local Detailed Care Records (DCRs), containing more comprehensive clinical information. NHS Care Records Service will also include a Secondary Uses Service (SUS) which will provide access to aggregated data for management, research and other 'secondary' purposes. Electronic Patient Records systems are being created in various countries like USA, Canada and Australia, as well as in Scotland, Wales and the European Union.

2.4 Application of Information Management Systems in health Care sectors of developing countries.

Gladwin et al. (2003) [5] the health system in developing countries has changed drastically in the last few years from a centralized system with hierarchical reporting system to a decentralized system. Health systems in a centralized system only used to focus on mobility and mortality reporting from individual health units to the district and national level. In developing countries like Tanzania, Malawi, Mali, Australia and Uganda, information systems have been introduced in hospitals in form of health management information systems (HMIS), but with a lack of relevant research carried out in these countries about the introduction and implementation of new technologies like information management/ records management systems in health sectors, there is not much to go by. In countries like Somalia and Sudan, these systems have failed due to the lack of support both from the people and the government. Their governments have failed to fund these health projects that could result into the development of these health management information systems.

2.5 Keys to Successfully Adopting Electronic Health Records (EHR)

According to Scott and Rundall, 2005 [15], in a fund-supported study, find that the keys to successful adoption and implementation of EHR include a participatory selection process, flexibility regarding staff roles and responsibilities, and decisive leadership at critical stages.

EHR systems have great potential to improve health care quality. However, real and perceived barriers from high costs and decreased productivity

2.6 Push for Medical Record Computerization

According to the report from Meghan, 2006 [9], he reported that advocates say electronic medical records could save 140 billion dollars a year in health care expenses on things like file clerks and space for file cabinets while saving tens of thousands of lives also each year by reducing medical errors. When Medical Records management is computerized, there are no rooms full of shelves lined with manila folders stuffed with charts. Instead, patients' insurance, medication, examination, and treatment records are maintained on eight Dell servers stacked in a large closet, (Meghan, 2006) [9]. The technology dramatically reduces the time between a patient's initial consultation with a physician and his receiving treatment allowing physicians to see between 30 to 35 patients a day. Analysts say that the use of EHR significantly reduces redundant and improper treatments, and cuts back on potentially fatal medical errors resulting from incomplete or erroneous information in a patient's medical file.

2.7 The Role of IT in Improving Health care Delivery

There is an opportunity to transform health care and improve patient safety by better leveraging information technology to improve the efficiency, accuracy, and effectiveness of the health care system According to Klein, 2006 [8]. However, adoption has been slow and the results have been mixed up. If deployed incorrectly, without well-conceived process improvements, IT systems can do just the reverse, leading to critical delays or mistakes.

2.8 Data Overload and out dated Technology

According to (Hendee *et al.*, 2006) [6], the 20th Century had a challenge of a deficit of patient information but the 21st Century is faced with a surplus. Compounding matters is the fact that the human brain, even a physician cannot keep up with the exponential growth in medical

knowledge that will occur in forthcoming years. The ability of most humans to memorize things has remained flat but the medical knowledge that needs to be assimilated is increasing at a very high rate. Sub-optimal medical care is often provided to patients because of the failure to access all the data necessary to make the right decision, (Chaiken *et al.*, 2006) [3].

(Bush, 2004) [2] Argues that many Americans die each year from medical errors and many have permanent disability because of inappropriate treatments, mistreatment, or missed treatments in ambulatory settings. All these problems of high costs, uncertain value, medical errors, variable quality, administrative inefficiencies, and poor coordination are closely connected to health information technology as an integral part of medical care. Unlike other industries, medicine still operates primarily with paper-based records. The doctors and nurses have to manage 21st century medical technology and complex medical information with 19th century tools. He reveals that, in the outdated paper-based system, patient's vital medical information is scattered across medical records kept by many different care givers in many different locations - and all of the patient's medical information is often unavailable at the time of care. He believes that innovation in electronic health records and the secure exchange of medical information help transform health care in America by improving health care quality, preventing medical errors, reducing health care costs, improving administrative efficiencies, reducing paperwork, and increasing access to affordable health care.

2.9 Health care Challenges Solved through Networking

According to (Cisco, 2005) [5], managing a clinical environment today involves a large amount of paper. Clinical information stored in paper charts is difficult to access, takes up costly space dedicated to chart storage, and can impact on quality of care. On the other hand, networking can be beneficial as:

1. Connected electronic health records provide effective distribution of information to care givers at the point of care to support higher quality of care with increased efficiency.
2. Care giver productivity and clinical efficiency can be improved by automating common activities, including prescribing, ordering labs, viewing results, and taking clinical notes over a network.
3. Clinicians can access patient charts and medical histories without having to search files or wait for chart pulls. Connected health care applications, including electronic health records, that streamline information and communications at the point of care are critical to health care organizations under pressure to cut costs, increase productivity, and improve patient care.

2.10 Conclusion

Although many scholars have written about computerization of health records as an urgent requirement and a lot of research has been carried out, implementation is still insufficient. However, according to the literature available, there are numerous benefits that accrue from EHR when compared with manual systems. For example there will be no duplication of records, sharing of information is made possible, the problem of missing and / or misplaced records is reduced and the information is available at the point of care. In order to continually improve the quality of healthcare, Uganda's Ministry of Health has put in place a routine reporting system backed up with electronic databases replacing all pre-existing totally paper-based reporting instructions in districts all over the country. This system, called the Health Management Information System (HMIS), is designed to produce relevant and functional information on the health services on a routine basis. It is kicked off at the grass-roots health units and the information gathered is transferred to health sub-districts, then on to the districts and finally to the national level for planning, managing and evaluating healthcare delivery. In other words, from the health unit it goes through the districts and straight to the National Health Databank.

(Weddi, D, 2005)[17]. Despite the efforts by the ministry of health, hospitals remain completely manual with traditional pen and paper records management. It is also seen from the above example that the efforts are only on reporting systems not minding on how these reports are produced and other processes managed. Healthcare IT is a sleeping giant. Although healthcare budgets contribute to the bulk of government spending, healthcare information technology lags far behind other IT businesses including banking, telecommunications and the media. Local and countrywide efforts to implement electronic health record (EHR) systems have been intermittently reported. The common threads, however, that link these efforts and how they contribute to the success, barriers or failure of implementation have not been identified.

(Steve, A. *et al.* 2006) [16]. the researcher decided to build on the literature and efforts available to solution for the problems of the manual system as a way forward. This exploits the benefits of the new technology as they are widely talked about.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the method that was used to achieve the objectives of the study. This describes how data was collected using literature review, interviews, questionnaires and observation and how collected data will be analyzed to aid the system development.

The methods chosen for data collection of this project are combination and quantitative methods which is often the best and most efficient approach of collecting complete information. Qualitative methods are for conducting researches that rely on open ended exploration of people's action, words, thoughts, and intentions. Qualitative methods include observation, focus groups and case studies. The quantitative methods the researcher intends to use are interviews, questionnaires and review of document chosen methods out of the above combination of techniques because of the advantages that each have.

3.2 Data collection techniques

This explains the different methods that were used by the researcher. A number of steps, procedures and tools that will be employed are as shown below:

3.2.1 Questionnaire

Questionnaires are special purpose documents that allows gathering of facts from large number of people while maintaining some control over their responses. The researcher used this method because of its advantages and disadvantages as below;

Advantages of using questionnaire as a fact finding technique.

1. People can complete and return questionnaires at their convenience.
2. Responses can be tabulated and analyzed quickly.
3. Relatively inexpensive way to gather data from a large number of people.

4. People are more likely to provide the real facts as responses can be kept confidential.
5. Can be delivered using different modes like postal service, email and people to people.

Disadvantages of questionnaire

1. Questionnaires may be returned incomplete
2. Cannot observe and analyze the respondent's body language
3. Can be time consuming to prepare questionnaire.
4. Number of respondent may be low possibly 5 – 10 percent (particularly if the postal service or email is used to deliver the questionnaires)

3.2.2 Interview

This is most commonly used and normally most useful fact finding technique used by the researcher to collect information from the individuals face to face. There can be several objectives of using interviewing such as finding out facts, checking facts, generating user interest and feelings of involvement, identifying the requirements and gathering ideas and opinions.

Advantages of using an interview as a fact finding technique

1. Allow interviewer to follow up on interesting comments made by interviewee.
2. Allows the interviewer to adopt or re-word questions during interview.
3. Allows interviewer to observe interviewee's bodily language.
4. Allows interviewee to respond freely and openly to questions.

Disadvantages of interview

1. Very time consuming and costly, and therefore may be impractical.
2. Success is dependent on communication skills of interviewee.

3.2.3 Observation

This technique was used to gather accurate information about how the system actually operates particularly about processes. This technique enabled the researcher to systematically watch and

record the behaviors and characteristics of operations and processes in the hospital. The method gives more detailed and context related information, permits the collection of information, permits tests of the reliability of the responses to the questionnaires, view operations of a program as they are actually occurring, and can adapt to events as they occur

Advantages of observation technique

1. Allows the validity of facts and data to be checked.
2. Observer can see exactly what is being done.
3. Observer can also obtain data describing the physical environment of the task.
4. It is relatively inexpensive

Disadvantages of observation technique

1. People may knowingly or unknowingly perform differently when being observed.
2. Some tasks may not always be performed in the manner in which they are observed.
3. May miss observation tasks involving different levels of difficulty or volume normally experienced during that time period.

3.2.4 Document Review

This tool was used to understand what has been written on the subject matter of capacity building of patient records in Kansanga Medical Centre. A thorough review of the documents was used in the hospital with the intent to study how things are done and discover areas where improvement is necessary. It enabled the researcher to investigate gaps, problems and benefits of the existing system. A number of documents were reviewed including patient charts, registers, tally sheets, periodic reports and lab reports among others. This method will be use because of the following;

1. It is inexpensive because the data is already there
2. It permits examination of trends over the past
3. Doesn't interrupt program or client's routine in program

4. There are few biases about information

From the above available data techniques, the researcher used document reviews to understand what has been written on the subject matter of capacity building of patient records, and observation technique to systematically watch and record the behaviors and characteristics of operations and processes in the hospital.

3.3 Area of study

The study covered the departments that directly deal with clinical services and only medical records was considered and these include; Patient personal information, Laboratory examinations, Diagnosis, Prescriptions and Treatment, and follow up of the patient.

3.4 Research design

The architectural and module design was integrated to make up the system using (UML) Unified Modeling Languages which is an Object Oriented Language. UML clarifies and specifies the workings of the system with the help of the UML standards. The requirements specifications from the requirements analysis was studied to prepare the system design which help in specifying the hardware and software requirements and it defines the overall system architecture.

3.5 Sampling procedures

The researcher used purposive sampling to select key informants (people with deep knowledge under investigation) for example doctors and heads of departments. Simple random sampling will be adopted to select other respondents at the Kansanga Medical Centre.

3.6 Data analysis and Design

3.6.1 Using the Qualitative Data Analysis Tool

Qualitative analysis is the use of non-quantifiable methods to evaluate investment or business opportunities and make decisions. Researcher provides a variety of ways to obtain summary measures for a set of data using qualitative analysis. Many investors also perform quantitative analysis of companies and investments, whereby things such as the company's cost of capital, percentage change in sales over time, or trends in net income as a percentage of sales or other measures are considered. Sound business judgment often involves incorporating both analytical methods, although there is considerable controversy about how much weight each method should receive when making particular business or investment decisions. Basing on the above, the qualitative analysis is the best method for suiting the collected data.

3.6.2 Requirements Specification Document

After data analysis, the requirements were documented into requirements specification which gives a detailed description of what the proposed system will perform. The document also contains the system functional, non functional, interface and user requirements which are the primary input for the design specifications of the proposed system.

3.7 Conclusion

This project report presents the concept of learning objective which sanctions to decompose the educational content into parts: learning objects. Whereas learning object is a small shareable piece of content that can be learned, a learning objective represents knowledge state that can be evaluated through evaluation exercises.

CHAPTER FOUR

SYSTEM DESIGN AND IMPLEMENTATION

4.1 Introduction

This chapter describes and verifies the weaknesses of the existing system at Kansanga Medical Center it also defines the advantages and system requirements of the proposed system.

4.2 System Study

The study was carried out from Kansanga Medical Center Kampala to support the understanding of the current patient monitoring system. The information obtained was used to come up with a suitable system (patient monitoring system) that created awareness and information delivery to the hospital management and the patients

4.2.1 Current System Study

According to the observations made at Kansanga Medical Center Kampala, the current system is a manual file – based system managed by both the nurses and the patients through whom all the information is passed, processed and distributed. The system was introduced by the hospital management in 1999 when the hospital commenced its operations. With this system, patient's records are kept in their respective individual files and automation is limited only to the use of calculators and in cost computations.

As a patient arrives at the hospital for treatment, the nurse notes down his / her credentials which are recorded on paper and enclosed in a file. The patient then takes this file to the doctor who checks out what the nurse has recorded down concerning their status, diagnoses the patient and then gives out the required medication. All the information the doctor gets from the patient is recorded in the patient's file. This file is given to the patient which then becomes his/her sole responsibility to keep it well and present it at the hospital the next time he/she reports for any other treatment.

4.2.2 Weaknesses of the Existing System

- i. The system is prone to errors due to the fact that it is manual throughout. The nurses have to manually capture data from patients and all humans are prone to making mistakes.
- ii. The system also makes tracking and retrieval of information time consuming as the paper archives are many and hard to navigate hence delay in processing of patient details.
- iii. Some patients lose their medical files which makes it hard for the doctor to trace the last medication which was administered to a given patient.
- iv. There are difficulties in registering patients who come in for treatment due to the long queues made as they wait for treatment.
- v. The system is also characterized of poor communication between the hospital management and the patients because patients never get time to talk to the doctors about their problems and inquiries.

4.3. Requirements Analysis

After data collection from the medical center, data was cleaned, ordered and organized. Useful information was extracted from it, identifying and listing functional and non functional requirements was made.

A number of tools were used to analyze the data like needs assessment matrix where people were interviewed, observations made and questionnaires.

Table 4. 1: Showing System Users and their Respective Requirements

System users	Summary	Requirements for each individual
Nurse	This is medical personnel at the hospital whose role is to registers the patient's credentials, carries out early diagnosis and forwards the patient to the doctor for further check up.	<ul style="list-style-type: none"> • Login with username and password • Register all incoming patients to the hospital system. • Perform early diagnosis of the patient's sickness. • Ensuring that a patient is assigned a particular doctor available.
Doctor	The doctor diagnoses the patient and then refers them to the pharmacist for prescription or to the ward for admission depending on the patient's condition.	<ul style="list-style-type: none"> • Login with username and password • Carries out medical checkup of the patient's illness. • Refers the patient to the pharmacist for prescriptions given or to the ward for further medication. • Monitoring of patient's medication.
Patient	A registered patient of the hospital responds to the system notifications received on his/her mobile phone in respect to the medical obligations.	<ul style="list-style-type: none"> • Register with the hospital management. • Respect the medical guidelines streamlined by the doctor • Respond to the notifications sent by the hospital management.
Pharmacist	This is a medical staff whose role is to ensure that the patient receives the right prescriptions given by the doctor.	<ul style="list-style-type: none"> • Login with username and password. • Administers the patient with the right prescriptions from the doctor

4.3.1 Functional requirements

Functional requirements included the functionality or services the system was expected to provide to its end users.

- (i) The system should effectively allow Storage of all the relevant information about patients, and the hospital management.
- (ii) The system should also allow enable patient registration
- iii) The patient monitoring system should enable patient monitoring,
- iv) The system should send out notifications to the patients.
- (v) The patient monitoring system should be accessible by the doctors using their mobile phone

4.3.2 Non-Functional Requirements

These are not directly concerned with specific functions delivered by the system. They pertain to system properties such as: reliability, accuracy to mention but a few. The following are the non-functional requirements:

- i. User-friendly; the system should support users in terms of simplicity. This refers to the ability to use the system with ease
- ii. Security; the system should measure to a high security to prevent unauthorized users from accessing or corrupting the database or system Access to the patient monitoring system profiles should be by authorized users only
- iii. Interoperability; The ability of the system or its components to interface or work with other systems or products.
- iv. Maintainability; The ease with which a system malfunction can be rectified
- v. The system should be routinely maintained and updated to ensure smooth running of activities.
- vi. There should be a disaster recovery plan in place to ensure that the system returns to full function without data loss after in case of a disaster.

- ii. The system should be able to operate on different platforms and perform as expected.
- ii. The system should be available at all times for the users.

4.2.3 Flow chart showing the flow of information at the Patient Monitoring System login

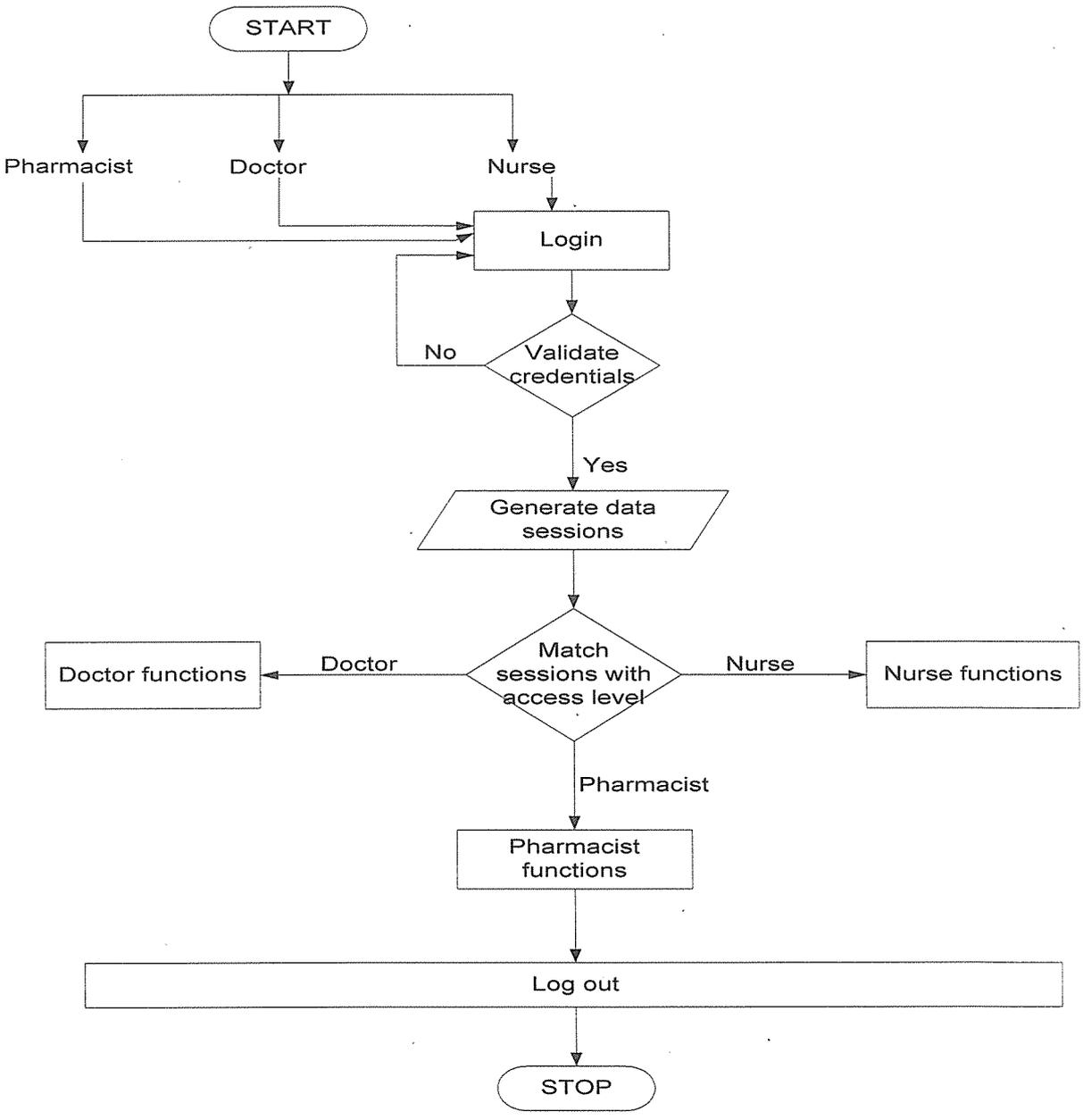


Figure 4.1: Flow chart showing the flow of information at the Patient Monitoring System login

4.4 System Specification

In order for the system to perform as expected, these were the specifications for hardware and software.

Table 4.2: Showing Hardware Requirements for the System

Hardware	Minimum System Requirements
Processor	Intel Pentium III or Higher for desktops
Memory	512 MB of RAM or higher
Hard Drive space	5GB Hard disk space
Monitor display	1024 × 768 High color-32 bit Recommended

Table 4.3: Showing Software Requirements for the System

Software	Minimum System Requirements
Operating System	Windows 7, 2000, Xp, and Vista
Server	Apache Web Server PHP 5.2 Mysql 5.0 FTP
Web Browser	Mozilla Firefox 3.5 or higher, Internet Explorer 6,

4.5 System Design

This involved how the functions of the Patient Monitoring System could be realized. This was through the use of system design tools such as: DFDs, EERDs that could be used in the development of the system and its database respectively.

4.5.1 Patient Monitoring System Activity Diagram

To come up with user interaction of the Patient Monitoring System layout, diagrams were used to show how different system users interact with the system to perform different activities as shown below.

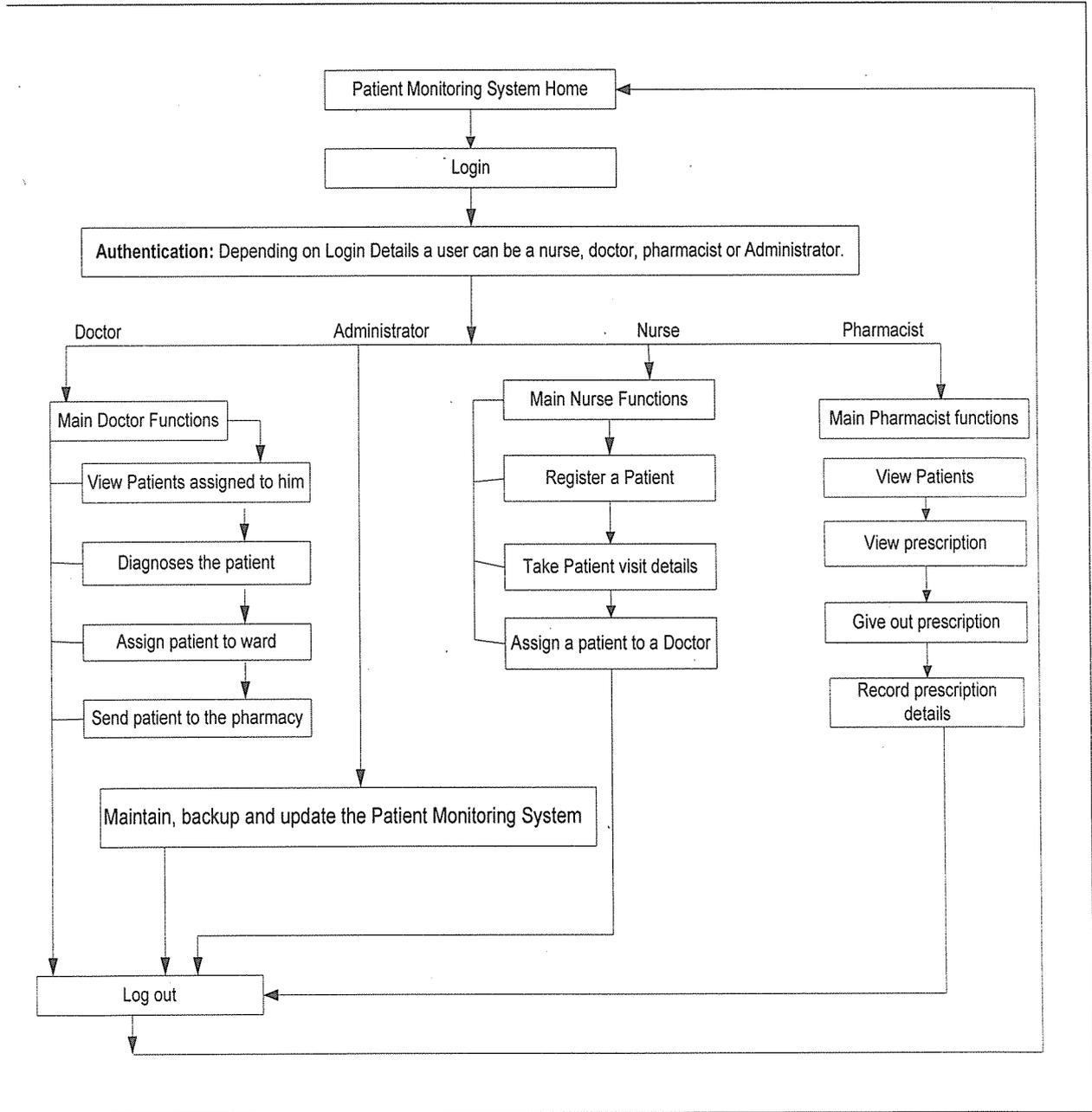


Figure 4.2: Activity Diagram

4.6 The Proposed System

The Patient Monitoring System was designed according to the requirements determined by examining the user needs based on observations, questionnaires, which were used at Kansanga Medical Center and study of similar information management systems. The study came up with such a system to solve the problems of the old system by capturing patient details and managing them as required in a centralized location (database) characterized by high security and confidentiality.

When the system is initiated, a home page is displayed with a registration form where the nurse logs in using the username and the password assigned by the administrator for authentication. When the nurse has logged in, she registers the patient's credentials after which she then registers the patient visit details including early diagnosis. A patient is automatically assigned a unique ID by the system that will always be used for tracking his / her medical records. The nurse finally assigns the patient to the doctor available.

A doctor views the patients assigned to him for treatment, diagnosis is done together with prescription and the patient is either referred to the pharmacist to get the medicine or to the ward for admission or the patient can be seen off depending on the sickness.

When logged in, the pharmacist can see the patients sent to him with their respective details, he can see the prescriptions noted by the doctor and then gives out the required medicine to the patient and also records the prescription details like, the medicine is "not taken" if not available, "partially taken" if given in bits and "fully taken". The administrator is responsible for updating staff information, registration of staff and wards

4.6.1 Strengths of the System

- It is effective in terms of record management since all the information captured by the system is stored in a database which is more secure and free from records misplacement. This also provides controlled access to staff and patient's records.

- It is cost effective since it requires less stationery as manual files to be filled are replaced with an automated computer application system and costs that would have been incurred buying more stationary are solved.
- The system has given the organization information confidentiality, integrity and availability. This is achieved through the security setup, data input validation and the fact that it is accessed by doctors on their mobile phones to access information on the system from anywhere at the time of their convenience without using their credit.

4.7 System Architecture of the Proposed System

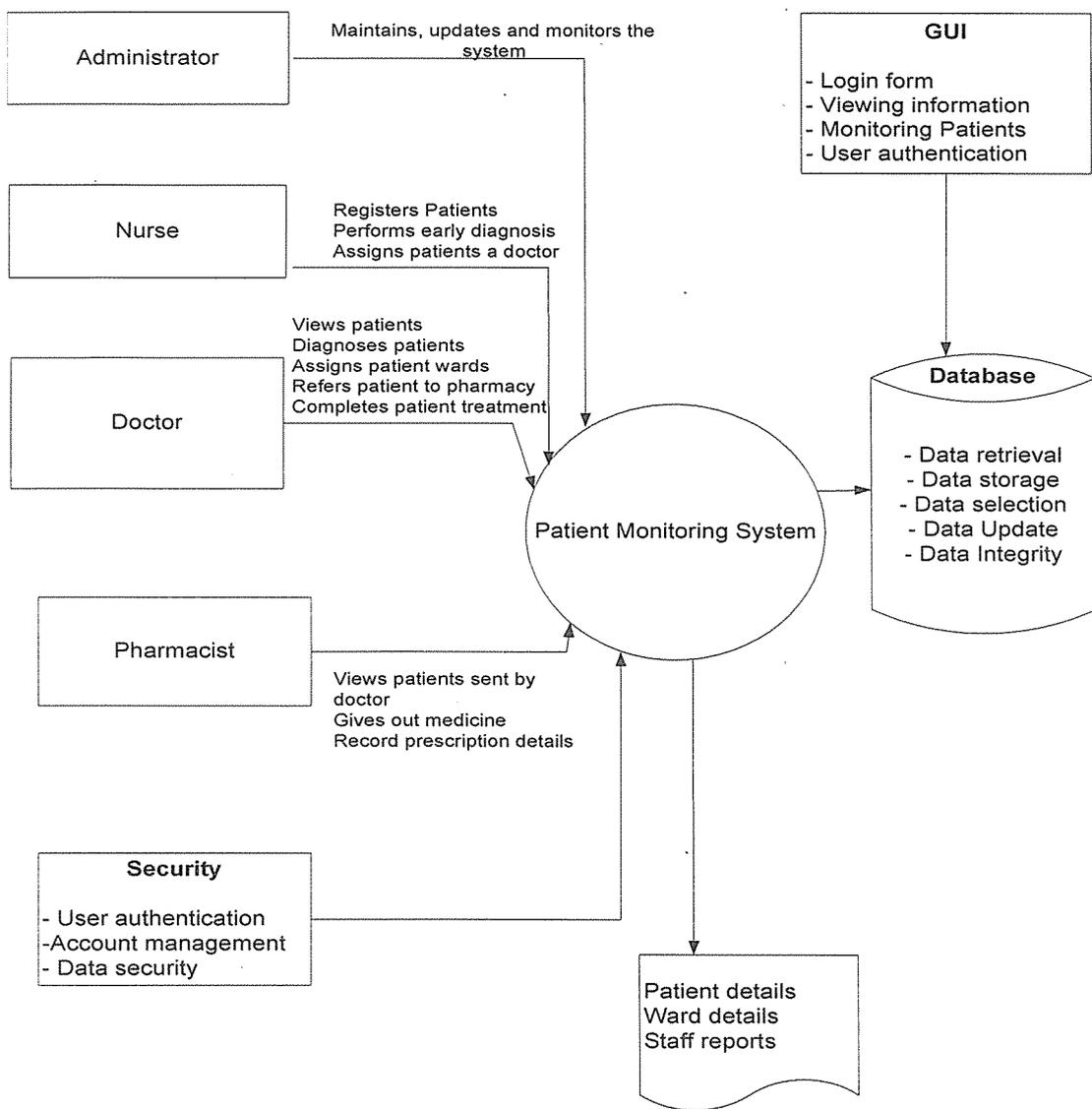


Figure 4.3: Showing the architecture of the proposed system

The system architecture gives an outlay of the overall patient monitoring system. The administrator maintains updates and monitors the system. The nurse registers patients, performs early diagnosis and assigns a patient to a doctor. The doctor diagnoses the patients assigns them either to the ward or the pharmacy and can also complete the patient’s treatment. The pharmacist views the patient sent by the doctor, gives out medicine and records prescription details of the

patient. The security of the system implements user authentication, account management, data security and integration. The system comprises of a database as the major storage system which performs data retrieval, data storage, data selection, data updating and data integrity.

4.8 Process Modeling

4.8.1 Data Flow Diagrams (DFDs)

Data flow Diagrams were used to examine inputs, outputs and processes of the Patient Monitoring System. They show how data moves or changes through a specified sequence using a graphical top-down fashion that represents system components, processes and interfaces.

4.8.2 Context Diagram

This is the highest level DFD that defines the scope of the system and provides an “outward” looking view from the system, shows system boundaries and interaction with external entities. It shows the other systems or groups of people that interact with the system and the main flows of data. It has data flows, external entities, one process (the system in focus), and has no data stores as shown bellow.

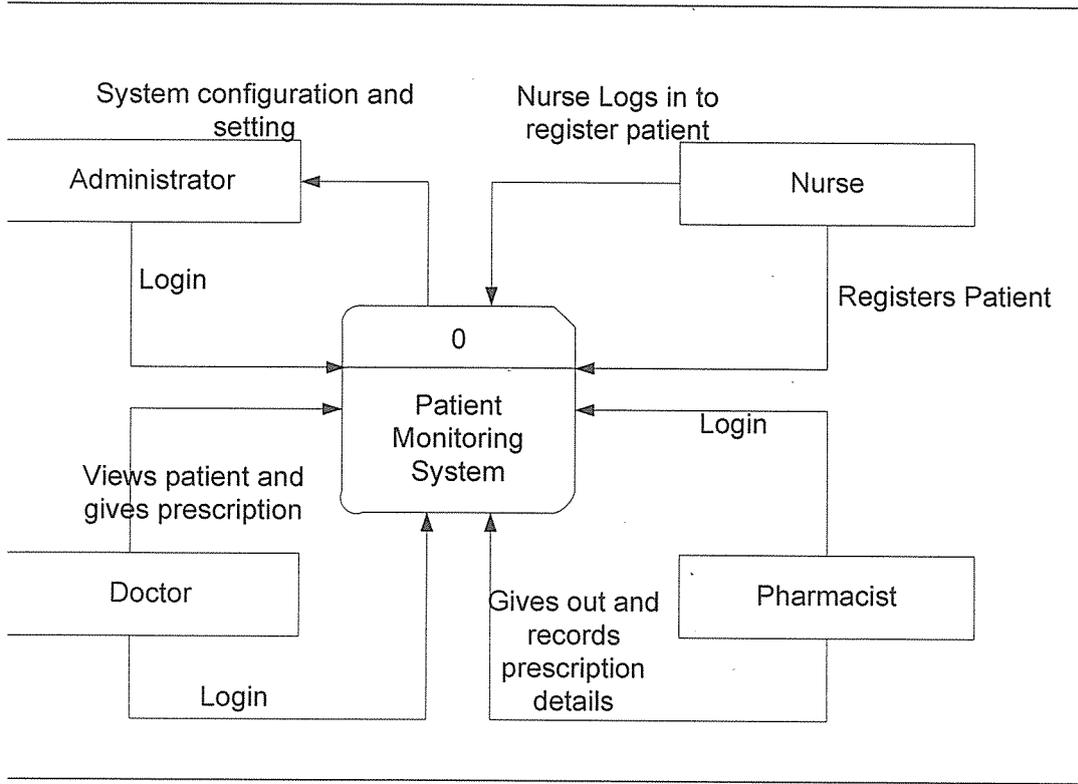


Figure 4.4: Context diagram showing the system users

- External entities: Nurse, Doctor, Pharmacist and System administrator
- Process: Patient Monitoring System

1.9 Data Modeling

1.9.1 Enhanced Entity Relationship Modeling Concepts

Database Design Showing the Tables their Entities and Relationships

Table 4.4: patient

Field	Type	Null	Key	Default	Extra
id	int(10)	NO	PRI		
fname	varchar(15)	NO			
lname	varchar(15)	NO			
dob	varchar(15)	NO			
birth	varchar(15)	NO			
nat	varchar(15)	NO			
gender	varchar(10)	NO			
residence	varchar(20)	NO			
occ	varchar(30)	NO			
box	varchar(10)	NO			
tel	varchar(15)	NO			
kname	varchar(30)	NO			
ktel	varchar(15)	NO			
rln	varchar(30)	NO			
info	varchar(50)	NO			
regby	varchar(22)	NO			

Table 4.5: prescription

Field	Type	Null	Key	Default	Extra
prec_id	int(20)	NO	PRI	NULL	auto_increment
fname	varchar(20)	NO			
lname	varchar(20)	NO			
prec	varchar(50)	NO			
date	datetime	NO			
patid	int(20)	NO			

Table 4.6: staff

Field	Type	Null	Key	Default	Extra
id	int(10)	NO	PRI		
fname	varchar(15)	NO			
lname	varchar(15)	NO			
grade	varchar(10)	NO			
other	varchar(15)	NO			
dob	varchar(15)	NO			
birth	varchar(15)	NO			
nat	varchar(15)	NO			
gender	varchar(10)	NO			
residence	varchar(20)	NO			
qualification	varchar(30)	NO			
employment	varchar(15)	NO			
box	varchar(10)	NO			
tel	varchar(15)	NO			
nname	varchar(30)	NO			
ntel	varchar(15)	NO			
info	varchar(50)	NO			
regby	varchar(22)	NO			

Table 4.7: treatment

Field	Type	Null	Key	Default	Extra
id	varchar(10)	NO			
temp	varchar(5)	NO			
pre	varchar(5)	NO			
dia	varchar(50)	NO			
other	varchar(50)	NO			
regby	varchar(25)	NO			
regtime	varchar(25)	NO			
docdia	varchar(50)	NO			
docother	varchar(50)	NO			
doc	varchar(25)	NO			
presc	varchar(50)	NO			
dispensor	varchar(25)	NO			
dcomment	varchar(30)	NO			
status	varchar(20)	NO			
visitid	varchar(20)	NO			
ward	varchar(10)	NO			

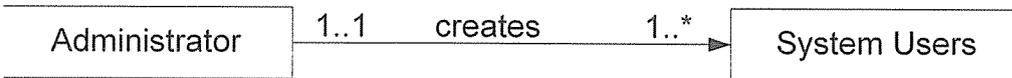
Table 4.8: users

Field	Type	Null	Key	Default	Extra
name	varchar(25)	NO	PRI		
id	varchar(10)	NO			
password	varchar(10)	NO			
grade	varchar(15)	NO			
log	varchar(25)	NO			
logout	varchar(25)	NO			
status	varchar(15)	NO			
regby	varchar(20)	NO			

Table 4.9: ward

Field	Type	Null	Key	Default	Extra
id	varchar(10)	NO	PRI		
wname	varchar(25)	NO			
capacity	varchar(25)	NO			
grade	varchar(25)	NO			
sup	varchar(25)	NO			
regby	varchar(25)	NO			
regt	varchar(25)	NO			

4.9.2 Relationship Modeling



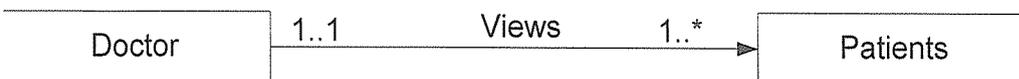
An Administrator creates one to many system users and system users are created by one and only one administrator.



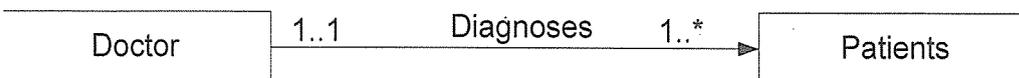
A Nurse registers one to many patients and patients can be registered by one and only one nurse.



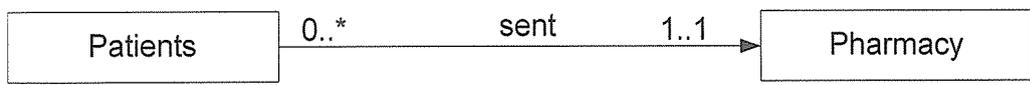
A Nurse assigns a doctor one to many patients and patients can be assigned to a doctor by one or many nurses.



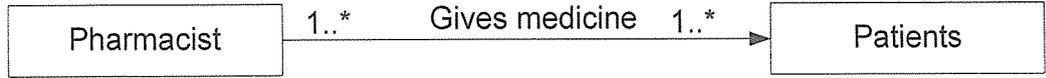
A Doctor views one to many patients and patients can be viewed by one and only one doctor.



A Doctor diagnoses one to many patients and patients can be diagnosed by one and only one doctor.



Patients are sent to one and only one pharmacy and a pharmacy can receive zero to many patients.



A pharmacist gives medicine to one or many patients and patients can be given medicine by one to many pharmacists.

Figure 4.5: Showing Database Design Showing the Tables their Entities and Relationships

4.9.3 Enhanced Entity Relationship Modeling

Below are tables in the database showing their relationships and cardinalities

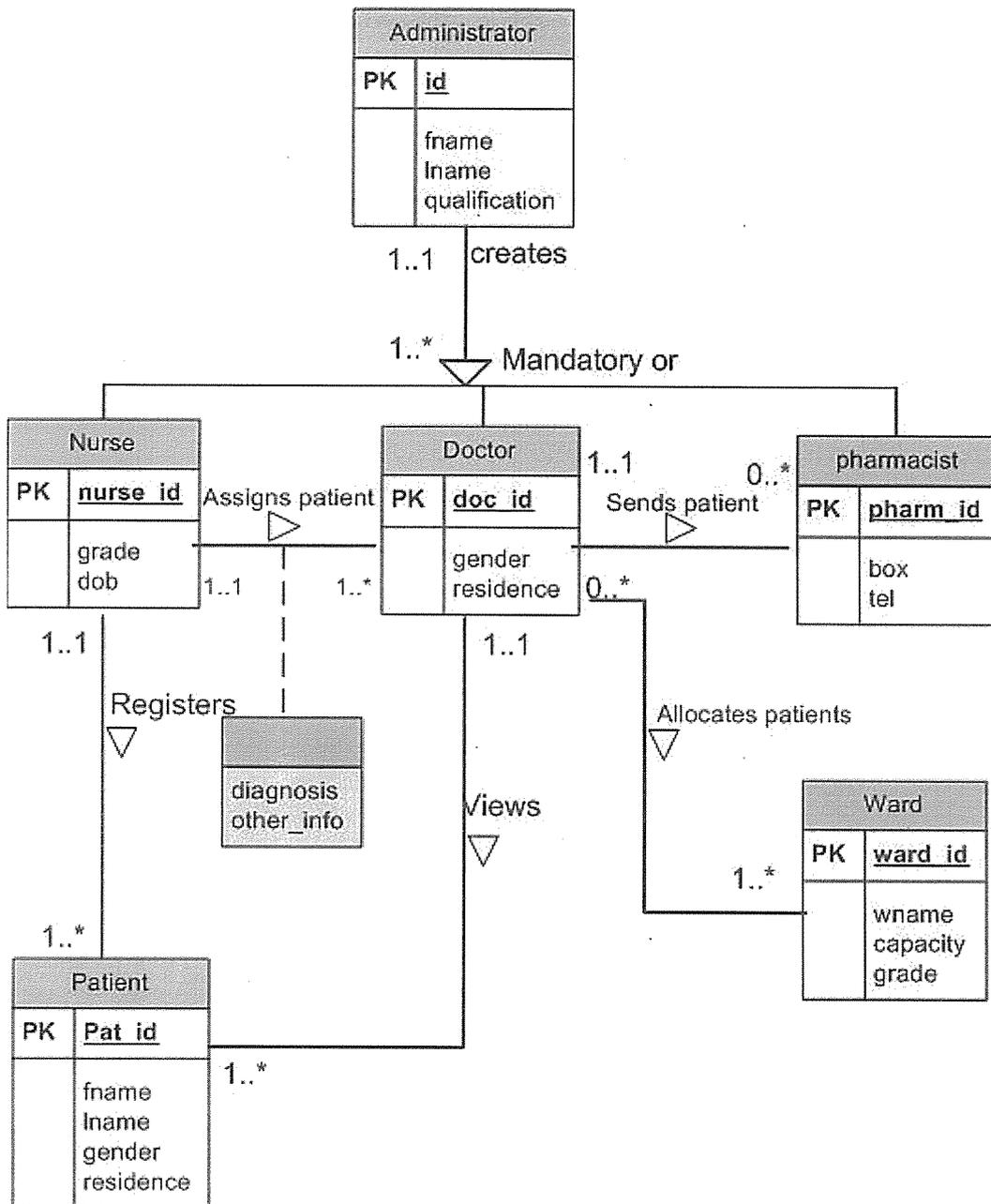


Figure 4.6: Enhanced Entity Relationship Diagram

1.10 System Implementation

1.10.1 Implementation Tools

We used Macromedia Dream Weaver, Java 2 Micro Edition (J2ME) and Wamp Server to implement the Patient Monitoring system.

Macromedia Dream Weaver was used as the editor because it has got development languages such as HTML (Hypertext Markup Language) as the editor for creating dynamic and interactive web pages, PHP for connecting the system interfaces to the database, JavaScript for validating the system web pages and CSS for modifying the appearance of the font and web pages.

Also, Adobe photo shop CS3 provided us with the environment for creating banners and customized images for the system.

On the other hand, the Wamp Server has the MySQL component that enabled us to create the system databases and tables that provided the platform from which the system information is stored.

The Macromedia Dream Weaver development software is a suite of development tools designed to aid system developers face complex challenges and create innovative solutions. The role of Macromedia Dream Weaver is to improve the process of development and make the work of achieving breakthroughs easier and more satisfying. The Macromedia Dream Weaver branded tools continually deliver better ways for system developers to do more with less energy wasted on repetition and drudgery. From efficient code editors, IntelliSense, Wizards, and multiple coding languages in one Integrated Development Environment (IDE) to high-end Application Life-cycle Management (ALM) products in Macromedia Dream Weaver software development system.

Macromedia Dream Weaver also offered us a choice of tools for all phases of software development that is to say system development, testing, deployment, integration, and management. It is also engineered to support development across all types of devices like Personal Computers, Servers and the Web.

Macromedia Dream Weaver is engineered and tested to being consistently dependable, secure, interoperable, and compatible. Macromedia Dream Weaver components offer an unmatched combination of security features, scalability, and interoperability. It is also designed to ensure backward-compatibility wherever possible. The Wamp Server was also used and it is a relational database management system (RDBMS) whose primary query language is MySQL.

Wamp Server (MySQL) supports different data types, including primary types such as Integer, Float, Decimal, Char (including character strings), Varchar (variable length character strings), Binary (for unstructured blobs of data), Text (for textual data) among others.

4.11 Testing and Validation

4.11.1 Testing

All components of the system were tested to ensure proper functionality. They were then integrated to form a fully functional system.

1 Unit Testing

This is a method where individual units of source code are tested to determine if they are fit for use. A unit is a smallest testable part of an application. The system was tested unit by unit to aid the programmer to isolate each part of the program to show that individual parts are correct.

2 Integration Testing

The various components of the system were meaningfully manipulated .This tested the functionality of the system as a whole.

3 Component Testing this included testing of defined individual component systems which among are the following:-

4 Data Analysis the data collected was quantitative data that was in its factual and final state.

5 Reports data was entered into the system and reports were generated from the data available in the database.

5 User Management under this, the nurse was able to register a patient into the system, the system administrator was able to create and manage system user accounts by updating or deleting from the system, managing existing patient records by updating the records or deleting them from the system.

7 Security Testing, We used incorrect usernames and password which did not exist in database to access the system but all attempts were unsuccessful meaning our authentication procedure was perfected.

8 System Testing

This is testing software or hardware conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. This testing falls within the scope of black box testing and should require no knowledge of the inner design of the code or logic. System testing was performed on the entire system in context of the functional requirements and system requirements.

System testing was carried out to ensure that the client cannot submit empty fields especially those that are mandatory. This was carried out by leaving certain fields empty to see whether the system can send an alert message.

4.11.2 Validation

This was done to ensure that data fed into the system satisfied the pre-determined formats and complied with stated length and character requirements including other defined input criteria. For example a field that requires a date should not allow letters. For accurate validation, sample data was fed into the system to find out if the system was be able to respond correctly to the test data fed into the application, that is if it is correct or incorrect data. Different people were left to interact with the system to find out its validity and the system was found to be valid.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the project, identifying what was achieved. It also recommends areas that need further attention and draws conclusions for the project findings

5.2 Summary

The researchers managed to achieve the objectives of the project.

The researchers developed a patient monitoring system. The system allows users to register patients, diagnose them, offer treatment and keep track of their medical details. The Patient Monitoring System was designed according to the requirements determined by examining the user needs based on literature, observations and questionnaires which were given to some hospital personnel for answering. The Patient Monitoring System runs on an easy to use interface which is provided by HTML, CSS and PHP with MySQL Database. Java 2 Micro Edition (J2ME) that was used to come up with a mobile application that can help the doctor to access the system on his phone through the GSM technology.

5.3 Problems / Constraints Encountered

During the study the researcher encountered a number of problems which to some extent seemed to stand in the way of success of the study. These among others include:

5.3.1. Financial constraints:

The study being a self sponsored venture, the researcher would sometimes face problems to finance some of the activities involved in the study. However, through hard and thin, it has come to an end successfully.

5.3.2. Time constraints:

The time allocated to the study looked not friendly given that the same period involved the class work where there are a lot of course works, tests and lectures.

5.3.3. Busy schedules:

The people working with current system were most of the time busy and this made the work of the researcher difficult especially during data collection. Nevertheless, they proved very cooperative despite their busy schedule which made the successful at the end of the day.

5.3.4. Fear for retrenchment:

Some of the staff members at the hospital, especially the records staff, feared for their jobs with the introduction of the computerized system. They expressed fear that they would be left with no work and risk being retrenched.

5.3.5. Power problem:

Throughout the whole study, electric power was never on the researcher's side. It would go off at critical times and this hindered smooth progress and planning was made difficult

5.4 Recommendations

The researcher recommends further work to be done in order to improve on the functionality of the system designed. Any further improvements should be done in the areas recognized below.

5.4.1 Train both staff and users on how to use the mobile phone application

There are multiple challenges brought about by new technologies that both hospital staff and users should be equipped with new skills and competencies through training or retraining to be able to effectively operate and undertake projects in electronic environment. This will enable Kansanga Medical Center to digitize its collections.

5.4.2 Ensure timely sending of notifications to patients.

This is one of the major reasons of creating this system so consistency is paramount in meeting the expectation of the designers

5.4.3 Expand on the hospital premises.

Expansion on the hospital premises will help them create more space for computers and other hardware.

5.5 Conclusion

Basing on the findings, it was established that Kansanga medical center has a lot to offer. Regarding ICT's Kansanga medical center has no ICT's thus no effectively support for both users and the hospital staff in rendering effective services. This implies that automation is lacking and there is need for a patients monitoring system that needs to be put in place since it was established that Kansanga medical center is not a digital hospital because everything is done manually. Thus the hospital should adopt the suggested strategies for the success of digitization so as to enjoy its various advantages

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Appendices

APPENDIX I: DATA COLLECTION TOOL (QUESTIONNAIRE)

I am Okot Samuel conducting an academic research which is one of the requirements that will lead to the award of a Diploma in Computer Science of Kampala International University. I therefore request for your utmost cooperation in this exercise. I assure you that this study is bound by research ethics, so your responses will be treated with maximum confidentiality and will be used for academic use only. Thus, you can freely share your experiences and knowledge in this insightful research. Thank you!

1. What is your name?

.....

2. Sex/Gender

.....

3. What is your level of Education?

.....

4. What is your profession?

.....

5. What is your department?

.....

6. In your opinion, what is the average percentage of hospitalised patients who will develop a health care-associated infection (between 0 and 100%)?

.....

7. How many patients do you see daily?

.....

8. What role do you play in the health records management?

.....
.....

9. Why is a hospital records management programme important?

.....
.....

10. How do you find the existing system (file based) of health records management?

.....
.....

11. Who is managing the existing system?

.....
.....

12. What problems do you face with the existing system?

.....
.....

13. Do you recommend to continue with the existing system, if yes why?

.....
.....

14. Have you ever been in a situation where you have needed to prove that the existing system is important? If yes, can u describe the situation?

.....
.....

15. Are you computer literate?

.....
.....

16. How do you feel when the new system is introduced?

.....
.....

17. Have you used any kind of electronic system that creates records? (For example, project management systems, compliance systems, E-mail, personnel management systems, electronic patient records systems, etc.)

.....
.....

18. How long have you used such systems?

.....
.....

19. Suppose the existing system was replaced with a computerized one, how would this help to improve health records management?

.....
.....

20. Who should have access to the new system?

.....
.....

21. Who is going to be responsible for managing the new system?

.....
.....

22. What would you expect from the new system (if introduced) as a person going to use it?

.....
.....

23. When you work with records, which format do you trust most and why?

.....
.....

24. What will be the perceived usefulness of computerized system with regard to the quality of care, cost effectiveness and work circumstances of nursing staff?

.....
.....

25. May I contact you again for future information?

.....
.....

Thank you for your co-operation!