Addis Ababa University

School of Information Science

And

School of Public Health

M.Sc in Health Informatics program

Design and Develop a Web Based Pharmacy Management System for

ALERT Hospital

By;-

Tadesse Mazengia

January, 2017

Addis Ababa, Ethiopia

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A project Paper submitted to the school of Graduate Studies of Addis Ababa University in partial fulfillment of the Requirements for the Degree of Masters of Science in Health Informatics.

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Name and Signature of the members of the examining board:

1. _____   _____

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          Advisor   **Signature**

3. _____   _____

          Examiner   **Signature**

4. _____   _____

          Examiner   **Signature**

Contents

Dedication

I dedicate this project work to the almighty God - who assisted me to begin and finish the long journey and my family_ for their limitless support.

Acknowledgments

List of Figures

List of Tables

List of Abbreviations and Acronyms

AAU - Addis Ababa University

AHRI - Armauer Hansen Research Institute

ALERT - All Africa leprosy TB, Rehabilitation Training

ART - Anti Retroviral Treatment

CEO - Chief Executive Officer

CPOE - Computerized physician order entry

CSA - Central Statistics Agency

DFD - Data Flow Diagram

DHIS - Development Health Information System

DIS - Drug Information System

DSS - Decision Support System

DS - Design Science

EMAR - Electronic Medical Administration Record

ER - Entity Relation

FDA - Food and Administration Agency

FMOH - Federal Ministry of Health

GUI - Graphical User Interface

HIV - Human Immune Virus

HCMIS - Health Commodity Management Information System

HTMLL - Hyper Text Markup Language

ICT - Information and Communications Technology

IT – Information Technology

IFRRF - Internal Facility Requisition Report Form

IPLS - Integrated Pharmaceutical Logistic System

LHSC - London Health Science Center

MIS - Management Information System

MVC – Model View & Control

NDOH - The National Department of Health

NGO - Non-Governmental Organization

OAS - Office Automated System

OOA - Object Oriented Analysis

OOD - Object Oriented Design

OOP - Object Oriented Programming

PDIS - Pharmacy Drug Inventory System

PEPFAR – President's Emergency Plan for AIDS Relief

PFSA - Pharmaceutical Fund and Supply Agency

PIS - Pharmacy Inventory System

PMIS - Pharmacy Management Information System

RRF - Report Requisition Form

SOMC - The Southern Ohio Medical Center

SQL - Structure Query Language

Summary

Pharmacy management System in developing countries lags seriously behind as we compared to the developed countries and the existing pharmacy drug management system is not enough to support pharmacy management functions. This project give more emphasize on pharmacy management system which involve activities like drug registration drug dispensing and expired drugs in pdf format. The researcher used interview, document review and observation for data collection and fact finding. The participant of the project was pharmacists and druggist who are working at the pharmacy.

The researcher also used tools for developing the system like Microsoft Visio, MySQL, ASP.Net and Model View and Controller (MVC). The project is aimed at designing and developing pharmacy management system. The major aim is in improving accuracy and enhances safety and efficiency in the pharmacy. It is obvious that management is one of the most important characteristics of all forms. Patient centered pharmacy management system promotes rational use of medication and has paramount importance in a resource limited setting. The project revealed that well organized pharmacy management system within the hospital leads to well documented and improved optimization of medication use. This system improves the hospital pharmacy management system by adding some features like:

- ➢ The user of the system can easily access.
- ➢ Patient safety will be improved with the automation of drug dispensing.
- ➢ Patient experience is enhanced as the automation of the labor intensive tasks reduces their waiting time.
- ➢ For health care institution it reduces cost and improves efficiency.
- ➢ It improves hospital safety by reducing the potential for medication errors.

CHAPTER ONE

1.1 Introduction

Now a day's information and communication technology ICT plays a great role in different fields or areas among thus health care system belongs to this. This leads to various studies and researches being conducted to selected health care facilities. It is necessary to ensure a technologically appropriate equitable affordable efficient and environmentally adaptable and consumer friendly system designed to fully utilize the ICT for the maximum benefit in the health care industry.

Here computers have great relevant on storing data's securely and ease access on them on short period of time.

In order to exploit the ICT in health care system pharmacy management system is being build. Pharmacy management system is robust, integrated technology. Pharmacy management system deals with the maintenance of drugs and consumables in the pharmacy unit. The setup of this pharmacy management system will ensure availability of sufficient quantity of drugs and consumable materials for the patient this will enhance the efficiency of clinical work and ease patient's convenience, bearing in mind that in Ethiopia is heading towards pharmaceutical care of patients. In addition, pharmacy management system will be able to process drug prescription with ease pharmacy management system (PMS).

In general, the pharmacy management system is based on computer technology that gives services for users managed by the pharmacist who give implementation of function relatively in effect times as well as will design for removing time wastage , saving resources easy data access of the medicine, security on data input and data access by removing almost manual based system.

Pharmacy management system is a management system that is designed to improve accuracy and to enhance safety and efficiency in the pharmaceutical store. It is a computer based system which helps the pharmacist to improve inventory management, cost, medical safety etc. the system allows the user to enter a manufacturing and expiry date for a particular product or drug during opening stock and sales transaction. The system will also give report showing the list of products expiry after a specified date before the product finally expires. It also involves manual entry upon arrival of new batches of drugs and upon drug movement out of the pharmacy for certain period, e.g. every month, the pharmacist may want to generate report for the movement of drugs in and out of the pharmacy, getting information about the drugs e.g. expiry date, number of drug types left, location of drugs in

the pharmacy. At present, manual system is being utilized in the pharmacy. It requires the pharmacist to manually monitor each drug that is available in the pharmacy. This is usually leads to mistakes as the workload of the pharmacist increases (Godano B et al. 2015).

1.2 Statement of the Problem

The manual-based Pharmacy management system (PMS) has kept paper record in filing cabinets. Managing a very large pharmacy with records on papers will be tedious and difficult to keep track of inventories with regards to the drugs in the store, expiry date, quantity of drugs available based on the categories and their functions. The pharmacist has to order drugs to replenish the already diminishing stock. In addition, ordering of drugs is being carried out manually. Significant amount of time is allocated for writing the order as the pharmacist needs to go through the stock balance and make rough estimate of the amount to order based on Figures. Drugs are not supposed to be used after they have expired.

Managing stocks of medicines using manual systems requires inordinate amounts of time and effort, which is problematic given chronic staff shortages in many health facilities, especially at primary health care levels. Additionally, ensuring key pieces of data are available, accurate, and up to-date is crucial for forecasting future medicines needs, monitoring current stock on hand, and making informed managerial decisions. Yet, all of these are difficult to manage with a paper-based tracking system. Effective pharmaceutical stock management is essential to avoid the negative effects of both stock-outs of medicines and medicines waste due to expiry. Paper- based systems have traditionally been used to manage storing and dispensing processes. Many facilities rely on stock cards which can be filled out incorrectly or not updated regularly and result in faulty information on stock movement and inventory control (WHO, 2012)

ALERT hospital pharmacy relies on manual process to determine drug management decisions. As can be expected, visual inspections and handwritten notes can lead to costly overstock and buying emergencies - preventable problems that could negatively impact staff productivity and patient experience.

Currently ALERT Hospital pharmacist's document and deliver care using paper records. However, there are lots of problems with the paper based dispensary reporting as obtained from

the observations and interviews of the pharmacy staff and data clerks of the departments in the hospital. Some of the problems identified by the researcher are: if the pharmacy department wanted to send report to Medical director, CEO and Audit Service they always refer the log book where they jot down each prescription record all drug information manually and count them all. Illegible handwriting in retrieving about the prescriptions and related drug information from the log book is also another challenge.

Currently, the hospital pharmacy is using paper based drug dispensing, report generating, and patient record. The other problem in this hospital pharmacy is data confidentiality and security, therefore it is hoped that designing and developing Pharmacy Management System (PMS) can resolve most of the above mentioned problems and improves the quality of health service delivery as well as customer satisfaction.

1.3 Significance of the Project

The purpose of this project is to design and develop PMS in ALERT Hospital. Designing this system could have the following significances.

For patients:

Since the main goal of the hospital is to give quality service for patients, patients should be benefited from the system by getting quality services which includes good documentation of their records.

For health professionals:

 The PMS system may have a better significance for health professionals by solving the problem of illegible hand writing in records and prescriptions. It would also help the health professionals from jotting the prescription down on the log book and availing for pharmacists from counting from the log book for reporting.

For the hospital:

The PMS could have a benefit for the hospital for giving a better health care service, for adequate planning and budgeting, for keeping adequate records, for prescription of drug and service reporting purposes as a source of relevant information. Examining the role of new technology in pharmacy: now and in the future (2017, 8 February). Retrieved from http://www.pharmaceutical-journal.com/examining-the-role-of-new-technology-in-pharmacy-now-and-in-the-future/11134174.article

1.4 Project Scope and Limitations

The scope of this PMS project was to design and develop PMS for ALERT hospital pharmacy department which will provide dispensary report, alert message to remind for the expiry date of each drug, automated process to manipulate data such as add, delete and searching record and alert message to remind for the critical quantity of each drug.

1.5. Objectives of the project

1.5.1 General objective

The general objective of this project was to design and develop a web based pharmacy management system for ALERT

1.5.2 Specific objective

- ➢ To collect requirement for the PMS system
- ➢ To analyze the requirement for the PMS system
- ➢ To design and develop the PMS system
- ➢ To design user interface prototyping of the PMS system

CHAPTER TWO

Literature Review

In the present study, mobile phones were used for pharmaceutical care, and pharmacists were able to provide patients with medication guidance by text message. This allowed pharmacists to extend their reach to patients who had been discharged; patients felt that through the improved access to pharmaceutical care they became more closely linked to the pharmacists. Compared with face-to-face guidance about medications, patients found that the mobile phone-based system allowed them to review and remember the guidance more clearly. In our hospital, the pharmacists have a heavy workload: nearly 9000 prescriptions need to be dispensed each day. (Mao, Y. Yantao, Z. and Suodi, Z. 2008).

The National Department of Health (NDOH) in South Africa has recognized RxSolution as a critical component of the national pharmaceutical management information system by endorsing it as the recommended tool for dispensing medications. As a result of increased demand for RxSolution,driven by the NDOH's recommendation, SIAPS is embarking on a stakeholder engagement process with PEPFAR, the NDOH, and provincial-level partners to expand its use.(An Electronic Inventory And Patient Management Tool Improves Access To And Rational Use Of Medicines (2015). Retrieved from: [www.siapsprogram.org/electronic-inventory-and -](www.siapsprogram.org/electronic-inventory-and-) patient-management-tool-improves- access.)

In addition to South Africa, RxSolution is being used in Lesotho, Namibia, Swaziland, Haiti, and Uganda. In Lesotho, RxSolution is functional at 13 hospitals and at the national pharmaceutical supply agency, where ART and laboratory information system data are now routinely analyzed and included as part of a feedback mechanism to facilities for the national ART program.

In Swaziland, RxSolution is in use at three central warehouses to manage over USD 50 million worth of medicines, and is also being used at 39 PEPFAR-supported sites for the day-to-day inventory management of medicines. Stock status, redistribution plans, monthly inventory, and issue reports are routinely generated with the tool. Reports generated from the system helped alert key stakeholders to potential stock situations ahead of time and allowed them to make informed procurement decisions to avoid stock-outs.

In Namibia, the Intermediate Hospital Oshakati has used RxSolution to improve pharmacy management by reducing the patient wait times from 41 to 14 minutes. The hospital has also reduced waste due to expiry of pharmaceutical products from over USD 10,000 per quarter to USD 2,400 per quarter in the two years before and after RxSolution.

In the healthcare industries, inventory management system can handle the inventory especially for Pharmacy Department. Drug Ordering and Stock Keeping System is designed and developed to enhance the efficiency and effectiveness in the management of Pharmacy Department. This includes all the activities that run in a pharmacy such as transaction, order items and generate reports. Currently, only medicine ordering activity is done using a computerized system and the rest activities are done manually. Some problems have occurred such as human errors in recording and calculating which lead to the lateness of the rest activities. Therefore, the computerized system that will be developed is for solving the problems that occurs or might occur. (Rohayu BT Ramli, 2007).

Health Commodity Management Information System, Facility Edition (HCMIS FE), locally developed software to manage product in the hospital stores. Health commodity management information system has improved inventory as well as reporting; managers can easily anticipate stock out, which has a negative impact in patient care, and request supplies before it run out.

Some of the benefits of this system are fast support less system downtime and improved customer satisfaction, cost saving by reducing the number of field visit and centralizing customer support provides better data on common problems and helps solve them in the future and have long term system sustainability. (Health Commodity Management Information System Call Center.(2014,Dec.)Retrievedfrom*Deliver.jsi.com*./dlvr.content/resources/allpubs/…/ET_HCMISCall CenterBrie.)

Hospital drug inventory in Ghana is seen as a vital management functions in hospital administrations. In the case of drug inventory, hospitals' pharmacies in the country have enough understanding of wastage and shortage of drug is due to inventory problems. The pharmacists serve as the gate keepers of drug distribution by ensuring the accuracy and appropriateness of prescribed medications. Pharmacists must make decisions regarding their inventory levels on how and when to produce or purchase drugs in response to or in anticipation of patient demand. Frequently, these decisions are made by measuring drug utilization from historical data and devising a common inventory level which makes the process easy to manage but not efficient (Prince Addo, S. 2012).

In Ethiopia, DHIS1.4 (statistical software) adapted from South Africa has been implemented in some of its regions and shows a significant progress in delivering timely and quality data to the higher levels. After seeing such changes FMOH start to implement computerized system in all levels of the health system. But it was difficult to implement throughout the country due to economic and infrastructural problems. And a gateway system is implemented which allows reporting the data from

the lower level facilities using paper and entre electronically in the provincial or zonal levels to report to the regional and central (national) levels (FMOH,2008).

Medical devices can cause a serious problem on users and patients, if they are not well managed during health care service provision. Food and Drug Administration (FDA) agency of United States in 2006EC reported 187,086 device related injuries, 2630 deaths and 87,485 malfunctions of device. This shows, that consequence of mismanaged medical device has effect on the health care service quality and resource constraints directly or in indirectly (WHO, 2003).

Computer assisted inventory management for oral and topical medicines are comparatively easy, since the amount of drugs used can be confirmed at the time of dispensing. However, automated inventory management for injection drugs is generally complicated. During the past decade, several systems in the inventory control system have been employed. The automation in the inventory control should be valuable in performing pharmaceutical practice as well as for the hospital revenue (Awaya, Toshio et al, 2016).

Pharmacy automation within the hospital is a relatively new and emerging concept in Africa and around the world. The degree to which individual hospital participate is dependent upon factors such as location, finance and requirements. In the year 1960's a new system about drug distribution system emerged, called the unit dose, in which the drugs were individually packed and sent to floor in 24 hours cycles (Novek, J. 2000).

Automated medication distribution system can be approached in two different ways: Centralized automation and a decentralize systems. Centralized automation is within the pharmacy and involves in filling medication with cart, single dose packaging functions and designed to reduce pharmacists' time. A decentralized system is a system designed to replace the manual dispensing of medication; it allows faster nurse access and a decreased error rate, especially if included into the institution's point of care information system (Tallon, Robert W. 1996).

In California, both the San Diego medical facilities and the University of San Francisco implemented the Pyxis Medstation which is a computerized system that replaces the traditional unit dose exchange system. The benefits of implementing Pyxis medstation include: a decrease in missing dose, time saving for pharmacy. Here was a net savings in labor costs, and an overall savings of an estimated

$1M US over 5 years despite the cost of each module costing between $20,000 US to $ 100,000 US (HO, S. and Broadway, BA. 2016).

Telemedicine systems have been proposed for nearly two decades as a means of supporting hospitals to achieve improvement. The present study employed text messaging for pharmaceutical care and it was effective and popular with the patients. The text messages provided patients with rapid, effective medication guidance and pharmaceutical care after discharge. The use of the MPSS should improve pharmaceutical care, widen the knowledge of
Pharmacists, reduce the burden on pharmacy staff, improve pharmacist–patient interaction, and improve the effect and safety of medication (Mao, Y. Yantao, Z. and Suodi, Z. 2008).

2.1 Related Works

The Novartis Company developed the SMS-based system for anti malarial drugs in sub-Saharan Africa. The technology was developed to prevent stock-out of anti malarial drugs in remote areas by taking advantage of the present availability of mobile phones network coverage even in rural areas. The system automatically sends weekly SMS text messages to mobile phones at public health facilities requesting information on their updated stock levels .The major challenges for the effectiveness of this system is that the remote health centers are served by the district hospital where the automated drug monitoring systems is not in place. Thus even if the SMS from the remote health center will be received will be difficult to be processed since even the district level can get out of stock without notification. This can be considered as a cal up on development of information system for drug monitoring and management at the hospital level (WHO, 2003).

According to Emily, the concept of computerization of medical prescription process is still developing however there are few functional and existing system already. Electronic prescription is currently widely in use especially in some countries, like Sweden, Finland, Denmark, and the Netherlands and also discussed the development and implementation of a computerized physician order entry (CPOE) system focusing specially on a home grown e prescribing system; in a community based integrate health care system. This was achieved by ensuring the bye-in of the organization, ensuring two way communication, iterative implementation, ongoing and readily accessible training to be available the involvement of clinicians in all facets of development that contributes to improvements, and also the workflow be resigned from the article, if their theories are implemented practically as specified then it would be an almost perfect implementation (B., Emily and Jennifer, L. 2016).

SMS-based medication guidance could be substituted for face-to-face medication guidance in the future, there would be time savings for the pharmacy staff. In addition, because of the virtue of its immediacy and the high ownership of mobile phones, pharmaceutical care using text messages may be more effective than Internet-based pharmaceutical care. During the development of the MPSS, our pharmacists set up an evidence-based drug information database, which covered more than 1200 medicines. The pharmacists were able to expand their knowledge through searching the database. The MPSS also has the potential to integrate with the hospital information system (HIS) and thus provide more effective and individualized pharmaceutical care (Mao, Y. Yantao, Z. and Suodi, Z. 2008).

The paper method of prescription in addition, causes stress to the patient as they would have to hand deliver the paper prescription to the pharmacist even in the ill state of the patient and worse would have to wait on queue. But, with the use of the e- prescription system medical drug prescription would be composed on system by the prescribing physician by selecting the drug name, accessing the patient record and then sending electronically to the pharmacy. In e- prescribing system, the pharmacist could prepare the medication which would be ready for the receipt before the patient arrives. Failures in communication between the pharmacist and the prescriber can also result in error in far too many cases besides the handwriting of the physician. The process of the physician sending his prescription electronically also reduces the rate of call backs to and from the pharmacy for clarity of prescription (Miller, Randolph A. et al. 2016).

CHAPTER THREE

Methodology

3.1. Introduction

The researcher used a phased development methodology of object –oriented approach was applied in this study. Document analysis and interview were used as the main tools to capture the business system requirement together with observation. Unified modeling language (UML) development techniques are applied for requirement capturing, modeling organizational business system and design.

3.2 Study Area

ALERT stands for ALL AFRICA LEPROSY TUBERCULOSIS REHABILITATION REAEARCH TRAINING CENTER**.** Situated at the peri- urban environments about 7km of the city of Addis Ababa, southwest on the way to Jimma. Originating from the previous surroundings of Zenebework Memorial Hospital back in 1965, founded by the Ministry of Health, Addis Ababa University, The Leprosy International, American Leprosy Mission and the Society for rehabilitation of the disabled. ALERT main mission was to provide training for both gender in multiple aspects of leprosy disease including prevention, treatment and rehabilitation in an African context of Environment.

Since July 2002, ALERT has modified its activities investing as a tertiary referral and teaching hospital for leprosy and skin diseases under the administration of the Ministry of Health of the Federal Democratic Government of Ethiopia.

Its main current mission is based on provision of quality service and Training Center for leprosy, Rehabilitation, Surgery, Tropical dermatology, Ophthalmology and relevant infectious disease.

Based on training and research, ALERT provides National and International short term courses on various aspect of Leprosy, Tuberculosis, Dermatology, Rehabilitative surgery and Programme Management recruiting participants Worldwide. Students have the opportunity to practice in the CD-ROMS, video, slide programmes and library. There is also an Internet access and other useful teaching Aid material to be used and practiced by the students and the staff almost all the times.

Students stay at the training hostel, which provide a single study room with almost all basic needs and a shared bath chamber. The institution workers regularly maintain all the cleanings and laundry

work. Catering department serves meals in a mixture of western and Ethiopian cultures. The main services provide at ALERT apart from research and training activities include:

1. **Outpatient services** for Routine and special dermatological clinics Leprosy_ medical and referral clinic which includes leprosy follow ups with Neuritis clinic Ophthalmology clinic with special emphasis on Glaucoma Surgical clinic for Hand and feet rehabilitative surgery (club foot, orthopedic and ulcer clinic)

2. **Inpatient services** with a capacity of 228 beds comprising of 3 medical wards 1 ophthalmic ward 3 surgical wards**.**

3. **Other services includes:** an orthopedic workshop for special shoes and prosthesis for leprosy patients Occupational therapy Physiotherapy Unit Pharmacy Laboratory services Pathological Unit.

RESEARCH

Within ALERT Campus, there is a research complex known as ARMAUER HANSEN RESEARCH INSTITUTE (AHRI) functioning as a renowned center of excellence in Leprosy research since 1970. It is also working on TB and other infectious diseases. This institute provides special trainings for Msc and PHD students as its contribution towards scientific manpower capacity building. It is also currently serving as Pan African Bioethics Initiative (PABIN) secretariat.

HUMAN RESOURES

ALERT is served by a combination of both experienced medical scientific technical and administrative staff of about 1212 workers comprising of 24 Specialist Doctors 48 General Practioners,10 Health Officers 28 Scientists 37 Pharmaceutical Technicians 28 Laboratory Technician 6 X-ray technicians 13 Anesthetist 12 Physiotherapist 1006 Administrative Staffs

It has also a good reputation on keeping "Human Resource Bank" and utilization of experienced retired workers especially in the field of training e.g. leprosy and Research methodology. ALERT also utilizes a number of scientific experts all around Ethiopia in their contribution towards various trainings when need arises. Leprosy patients are rehabilitated in the old Zenebework building where they are engaged in different activities according to ones occupation here they have the opportunity to utilize their talents as per ones capacity. With the help of their families, they make different things including Ethiopian traditional attires, carving etc that latter is sold in the craft shop within the building; the money got is used to help them and their families.

(ALERT Center Human Resource Annual Report Document, 2007).

Human Resource Description of ALERT Center

Table 1: Human Resource Allocation

S.NO	Types of Professional	Number of Professionals	Remark
1	Specialists	24	
2	GP's	48	
3	HO's	10	
4	Nurses	147	All types (B.sc, MWN nurse)
5	Lab.Technologist/Technician	28	
6	Pharmacist/Pharmacy Tehnician	37	All types
7	X-ray Technician	6	
8	Anesthetist	13	
Total		313	

3.3 Study Design

The project is conducted from Dec 2015 to June 2016. The project used both the design science and object oriented methodology. The design science methodology is used for applying techniques, models, theory for creating artifacts for satisfying the functional requirements and methods where as the Object oriented methodology is used for requirement analysis and design. The methodology enables the developed system more scalable and flexible.

Design Science is an outcome based information technology research methodology which offers specific guidelines for evaluation and iteration with research projects (March, Salvatore T. and Gerald F.Smith 1995).

The design science research method plays a primary role in solving IT problems. IT research deals with artificial solutions instead of natural solutions. Design Science research always seeks an innovative way to define ideas, analyse problem, and to design and implement solutions for problem solving effectively. There are six core steps during the design science research process . Problem identification and motivation; definition of the objectives for a solution; design and development; demonstration; evaluation and communication. In this research according to the above research process, document review, interview question and literature review will become problem identification and motivation, definition and objects for a solution phase of design science. Prototype system design and development will be the design and development combined with demonstration phases of design science. Experiments and results through the software application could be evaluation and communication phase of the design science (K, Peffers and Tuunanen T. 2004).

3.4. Study Population

The source population of the study was individuals working at ALERT Hospital. In addition documentary sources and literatures were also used as sources of the study. The study populations were pharmacists, druggists, data clerk and ICT focal person), HMIS officer working in the hospital.

3.5. Sampling Method

The project was done at All AFRICA LEPROSY TUBERCULOSIS REHABILITATION TRAINING Center (ALERT), which makes it purposive in finding the area of the project, where the situational analysis.

3.6. Software Development Life Cycle (SDLC)

There are various software development approaches defined and designed which are used/employed during development process of software, these approaches are also referred as "Software Development Process Models"(Waterfall model, incremental model, V-model, iterative model, RAD model, Agile model, Spiral model, Prototype model).

Waterfall model: The waterfall Model was first Model to be introduced. It is also referred as a linear- sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed fully before the next phase can begin. This type of software development model is basically used for the project which is small and there are no uncertain requirements. At the end of each phase, a review takes place to determine if the project is on the right path and whether or

not to continue or discard the project. In this model software testing starts only after the development is complete.

Incremental model: In incremental model the whole requirement is divided into various builds. Multiple development cycles take place here, making the life cycle a "multi- waterfall" Cycles are divided up into smaller, more easily managed modules. Incremental model is a type of software development model like V-model, Agile model etc. In incremental model the whole requirement is divided into various builds.

V-model: V-model means Verification and Validation model. Just like the waterfall model, the v-shaped life cycle is a sequential path of execution of processes. Each phase must be completed before the next phase begins and testing of the product is planned in parallel with a corresponding phase of development in V-model.

Iterative model: An iterative lifecycle model does not attempt to start with a full specification of requirements. Instead development begins by specifying and implementing just part of the software, which can then be reviewed in order to identify further requirements.

RAD model: RAD model is Rapid Application Development model. It is a type of incremental model. In RAD model the components or functions are developed in parallel as if they were mini projects. The developments are time boxed, delivered and then assembled into a working prototype.

Agile model: Agile development model is also a type of incremental model. Software is developed in incremental, rapid cycles. This results in small incremental releases with each release building on previous functionality.

Spiral model: The spiral model is similar to the incremental model, with more emphasis placed on risk analysis. The spiral model has four phases: planning, Risk Analysis, Engineering and Evaluation. A software project repeatedly passes through these phases in iterations/Spirals in this model. The baseline spiral starting in the planning phase, requirements are gathered and risk is assessed.

Prototype model: The basic idea in Prototype model is that instead of freezing the requirements before a design or coding can proceed, a throwaway prototype is built to understand the

requirements. This prototype is developed based on the currently known requirements. Prototype model is a software development model. By using this prototype, the client can get an "actual feel" of the system, since the interactions with prototype can enable the client to better understand the requirements of the desired system. Prototyping is an attractive idea for complicated and large systems for which there is no manual process or existing system to help determining the requirements. Among the software development life cycle mentioned above the researcher preferred for his project work a development life cycle called waterfall approach. (What is Waterfall model-advantages disadvantages and when to use it. (2017, 8, February)**.**Retrieved from http://istqbexamcertification.com/what-is-waterfall-model-advantages-disadvantages-and-when-to-use-it/)

Object-oriented modeling: is a common approach to modeling applications, systems, and business domains throughout the entire development life cycles. And has the following benefits

Efficient and effective communication

Visual model diagrams can be more understandable and can allow users and stakeholders to give developers feedback on the appropriate requirements and structure of the system. A key goal of the object-oriented approach is to decrease. A key goal of the object-oriented approach is to decrease the "semantic gap "between the system and the real world.

Object-oriented design: During object-oriented design (OOD), a developer applies implementation constraints to the conceptual model produced in object oriented analysis. Constraints include the hardware and software platforms, the performance requirements, persistent storage and transaction, usability of the system.

3.7. Water Fall Approach

The waterfall Model was first Model to be introduced. It is also referred as a linear- sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed fully before the next phase can begin. This type of software development model is basically used for the project which is small and there are no uncertain requirements. At the end of each phase, a review takes place to determine if the project is on the right path and whether or not to continue or discard the project. In this model software testing starts only after the development is complete.

In some approaches to software development- known collectively as waterfall models - the boundaries between each stage are meant to be fairly rigid and sequential. The term "waterfall" was coined for such methodologies to signify that progress went sequentially in one direction only, i.e., once analysis was complete then and only then was design begun and it was rare (and considered a source of error) when a design issue required a change in the analysis model or when a coding issue required a change in design.

In an Object oriented analysis and design, describes the real world of its objects, the attributes, operations, and relationships. It is the object perspective of the problem domain. In contrast with the structured modeling, object oriented modeling combines data and processes that act on the data into things called objects. It is flexible, efficient, and scalable and provides an easy transition to OO programming languages make it popular in an information system development (Shelly, Cashman, Rosenblatt, 2003).

The time given for the completion of the project was four months and to have the necessary information and selecting the interviewee from study area, source and study population were challenging. Hence, delivering the project within the specified period of time and other constraints the researcher preferred a methodology called waterfall software development methodology are applied. The methodology above has the phases mentioned below.

➢ System Investigation phase
➢ System Analysis Phase
➢ System Design Phase
➢ System Implementation or coding phase
➢ System testing phase
➢ System Deployment phase
➢ System Maintenance phase

3.8 System Investigation Phase

Requirement Gathering Tools

Requirement Collection Instruments are used for collecting relevant and useful information from pharmacy head, pharmacists and data clerk who are responsible and work on the current system.Since it helps me for collecting functional as well as non-functional requirements. The researcher used different types of instruments for collecting the requirements such as document

review, observation and interview. The researcher interviewed 10 pharmacy professionals and 1 data clerk. It is used because through interview it is simple and easy to understand the opinions than analyzing the document and observation. Interview and document analysis was important for clearly see what the existing system looks and how it works and see how the data is collected, organized and summarize.

> **Observation**

Through observation the researcher tried to see how the data flow of current system and day to day activities in order to identify the problem of the current system.

> **Interview**

In this project, the researcher interviewed head pharmacy, pharmacists and data clerk of the hospital pharmacy were interviewed about the current paper based system and related issues for enabling the researcher what the main problems were in the existing system.

3.9. System Analysis Phase

After having the necessary requirement through interview, observation and document review the result was analyzed. The results of the system modeling that help for understanding the system models for analysis, the researcher used tools like the use cases, activity diagram and sequence diagram.

Models

A model is a representation of an important aspect of the real world. It is sometimes called an abstraction as it is used to separate out and aspect of particular importance. Data depiction were made using the following models

> System Use Case Description
> Sequence Diagram
> Class Diagram
> Activity Diagram
> Entity Relationship Diagram

Use case

A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. The use case is made up of a set of possible sequences of interactions between systems and users in particular environment and related to a particular goal. It consists of a group of elements that can be used together in a way that will have an effect larger than the sum of the separate elements combined. The use case should contain all system activities that have significance to the users. A use case can be thought of as a collection of possible scenario related a particular goal, indeed, the use case and goal are sometimes considered to be synonymous.

Use cases are software modeling technique which helps Architects and Analysts to put together the features to implement and how to fix the errors in simple pictures. Due to its simplicity in conveying its ideas to customers, technical gurus and executives a like it is very popular and often considered powerful. A use case can identify, clarify and organize system requirements in simple steps and can help avoid scope creep. Systems Analysts tries to put a set of all possible sequences of interactions between systems and actors in a particular environment related to a specific goal. It consists of a group of elements that can be used together in such a way that will have an effect larger than the sum of the separate elements combined. A use case can be thought of as a collection of all possible scenarios related to a specific goal (Armor & Miller, 2000).

Tools

A tool for software development is a software support that helps for creating models and other components required in the project. The tools used for analysis and design of this project was:

➢ Microsoft Visio for drawing various modeling diagrams
➢ MySQL Database application to store information
➢ The programming language used for this project was MVC with ASP.Net

Front end: for developing user interface for accessing the database ASP.Net is used**.**

Back end: MySQL is used as a back end since it is inexpensive and can run in a variety of operating system such as Linux, UNIX's and others

3.10. System Design Phase

In system design phase the system and software design is prepared from the requirement specification studied in the first phase**.** The system design was done based on functional and non-

functional requirements known on the previous phase. Microsoft Visio 2010 is used for designing the architecture of PMS developed.

3.11. System Implementation

For implementing the prototype, the researcher used HTML to develop the user interface of client side web page. MVC was used to write the code that connects the web page and the relational database which is created using MYSQL.

3.12. System Testing Phase

We used formative usability testing to maximize the usability of the prototype PMS developed. The prototype PMS is tested against the requirements to make sure that the system developed is actually solving the needs gathered during the requirement phase.

Table11: Summary of methods, techniques, and tools used in each phase of the project

Phases of the Software development	Model and Techniques	Tools	Approach
Feasibility, requirement gathering /planning phase	➢ Interview ➢ Observation ➢ Document analysis	➢ Questionnaire ➢ Observation Checklist	Water fall approach
Analysis phase	➢ System Use Case Description ➢ Class Diagram ➢ Activity Diagram ➢ Entity Relationship Diagram	➢ Microsoft Visio 2007/2013	
Design phase	➢ Architecture layout of the proposed system. ➢ User interface design diagram	➢ Microsoft Visio 2010/2013	
Development Phase	➢ Object Oriented Analysis and Design Programming	➢ HTML ➢ MY SQL ➢ MVC	
Testing Phase	➢ Informal software usability testing	➢ Questionnaire checklist	

19

3.13. Operational Definitions

Internal facility Report Resupplied Form: - is IPLS format that is used for reporting and resupplying pharmacy commodities from facility store to the pharmacy.

Maximum Stock level: - in IPLS the maximum stock level designed and holds to facilities is four months of stock.

Minimum stock level: - designed and holds to facilities is two months of stock.

Bin card: - is IPLS/LMIS format which records received or issued data.

Pharmacy technician: - Is a pharmacy, whose job is performing pharmacy related functions, especially the technician works under the direct supervision of a licensed pharmacist.

RRF data validation: - means checking the correctness data by Comparing the "Ending balance" indicated on the bin card to physical count at the time of visit, Comparing the "beginning balance in the store" to the "Ending Balance in the store" of the of the previous report (which should be equal), Comparing "Loss and Adjustment" on the RRF to the quantity in the Bin Card.

IPLS Implementation means :- if the facility availed and used all recording and reporting tools, products that required, established Max/Min inventory control system, acceptable storage practice, established internal reporting and resupplying system, facility report, requisition and re supply system and management ownership (institutionalization of the system).

Facility Report and Requisition System: - the facility should continuous RRF reporting to PFSA branch, timely Reporting (within 10 days from the last date of the previous reporting interval) and timely re supply (Duration of time for PFSA to deliver supplies after receiving RRF from health facilities.

Overstock: A supply imbalance that occurs when stocks exceed the established maximum level may result in losses due to expiry.

Reporting Period:-The reporting interval of the facilities to the respective hub is every two months.

Stock out on the day of the visit: - was defined as not having any available stock on the day that the data collector arrived.

Pharmacy Management Information System: - It integrates pharmaceutical data collection, processing, and presentation of information that helps to manage pharmaceutical services (MSH – PMIS-2011)**.**

A drug information system: - is a tool that enables authorized health care providers to access, manage, share and safeguard patients' medication histories.

Pharmacy Information Systems: - Designed to address the demands of a pharmacy department, **PIS** helps pharmacists monitor how medication is used in hospitals.

3.14. Ethical Clearance

Ethical Clearance was sought from Addis Ababa University research and ethical committee of Addis Ababa University Medical faculty through School of Public Health and permission from ALERT Center were obtained before the proposed project started.

CHAPTER FOUR

System Development

4.1. Introduction

Object Oriented modeling methodology and iterative process model is used to analyze, design and implement the project. Having a detail understanding of the existing system enable the developer to design and develop an information system. There are techniques used for identifying and analyzing system requirements like mentioned in the methodology part by using UML modeling techniques. The information about the existing system is gathered by interview and document review. Here the requirement analysis and design of the system will be presented.

4.2 System Analysis

4.2.1. Current System

The existing system of the organization is reviewed so it makes simple to distinguish the gap.

The researcher organized the findings under five major subtitles, the existing hardware, software, data, procedure and management.

4.2.1.1 Hardware

In each pharmacy department in the Hospital there is at least one desktop computer which is functional. Even if there is a desktop computer the main problem is it has no specific requirement of hardware mentioned previously within the organization.

Table 2: Hardware Inventory of the Existing System

Section	Type of Hardware	Quantity	Brand and Model	Processer(GHz)	Hard Disk(GB)	RAM(GB)	Purpose
Pharmacy Head	Computer	1	DELL	3.20GHz	450	1	To prepare report
	Printer	1					
Pediatric Pharmacy	Computer	1	DELL	3.20GHz	450	1	For office
Trauma Pharmacy	Computer	1	DELL	3.20GHz	450		For office
DIS	Computer	1	DELL	3.20GHz	450	1	Entering data
	Printer	1					
Special Pharmacy	Computer	3	DELL	3.20GHz	450	1	Entering data
Store	Computer	1	DELL	3.20GHz	450	3	To register drug in excel format

4.2.1.2 Software

Currently the organization is not using any specific software application related to pharmacy management system. However the organization has plans to get software to help them in the management of medical equipment in the near feature.

4.2.1.3 Data / Process

As the researcher tried to see from interview and document review there is no enough documentation on pharmacy management system of the hospital**,** the hospital pharmacy undergo inventory of drug quarterly by closing the store to know the quantity of drug available in the stock.

4.2.1.4 Procedure

The organizational structure of the hospital is divided hierarchically starting from CEO of the hospital to different directorate. Some directorate further divided into many case team such as hospital service directorate divided into emergency, outpatient, impatient, rehabilitation and physiotherapy, pharmacy case team and laboratory case team. The researcher main focus is on pharmacy case team for his project work.

4.2.1.5 Management

`   A) **Communication**

➤ The pharmacy department has direct communication with medical director and other facilities. Facilities make request for drug.

4.2.2 Proposed System

The proposed system is relevant to the health center and pharmacy department and implemented using client /server system architecture. A computerized web based system for pharmacy management system includes drug dispensary report alerting drug expiration date earlier. The proposed pharmacy management system includes prescription registry, patient registry and dispensing.

4.2.3. System Analysis Models

➤ Generate report Login
➤ Create an account
➤ Register drug
➤ Register patient

- Dispensary Report in PDF Format
- List of Expiry Report in PDF Format

4.2.4.1 Use Case Diagram

To create use case diagram for the system which is going to be developed , process that need to be added in the system are distinguished depending on the document reviewed and by assessing the existing system findings. The primary and secondary actors for each use case are identified and each actor is related with its corresponding use cases.

Table4. List of Use Case Actors

| Name	Explanation
Data Clerk/Cashier	The data clerk register drug on excel worksheet.
Ward Nurse	Take medicine for patients who are admitted.
Physician	Physician will diagnose the patient and order medicine.
Pharmacist	Pharmacist issue medicine for patient according to prescription.
Patient	A person who need treatment
System Administrator	Administrator refers to the person who administers the system.
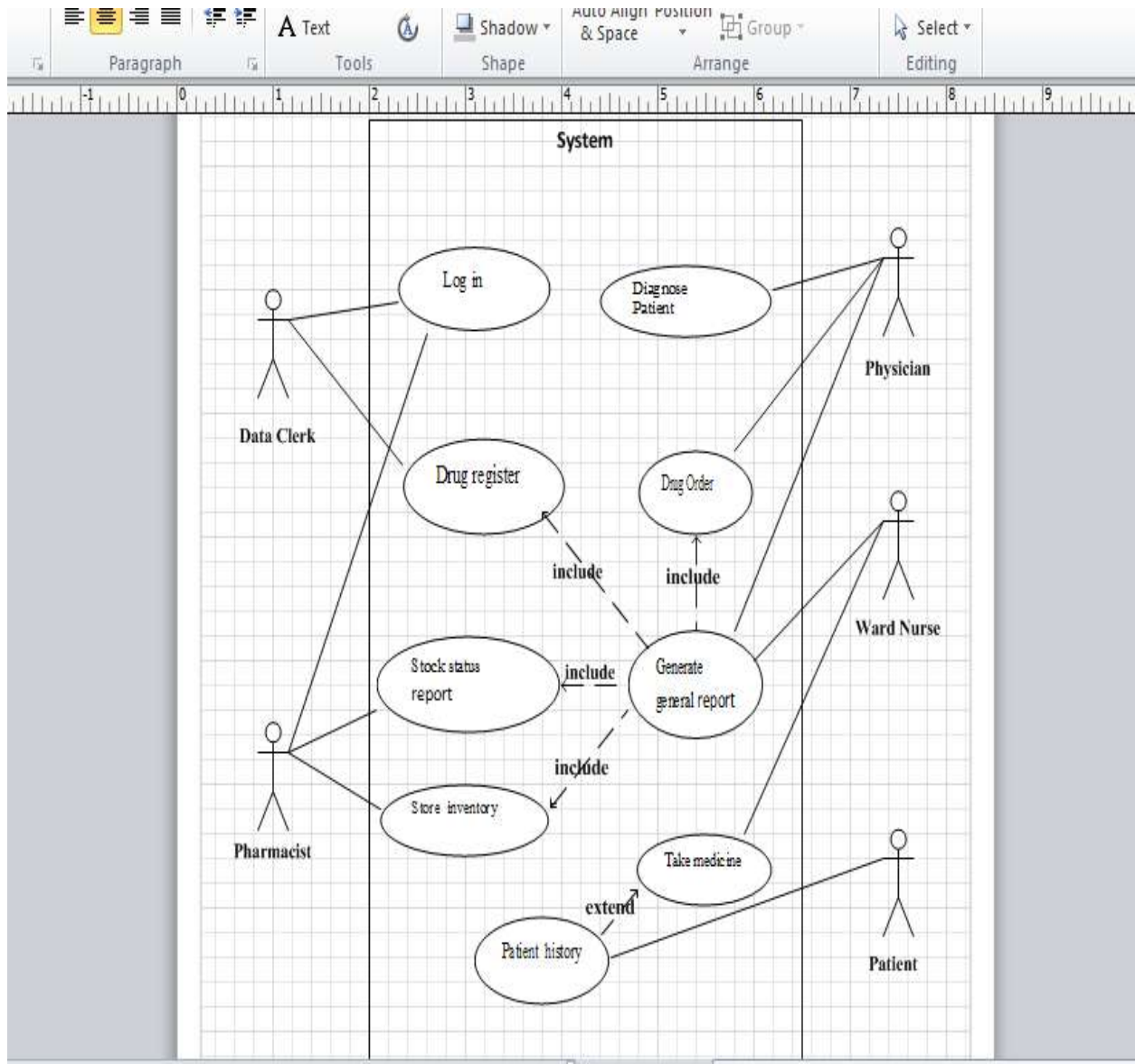
Fig1. Use Case Diagram for Drug Management

4.2.5. System Requirements

Requirement constitutes a specification for the proposed system. It is the beginning for measuring the accuracy, performance and completeness of the system finished before passing to system design. In analysis, distinguishing functional from non-functional requirement is key point.

4.2.5.1. Functional Requirements

Functional requirement define what the system should do. Some of the functional requirements of the proposed system are listed below.

➢ Separate ordinary user from administrator
➢ Allow authenticated user to log in to the system
➢ Enable authenticated user to edit, search and delete records
➢ Generate report

4.2.5.2. Non-functional Requirement

A non-functional requirement is a requirement that specifies criteria that can be used to judge the operation of a system rather than specific behaviors. It defines how a system is supposed to be. The following are some of the non-functional requirements of the proposed system.

➢ The system shall provide 24 hours per day service.
➢ The system uses English language
➢ The system shall be changeable
➢ The system shall use client server system architecture

4.3. System Design Models

4.3.1. System Class Diagram

The class diagram is used to present the system classes, their attributes, association between classes, attribute type or what a class can do and their dependencies among them.
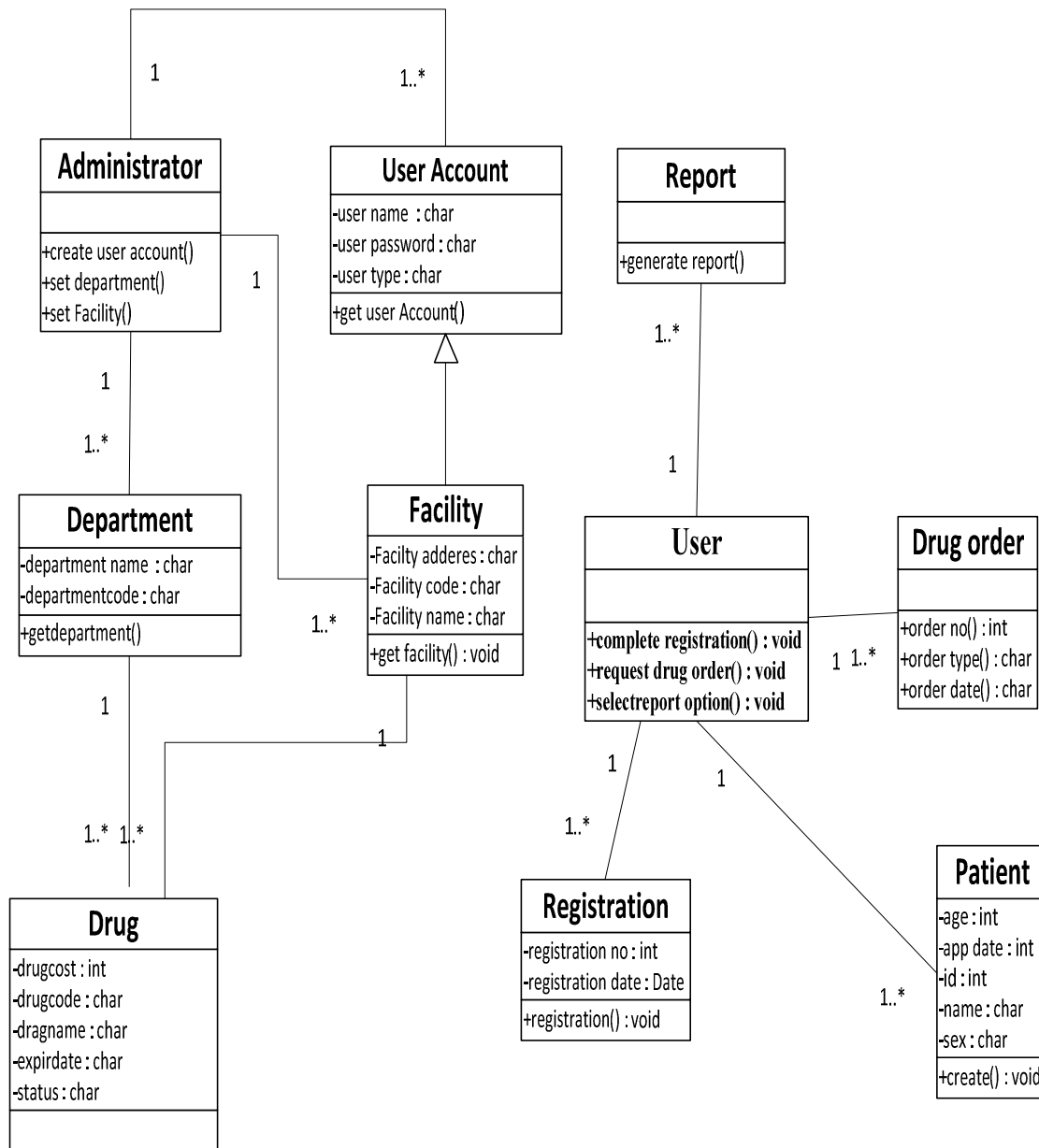
Administrator

+create user account()
+set department()
+set Facility()

User Account

-user name : char
-user password : char
-user type : char
+get user Account()

Report

+generate report()

Department

-department name : char
-departmentcode : char
+getdepartment()

Facility

-Facilty adderes : char
-Facility code : char
-Facility name : char
+get facility() : void

User

+complete registration() : void
+request drug order() : void
+selectreport option() : void

Drug order

+order no() : int
+order type() : char
+order date() : char

Drug

-drugcost : int
-drugcode : char
-dragname : char
-expirdate : char
-status : char

Registration

-registration no : int
-registration date : Date
+registration() : void

Patient

-age : int
-app date : int
-id : int
-name : char
-sex : char
+create() : void

Fig2. Design Level Class Diagram

28

4.3.3. System Architecture

System Architecture gives a high level view of the new system along with the main components of the system and services they provide and how the system interacts. The system is implementing using a three tired architecture that consists of user interface, process management and database management system as shown below.
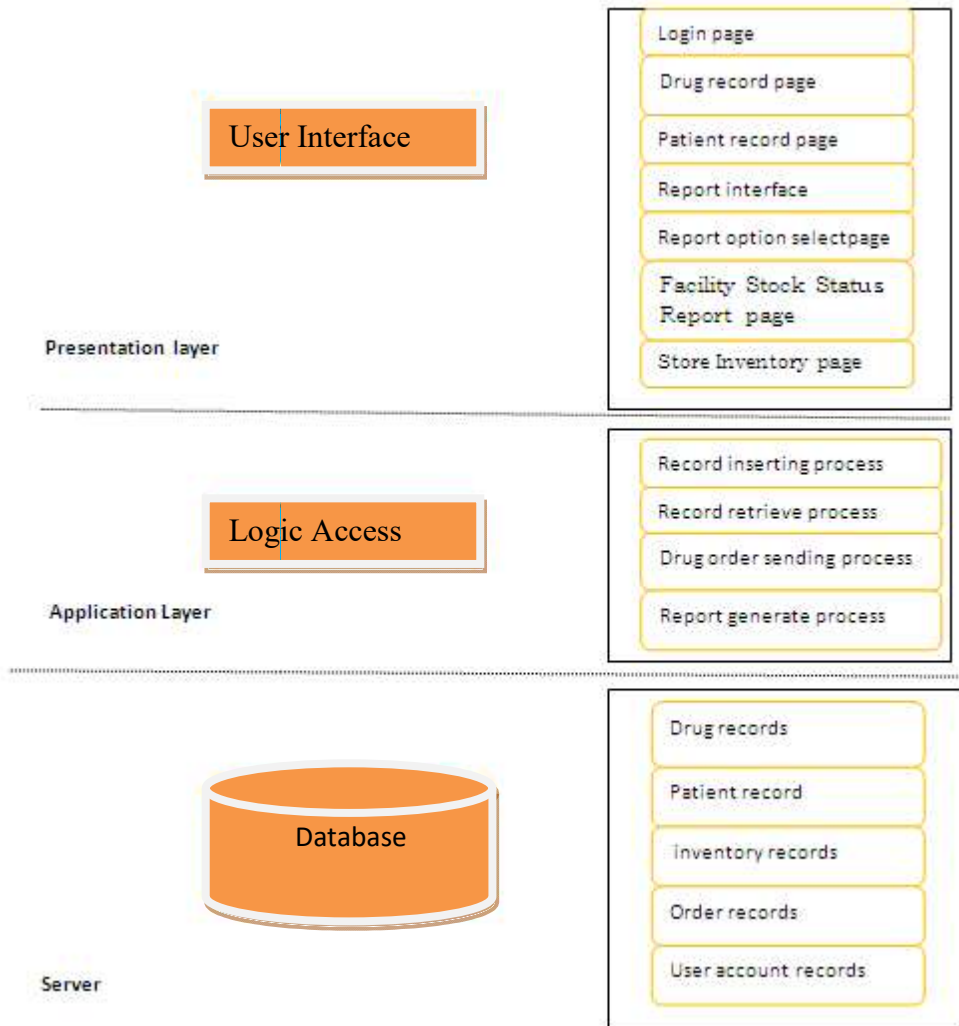

Fig.3 System Architecture

Deployment Diagram

Deployment diagram describes a static view of the run-time configuration of processing nodes and the components that run on those nodes. In other words, deployment diagrams show the hardware for the system, the software installed on that hardware, and the middleware used to connect the different machine. The architecture of the new system is a 3-tier in which one tier acts as a client and the other two acts as a server.
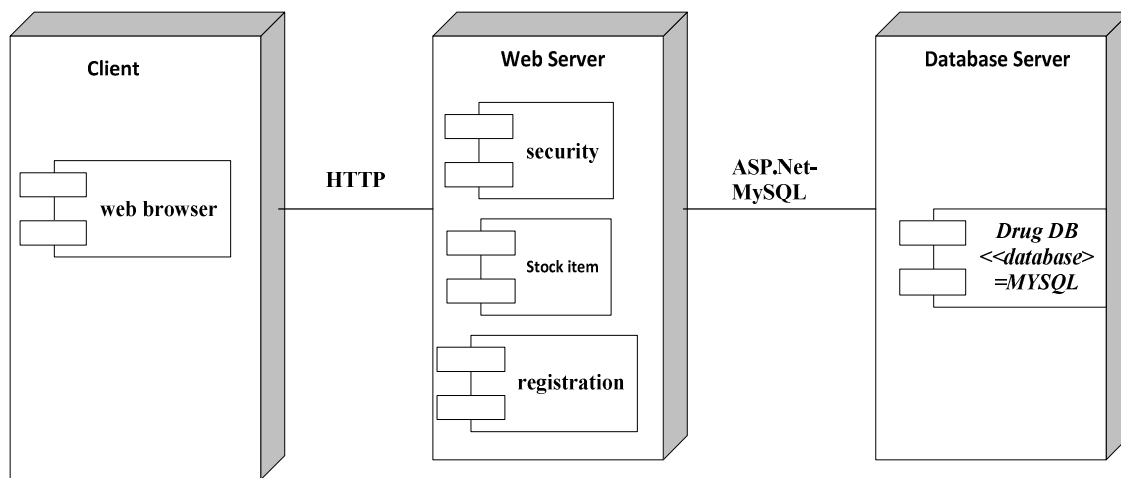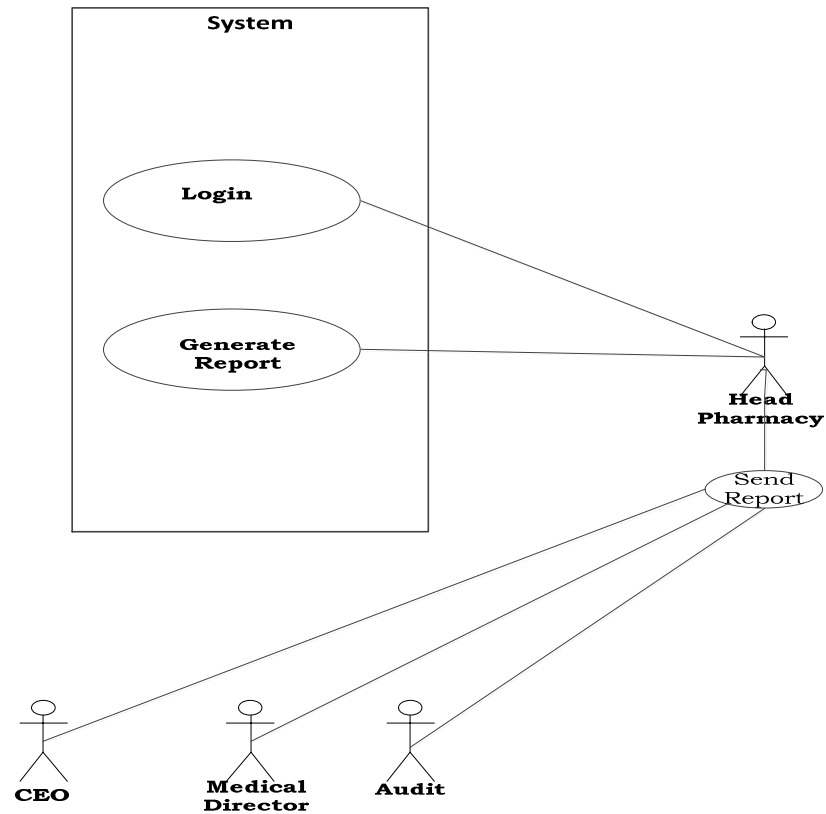
Fig4. Deployment Diagram

Fig. 5 Use Case Diagram for generating report by Pharmacy Head

4.4. Implementation of Prototype

In implementing PMS, the researcher used three parts. The presentation, application and database layer. The presentation layer which is the user interface is implemented using HTML and MVC. The database is developed by using MySQL database management system and the application layer which help to connect the user interface and database is Asp.net and MVC.

4.4.1. Presentation Layer

4.4.1.1. Pharmacy Management System Log in Form

Figure4   Shows Pharmacy Management System Log in form which allows user to enter user name and password to enter into the main home page.
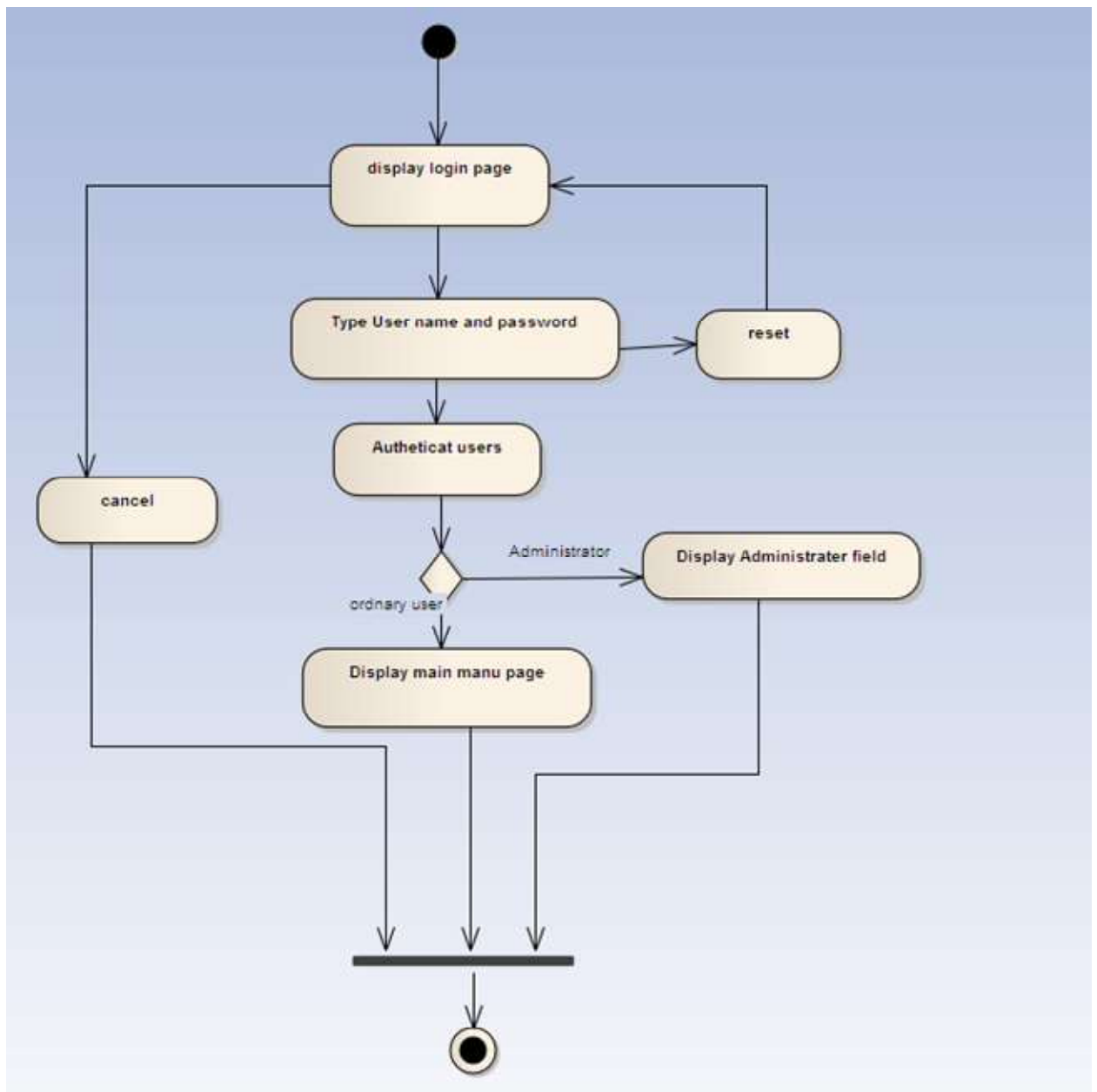
Fig 6: Activity diagram for display login page

Table 5: Use Case 1: Login

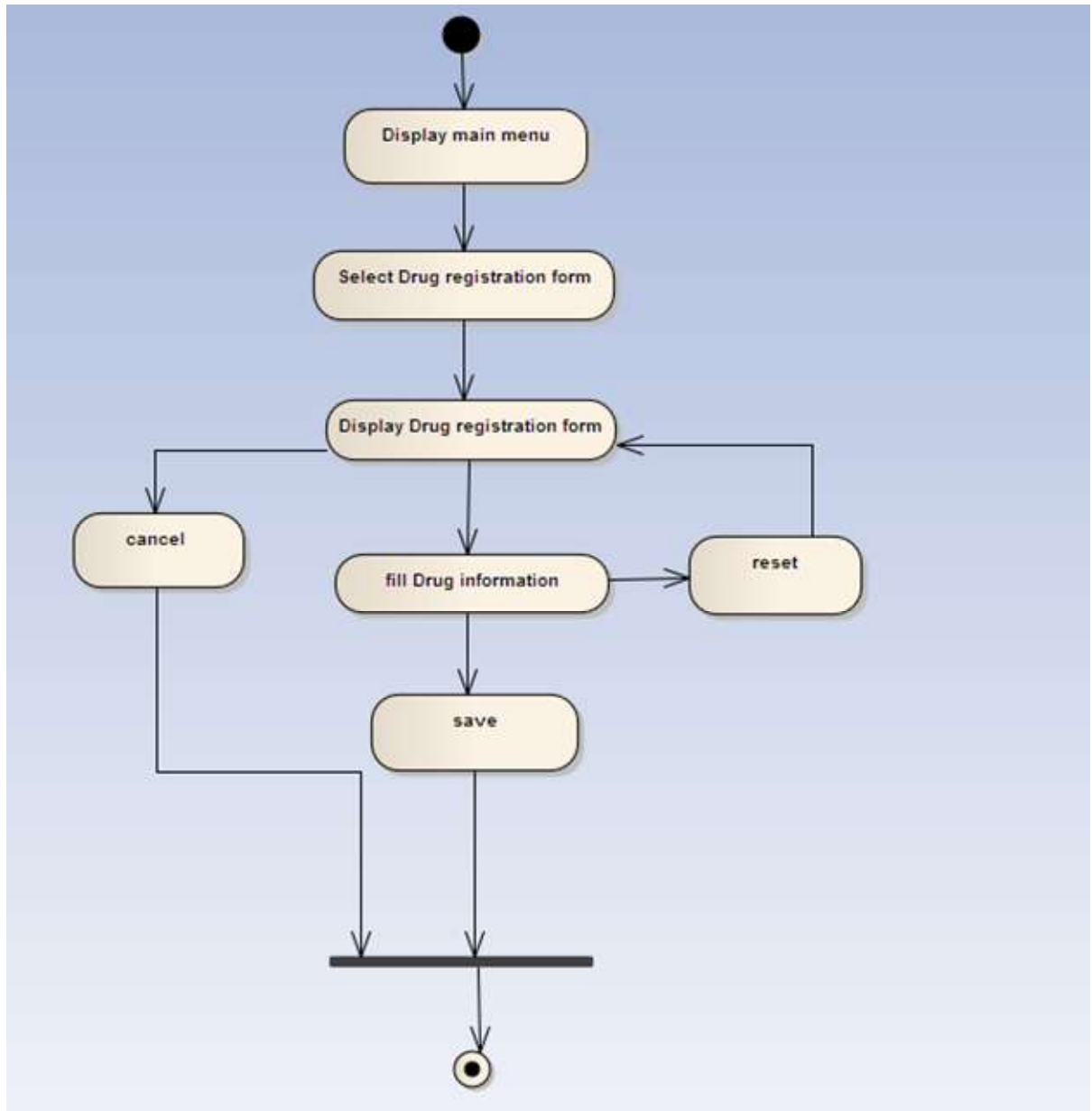| Use Case Name:	**Login**
Use Case ID:	**UC-1**
Actors:	Pharmacist, Data Clerk
Description: This Use Case is used to accept user name and password to enter into the main page	
Basic course of action: 1. The use case begins when the user open the form which allows users to enter username and password.	
2. The user enters username and password in the system login form	
3. The systems checks whether the username and password is correct.	
4. The system informs successful login message	
5. Use Case ends when systems display a general user interface with buttons that move from one window to another.	
Post Condition: user into the system and perform his/her work	
Alternate Flows 3a. Invalid user name and password	
1. The system informs the user as not properly enter his/her user name and password.	
2. After certain trial the system informs the user to contact the system administrator.	
Post Condition The system prevent the user from entering into the system	
Frequency of use every day	

Fig 7: Activity diagram for drug registration

Table 6: Use Case 2: Drug Registration

Use Case Name:	**Drug Registration**
Use Case ID:	**UC-2**
Actors:	Pharmacist, Data Clerk
Description:	This use case helps the pharmacist or data clerk to register new drug.
Trigger:	donation or drug purchase
Precondition:	when drug run out and substitute
Basic course of action:	1. The pharmacist or data clerk click the drug registration screen from home page
	2. System displays drug registration screen with button create, update, Search, Save and Cancel.
	3. The pharmacist or Data Clerk check the drug is new.
	4. The pharmacist or Data Clerk registers the drug.
	5. Use Case ends when systems registering the new drug.
Post Condition:	the pharmacist or data clerk registering the new drug arrived.
Frequency of use	every day

Table 7: Use Case 3: Drug Search

Use Case Name:	Drug Search
Use Case ID:	UC-3
Actors:	Pharmacist
Description:	This use case helps the Pharmacist for searching drug.
Trigger:	diagnosed patient with prescription
Precondition:	availability of drug in the store
Basic course of action: Login form	1. The pharmacist enter into the login form through UI1 system
	2. The pharmacist click the search button for checking availability
name	3. The system view search form with list of search button like drug
button.	4. The pharmacist fills the drug prescribed then clicks the search
	5. The search prescribed drug will display.
Post Condition:	Search may or may not successful
Alternate Flows	6. System determine as the drug is not available
	6.1 The system informs for the pharmacist the search result is not found.
Post Condition:	The system return back to drug registration
Frequency of use:	every day

Table 8: Use Case 4: Stock Status Analysis Report

Use Case Name:	Stock Status Analysis Report
Use Case ID:	UC-5
Actors:	Pharmacist (Store man)
Description:	This Use Case helps the Store man/Pharmacist to check the availability of drug in the store.
Trigger	
	• Question rose from department
	• Question rose from ward
	• Question rose from donors
	• Question rose from other health facilities
Basic Course of Action	1. The pharmacist clicks the medicine menu from home page screen.
	2. The pharmacist checks whether enough amount of drugs or not.
	3. The drug information system personnel orders drug acquisition
	4. The pharmacist receives and registers it.
Post condition:	3a. If there is enough amounts generate report and disseminate it to the concerned body.
Frequency of use:	every fifteen days

Table 9: Use Case- 5   Report   Generating

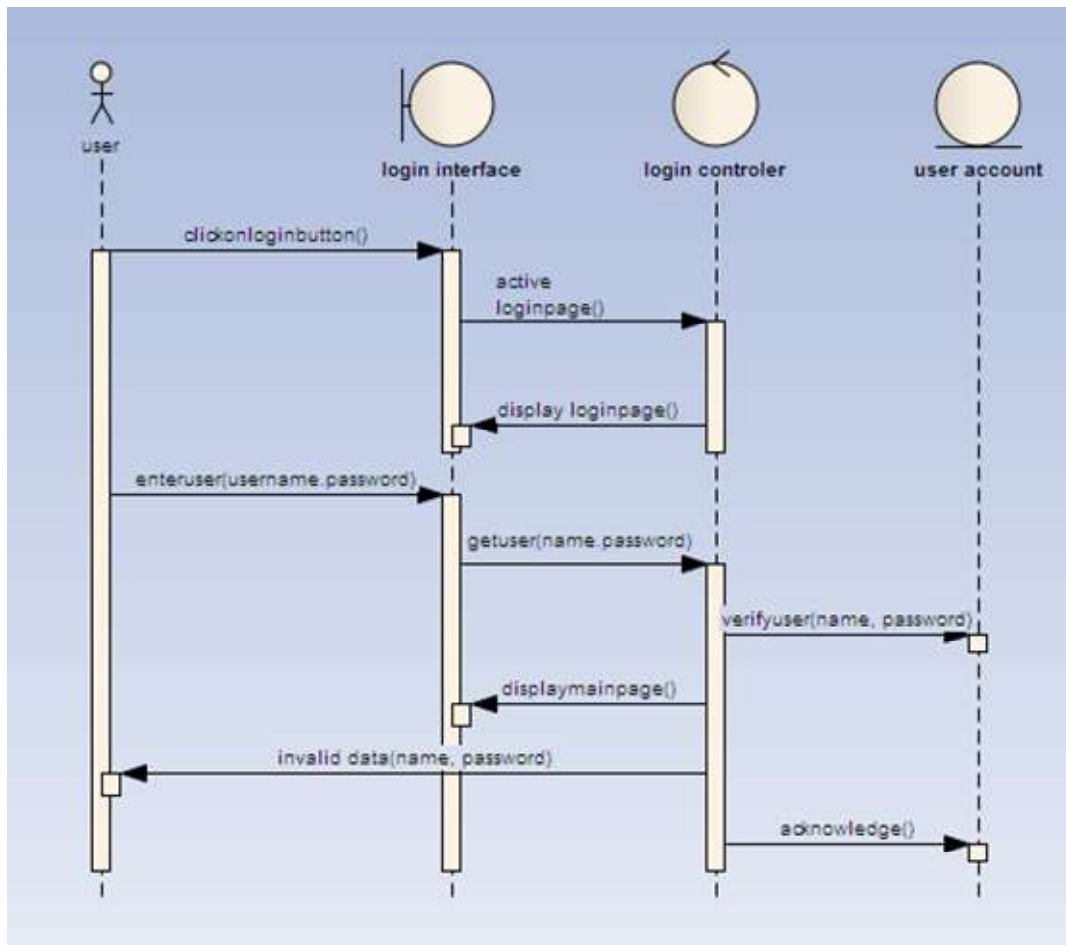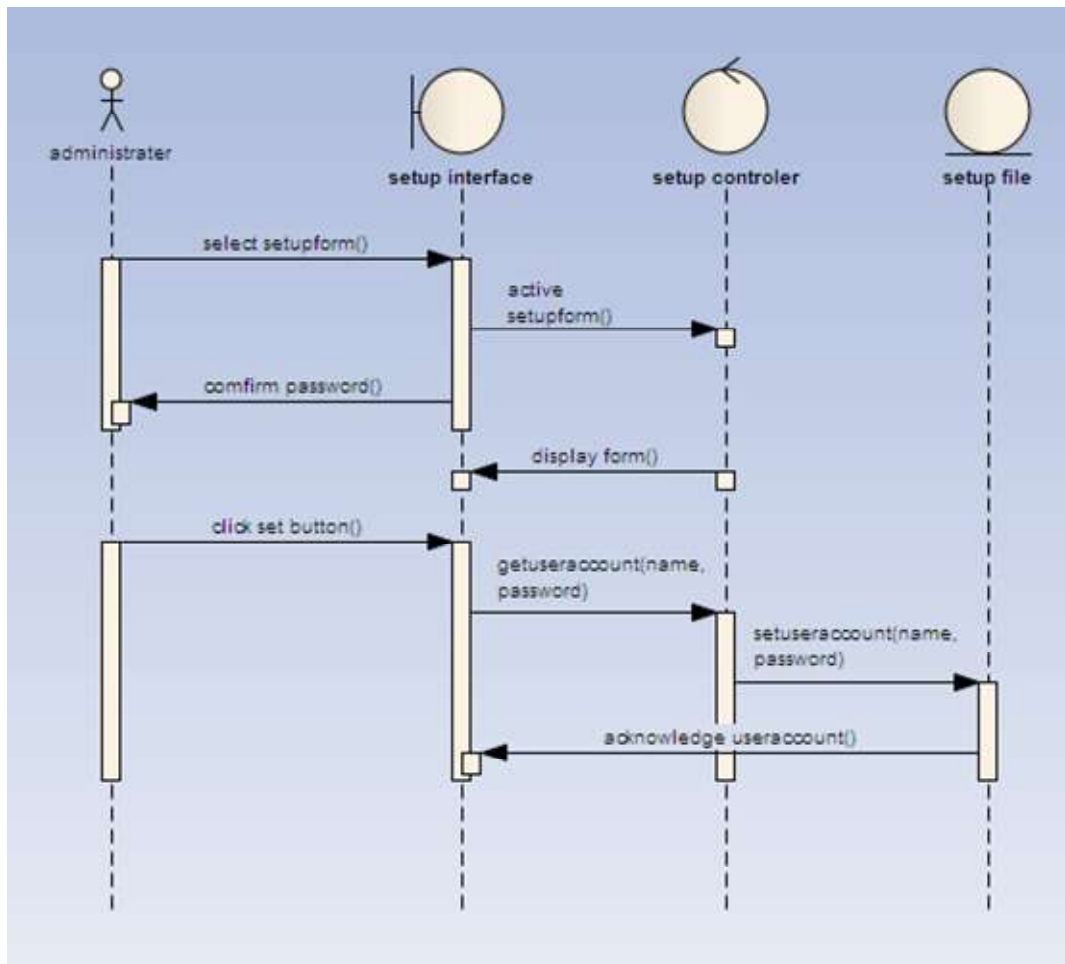| Use Case ID:	UC-8
Use Case Name:	Generate Report
Actors :	Pharmacy Head, Pharmacy Case Team
Description:	This use case is used for generating report from pharmacy case team to pharmacy head and then to Medical Director, Audit and chief executive office of the hospital.
Trigger:	Report Request
Preconditions:	There must be document containing valuable condition.
Basic Course of Action:	1. The pharmacy head clicks the report generation from HOME PAGE 2. The system displays the report generation screen 3. The pharmacy head select the report he/she wants to generate, 4. The pharmacy head select generate report, 5. The system generates report. 6. The pharmacy head disseminate this report to Medical Director, Audit and Chief Executive office of the hospital
Post condition **:**	7. Report is disseminated to Hospital management.
Alternative Flows:	None
Frequency of Use:	Every month

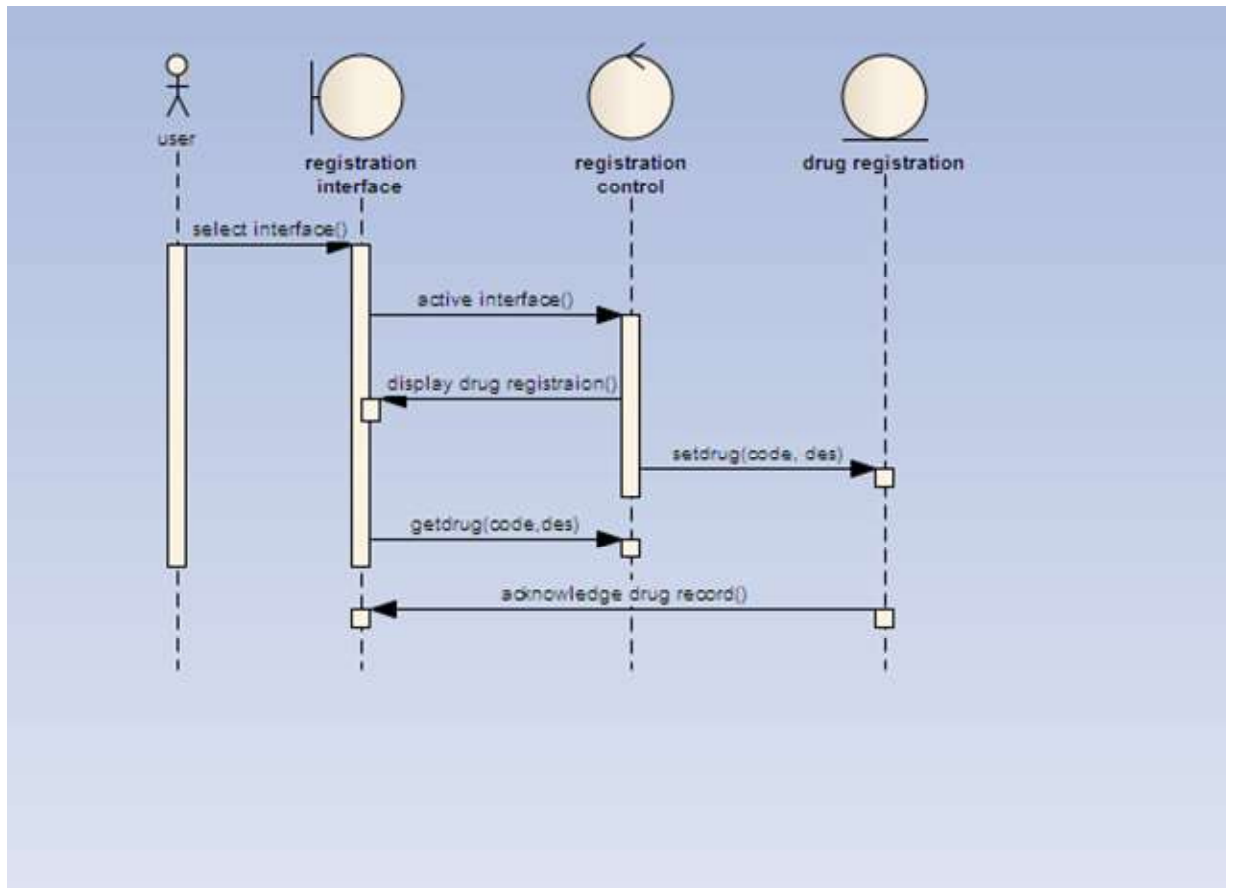**Fig 8: Sequence login**

Fig 9: Sequence setup

Fig 10: Sequence diagram for drug registration
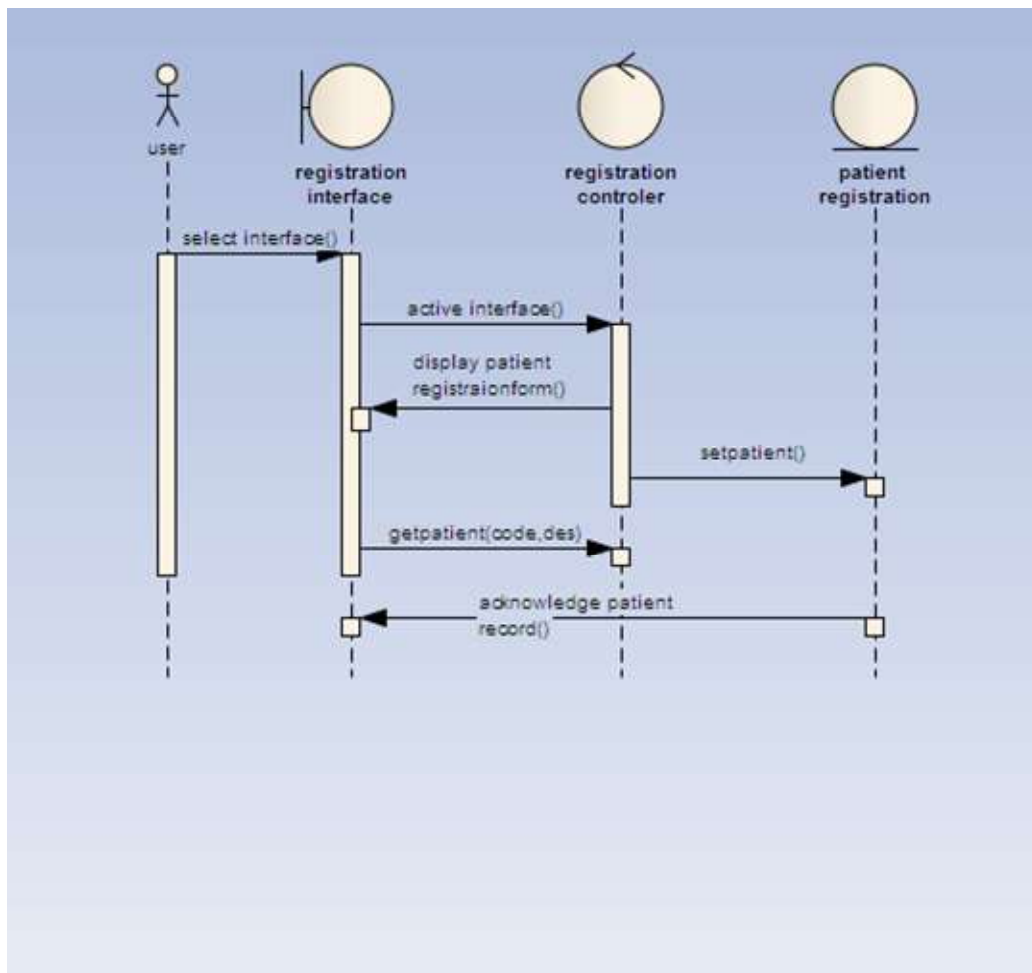
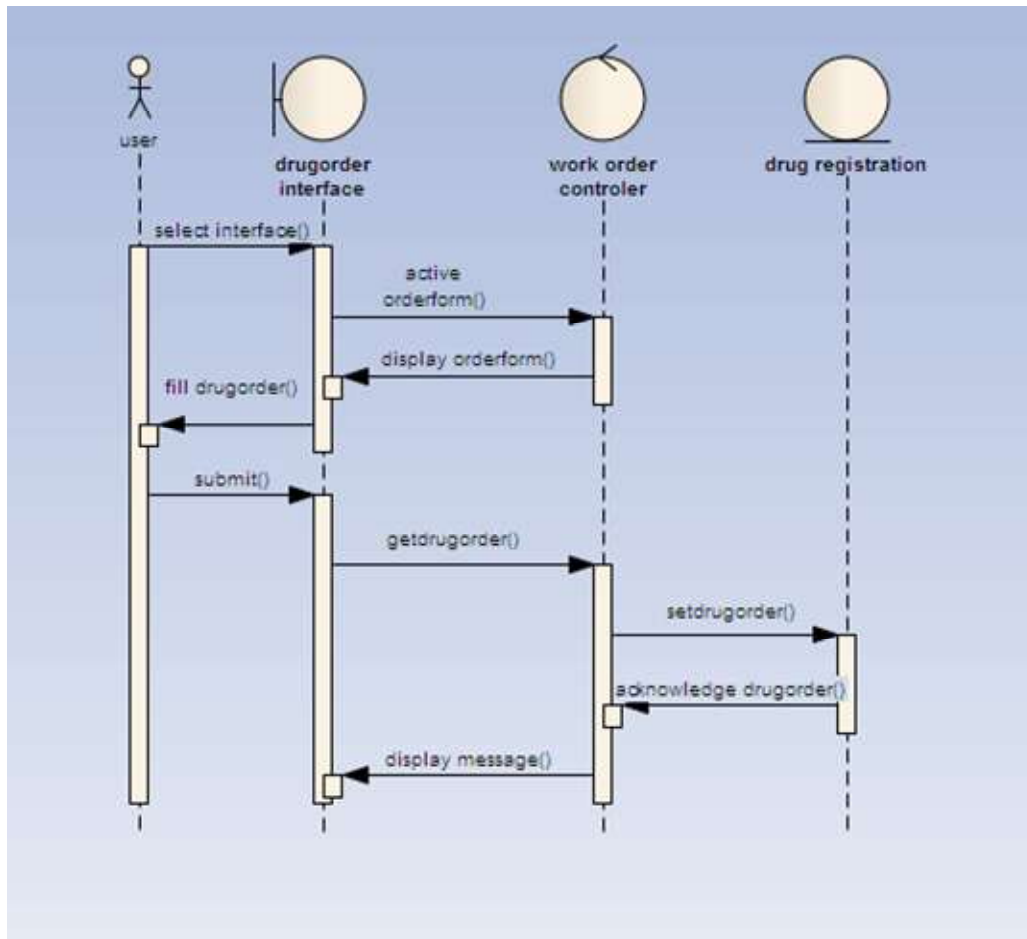**Fig 11: Sequence diagram for patient**

Fig 12: Sequence diagram for ordering drug

4.4.2. Database Layer

4.4.2.1. Database Model

As per the needs depicted in the class diagram, data storage area is created using tables in the database. All fields of the table and the corresponding primary key within each table are identified.
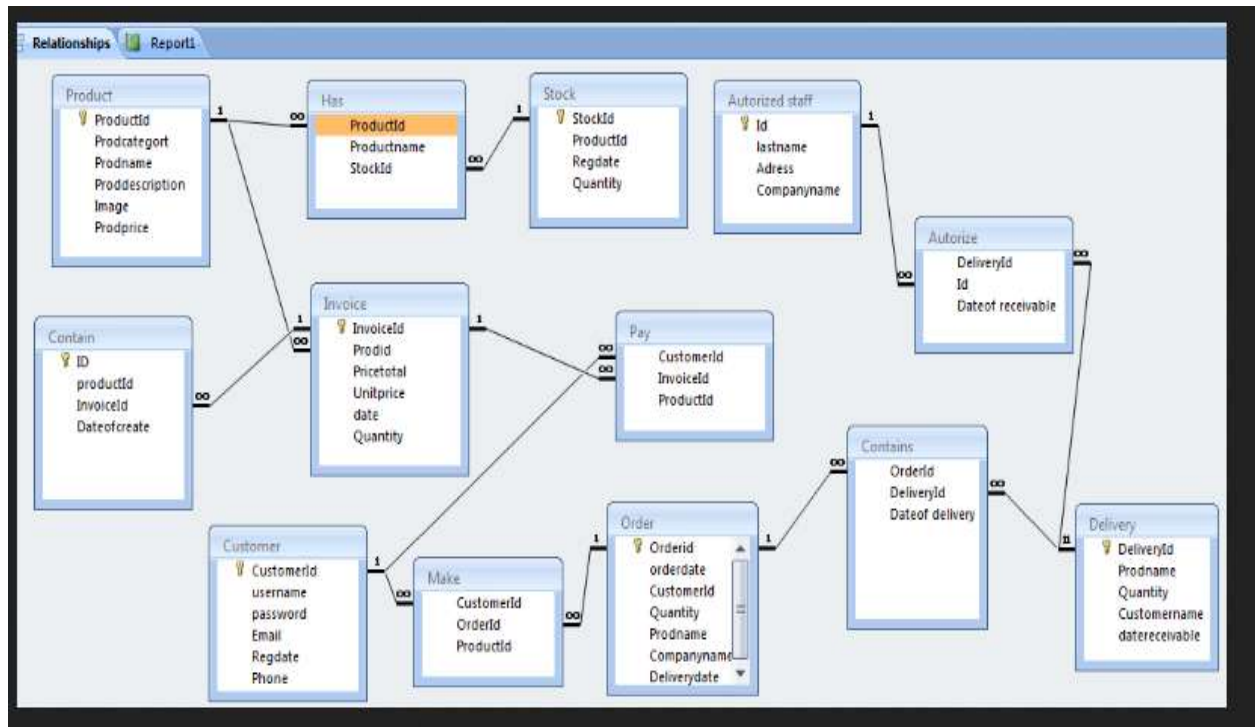
Fig13. Entity Relationship

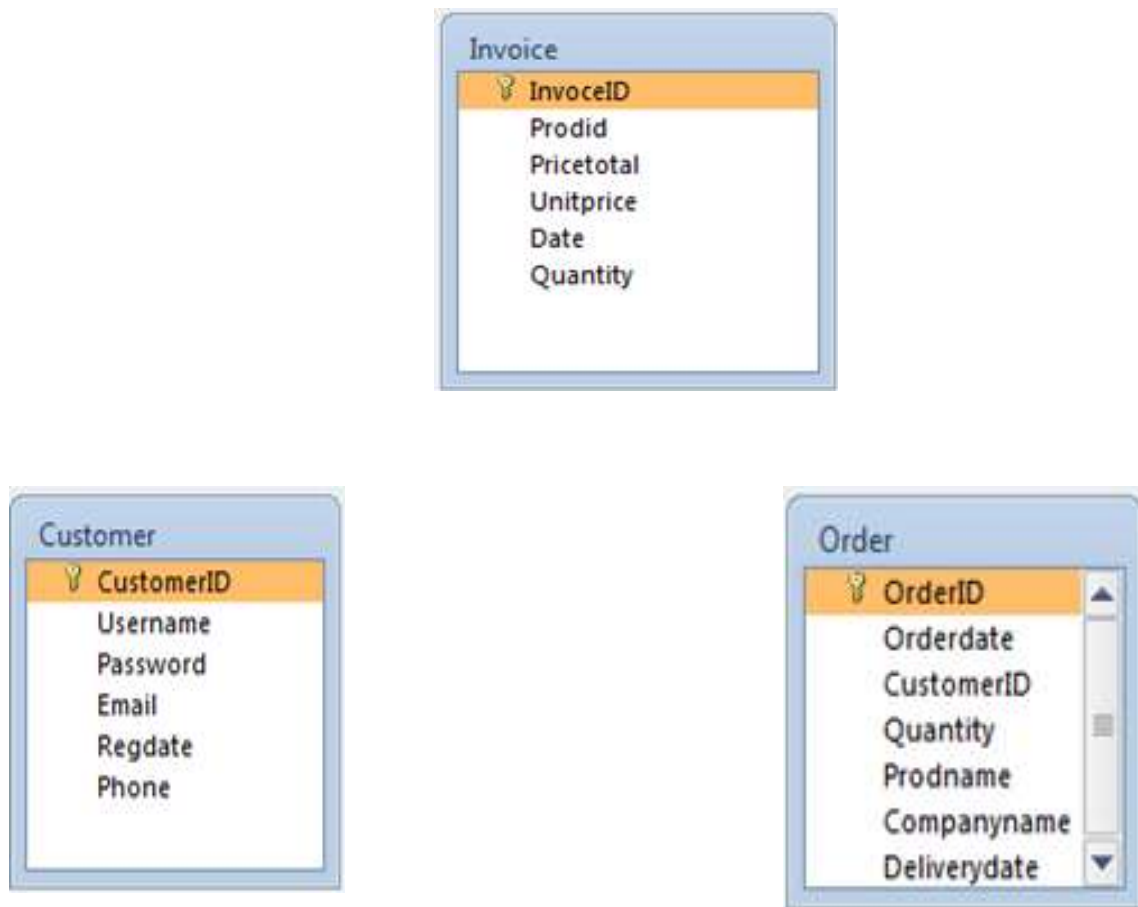Fig14. Key Database tables

4.4.3 Application Layer

This layer is used to connect user interfaces and the database created, MVC and Asp.Net codes are used.

4.4.4 Description of user interface prototype

User interface prototype is a model used to stimulate the system during system design. It is developed using Visio. It helps to enable the end user to test the system at an early stage and identify

the gaps in very low cost and time. It helps to exchange information among the users as well as the stakeholders.

4.4.5. Usability Testing for User Interface

Since the user of the user interface is pharmacists the researcher focused more on them to assess the usability testing by preparing the questions below and got the responses accordingly. As the researcher tried to explain at the beginning of this project on requirement gathering techniques and tools, data collection was held through interview, document review and observation. The researcher interviewed pharmacists and data clerk how the pharmacy department manages the pharmacy management system looks like within the hospital and got different responses and depending on the information gathered the researcher design a web based pharmacy management system and test the usability of the user interface by preparing a check list for eighteen professionals twelve of them from pharmacy department and the rest from other departments and the result found is shown in the form of table.

Table 10: User Interface Test Result

S.No	Test Questions	Yes	No
1	Is the interface easy and understandable?	8	2
2	Is the color has impact on interface?	-	10
3	Is the interface encompasses all necessary content?	6	5
4	Is there to much discrepancy in the system interface?	0	10
5	Is there any content to be added further?	8	-
6	Is there any unwanted content available on the interface?	-	10

CHAPTER FIVE

Conclusion and Recommendations

5.1. Conclusion

The major aim of this project is design and develops pharmacy management system for ALERT Hospital. The system to be developed is mandatory since it helps the health professional especially for pharmacists. Further, the system will help the hospital workers to have their own contribution for requirement gathering. In addition, the system was designed by using design science and object oriented approach which is good methodology for having good document. For collecting data necessary for the project open ended questions for the interview, observation and document review were used. The result of the study was displayed using use case, activity diagram and ER diagram.

PMS is a system that records information about drug within each pharmacy department. The information includes registering drug name, patient name, date expired and dispensary. It supports for planning as well as decision making for organization. The project is the initial steps for developing PMS. Since it follows an iterative process, it depicts the first artifacts that will be developing through the cyclic development. During the time of analysis and design of the system the documentation was not full organized and complete, A manual documentation system is used as the bases for the system proposed.

Since there are lots of factors that affect the quality of care, PMS is thought as one factor that improves the quality of health care. Now ALERT hospital uses paper based system. So it has problems related with having quality of care at the pharmacy in serving the patient. The project will have better contribution in understanding the benefit of PMS and solve the problem around the pharmacy. The researcher gathered information that requires for developing the new system through different data collection tools and techniques. The business process of the current system, functional and non functional requirement and system requirement were described. The proposed system was analyzed by using the analysis model (use case diagram and use case description). The data model of the newly developed system was presented by using entity relationship. The newly developed system has many features that distinguished from other similar project developed as an example the system developed by USAID, if there is a problem in the system not the user who maintained it rather the user of the system must wait the professional until a phone call made from head office to correct it

and the user of the system and the profession register the drug issued on the log book which is tedious but the newly developed system solve this problem by preparing the system to function this system electronically by registering drug name, patient name, price , formulation etc. and when the department need information about dispensing the only thing what the user do is ordering the dispensing report then it comes in pdf format no navigation is required from one form to another simply on the home page there are buttons that enables the user of the system to have one click and open do what they want like generating a report concerning dispensing as well as expiry drug and so on.

5.2 Recommendations

At the time of studying this project the hospital do not have pharmacy management system that works properly. They were using manual system for dispensing which has also its own problem like when a patient come with prescription, the pharmacists should register the patient name, the drug prescribed on the log book prepared and dispensary report is done from the log book by counting it. So an attempt was done to design and develop Pharmacy Management System which assists a permanent solution when it is fully implemented. The hospital administrator and other stake holders should do some major functions to solve the poor handling methods of patients who come to the pharmacy to take medicine.

- ✓ ALERT Hospital should fulfill the necessary hardware like computer and server which is important for the implementation of the system.

- ✓ The workers should get training to have clear understanding about the newly developed System
- ✓ The hospital should provide a better infrastructure to deploy the system.
- ✓ The hospital should provide training on basic computer skill and PMS system to its staff.

Annexes

Annexes I
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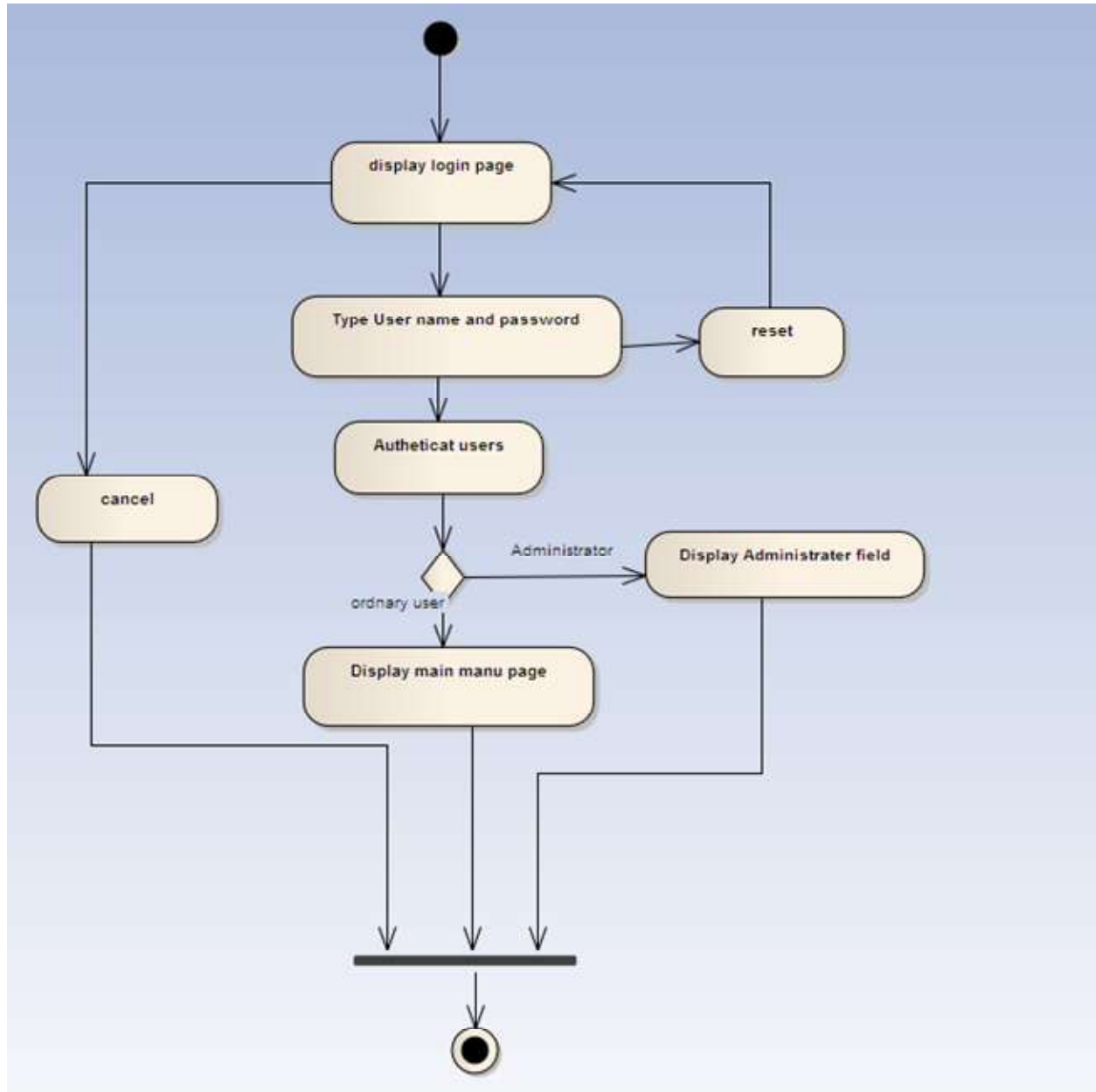
Annex II

List of Activity Diagram

Fig 4: Activity diagram for display login page
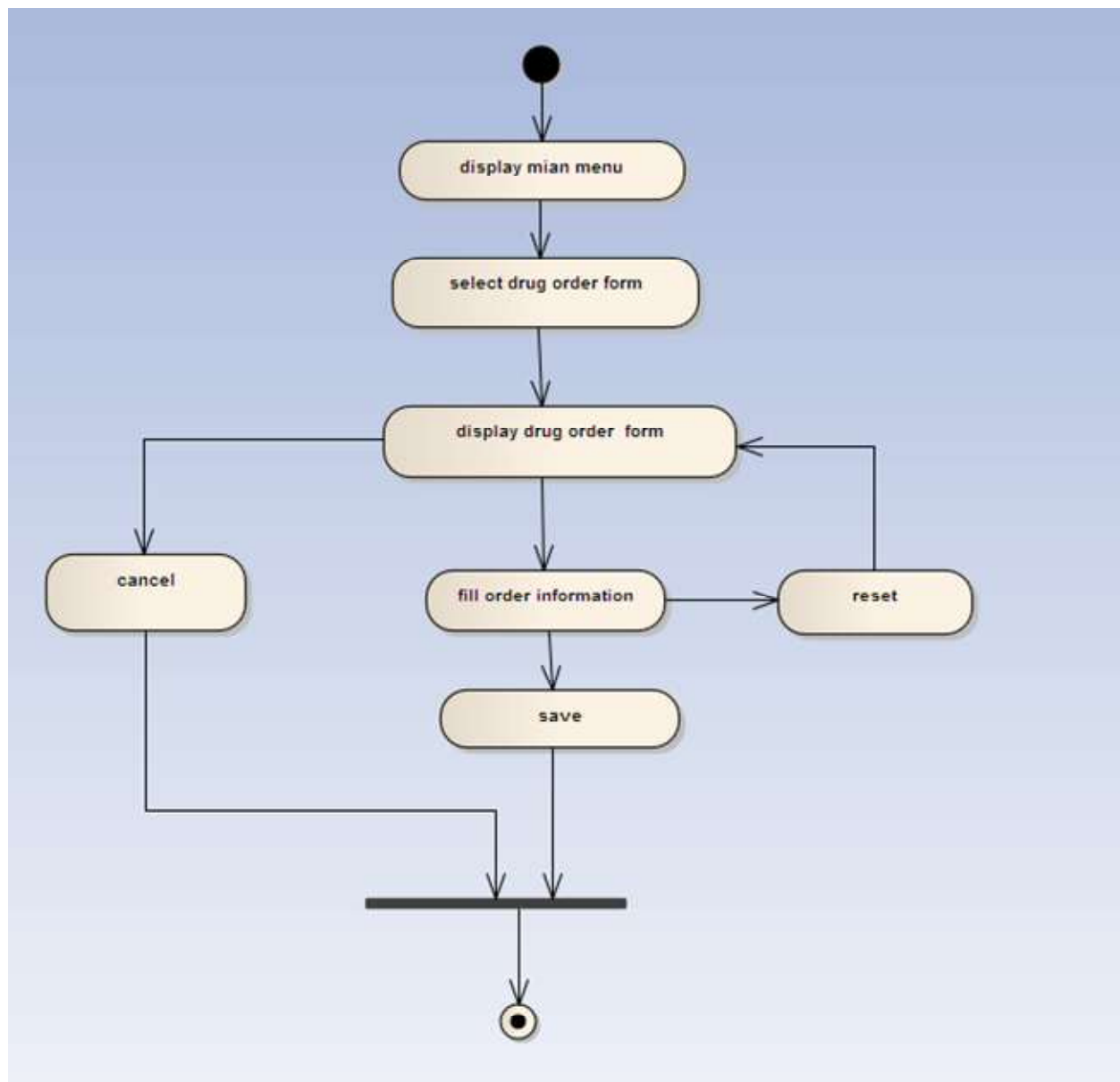
Fig 5: Activity diagram for drug order

Annex III

Interview Guide

Interview guide

Data process

1. How does the hospital pharmacy drug inventory process look like?(generally)

_____
_____
_____

2. How does drug inventory problems traced out?

_____
_____
_____
_____
_____

3. How do you control drug inventory process?

_____
_____
_____
_____
_____

4. Is there any problem on the existing drug inventory management system?

_____
_____
_____
_____
_____

Report/Communication

5. How do you generate pharmacy report?

   _____

   _____

6. To whom this report submits?

   _____

7. How often did you submit the report to the concerned body?

   _____

8. How do you report?

   _____

9. How often do you check the availability of drugs in stock? (What methods do you use for doing it?)

   _____

Computer software

10. Is there any computer software for the existing system? (What are they?)

    _____

    _____

11. What are the functions of the software?(if available)

    _____

    _____

12. Does the hospital have plan to make the drug inventory   system computerized (automated)?

13. Does the hospital ready to support the development of drug inventory system? To what extent?

    _____

    _____

Computer Hardware

14. Is there any computer hardware being used in the existing drug inventory system? List out them?

    _____

    _____

15. Is the hospital ready to fulfill suitable hardware for infrastructure in the development of drug inventory management system? To what extent?

    _____

    _____

Document Review Guide

16. Is there any recording process during drug inventory?

    _____

    _____

17. What type of recording method do you use?

    _____

    _____

18. What kind of information is included in your record?

    _____

    _____

19. Is there any planned inventory recording format? (if yes, please list them)

_____

_____

_____

20. What information does this recording format includes?

_____

_____

Annex IV

User Interface Usability Testing Checklist

1. Is the interface easy and understandable?

   1. ○   2. ○

      Yes   No

2. Is the color has impact on interface?

   1. ○   2. ○

      Yes   No

3. Is the interface encompasses all necessary content?

   1. ○   2. ○

      Yes   No

4. Is there to much discrepancy in the system interface?

   1. ○   2. ○

      Yes   No

5. Is there any content to be added further?

   1. ○   2. ○

      Yes   No

6. Is there any unwanted content available on the interface?

   1. ○   2. ○

      Yes   No