ADDIS ABABA UNIVERSITY GRADUATE STUDIES
SCHOOL OF PUBLIC HEALTH AND INFORMATION SCIENCE

M.SC IN HEALTH INFORMATICS PROGRAMME PROJECT REPORT

REQUIREMENT ANALYSIS AND DESIGN OF WEB BASED DRUG INFORMATION SYSTEM IN ETHIOPIA

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DEDICATION

This project work is dedicated in loving memory to my kin and kith Mother, Kelemuwa Tefera and Father, Abera Demessie who had been my constant source of brainwave.

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I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them.

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Table of Contents

TABLE OF FIGURES

TABLE OF TABLES

ACRONYMS AND ABBREVIATIONS

WBDIS: Web-Based Drug Information System

DIC: Drug Information Centers

DHS: Demographic and health survey

FDRE: Federal Democratic Republic of Ethiopia

HIV/AIDS: Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

PHP: Hypertext Preprocessor

HTML: Hypertext Markup Language

MySQL: My Structured Query Language

FMHACA: Federal Medicine, Health, Administration and Control Authority

FMoH: Federal Ministry of Health

JAC: Joint Academic Commission

AAU: Addis Ababa University

BLH: Black Lion Hospital

PC: Personal Computer

ABSTRACT

Background: Web-Based Drug Information System (WBDIS) is a computerized system designed to meet the information needs of doctors, pharmacist and clients as well in hospital with respect to drugs. It is a system that provides electronic drug references data in the pharmacology field. WBDIS will provide versatile benefits in terms of granting up-to date, impartial and scientific drug information to medical professionals and the public at large. The doctors and pharmacists always refer to the drug references data in order to know the details about the specific drug data. At the government hospital, the process of finding the drug references data still done in manual way by drug references books. Other than that, the drug references books are outdated. There are no standard drug references systems that can be referred by the doctors and pharmacists.

Objective: This project aims to analyze requirements gathered and design of drug information system that is rendered by Drug Information Centers (DIC) at national level.

Methods Among various software development life cycle models defined and designed which are followed during software development process, waterfall SDLC model was followed to design and analyze WBDIS. This project carried out within public medical and paramedical professionals and their clients in Federal hospitals located in Addis Ababa. Requirements for the project analysis and design gathered through interview and document review.

Tools and Techniques: Word document and Visio diagrams are the tools used to create this document. Use cases and UML diagrams are created to describe the scenarios.

Results: Analysis and design documents of WBDIS were the deliverables following the completion of the project, including Software Requirement Specification (SRS) and Software Design Specification (SDS).

Conclusion: In this project, I analyzed the current DIS and designed Web-based drug Information System that provides online drug information safely and easily to the health professionals and the public. The system was not only analyzed and designed to provide merely drug information, but was also analyzed and designed in a way that the users is allowed to interact with the system by posting requests and comments. WBDIS have also a separate administration part that helps the system administrator to manage all drugs data, users, drug category, security and user`s request.

CHAPTER 1: INTRODUCTION

1.1Background

Essential drugs play a crucial role in many aspects of health care. If available, affordable, of good quality and properly used, drugs can offer a simple, cost-effective answer to many health problems. In many countries drug costs account for a large share of the total health budget. Despite the obvious medical and economic importance of drugs there are still widespread problems with lack of access, poor quality, irrational use and waste. In many settings essential drugs are not used to their full potential. Even people who have access to drugs may not receive the right medicine in the right dosage when they need it. Many people buy, or are prescribed and dispensed, drugs that are not appropriate for their needs. Some use several drugs when one would do. Others use drugs that carry unnecessary risks. The irrational use of drugs may unnecessarily prolong or even cause ill-health and suffering, and results in a waste of limited resources. (1).

According to a report published by The Japan Council1 for Quality Health Care, 400 accidents and 180,000 incidents related to drugs occurred in 2010. In one case where a doctor prescribed 1800 mg of the total amount of a powder drug, the patient received 1800 mg of the active ingredient instead. To prevent such errors, it is necessary to check prescriptions and find errors. (2).

Medication error (ME) is a significant problem within our health care system, in terms of patient harm and cost. In July 2002, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) cited the need to reduce medication errors as a top priority. Several studies suggest that medical error is the third-leading cause of death in the United States, closely trailing heart disease and cancer. (3, 4)

Since the 1960s, there has been a dramatic increase in the amount of drug information. The number of chemical compounds alone is growing at a tremendous rate. Around 4000 substances are added every day. There have been many developments in data storage and communication technology, which have impacted on the type of medium used to contain CD – ROMs, DVDs and internet servers. There has been a drastic explosion of drug information on the World Wide

Web during the past few years. The term drug information developed as an identity in the early 1960s when used in conjunction with the world centre and specialists. In 1962, the first drug information centre was opened at the University of Kentucky Medical Centre. The centre was to be a source of selected comprehensive drug information for staff physicians and dentist to evaluate and compare of drugs as well as provide the drug information of nurses, and later on new centers were opened up in 1973 identified 54 pharmacists operated centers in the united states was found in the formal survey. The individual responsible for operation of the centre was called the drug information specialist. The development of the drug information centers and drug information specialists was the beginning of the clinical pharmacy concept. It laid the ground work for pharmacists, to demonstrate the ability to assume more responsibility in providing input on patient drug therapy. By using their background in certain areas, pharmacists could offer their expertise as consultants on drug therapy. (5)

Few reliable data on the prevalence, patterns and trends of illicit drug consumption exist in most countries of the world [“World situation with regard to drug use, in particular the spread of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) through drug injection: report of the Secretariat”. (6)

This information deficit seriously impedes the development, implementation and evaluation of policies and programs designed to reduce levels of drug consumption or limit the adverse health and social consequences associated with such behavior. The paucity of good data is particularly apparent in Africa. To date, most of the information on drug epidemiology available from Africa has been in the form of rapid situation. Therefore, Epidemiologists in Africa, and indeed any professionals in the field of human development, are faced with a number of challenges when developing drug information systems.

Offering effectual quality health service becomes the main focus for every health organization nowadays. One of the ways to move towards efficient service is moving from the manual task to the electronic system. In the government hospital, majority of the medical tasks are done manually such as registration process, doctors' prescription for patients, and beds arrangement in the wards as well as the drug references for doctors and pharmacists to refer to. The same

scenario happens at the public hospitals in Ethiopia. The quality service at the hospitals can be improved by transforming manual task into the computerize system.

Despite major strides to improve the health of the population in the last one and half decades, Ethiopia's population still face a high rate of morbidity and mortality and the health status remains relatively poor. Vital health indicators from the DHS 2005 show a life expectancy of 54 years (53.4 years for male and 55.4 for female), and an IMR of 77/1000. Under-five mortality rate has been reduced to 101/1000 in 2010v. Although the rates have declined in the past 15 years, these are still very high levels. The major health problems of the country are largely preventable communicable diseases and nutritional disorders. The major health problems of the country are largely preventable communicable diseases and nutritional disorders. More than 90% of child deaths are due to pneumonia, diarrhea, malaria, neonatal problems, malnutrition and HIV/AIDS, and often as a combination of these conditions. (HSDP IV). In response to this sickening situations, FDRE government has been implementing a series of five- year strategic plan for the health sector known as Health Sector Development Program(HSDP I, II, III and IV) starting from 1995 E.C. Currently, HSDP IV is under implementation. Among the foremost ten strategic objectives of the HSDP IV, improving pharmaceutical supply and services is strategy that is designed to increase the availability of pharmaceuticals (medical equipment and products for prevention, diagnosis and treatment) at an affordable price and in usable condition, ensuring an uninterrupted and adequate supply to health facilities. It also aims to achieve improved rational drug use and a significant reduction in pharmaceutical wastage. The intended outcome will be adequate availability of the right pharmaceuticals at the right place and at the right time in the right condition and used properly by patients and clients. (HSDP IV). This is also reflected on national drug policy of the transitional government of Ethiopia. (7)

Rational use of drugs requires access to objective drug information. Health professionals need a good understanding of the therapeutic action, the possible hazards and the cost of drugs they prescribe; the public's need to know the do's and don'ts of self-medication and the general principles of drug use and storage. Drug information is disseminated among others through bulletins, posters and brochures. Considering the need for disseminating drug information, FMHACA has been providing objective, unbiased, and up-to-date drug information through

bulletin, posters, brochures and radio. Recognizing the significance of providing such drug information to the public and health professionals in an organized way for promoting rational drug use, it is planned to strengthen those activities and also provide new services.(8)

FMHACA has planted a national level DIC, which coordinates regional and facility-level DIS centers. Its purpose is that managing routine and specific drug information requests.

1.2 Statement of the Problem

In Ethiopia where majority of the people are poor, the need to have drugs are safe, affordable and dispensed rationally and equitably.

The doctors and pharmacists always refer to the drug references data in order to know the details about the specific drug data. At the government hospital, the process of finding the drug references data still done in manual way by drug references books and using DIS provided by DIC. Other than that, the drug references books are outdated. There are no sufficient and up to date standard drug references systems that can be referred by the doctors and pharmacists.

To solve these problems, a system to transform the manual process of finding drug references data into the computerized system is very crucial. By transforming the manual drug references data into the web-based system, the doctors and pharmacists time for searching the drug data for references can be reduced. Beside, the drug references data can be updated as soon as possible if the immediate update is needed and doctors and pharmacists are able to view the updated data.

Medication error (ME) is a significant problem within our health care system, in terms of patient harm and cost. In July 2002, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) cited the need to reduce medication errors as a top priority. Several studies suggest that medical error is the third-leading cause of death in the United States, closely trailing heart disease and cancer.1, 2 In fact, at least 7,000 inpatient deaths occur annually as a direct result of medication errors in hospitals and 106,000 deaths occur each year, due to adverse effects of medications.(9) Therefore, WBDIS might lessen such problem in such a way that by protecting the health professionals and the public not to decide the drug management inaccurately.

Doctors and pharmacist are, in the hospital nowadays, still referred the drug data in manual approach. They use FMHACA books as it is the official drug reference. This approach will create another problem that affects providing efficient service to patients such as:

I. Doctors and pharmacists waste their time by turning page to page of books in order to search for the particular drug information.

II. The doctors and pharmacists are not able to find the latest drug data as the FMHACA latest volume is published after some years.

III. Drug formularies prepared and published by FMHACA is not easy to use and even handy.

IV. If any latest drug information is available, there is no immediate update can be made and informed to all doctors and pharmacists.

V. The existing manual system of providing drug information is not easily accessible for the public (patients).

The main factor is there is no an electronic system for drug references that can be viewed by doctors and pharmacists even by the public. And if any updates for the latest drug data must be made, there is no faster way to update it so that the doctors and pharmacist can only referred to the up to date drug data as their references.

In short, in the history of pharmaceutical development in Ethiopia, the effect of not having safe and reliable drug information is very lethal. Developing technology way out like WBDIS might alleviate the problems seen in pharmaceutical sector of Ethiopia, specifically in DIS.

1.3 Objective

1.3.1 General Objective

The general objective of this project work is to analyze gathered requirements the current manual DIS and design of WBDIS in Ethiopia.

1.3.2 Specific objectives

- To produce Software Requirement Specification(SRS)
- To Produce Software Design Specification(SDS)

1.4 Significance of the Project

Web-based systems have become increasingly important due to the fact that the Internet and the World Wide Web has become ever-present, exceeding all other technological developments in our history. The Internet and especially companies websites has rapidly evolved in their scope and extent of use, from being a little more than fixed advertising material, i.e. a "web presences", which had no particular influence for the company's business, to being one of the most essential parts of the company's core business.(11)

There are lots of advantages by implementing WBDIS in the hospital. This implementation will provide doctors and pharmacists from all departments in the hospital accessing the same standard and drug references data. The drug searching in electronic way will be faster rather than using manual reference books that public, doctors and pharmacists have to turn page by page until their find the particular drug information. Besides, the WBDIS also provide the medical staffs and the public to give their suggestion for the new drug information or any unavailable drug data that they are needed to search.

Furthermore, if the medical staffs detect any error for the drug information, they are able to report the error to the administrator immediately by using WBDIS. As a result, the administrator will be able to update the required drug information or fix any drug information error immediately. The WBDIS also provides updates for the drug data. As another way to say, the administrator can manage the drug data by himself in order to make the WBDIS always up to date and fulfils the medical staffs' needs for any drug information. Other than that, the WBDIS accessibility is not limited in the hospital area only. It can be access outside the hospital as this WBDIS is going to be implemented in the web-based application. As there are many advantages about the idea of WBDIS, it shall be developed to give better facilities for medical staffs and the public at large to increase their job qualities.

In short, the Proposed System will provide a key solution to avoiding all the problems mentioned previously is to find a unified way to solve the problems mentioned earlier. The only unified way is by computerization.

1.5 Scope and Limitation

The project scope is limited to analyzing and designing of WBDIS which includes:

- Producing Software Requirement Specification(SRS)
- Producing Software Design Specification(SDS)
- Preparing analysis model of the system
- Preparing system design models

This project has not addressed the remaining phases of the waterfall model of system development, these are:

- Implementation of the system
- Testing of the system
- Deployment of the system

CHAPTER 2: LITERATURE REVIEW

2.1 Literature

As a basis for designing complex information systems the Web-technology has matured a lot over the last few years. The technology is still fairly simple with a number of unsolved problems, but the advantages and potentials are so significant that most of today's design of information systems to some extent is based upon web-technology. Organizations increase their investment in and usage of web-based technology. The scope of web-based application has grown enormously and has moved to become a platform that can support all facets of organizational work. Furthermore, the web-technology differs from the traditional information technology in that "it might be labeled as a new type of information system, but [...] it is fundamentally a new medium of human communication" (12).

The literature on design and development of web-based information systems seems to agree that development of web-based systems is different from development of 'traditional' IT-based systems. Kristin Braa et al. argue that the technology mainly is an interaction medium and that in a www-environment new applications will be developed and assembled by cloning existing components. Thus the notion of tinkering is more important in web-application development than 'rational' design decisions. From this they argue that the key-words of the information systems discipline will be "prototyping, object orientation, reuse and bricolage, 'quick and dirty ethnography', networking, redundancy, plug-ins, innovations, customer focus and time to market." Others argue that development of web-sites (a set of web-pages) differs a lot from development of web-based information systems. Tomás Isakowitz et al. state that the latter "supports work, and is usually tightly integrated with other non-WISs such as databases and transaction processing systems". Web-based information systems are, however different from traditional information systems in the sense that they require new approaches and often are results of grass-root efforts. Some authors also stress the differences in terms of the speed of change in the technological basis. The pace at which the continuous evolvement of tools and features are running at the web-technology is extreme even compared to the rest of the IT-area,

and that these tools "have lured people away from recognizing the need for a systematic design approach" (13).

4.1.1 Overview of Web- Based Drug Information System (DIS)

It is illogical to define DIS without first defining information system. As pursuant to M. Kumar information system is defined as *"an integrated effort to collect, process, report and use information and knowledge to influence policy making, program and research"*. Any specific information system aims to support operations, management and decision making. (14) In a broad sense, the term is used to refer not only to the information and communication technology (ICT) that an organization uses, but also to the way in which people interact with this technology in support of business processes.(15) Silver et al. (1995) provided two views on IS that includes software, hardware, data, people, and procedures. (15) A second managerial view includes people, business processes and Information Systems. The Association for Computing Machinery defines "Information systems specialists [as] focus[ing] on integrating information technology solutions and business processes to meet the information needs of businesses and other enterprises."(17)

A Computer (-Based) Information System is essentially an IS using computer technology to carry out some or all of its planned tasks. The basic components of computer based information system are:

- Hardware- these are the devices like the monitor, processor, printer and keyboard, all of which work together to accept, process, show data and information.
- Software- is the programs that allow the hardware to process the data.
- Databases- are the gathering of associated files or tables containing related data.
- Networks- are a connecting system that allows diverse computers to distribute resources.
- Procedures- are the commands for combining the components above to process information and produce the preferred output.

The first four components (hardware, software, database and network) make up what is known as the information technology platform. Information technology workers could then use these

components to create information systems that watch over safety measures, risk and the management of data. These actions are known as information technology services. (18)

Information technology departments in larger organizations tend to strongly influence information technology development, use, and application in the organizations, which may be a business or corporation. A series of methodologies and processes can be used to develop and use an information system. Many developers have turned and used a more engineering approach such as the System Development Life Cycle (SDLC) which is a systematic procedure of developing an information system through stages that occur in sequence. An Information system can be developed in house (within the organization) or outsourced. This can be accomplished by outsourcing certain components or the entire system. (18)

The **World Wide Web** (abbreviated as **WWW** or **W3**, commonly known as **the web**) is a system of interlinked hypertext documents accessed via the Internet. With a web browser, one can view web pages that may contain text, images, videos, and other multimedia and navigate between them via hyperlinks. The terms Internet and World Wide Web are often used in everyday speech without much distinction. However, the Internet and the World Wide Web are not the same. The Internet is a global system of interconnected computer networks. In contrast, the web is one of the services that run on the Internet. It is a collection of text documents and other resources, linked by hyperlinks and URLs, usually accessed by web browsers from web servers. In short, the web can be thought of as an application "running" on the Internet.(19)

In our context, WBDIS is information system for Ethiopia based on the internet where:

- To provide comprehensive, objective and evaluated information on drugs with a view to enhancing the rational use of drugs.
- To disseminate technical, scientific & objective information to health care providers.
- To disseminate appropriate drug information to the general public
- To generate, collect, analyze and maintain drug information data
- To design produce and distribute drug information materials
- To give appropriate information on toxicology and poisoning

2.1.2 Over view of Web based Application.

In computing, a **web-based application** is any application that uses a web browser as a client.(20) The term may also mean a computer software application that is coded in a browser-supported programming language (such as JavaScript, combined with a browser-rendered markup language like HTML) and reliant on a common web browser to render the application executable. Web applications are popular due to the ubiquity of web browsers, and the convenience of using a web browser as a client, sometimes called a thin client. The ability to update and maintain web applications without distributing and installing software on potentially thousands of client computers is a key reason for their popularity, as is the inherent support for cross-platform compatibility.

In contrast, web applications use web documents written in a standard format such as HTML and JavaScript, which are supported by a variety of web browsers. Web applications can be considered as a specific variant of client-server software where the client software is downloaded to the client machine when visiting the relevant web page, using standard procedures such as HTTP. Client web software updates may happen each time the web page is visited. During the session, the web browser interprets and displays the pages, and acts as the *universal* client for any web application. (21)

The following are its benefits:

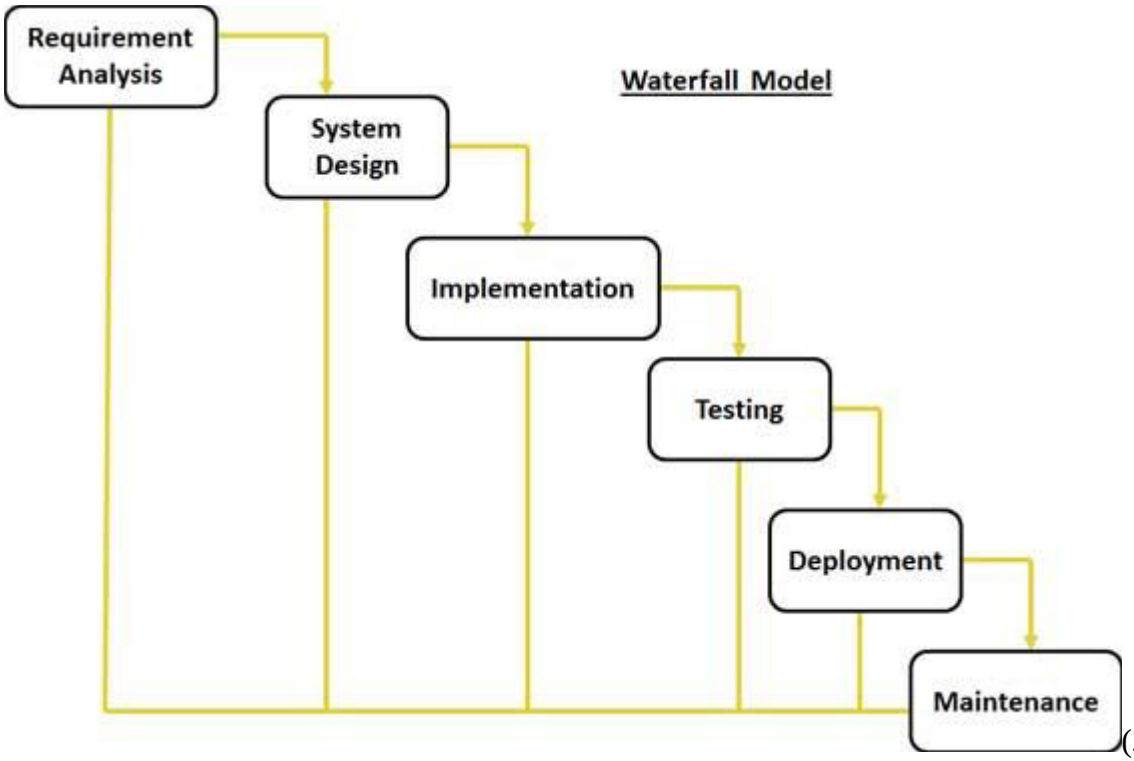
- Web applications do not require any complex "roll out" procedure to deploy in large organizations. A compatible web browser is all that is needed;
- Browser applications typically require little or no disk space on the client;
- They require no upgrade procedure since all new features are implemented on the server and automatically delivered to the users;
- Web applications integrate easily into other server-side web procedures, such as email and searching.
- They also provide cross-platform compatibility in most cases (i.e., Windows, Mac, Linux, etc.) because they operate within a web browser window.

- With the advent of HTML5, programmers can create richly interactive environments natively within browsers. Included in the list of new features are native audio, video and animations, as well as improved error handling.
- Modern web applications support greater interactivity and greatly improved usability through technologies such as AJAX (Asynchronous Javascript and XML) that efficiently exchange data between the browser and the server.
- Web applications allow for easier introduction of new user devices (e.g. smart phones, tablets) because they have built-in browsers

4.1.2 Overview of Waterfall SDLC Model

Waterfall model is the earliest SDLC approach that was used for software development .The waterfall Model illustrates the software development process in a linear sequential flow; hence it is also referred to as a linear-sequential life cycle model. This means that any phase in the development process begins only if the previous phase is complete. In waterfall model phases do not overlap.

Waterfall approach was first SDLC Model to be used widely in Software Engineering to ensure success of the project. In "The Waterfall" approach, the whole process of software development is divided into separate phases. In Waterfall model, typically, the outcome of one phase acts as the input for the next phase sequentially.



(23)

Figure 1: Diagrammatic Representation of Different Phases of Waterfall Model

All these phases are cascaded to each other in which progress is seen as flowing steadily downwards (like a waterfall) through the phases. The next phase is started only after the defined set of goals are achieved for previous phase and it is signed off, so the name "Waterfall Model". In this model phases do not overlap. (24)

2.2 Related Works

As many literatures indicate, there is no any related works in Ethiopia to date. Nonetheless, there are some in other areas of the world. The first study was conducted in Haiti rural by Elisabeth J. Berge et al. titled as "*Implementation and Evaluation of a web based system for Pharmacy Stock Management in Rural Haiti*". (24). As per this study, we are able to see that the web based system transformed the pharmaceutical services of the community by rendering quality service even if it did not introduced drug information system.

Another qualitative study conducted by UK titled as, "*Taking Pharmacy Services to a new level with the Intranet*". (25) As pursuant to Tugwell`s work the pharmacy service can render the

following through the intranet system: Prescribing guidelines, pediatric formulary, pharmacy bulletin, polices on medicine, Drug information system (DIS), summaries of conferences and seminaries, status of newly marketed drugs and so forth. This study showed that Wed based system makes the pharmaceutical sector very useful to health professionals in granting evidence based services.

In a nutshell, it is easy to realize that WBDIS brings about transformation in the health sector by rendering quality and evidence based service to the professionals and the public at large.

The waterfall development model originates in the manufacturing and construction industries; highly structured physical environments in which after-the-fact changes are prohibitively costly, if not impossible. Since no formal software development methodologies existed at the time, this hardware-oriented model was simply adapted for software development. (26)

In literature there seems to be an agreement on problems connected to the use of the waterfall model. Problems are (among others) that the model does not cope well with change, generates a lot of rework, and leads to unpredictable software quality due to late testing. Despite the problems identified, the model is still widely used in software industry; some researchers are even convinced that it will be around for a much longer period of time. The following trends can be seen in research. First, the model seems to be of very little interest for researchers to focus on as it seems to be old-fashioned. Instead, recent studies have much more focus on agile and incremental development. Secondly, there is very little empirical research backing up what we believe to know about the waterfall model.

Some waterfall proponents prefer the waterfall model for its simple approach and argue that it is more disciplined. The waterfall model provides a structured approach; the model itself progresses linearly through discrete, easily understandable and explainable phases and thus is easy to understand; it also provides easily identifiable milestones in the development process. It is perhaps for this reason that the waterfall model is used as a beginning example of a development model in many software engineering texts and courses.

It is argued that the waterfall model in general can be suited to software projects that are stable (especially those projects with unchanging requirements) and where it is possible and likely that designers will be able to fully predict problem areas of the system and produce a *correct* design

before implementation is started. The waterfall model also requires that implementers follow the well-made, complete design accurately, ensuring that the integration of the system proceeds smoothly. (27)

Advocates of Agile software development argue the waterfall model is a bad idea in practice believing it impossible for any non-trivial project to finish a phase of a software product's lifecycle perfectly before moving to the next phases and learning from them.

For example, clients may not know exactly what requirements they need before reviewing a working prototype and commenting on it. They may change their requirements constantly. Designers and programmers may have little control over this. If clients change their requirements after the design is finalized, the design must be modified to accommodate the new requirements.

Designers may not be aware of future implementation difficulties when writing a design for an unimplemented software product. That is, it may become clear in the implementation phase that a particular area of program functionality is extraordinarily difficult to implement. In this case, it is better to revise the design than persist in a design based on faulty predictions, and that does not account for the newly discovered problems. (28)

By and large, the reasons why I favor waterfall SDLC method compared to Agile methodology are:-

- Simple and easy to understand and use
- Easy to manage due to the rigidity of the model.
- Easy to arrange tasks.
- Process and results are well documented.
- Each phase has specific deliverables and a review process
- Works well for smaller projects where requirements are very well understood

The major right of way areas that describe the essential characteristics of WBDIS in Ethiopia are emanated from Policy statements, Policy implementation guidelines, and identified fact in government strategies. These policy statements and identified facts are dealt under HSDP IV documents (HSDP IV). In the document, the directions and guiding principle towards the pharmaceutical sector and objectives, goals and targets that the government aims to achieve are undoubtedly acknowledged.

As far as the researcher knowledge is concerned, no WBDIS has been designed and developed in Ethiopia yet. Consequently, this project fills the gap with respect to current manual drug information services rendered by respective DIC in public hospitals.

CHAPTER 3: METHODOLOGY

3.1 The Project Setting

This project undertook at Addis Ababa, capital city of the Country, which is composed of 10 sub-cities during the fall of the year 2006 E.C. There are about 4 Federal Public Referral Hospitals and DIC is established in each hospitals. Among these 4 Federal Hospitals, DIC of Black Lion Hospital is well established and organized services are also delivered. Consequently, I favored this grand health institution in Ethiopia as the project setting by which the project product is emanated. The other rationale to carry out the project at Addis Ababa is that many stakeholders, both primary and secondary, are easily accessible to deliberate about the project and to collect reliable requirements (data) as best as possible.

3.2 Source and Project Population

The source populations are health professionals (pharmacist, Medical Doctors, Nurses, and the like) staffs at DIC reside at Black Lion Referral Hospital, Some experts on DIC from FMHACA and some any clients of the DIC. The inclusion criteria to undertake of interview this for requirement determination are:

- Both the professionals and the clients should be basic computer literate
- The health professionals should deal with human clients.
- Both the professionals and the clients should be located in Addis Ababa.

3.3 Data Collections

3.3.1 Tools

For the purpose of requirement determination of the system, both primary and secondary data were employed from the project source and the population.

Structured Self- Administered interviews for requirement collection were also conducted with designated experts from FMHACA and Health professionals, DIC Staffs and clients of the DIC in Black Lion Hospital. And the requirement was gathered from 20 health professionals in the BLH including DIC staffs, from 5 staffs of FMHACA and from 15 willing clients of the DIC at BLH. The interviews were undergone using separate interview guide for each interviewee based on their status. The interviews were carried out by two data collectors and the researcher. Tape recorder could not be used since the project owner was not allowed to do so by the key informants, rather responses were manually recorded.

3.4 Data management and Analysis

For the purpose of selecting respondents for interview among health professional working on BLH, clients of DIC at BLH and Staffs of FMHACA, I used purposive and convenience sampling of non probability Sampling method.

Three steps of requirement analysis were followed, these are: understanding the existing situation (the as- is system), identifying improvement and defining requirements for the new system (the to-be system).

3.5 Methods of Dissemination of Results

The final product (deliverables) of this project will be presented to the Joint Academic Commission (JAC) of School of public Health and Information science of AAU, as a project partial fulfillment of Master of Science degree (MSc) in Health Informatics. This project product will also be submitted to FMHACA and Black Lion Hospital DIC and FMoH as well. Moreover, the result of the project will too be presented to public conferences when so demands.

3.6 Operational Definitions

Drug: means any substance or mixture of substances or medical equipments or supplies, used for human and animal health care (i.e. diagnosis, treatment mitigation or preventions of diseases or symptoms) including poisons, narcotics & psychotropic substance, chemicals, blood and blood products, vaccines, sera, radio-active pharmaceuticals, pharmaceutical cosmetics and sanitary products.

Drug Information Center: A unit designed for receiving, collecting, analyzing, and providing unbiased, accurate and up-to-date information about drugs and their use.

Drug information Service: The activities function and projects through which centers achieve their objectives and which constitute their programs of work.

Health Institution: means public Hospital or Health center.

Health Professionals: clinicians include Medical Doctors, Nurses, Mid-wifes, Pharmacists and the like who have professional license and registered.

Web-based System: is a system that is installed from and run on the Internet.

Web-based Information System: It is an information system based on the Internet and that allows its components to communicate using browser software. It is always connected with connection to the Internet.

IT infrastructure: the presence and functioning of computer and/or internet connection in DIC.

3.7 Ethical clearance

Ethical clearance was obtained from AAU, school of Public Health. Following the issuance of the ethical clearance, the proposal was provided to Black Lion Hospital, FMHACA, and FMoH in order for obtaining permission for requirement collection from respective respondents.

The objective of the project work is clearly stated on the information sheet prior the interview guides. Key informants were also asked about their consent for sincere participation in the interview through a consent letter in addition to oral agreement. The information sheet and consent letter are presented and described to each interviewee verbally. The key informants were also made certain that their responses and any comment are confidential and shall be used simply for the purpose of the project work.

CHAPTER 4: ANALYSIS OF EXISTING SYSTEM AND DESIGN OF WBDIS

4.1 System Analysis

The existing manual system of DIC was analyzed using requirement determination and meticulous document review.

4.1.1 Current System

The current system(As-Is) of drug information system is manual through DIC Staffs that has been established in some public hospitals located in Addis Ababa, Dire Dawa And Some regional hospitals according to FMHACA DIC guidelines.

The current manual system has been delivering drug information to the public and health professionals in an organized way for promoting rational drug use, it is planned to strengthen those activities and also provide new services no matter what having its own limitations.

The first and foremost limitation of this manual system is not effective and efficient in such a way that it has not been easily and more accessible for the user since it is only confined in the specific health institutions.

In light of productivity it is usually lower, particularly in routine (operational) function of drug information dissemination. Processing of drug information is also slower where volumes of data need to be dealt with. Slower processing is meant some information that could be provided if computerized systems were used that will not be provided at all, because there is not time. Furthermore, the other constraints of the existing paper-based system of drug information are issues of great risk of error, difficulty of making corrections and updating the information when so demands and output quality that is often less consistent and not well designed. At worst, hand written records may be illegible and so completely useless since poorly presented information may fail to communicate key points. The last but not the drawback of the existing manual DIS is that its overly bulky nature both to handle and to store at the expense of office space.

Notwithstanding the existing paper-based DIS have the aforementioned downsides, it solves the problems with respect to having drug information that are rampant on health professionals and public by hook or by crook.

1) Purpose of the Current System

- To provide comprehensive, objective and evaluated information on drugs with a view to enhancing the rational use of drugs.
- To disseminate technical, scientific & objective information to health care providers.
- To disseminate appropriate drug information to the general public
- To generate, collect, analyze and maintain drug information data
- To design produce and distribute drug information materials
- To give appropriate information on toxicology and poisoning

2) Organization of the Current System

A National DIC is organized under the planning and drug information establishment and distribution department of DACA.

Regional DIC will be organized under the appropriate pharmacy related department based on structural organization of the RHB.

And a health institution DIC is organized under the pharmacy Department of the Health Institution.

3) Personnel

At National Level

Staff members of the planning and drug information establishment and distribution department of DACA will run the national DIC. The staff members shall comprise pharmacists with formal training on clinical use of drugs or clinical based experience and a physician.

At Regional Level

The regional DIC is managed by a group/committee, which comprises a pharmacist, physician and IEC officer or a focal person. The pharmacist will be the chairperson of the group/committee.

At Health Institution Level

- The health institution DIC will be coordinated by the pharmacy department.
- The drug information officers (trained physician and pharmacist) will closely work with the Drugs and Therapeutics Committee (DTC) and in consultation with specialists.

4) Facilities

The Drug information Center:

- Has its own office with adequate size and furniture.
- Has a direct telephone line and Internet access.
- Is equipped with computer, the required software and necessary reference materials.

5) Tasks of the current system

The National DIC accomplishes the following tasks:

A) Developing and distribution of Educational and informational materials:

- It prepares, publish and distribute quarterly drug information bulletins targeting the general public and health professionals.
- It prepares publish and distribute newsletter, brochures, and posters as needed which is appropriate to the target.
- It prepares, publishes and distributes formularies, textbooks and other reference materials.

B) Education and Training:

- It provides education on drugs to the target audience (health professionals and consumers) using/through mass media and educational materials.
- It provides education on how to improve rational prescribing and dispensing practices and the use of individual drugs of categories of drugs.
- It organizes trainings and continuing education programmers on drug information, to health professionals.
- It trains drug information officers to work in the other levels.

C) Conduct Research and/or participate in drug utilization studies:

- It conducts on its own or in collaboration with others in carrying out drug utilization studies.
- It periodically assesses the needs in drug information and the design and value of drug information materials.

D) Supporting and Supervising:

- It supports other DICs through provision of bulletins, CDs, references and printed materials.
- It conducts supportive monitoring and evaluation on other DICs.

E) Quality Assurance

- The center should maintain and provide a high standard quality of drug information services.
- The center adheres, in quality assurance program, to the following:
    - Assessment and identification of problems
    - Implementation of solution
    - Monitoring and evaluation of solutions
    - Documentation and dissemination of results

F) Selection of Drug information and Drug information Source:

- The center develops and maintains an effective and efficient system for handling the different sources of information, such as textbooks, journals, magazines, bulletins, and abstracts.
- The center evaluates data and commercial claims and abstract as well as present the information effectively.
- The center selects drug information which are:
    - Understandable by the users
    - Relevant to the target audience
    - Independent and unbiased
    - Not having motive for promotion
    - Complete, objective and based on scientific grounds only.

G) Ethical Provision of Drug information:

- The information provided should not be conflicting between the needs of the audience and legal or public health consideration.
- The information provided should not violate the relationship between the Prescriber/Dispenser and the patient. Rather it should strengthen the relationship between the two.

- The center does not give information on chemical entities whose therapeutic merits are not yet provide and not released to the market for public consumption.
- Provides drug information for medico-legal cases.
- The center provides independent information and without having in advertising a particular product for commercial purposes, in the provision of drug information.
- The center provides reliable, accurate, up-to-date information in sustainable manner, which should be supported by references/literatures.

H) Collaboration with regional, institutional and international centers

- The national DIC coordinates information resources and cooperates with regional and health institution DICs to avoid unnecessary duplication and to provide extensive coverage of the literature.
- The national DIC makes all the necessary efforts to keep contacts between regional, health institution DICs and potential international centers to receive drug information bulletins and other publications.
- The national DIC makes efforts and request to exchange experiences on the provision of drug information between regional, health institution DICs and international centers.

I) Answering enquires

- The center answers drug related enquiries coming from health professionals and general public from any part of the country.
- Answers given to public enquiries should be handled in conjunction with treating physician and results should be followed up by the center
-

J) Monitoring and evaluation

- It monitors and evaluates the status of drug information services of the centers at RHBs & federal health institution level.

4.1.2 Proposed System

4.1.2.1 Overview of the System

The projected system of Web-Based Drug Information System (WBDIS) will be obtainable at anytime, anywhere and display the drug information based on the FMAHCA guideline of Drug information Center.

The proposed system is going to:

- Provide web-based comprehensive, objective and evaluated information on drugs with a view to enhancing the rational use of drugs and quality health service.
- Disseminate automated technical, scientific & objective information to health care providers.
- Disseminate computerized appropriate drug information to the general public
- Generate, collect, analyze and maintain drug information data electronically.
- Display drug information materials electronically.
- Give appropriate information on toxicology and poisoning.
- Have different means of searching the drug information
- Be available online.
- Have an easy interface to make a search.
- Interact with the System user to post request the drug related queries, comment on the information provided.
- Have an administrator page to handle drug data, users, request and security of the system.
- Have an administration page to manage major system functionalities that embrace view, add, edit, delete, publish drug data, and manage additional tasks like managing users, managing security, and managing user's request.

4.1.2.2 Functional Requirements

Functional requirement defines a function of a system or its component and specify particular results of the system. It also describes the interaction between the system and the users independent of its implementation. The functional requirements of the proposed system are listed as follows:

- The system should provide searching facilities.
- The system should have the facility to navigate drugs by diverse category.
- The system should provide the facility to write only English words.
- The system should display the result of the search with the link recommendation.
- The system should make available validation mechanism for user inputs.

- The system should notify the user if the information is not available in the database and an appropriate link recommendation.
- The system should authenticate the user and assign privileges according to the assigned rights.
- The system should deny access if the user supplies wrong username or password.
- The system should provide the facility to change password
- The system should the grant the facility to view, detail information, add, edit and delete dictionary data.
- The system should the grant the facility to create, edit and delete user account.
- The system should register the time, date, and by whom the data is registered.
- The system should provide the facility to publish posted data.
- The system should display the administration page menu according to the assigned user`s right and so on.

Hence, in the nutshell, the system shall:

- Have online search facilities
- Have facility to post user request
- Enables users to manage and validate drug data
- Authenticate and authorize users according to assigned user`s right
- Enables administrator to manage the users.
- Enables administrator to manage posted data.
- Have facility to response to the user`s request.

4.1.2.3 Non-functional Requirement

A non-functional requirement (qualities of the system) 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 the non-functional requirements of the proposed system:

I. Documentation

For the booming completion of the project the activities and outputs of each system development stage in the project workflow shall be properly document shall be properly documented. These documents will be produced at the end of each stage shall be organized and compiled together at the end of the project for system support, future reference and system maintenance.

II. User Interface and Human Factor

The system shall have a user friendly menu driven interface that is easy to navigate with. The greatest degree of user system interface consistency

and standard shall be provided for all user interfaces. The system is able to run any web browser preferably supporting both JavaScript and PHP.

III. Reliability

There shall be a frequent and full backup mechanism to avoid any information loss and inconsistency. And the system shall be uploaded on a unswerving machine.

IV. Performance Characteristics

The system will be interactive and the user is going to get the expected result within not many second or it must enable users to do something else while fetching result for their request to hide response latency. In addition the system will perform operations within a minimum amount of time.

V. Security issues

Administration part of the system is handy only for the authorized Administration staffs as per their assigned rights. An Unauthorized user of the system ought to not access the administration page by any means. Some of the resources and activity shall be restricted and allowed for authorized users. Consequently, the system must user identification method and it must render or deny accesses to users pursuant to the privilege of the potential users

4.1.3 Analysis Model

4.1.3.1 Use Case Diagram

At its simplest, a use case diagram is a representation of a user`s interaction with the system and depicting the specification of a use case. Its main purposes are used to gather requirements of a system; to get an outside view of a system; to identify external and internal factors influencing the system and Show the interacting among the requirements are actors.

The recognized use cases of the system are the following

No	Use Case	Description
1	SearchDrugInformation	Used to search drug information
2	ManagePostRequest	Used to manage the posting of the user request
3	MaintainUsers	Used to create, modify ,and delete users account`s
4	MaintainDrugData	Used to create, edit, delete and publish drug data. It is also deals with managing additional resources.
5	ManageLogin	Used to manage the login to the system and change password task
6	ViewInformation	Used to view drug information

7	ManageSecurityPage	Used to manage security page that serves as the list privileges assigned to users.
8	ManagAccessPrivilages	Used to manage access privileges.

Table 1: Identified Use Cases of WBDIS

1) View Information and/Events

Use Case ID	WBDIS-1
Use Case Name	View Information
Use Case Description	This use case enables the user to view drug information and events
Primary Actor(s)	Users
Pre-Conditions	The user initiates the browser after logging in.
Post-Conditions	View information and events
Basic Scenario	The use case starts when: 1) The user activates WBDIS from his terminal using His/her browser.. 2) WBDIS responds by presenting the home page along with the different menus and tabs as well as link. 3) The user views the information and click on his/her preference tab/link. 4) WBDIS presents the clicked tab/link The use case ends
Alternative Scenario	None
Frequency of Use	throughout the day
Special Conditions	None

Table 2: View Information or events use case

2) Search Drug Data

Use Case ID	WBDIS 2
Use Case Name	SearchDrugData
Use Case Description	It is used to search drug data/ information
Primary Actor(s)	User
Pre-Conditions	The user initiates the browser after logging in
Post-Conditions	Search result
Basic Scenario	The use case starts when: 1) The user clicks on search box from home page. 2) The user enters the text(words) and presses the search button[double click on the word from the list box] 3) The system validates the data and display the result. 4) If the system found the requested word, it displays the result else it displays a message that the word is not found. The use case ends
Alternative Scenario	If the system shows no results at all: 2a) use WBDIS main case scenario (3) to (4).
Frequency of Use	right through the day
Special Conditions	None

Table 3: Maintain drug data use case

3) Maintain Post Request Use- case

Use Case ID	WBDIS-3
Use Case Name	**MaintainPostRequest**
Use Case Description	It is used to view, modify or delete user request.
Primary Actor(s)	Administrator
Pre-Conditions	1) The user successfully logged in 2) The *drug Admin Main Page* is displayed
Post-Conditions	The user request is screened
Basic Scenario	The use case begins while

	1) The user chooses "User request" menu item from Admin Main menu. 2) The user clicks on "view user request" link 3) The system displays user request information. 4) The administrator evaluates the user request and presses accept or deny button. **4.1 modify the request when the administrator press accept** 1) the system populates *Add new data Form* based on the user request 2) Administrator performs the required modification, additional information and presses the S*ubmi*t button. 3) The system validates the data and displays confirmation message. **Post condition:** the user request is added to the drug data table(the data base) **4.**2 delete the user request when the Administrator press deny **1)** the system displays confirmation message **Post condition:** the user request is deleted permanently The use case ends
Alternative Scenario	None
Frequency of Use	Right through the day
Special Conditions	If the user request is comment, the administrator will act accor as so requires.

Table 4: Maintain post request table

4) Maintain user

Use Case ID	WBDIS-4
Use Case Name	**MaintainUser**
Use Case Description	This use case is used to create, modify or delete user's accounts.
Primary Actor(s)	Administrator
Pre-Conditions	1. The user is successfully logged in 2. The *Drug Admin Main Page* is displayed.
Post-Conditions	The new user account is saved into the user account file.

Basic Scenario	The use case start in when: 1) The user clicks "Users" menu item from *Admin Main Menu*. 2) The user clicks on "*Add new user*" link 3) The system displays Add new user Form 4) The user enters full name & account information like username, password, confirm password, status and presses the *Save* button 5) The system validates the data & displays confirmation message. **2.1 Modify the record of existing User** 1. The user selects an account from the list of available users. 2. The system populates detail user information such as full name, username, type(user/administrator) in the *Edit User Form* 3. The user performs the required modification and presses the *Save* button 4. The system validates the data & displays confirmation message. **Post Condition**: The record of user account information is modified. **2.2 Delete the record of existing User permanently** 1. The user selects an account from the list of available users 2. The user presses the *Delete* button 3. The system displays confirmation message **Post Condition**: The record of user account information is deleted
Alternative Scenario	None
Frequency of Use	Twice a week
Special Conditions	None
Includes	Login
Priority	High
Business Rule	1. The administrator can activate or deactivate users account and reset the password. However, S/he can`t view user's password. 2. Password cannot be less than 6 characters.

Table 5: Maintain user use case

5) Maintain Drug Data

Use Case ID	WBDIS-5
Use Case Name	**MaintainDrugData**
Use Case Description	This use case is used to create, modify or delete drug data.
Primary Actor(s)	Administrator
Pre-Conditions	1. The user is successfully logged in 2. The *Drug Admin Main Page* is displayed.
Post-Conditions	The new data is saves into the drug database
Basic Scenario	The use case begins while 1. The user chooses "*Drug*" menu item from *Admin main Menu* 2. The user clicks on "Add new data" link. 3. The system displays Add New Data Form 4. The user enter all the required information and presses the *Save* button. 5. The system validates the data & displays confirmation message. **2.1 Modify the record of existing data** 1. The user selects a data from the list of drug data/info 2. The user clicks on "*Edit data*" button. *3.* The system populates all posted information in the *Edit Data Form* *4.* The user performs the required modification and presses the *Save* button *5.* The system validates the data & displays confirmation message. 2.2 delete the record of existing data permanently 1. the user selects a data from the list 2. the user presses the *Delete* button 3. the system displays confirmation message **Post Condition**: The record of user account information is deleted permanently
Includes	Login

Frequency of Use	Once a week
Special Conditions	None

Table 6: Maintain drug data

6) Manage Login

Use Case ID	WBDIS-6
Use Case Name	**ManageLogin**
Use Case Description	It is used to manage login users
Primary Actor(s)	User
Pre-Conditions	1. The user is successfully logged in 2. The Login Form is displayed.
Post-Conditions	User`s password is changed
Basic Scenario	The use case begins while 1. The user selects *Change Password* menu item from *Drug Admin menu* 2. The system displays *Change Password Form* populated with user id/username 3. The user enters old password, new password, and password confirmation information and presses the Save button. 4. The system validates the data and saves the changes. **Login to the System** 1. The user enters the URL of the Drug Admin page 2. The system displays the *Login Form* 3. The user enters the user name and password and presses the login button 4. The system validates the data and redirects the user to system functionality set to the user 5. The administration main menu is dynamically created according to the assigned Access right of the user. **Post Condition:** the user is successfully logged in
Alternative Scenario	None
Frequency of Use	right through the day
Special Conditions	None

Includes	Login

Table 7: Manage login use case

7) Manage Security Page

Use Case ID:	WBDIS-7
Use Case Name:	**ManageSecurityPage**
Use Case Description	It is used to administer security page
Primary Actor(s):	Administrator
Pre-Conditions:	1. The user is successfully logged in 2. The Drug Admin main page is displayed.
Post-Conditions:	The security page is saved.
Basic Scenario:	The use case start in when: 1. The user clicks *Security Page* menu from the administration main menu. 2. The system displays list of security page. 3. The user clicks on "Add new Page" 4. The system displays Add New Page Form 5. The user fill page title that will be displayed as privilege list and the name of file and submit the form. 6. The system validates the data and saves. **2.1 Modify the Security page** **1.** The user selects the page from the list *2.* The system populates detail page information the *Edit Security Page Form* *3.* The user performs the required modification and presses the Save button *4.* The system validates the data and displays confirmation message **Post Condition**: The security page information is modified **2.2 Delete the record of the existing page Permanently** 1. The user selects the page from the list. 2. The user presses the *Delete* button 3. The system displays confirmation message 4. The system displays confirmation message Post Condition: the page is deleted permanently

Alternative Scenario:	None
Frequency of Use:	right through the working day
Special Conditions:	None
Includes:	Login

Table 8: Manage security page use case

8) Manage Access Privileges

Use Case ID	WBDIS-8
Use Case Name	**Manage Access Privileges**
Use Case Description	This use case enables the administrator to mange access privilege
Primary Actor(s)	Administrator
Pre-Conditions	1. The user successfully logged in. 2. The Drug Administrator Main page is displayed.
Post Condition:	The new access privilege is saved to the selected user account.
Basic Scenario	The use case starts when: 1. The user chooses Privileges menu from the Administration. 2. The system displays list of users and the list of access privileges 3. The user selects a username from the list and select the access right to the user and presses the submit button 4. The system saves the access privilege
Alternative Scenario	None
Frequency of Use	throughout the day
Special Conditions	None
Includes :	Login

Table 9: Manage access privileges

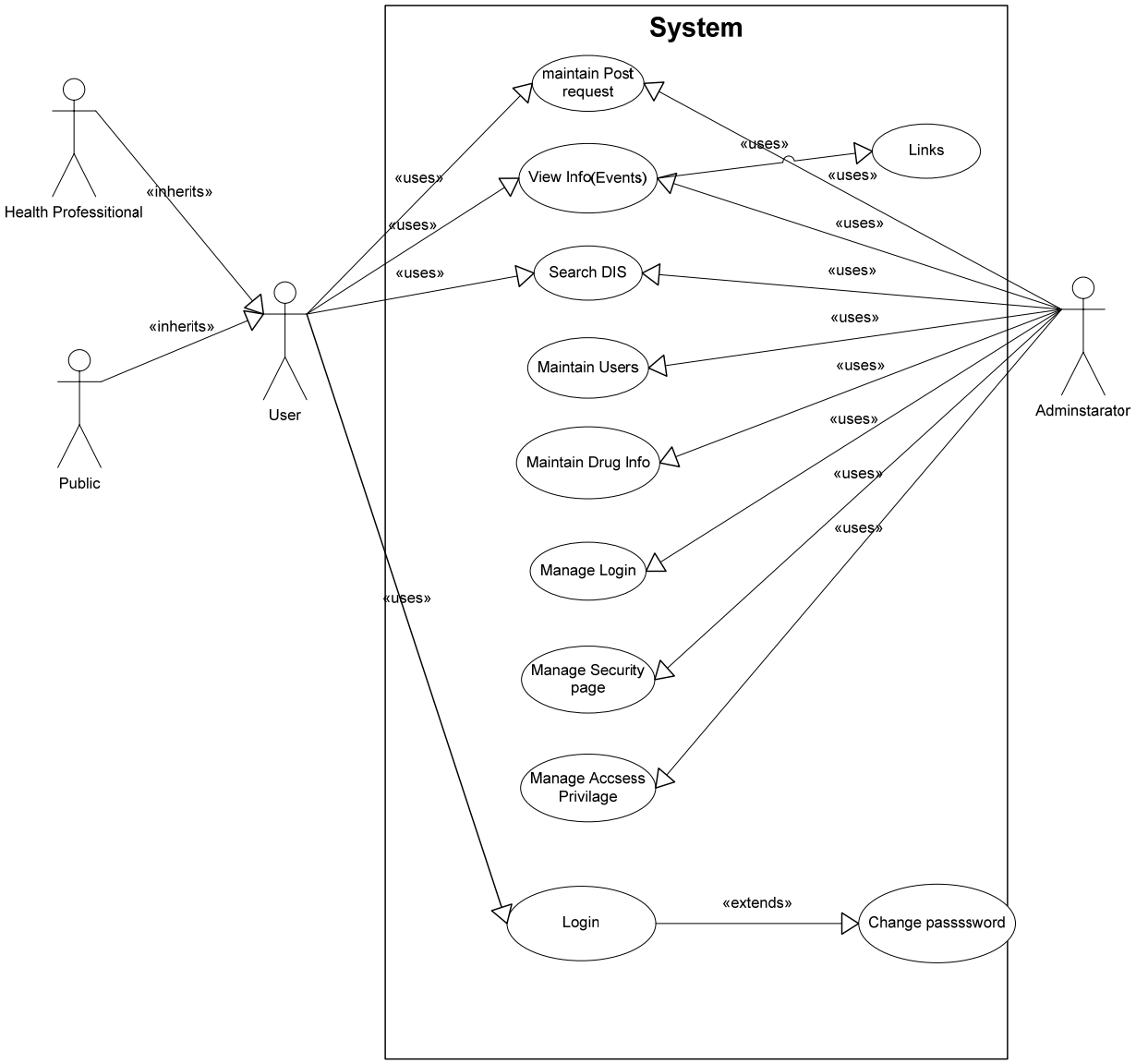


Figure 2: Use case diagram of the system

4.1.3.2 Sequence Diagram

Sequence diagram is an interaction diagram that shows how processes operate with one another and in what order. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. It is used to formalize the behavior of the system and to visualize the communication among objects of the system. The following sequence diagrams portray for the various use cases.

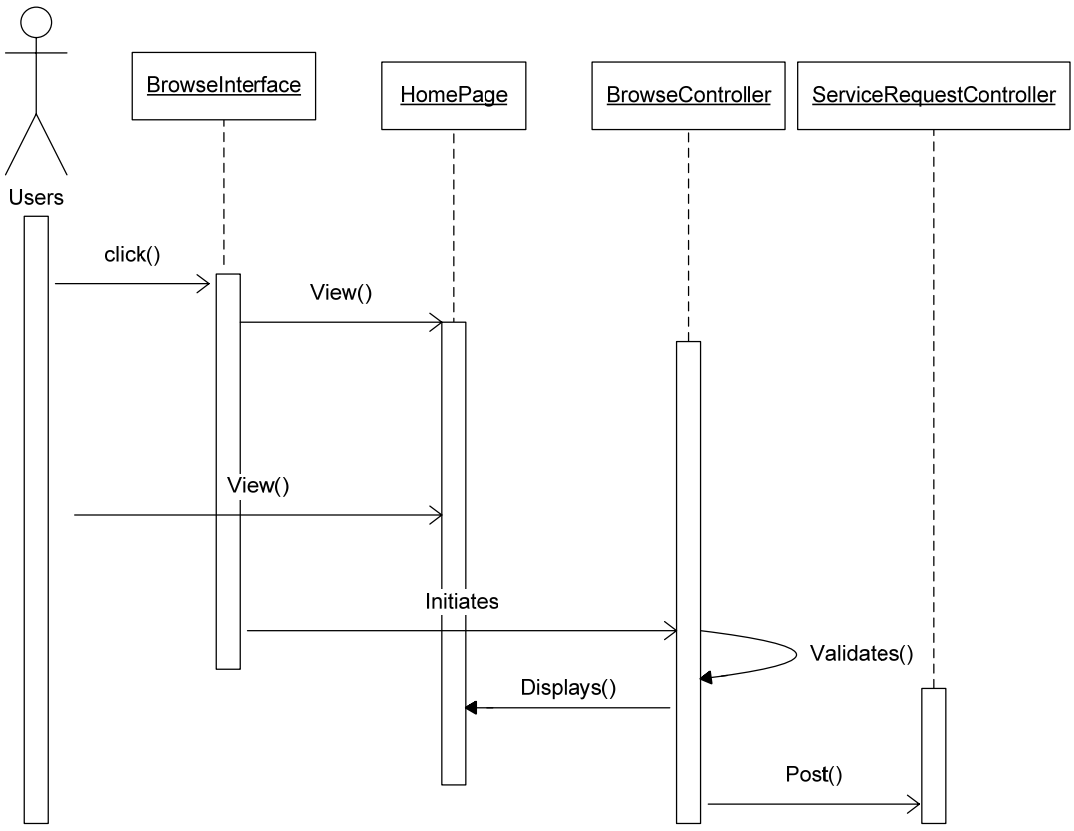


Figure 3: Sequence diagram for view information use case

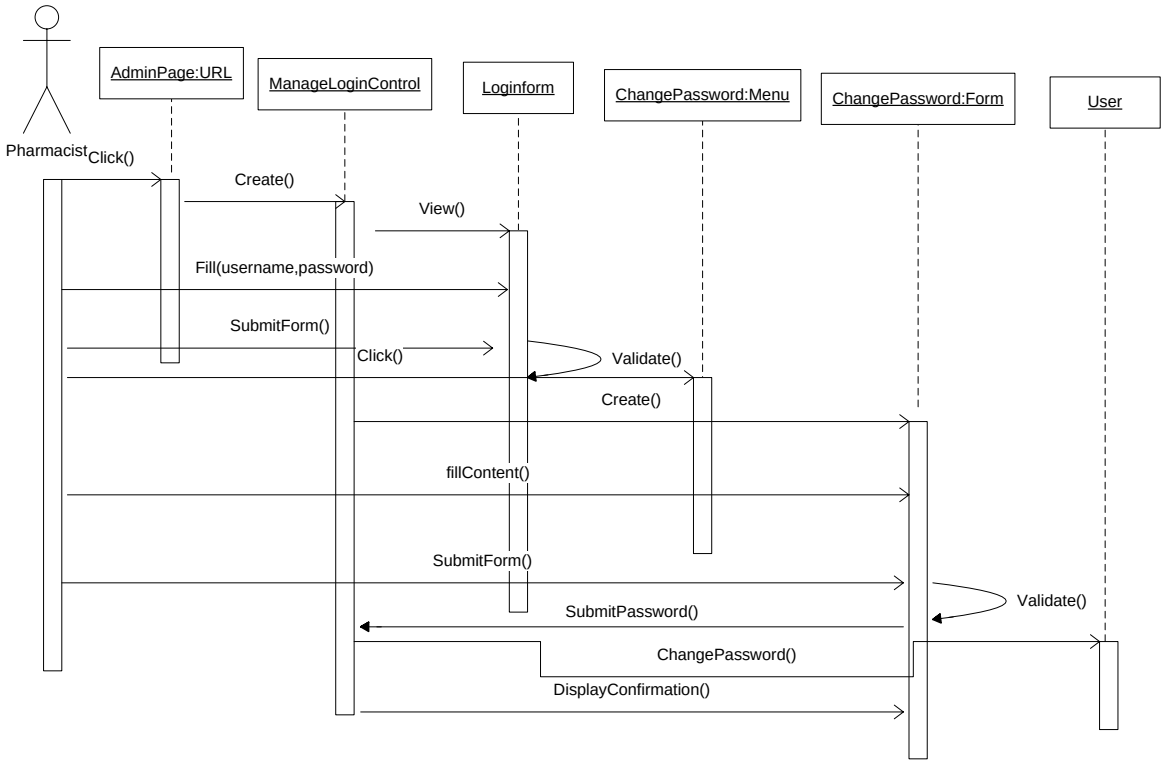


Figure 4: Sequence Diagram for Login use Case

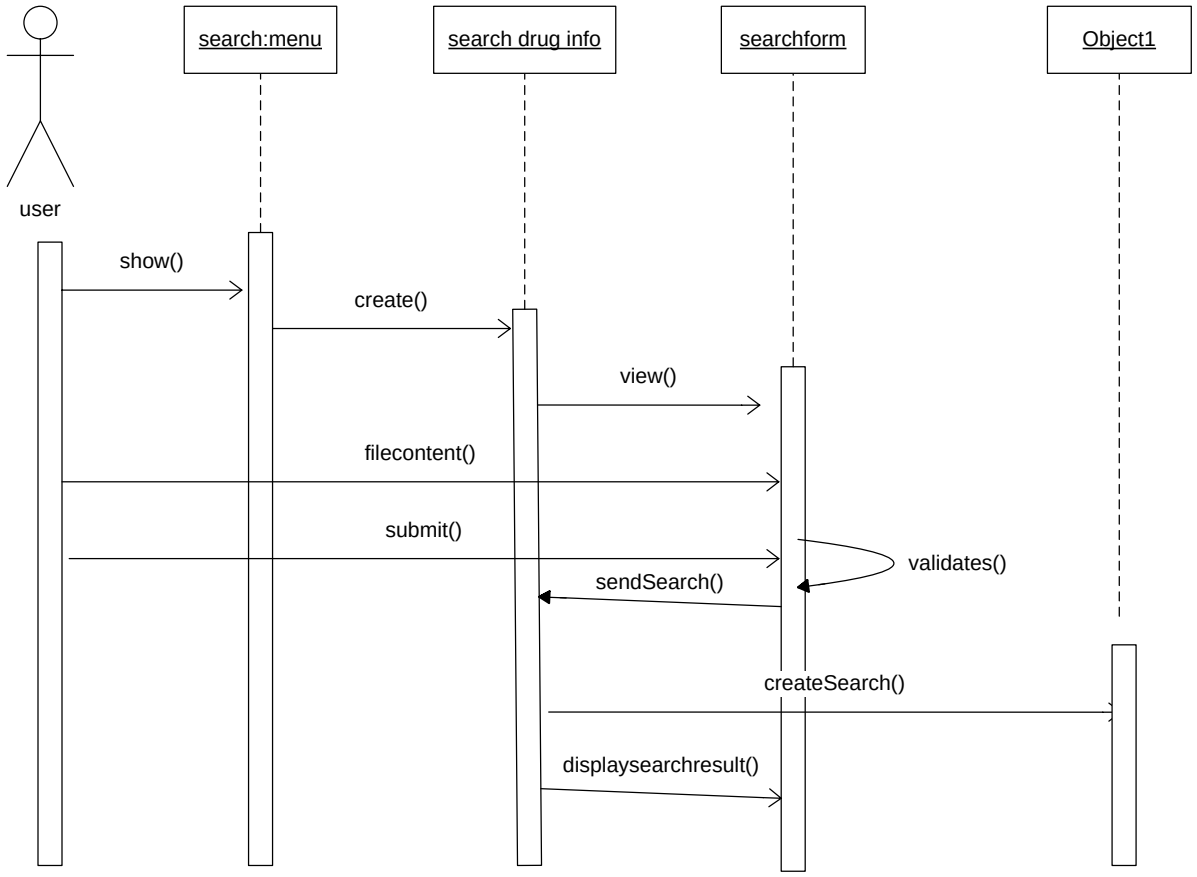


Figure 5 : Sequence Diagram for Search Drug Data Use case

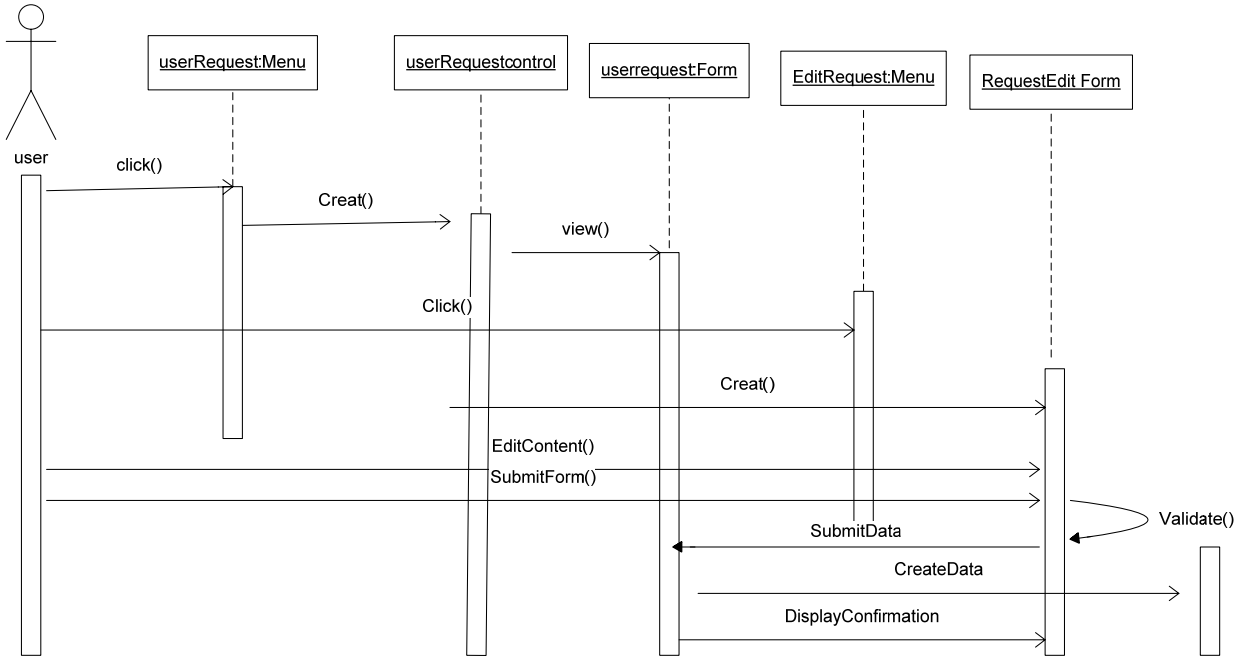


Figure 6: Sequence Diagram for Manage Post Request

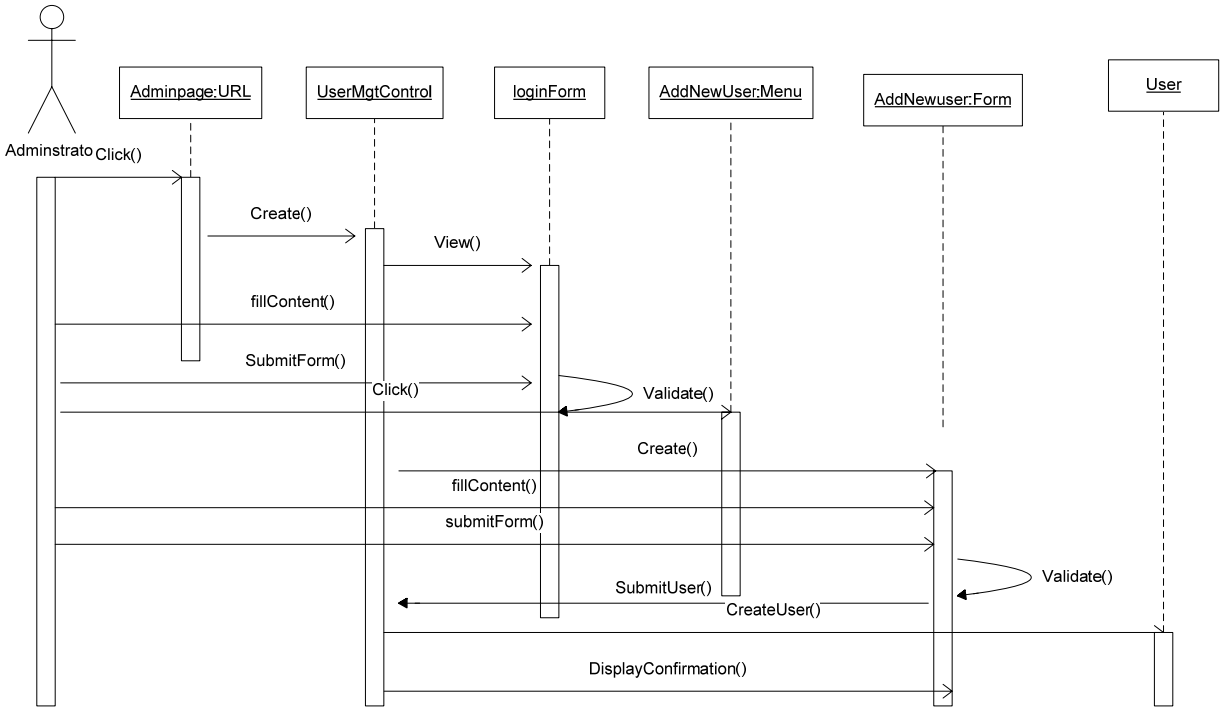


Figure 7: Sequence diagram for Maintain Users

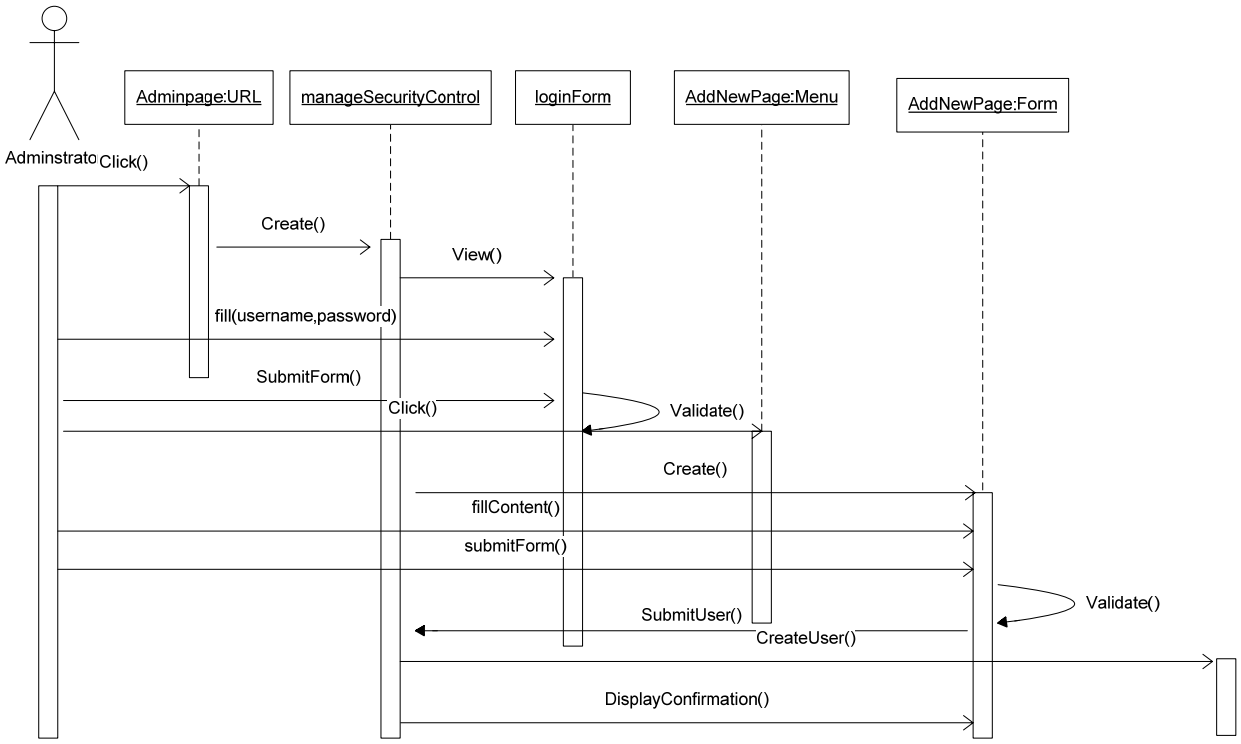


Figure 8: Sequence Diagram for Manage Security Page Use case

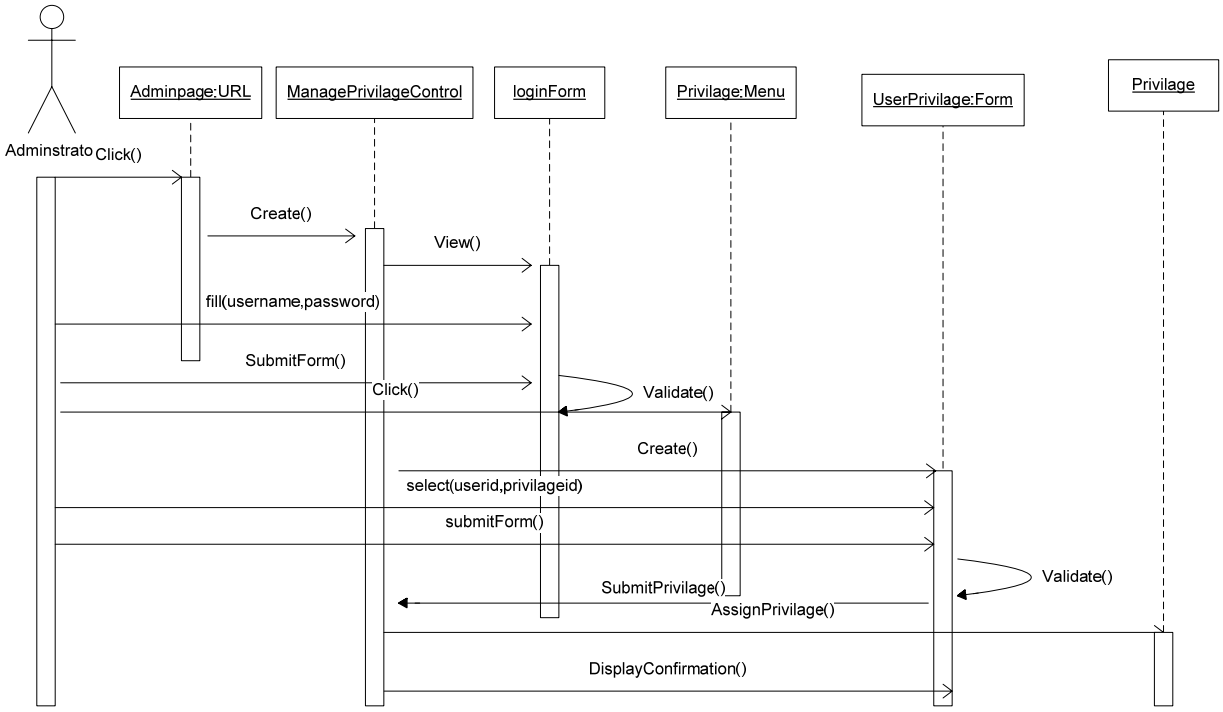


Figure 9: Sequence Diagram for Manage Access Privileges use case

4.1.3.3 Class Diagram

Class diagram is a type of static structure diagram that describes the structure of a system by showing the system`s classes, their attributes, and the relationships among objects.

The following diagram shows the structure of WBDIS.

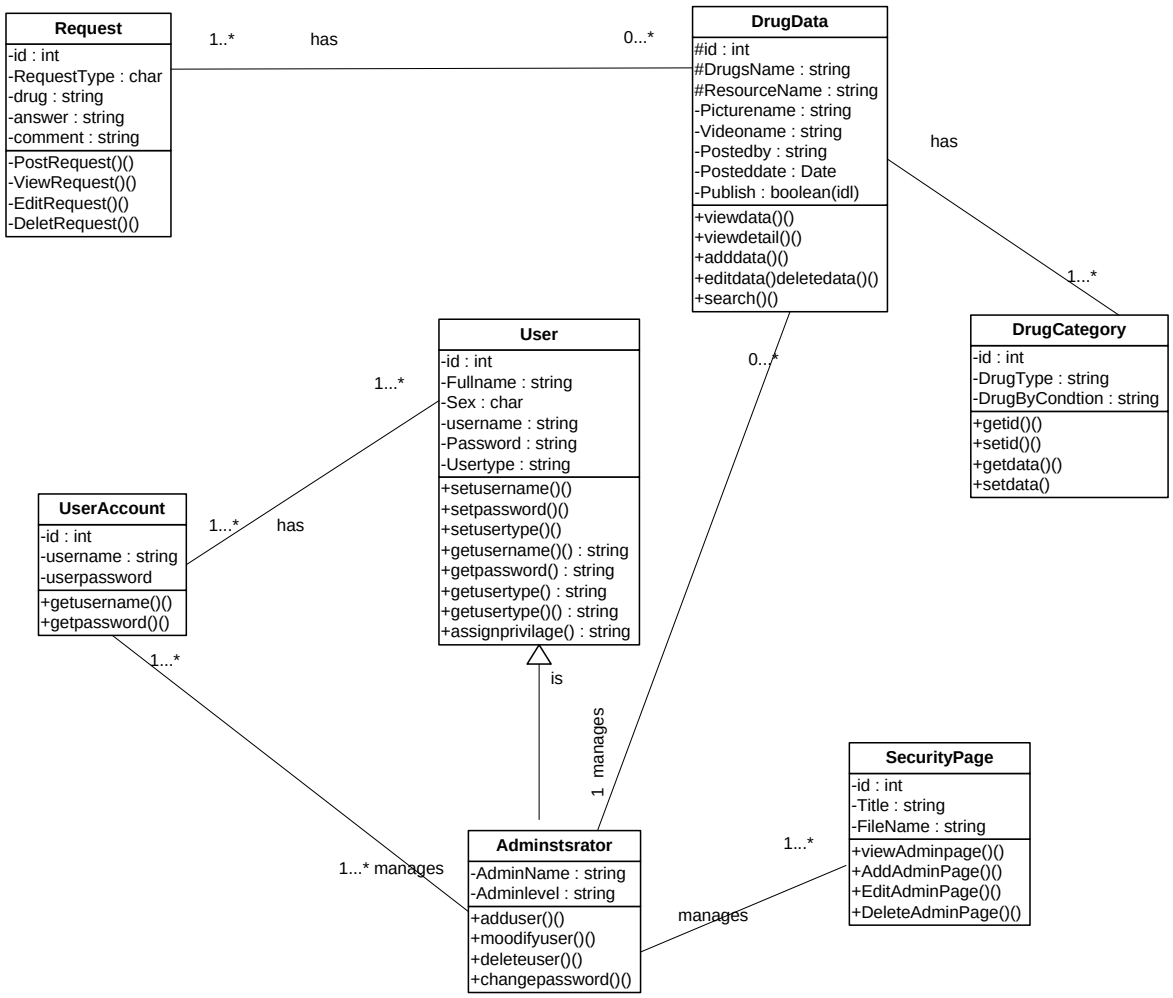


Figure 10: Class diagram of the system

4.1.3.4 Activity Diagram

Activity diagram is a graphical representation of workflows of stepwise activities and actions with support for choice, iteration and concurrency. It is intended to show the overall flow of control.

The figure shown below depicts the activity diagram of the system.

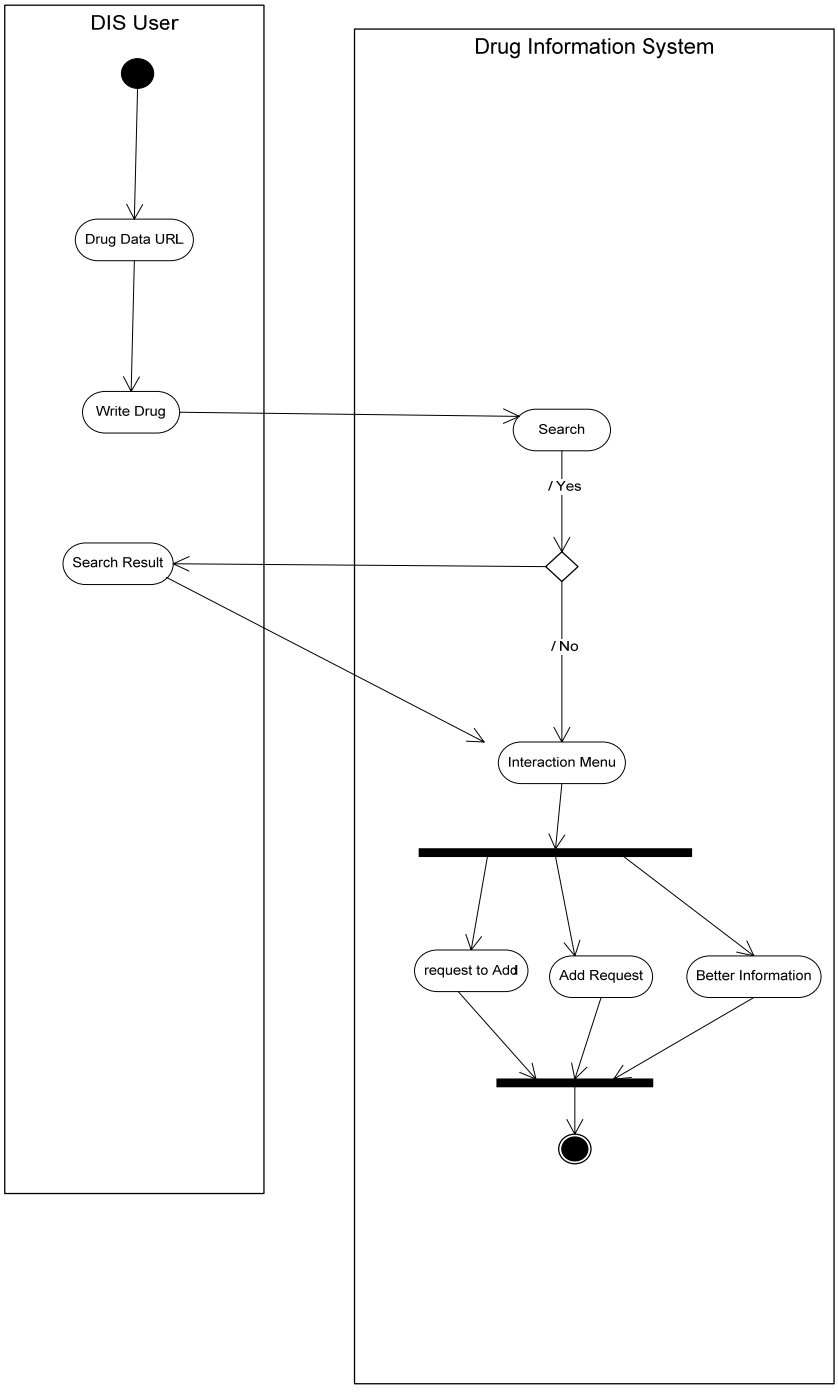

DIS User
Drug Information System
Drug Data URL
Write Drug
Search
/ Yes
Search Result
/ No
Interaction Menu
request to Add
Add Request
Better Information

Figure 11: Activity Diagram of the System

4.2 System Design

In this sub section is design phase of the system, which is all about the design goal of the system and subdividing the system into smaller parts (subsystems) that can be easily realized in order to tackle, problems in organized manner, is dealt. The deliverables this section are description of each subsystem, design goal criteria, proposed system architecture and persistent data management.

4.2.1 Design Goal Criteria

The system is expected to run on a web server for it is a system to be accessed online from different end of the country, even the world. As a result, performance, dependability, cost, maintenance and end user criteria determine the design goal of the system.

Performance

Response time: the allowed execution time on any web server is limited coding should follow simple, efficient and fast algorithms.

Throughput: the system considers the issue of congruency from two point of access corner, these are accesses which require database (accepts 10,000 user at a time) and those not require database.

Memory: memory is required during a user request plus when the server is preparing the response.

Dependability

Robustness: correction and completeness of all user input will be checked and verified before it is passed as a parameter for further execution at the server side.

Reliability: the system must give consistent, reliable and correct output for various type of input it is given.

Availability: the system will be deployed on a web server that is available 24hrs.

Fault tolerance: to handle and tolerate fault that may arise during execution, Error handlers and Record set control objects will be used.

Security: to protect the system from malicious attack the system will be well protected and secured through protection of database password, authorized user and storing users' password in database

Maintenance

Modifiability: the functionality of the system is modified to make the system flexible.

Traceability of Requirement: the system will be developed according to the system analysis and the design specification.

End user

Usability: the system shall be developed in such a way that to be easy for user to use and understand.

4.2.2 Proposed Software Architecture

4.2.2.1 Overview

Since the system is wed-based, it gives drug data searching facilities and collects request from different drug information seekers, it expected that the system will maintain a central data store which can be maintained and accessed from different areas by a considerable users. Hence the system mainly follows Client/ server architecture which is a special type of repository architecture.

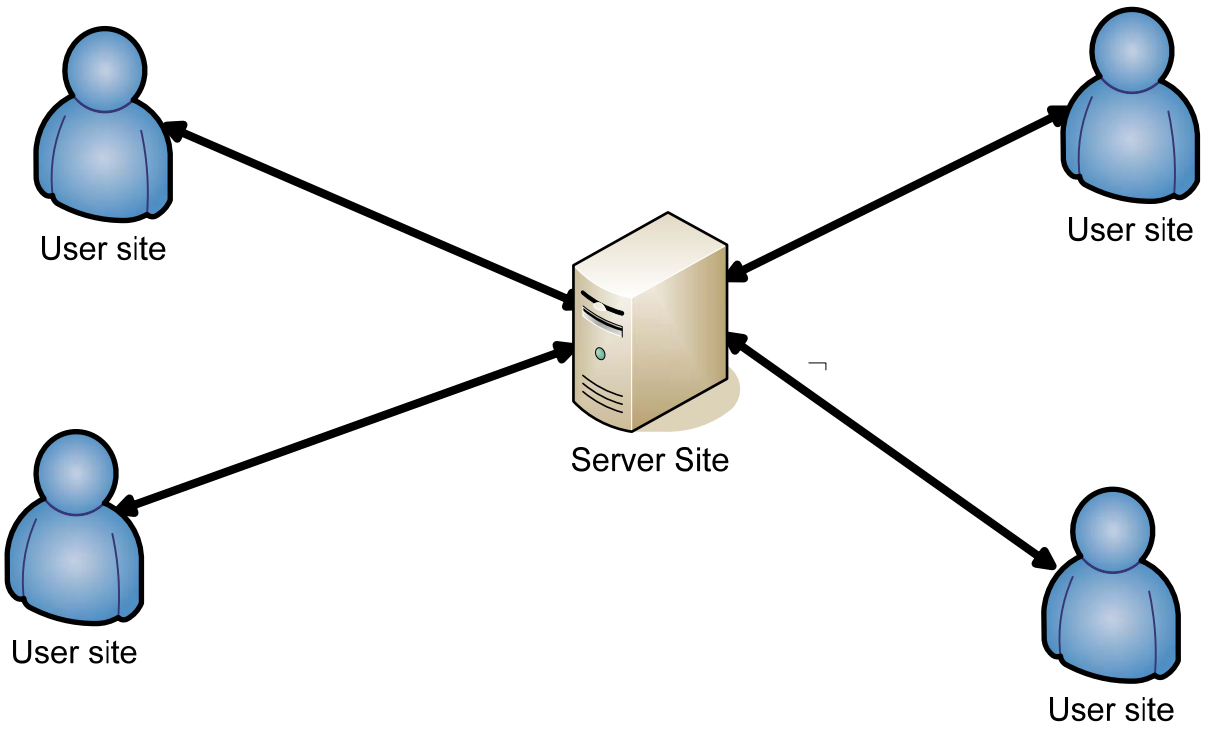


Figure 12: Client-Server architecture

In WBDIS, the service will be readily available on the server and users from different area can access it.

4.2.2.2 System Architecture

The proposed system is decomposed in to four main subsystems. The system is decomposed according to the specialized task it performs to ensure high coherence. The level of coupling is very high in that the interactions between subsystems are only exchange of data the following four sub system will handle major task of the drug data.

1) **Search Sub System**
   It deals with the electronic and online search facilities of the system in addition to dealing with new information capturing from the users to meet the interactivity of the system. It provides search the facilities of searching English Drug data/information, interacting to the system and managing user request.
2) **Drug Subsystem**
   It is in charge of managing and maintaining information for English Drug data/information. It also deals with maintaining requirement of the system that is required to add, edit, display and publish drug data. It renders the facilities of maintaining drug data, managing drug data and drug category.
3) **Users Subsystems**
   It is all about managing and maintaining information about users that provides the facilities to modify user account and to maintain users account.
4) **Security Subsystems**
   It deals with the security of the system plus involves creating the list of security pages. It enables to maintain security pages.

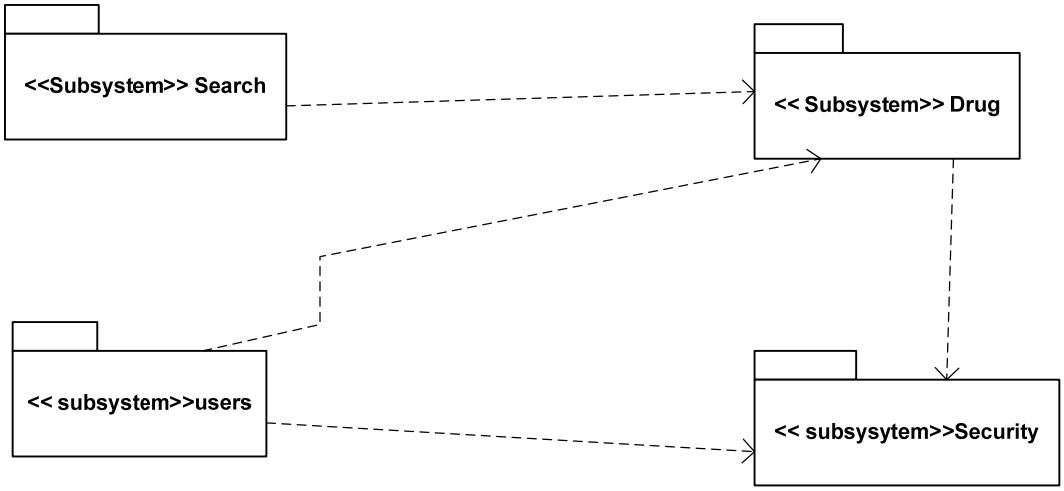


Figure 13: WBDIS`s Sub-System Decomposition

4.2.2.3 Persistent Data Management

The persistent data management of WBDIS is emanated from original class diagram that is produced in the analysis phase of the system.

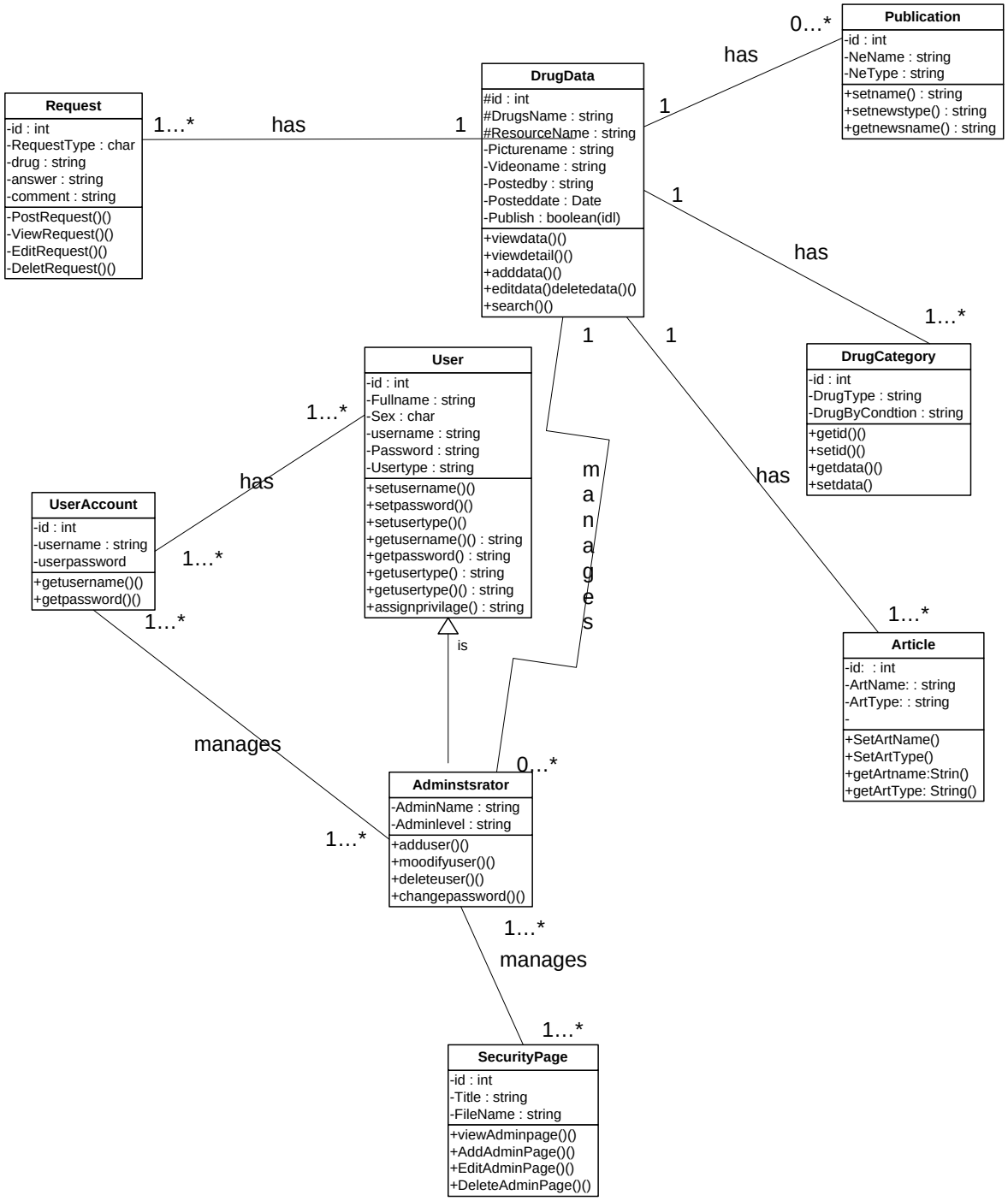


Figure 14: Modified Class Diagram

Below, E-R diagram of the database of the system is also depicted.

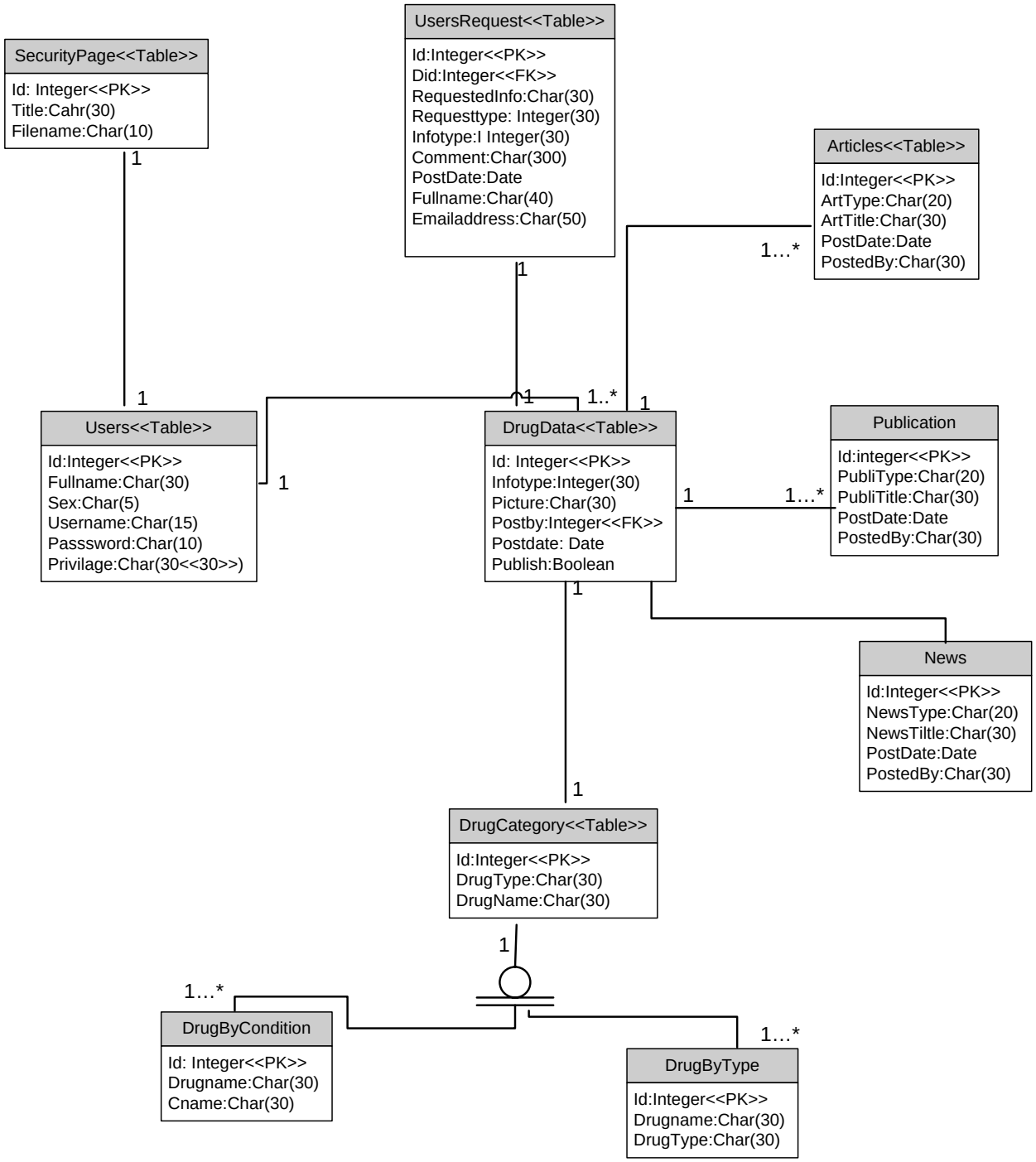


Figure 15: E-R diagram of the System

4.2.2.4 Hardware/ Software mapping

Since WBDIS architecture is client-server, the system is going to operate at the server side while the output of the system processes directed to the server.

Therefore, at client side a web browser that is capable of interpreting basic HTML tags can be used. The system and the database as well will reside on the web server which **IIS** and **.NET** framework enabled**.**

The system will deploy a Relational Database system; **Microsoft SQL** that is found to ideal client server architecture and capable of handling concurrent record access.

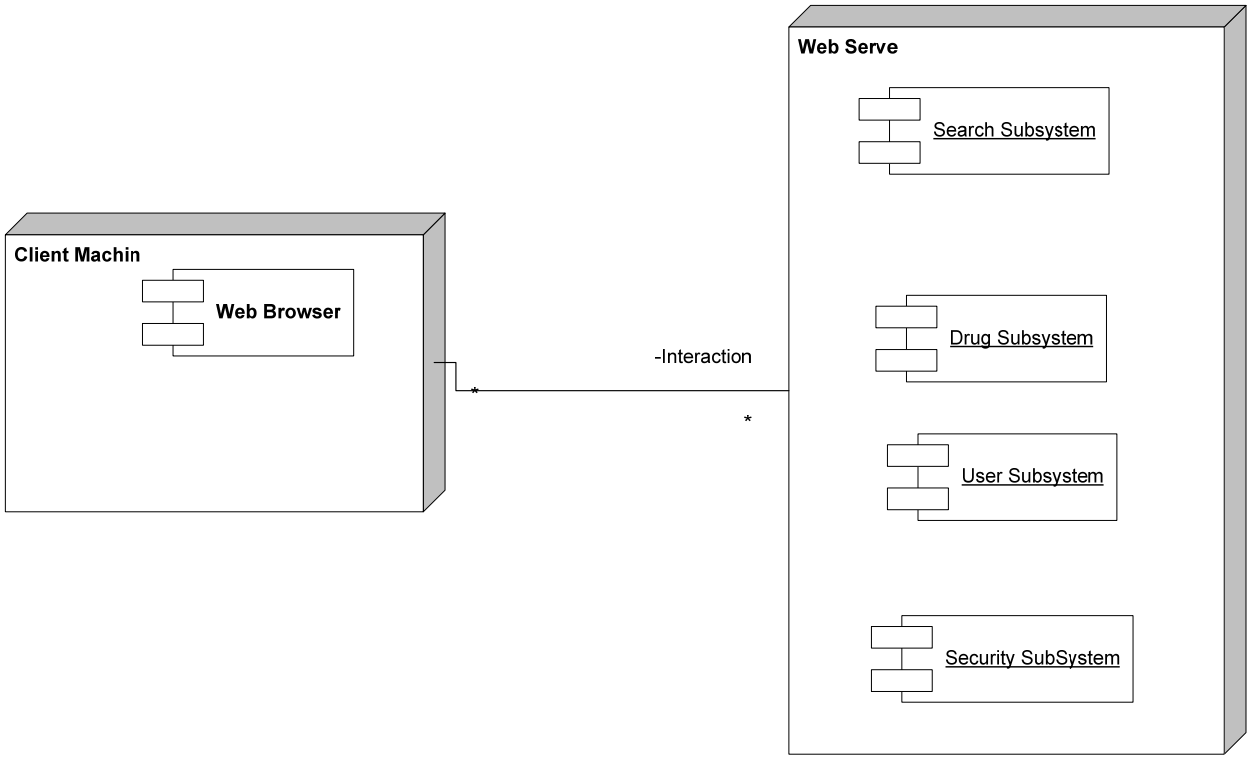


Figure 16: WBDIS Deployment Diagram

4.2.3 System Specification and Service

	Standard client	Standard web server	Standard Application server	Standard database server
Operating system	Windows 2003 Mozilla	Linux	Linux	Linux
Special Software	HTML XHTML	Apache	JavaScript ASP.NET	MySQL
Hardware	60 GB disk-drive Dual-core Pentium 17- inch Monitor	80-GB disk-drive Dual-core Xeon	80-GB disk-drive Dual-core Xeon	200-GB disk drive RAID
Network	Always broadband, preferred Dial- up at 60Kbps	Dual 150 Mbps Ethernet	Dual 150 Mbps Ethernet	Dual 150 Mbps Ethernet

Table 10: Specification of WBDIS

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this project, I have analyzed and designed Web-based drug Information System that provides online drug information safely and easily to the health professionals and the public.

The system was not only analyzed and designed to provide merely drug information, but was also analyzed and designed in a way that the users is allowed to interact with the system by pasting requests and comments. WBDIS have also a separate administration part that helps the system administrator to manage all drugs data, users, drug category, security and user`s request.

Operationally, the system can run on handheld devices, may be able to integrate with the existing drug information system and should be able to work on any Web browser. In addition, any interaction between the user and the system should not exceed 2 seconds, should be available for use 24 hours per day, 365 days per year and also supports 300 simultaneous users.

As far as the security issue of the system is concerned, only direct managers can see personnel records of user circumstances, and the system includes all available safeguards from viruses, worms, Trojan horses, etc.

Nevertheless, at present, the project results are inconclusive since development has not been done. As a result, this section describes the future work necessary to develop and implement the virtual product.

5.2 Recommendation

Recently Web-based information systems (WBISs) are attracting significant interest among business process practitioners as flexible and low-cost solutions to distributed collaborative work. "Intranet" is a typical targeted environment for WBISs. A WBIS not only disseminates information, but also proactively interacts with users and processes their business tasks to accomplish their business goals. The same holds true in WBDIS.

To provide eminence and advanced drug information system, this WBDIS project is better to integrate the following items:

- General product information
- Therapeutic efficacy
- Pharmaceutical Information
- Indication
- Side effects/Adverse effects
- Contraindication
- Drug interaction
- Toxicology
- Drug dosing (both adult, child)
- Special precautions
- Drug use in childhood, pregnancy, lactation, old age, and disease conditions
- Rational drug use
- Drug supply management

Since users` comments and requests improve the service of the WBDIS, the administrator and developers should consider users` comments and request on regular basis.

The following are recommendations for the future works:

- **Multilingual Requirements:** the language in which the system will need to operate. The system will operate in Amharic, Oromiffa, Tigrigna and Somalia.
- **Multimedia Content**: to make easy to use for those who could not read.
- **Text to Speech Conversation:** to decrease the time of inserting data.
- **Pill Identifier:** used to identify drugs by pictures, shapes, color and numbers quickly and easily.

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ANNEXES

Annex-A: Information sheet Consent form

Interview #:_____

My name is _____. I am here to gather requirements on behalf of Ato Endashaw Abera, graduate student at AAU school of Public Health And Information Science, for His Project work entitled:

"Analysis and Design of WBDIS in Ethiopia"

A WBDIS is computer-based information system by which drug information are managed and exchanged to health professionals, organizations and the public. The information to be delivered and managed is general product information, genera pharmaceutical Information, rational drug use, drug supply and stock management.

The objective of this interview merely to gather baseline requirements from users of DIC to develop WBDIS in Ethiopia in that without your sincere participation, the project will be in vain. For that reason, it is my utmost pleasure to select you as a key informant for the interview and more prominently I can assure you that the information you are going to respond is entirely confidential and will be used only to analyze and design the product.

Considering your permission, I would like to appreciate your co-operation by participating in the interview and also for your time.

Name of the Interviewee: _____ Name of Supervisor:_____

Signature:_____ Date:_____ Signature: _____Date:_____

Do you agree to be a key informant? YES or NO (please encircle)

Annex-B: Consent form

I, the undersigned, am informed that the key informant interview is conducted to gather requirements for the prospect WBDIS in Ethiopia. The responses are meant to be used as inputs to the project work entitled:
"Requirement Analysis of Drug Information System and Design of WBDIS in Ethiopia"

Moreover, confidentiality of the responses shall be maintained therein.

Name of the Interviewee: _____
Profession: _____
Role: _____
Date: _____
Signature: _____

Annex-C: Interview Guide Questions

Part I: Establishing user/stakeholder profile

1. Name:
2. Hospital:
3. Job title:
4. What are your key responsibilities?
5. What output you produce?
6. How success is measured?
7. Which problem does interfere with your success?
8. What, if any, trends make your job easier or difficult?

Part II: Assessing the problem

9. For which problem (application) do you lack solution?
10. For each question keep asking the ff:

- ✓ Why does this problem exist?
- ✓ How do you solve it?
- ✓ How would u like it to solve?

Part III: Understanding user environment

11. Who are the users?
12. What is their educational background?
13. What is their computer literacy background?
14. Are users experienced with the system?
15. What are your plans for future?
16. What are your expectations for usability of the system?

Part IV: Assessing my solution (if applicable)

17. What if you could:
18. How would you rank the importance of these?
19. Part VII: Assessing the Opportunity
20. Who in your organization needs this application?
21. How many of these types of users would use the application?
22. How would you value a successful solution?

Part VIII: Assessing the reliability, performance, and support Need

23. What are your expectations for reliability?
24. What are your expectations for performance?

25. Will you support the product or will others support it?
26. Do you have special needs for support?
27. What about maintenance and service access?
28. What are the security requirements?
29. What are the installation and configuration requirements?
30. Are there special licensing requirements?
31. How will the software be distributed?
32. Are there labeling and packaging requirement?

Part IX: Other Requirements

31. Are there any legal, regulatory, or environmental requirements or other standards that must be supported?

Can you think of any other requirement we should know about?

Part X: Wrap-up

Are there any other questions I should be asking?

If I need to ask follow-up questions, may I give you a call? Would you be willing to participate in a requirements review?

Part XI: The Analyst's summary

After the interview, and while the data is still fresh in your mind, summarize the three highest-priority needs or problems identified by this user/customer.

a)
b)
c)

Annex-D: System Requirement Specification (SRS)

1. Introduction

- **Purpose of the system**.: the purpose of the WBDIS is to transform manual service of drug information system into web-based system (computerized system).
- **Scope of the system:** This software system will be a Web-based drug information System used for health professionals and the public in Ethiopia. This system will be designed to maximize the quality health service through developing WBDIS by providing up to date and eminence drug information which would otherwise have to be performed manually.
- **Objectives and success criteria of the project:** Objective of the project is that to develop and implement WBDIS in Ethiopia. Producing usable and easy to use WBDIS software is the Success criteria of the project.
- **References**

✓ National Drug Policy of Transitional Government of Ethiopia.1993.
✓ FMHACA: Guideline for Establishment of Drug Information Center. 1999

- **Overview of the Document:** The purpose of this document is to present a detailed description of the WBDIS. It explain the purpose and features of the system, the interfaces of the system, what the system will do, the constraints under which it must operate and how the system will react to external stimuli. This document is intended for both the stakeholders and the developers of the system.

  Section I, introduces the project. Section II, Provides the brief about the existing system of DIS in Ethiopia. Section III, describes the proposed in more detail, including functional and non functional requirements as well as system models. Section IV, explores the important terms as a glossary.

2. Current system

The current system(As-Is) of drug information system is manual through DIC Staffs that has been established in some public hospitals located in Addis Ababa, Dire Dawa And Some regional hospitals according to FMHACA DIC guidelines. The current manual system has been delivering drug information to the public and health professionals in an organized way for promoting rational drug use, it is planned to strengthen those activities and also provide new services no matter what having its own limitations.

The first and foremost limitation of this manual system is not effective and efficient in such a way that it has not been easily and more accessible for the user since it is only confined in the specific health institutions. In light of productivity it is usually lower, particularly in routine

(operational) function of drug information dissemination. Processing of drug information is also slower where volumes of data need to be dealt with. Slower processing is meant some information that could be provided if computerized systems were used that will not be provided at all, because there is not time. Furthermore, the other constraints of the existing paper-based system of drug information are issues of great risk of error, difficulty of making corrections and updating the information when so demands and output quality that is often less consistent and not well designed. At worst, hand written records may be illegible and so completely useless since poorly presented information may fail to communicate key points. The last but not the drawback of the existing manual DIS is that its overly bulky nature both to handle and to store at the expense of office space.

Notwithstanding the existing paper-based DIS have the aforementioned downsides, it solves the problems with respect to having drug information that are rampant on health professionals and public by hook or by crook.

4.3 Proposed System

- **Overview of the system:** The projected system of Web-Based Drug Information System (WBDIS) will be obtainable at anytime, anywhere and display the drug information based on the FMAHCA guideline of Drug information Center.

The proposed system is going to:

- ✓ Provide web-based comprehensive, objective and evaluated information on drugs with a view to enhancing the rational use of drugs and quality health service.
- ✓ Disseminate automated technical, scientific & objective information to health care providers.
- ✓ Disseminate computerized appropriate drug information to the general public
- ✓ Generate, collect, analyze and maintain drug information data electronically.
- ✓ Display drug information materials electronically.
- ✓ Give appropriate information on toxicology and poisoning.
- ✓ Have different means of searching the drug information
- ✓ Be available online.
- ✓ Have an easy interface to make a search.
- ✓ Interact with the System user to post request the drug related queries, comment on the information provided.
- ✓ Have an administrator page to handle drug data, users, request and security of the system.
- ✓ Have an administration page to manage major system functionalities that embrace view, add, edit, delete, publish drug data, and manage additional tasks like managing users, managing security, and managing user’s request.

- **Functional Requirements:** Functional requirement defines a function of a system or its component and specify particular results of the system. It also describes the interaction between the system and the users independent of its implementation. The functional requirements of the proposed system are listed as follows:

✓ The system should provide searching facilities.
✓ The system should have the facility to navigate drugs by diverse category.
✓ The system should provide the facility to write only English words.
✓ The system should display the result of the search with the link recommendation.
✓ The system should make available validation mechanism for user inputs.
✓ The system should notify the user if the information is not available in the database and an appropriate link recommendation.
✓ The system should authenticate the user and assign privileges according to the assigned rights.
✓ The system should deny access if the user supplies wrong username or password.
✓ The system should provide the facility to change password
✓ The system should the grant the facility to view, detail information, add, edit and delete dictionary data.
✓ The system should the grant the facility to create, edit and delete user account.
✓ The system should register the time, date, and by whom the data is registered.
✓ The system should provide the facility to publish posted data.
✓ The system should display the administration page menu according to the assigned user`s right and so on.

Hence, in the nutshell, the system shall:

✓ Have online search facilities
✓ Have facility to post user request
✓ Enables users to manage and validate drug data
✓ Authenticate and authorize users according to assigned user`s right
✓ Enables administrator to manage the users.
✓ Enables administrator to manage posted data.
✓ Have facility to response to the user`s request.

- **Non-functional Requirement:** A non-functional requirement (qualities of the system) 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 the non-functional requirements of the proposed system:
    - ✓ **Documentation:** For the booming completion of the project the activities and outputs of each system development stage in the project workflow shall be properly document shall be properly documented. These documents will be

produced at the end of each stage shall be organized and compiled together at the end of the project for system support, future reference and system maintenance.

- ✓ **User Interface and Human Factor:** The system shall have a user friendly menu driven interface that is easy to navigate with. The greatest degree of user system interface consistency and standard shall be provided for all user interfaces. The system is able to run any web browser preferably supporting both JavaScript and PHP.
- ✓ **Reliability:** There shall be a frequent and full backup mechanism to avoid any information loss and inconsistency. And the system shall be uploaded on a unswerving machine.
- ✓ **Performance Characteristics:** The system will be interactive and the user is going to get the expected result within not many second or it must enable users to do something else while fetching result for their request to hide response latency. In addition the system will perform operations within a minimum amount of time.
- ✓ **Security issues:** Administration part of the system is handy only for the authorized Administration staffs as per their assigned rights. An Unauthorized user of the system ought to not access the administration page by any means. Some of the resources and activity shall be restricted and allowed for authorized users. Consequently, the system must user identification method and it must render or deny accesses to users pursuant to the privilege of the potential users

2. System model

a) Use case model

View Information and/Events

Use Case ID	WBDIS-1
Use Case Name	View Information
Use Case Description	This use case enables the user to view drug information and events
Primary Actor(s)	Users
Pre-Conditions	The user initiates the browser after logging in.
Post-Conditions	View information and events
Basic Scenario	The use case starts when: The user activates WBDIS from his terminal using His/her browser..

	WBDIS responds by presenting the home page along with the different menus and tabs as well as link. The user views the information and click on his/her preference tab/link. WBDIS presents the clicked tab/link The use case ends
Alternative Scenario	None
Frequency of Use	throughout the day
Special Conditions	None

Table 2: View information or events use case

Search Drug Data

Use Case ID	WBDIS 2
Use Case Name	SearchDrugData
Use Case Description	It is used to search drug data/ information
Primary Actor(s)	User
Pre-Conditions	The user initiates the browser after logging in
Post-Conditions	Search result
Basic Scenario	The use case starts when: 1) The user clicks on search box from home page. 2) The user enters the text(words) and presses the search button[double click on the word from the list box] 3) The system validates the data and display the result. 4) If the system found the requested word, it displays the result else it displays a message that the word is not found. The use case ends
Alternative Scenario	If the system shows no results at all: 2a) use WBDIS main case scenario (3) to (4).
Frequency of Use	right through the day
Special Conditions	None

Table3: Maintain drug data use case

Maintain Post Request Use- case

Use Case ID	WBDIS-3
Use Case Name	**MaintainPostRequest**
Use Case Description	It is used to view, modify or delete user request.
Primary Actor(s)	Administrator
Pre-Conditions	The user successfully logged in The *drug Admin Main Page* is displayed
Post-Conditions	The user request is screened
Basic Scenario	The use case begins while The user chooses "User request" menu item from Admin Main menu. The user clicks on "view user request" link The system displays user request information. The administrator evaluates the user request and presses accept or deny button. **4.1 modify the request when the administrator press accept** 1) the system populates *Add new data Form* based on the user request 2) Administrator performs the required modification, additional information and presses the S*ubmi*t button. 3) The system validates the data and displays confirmation message. **Post condition:** the user request is added to the drug data table(the data base) **4.**2 delete the user request when the Administrator press deny **1)** the system displays confirmation message **Post condition:** the user request is deleted permanently The use case ends
Alternative Scenario	None
Frequency of Use	Right through the day
Special Conditions	If the user request is comment, the administrator will act accor as so requires.

Table4: Maintain Post request table

Maintain user

Use Case ID	WBDIS-4
Use Case Name	**MaintainUser**
Use Case Description	This use case is used to create, modify or delete user's accounts.
Primary Actor(s)	Administrator
Pre-Conditions	The user is successfully logged in The *Drug Admin Main Page* is displayed.
Post-Conditions	The new user account is saved into the user account file.
Basic Scenario	The use case start in when: The user clicks "Users" menu item from *Admin Main Menu.* The user clicks on "*Add new user*" link The system displays Add new user Form The user enters full name & account information like username, password, confirm password, status and presses the *Save* button The system validates the data & displays confirmation message. **Modify the record of existing User** The user selects an account from the list of available users. The system populates detail user information such as full name, username, type(user/administrator) in the *Edit User Form* The user performs the required modification and presses the *Save* button The system validates the data & displays confirmation message. **Post Condition**: The record of user account information is modified. **Delete the record of existing User permanently** The user selects an account from the list of available users The user presses the *Delete* button The system displays confirmation message **Post Condition**: The record of user account information is deleted
Alternative Scenario	None
Frequency of Use	Twice a week
Special Conditions	None
Includes	Login
Priority	High
Business Rule	The administrator can activate or deactivate users account and reset the password. However, S/he can`t view user's password. Password cannot be less than 6 characters.

Table5: Maintain user use case

Maintain Drug Data

Use Case ID	WBDIS-5
Use Case Name	**MaintainDrugData**
Use Case Description	This use case is used to create, modify or delete drug data.
Primary Actor(s)	Administrator
Pre-Conditions	The user is successfully logged in The *Drug Admin Main Page* is displayed.
Post-Conditions	The new data is saves into the drug database
Basic Scenario	The use case begins while The user chooses "*Drug*" menu item from *Admin main Menu* The user clicks on "Add new data" link. The system displays Add New Data Form The user enter all the required information and presses the *Save* button. The system validates the data & displays confirmation message. **Modify the record of existing data** The user selects a data from the list of drug data/info The user clicks on "*Edit data*" button. The system populates all posted information in the *Edit Data Form* The user performs the required modification and presses the *Save* button The system validates the data & displays confirmation message. delete the record of existing data permanently the user selects a data from the list the user presses the *Delete* button the system displays confirmation message **Post Condition**: The record of user account information is deleted permanently
Includes	Login
Frequency of Use	Once a week
Special Conditions	None

Table6: Maintain drug data

Manage Login

Use Case ID	WBDIS-6
Use Case Name	**ManageLogin**
Use Case Description	It is used to manage login users
Primary Actor(s)	User
Pre-Conditions	The user is successfully logged in The Login Form is displayed.
Post-Conditions	User`s password is changed
Basic Scenario	The use case begins while The user selects *Change Password* menu item from *Drug Admin menu* The system displays *Change Password Form* populated with user id/username The user enters old password, new password, and password confirmation information and presses the Save button. The system validates the data and saves the changes. **Login to the System** The user enters the URL of the Drug Admin page The system displays the *Login Form* The user enters the user name and password and presses the login button The system validates the data and redirects the user to system functionality set to the user The administration main menu is dynamically created according to the assigned Access right of the user. **Post Condition:** the user is successfully logged in
Alternative Scenario	None
Frequency of Use	right through the day
Special Conditions	None
Includes	Login

Table7: Manage login use case

Manage Security Page

Use Case ID:	WBDIS-7

Use Case Name:	**ManageSecurityPage**
Use Case Description	It is used to administer security page
Primary Actor(s):	Administrator
Pre-Conditions:	The user is successfully logged in The Drug Admin main page is displayed.
Post-Conditions:	The security page is saved.
Basic Scenario:	The use case start in when: The user clicks *Security Page* menu from the administration main menu. The system displays list of security page. The user clicks on "Add new Page" The system displays Add New Page Form The user fill page title that will be displayed as privilege list and the name of file and submit the form. The system validates the data and saves. **Modify the Security page** The user selects the page from the list The system populates detail page information the *Edit Security Page Form* The user performs the required modification and presses the Save button The system validates the data and displays confirmation message **Post Condition**: The security page information is modified **Delete the record of the existing page Permanently** The user selects the page from the list. The user presses the *Delete* button The system displays confirmation message The system displays confirmation message Post Condition: the page is deleted permanently
Alternative Scenario:	None
Frequency of Use:	right through the working day
Special Conditions:	None
Includes:	Login

Table8: Manage security page use case

Manage Access Privileges

Use Case ID	WBDIS-8
Use Case Name	**Manage Access Privileges**
UseCase Description	This use case enables the administrator to mange access privilege
Primary Actor(s)	Administrator
Pre-Conditions	The user successfully logged in. The Drug Administrator Main page is displayed.
Post Condition:	The new access privilege is saved to the selected user account.
Basic Scenario	The use case starts when: The user chooses Privileges menu from the Administration. The system displays list of users and the list of access privileges The user selects a username from the list and select the access right to the user and presses the submit button The system saves the access privilege
Alternative Scenario	None
Frequency of Use	throughout the day
Special Conditions	None
Includes :	Login

b) Object model

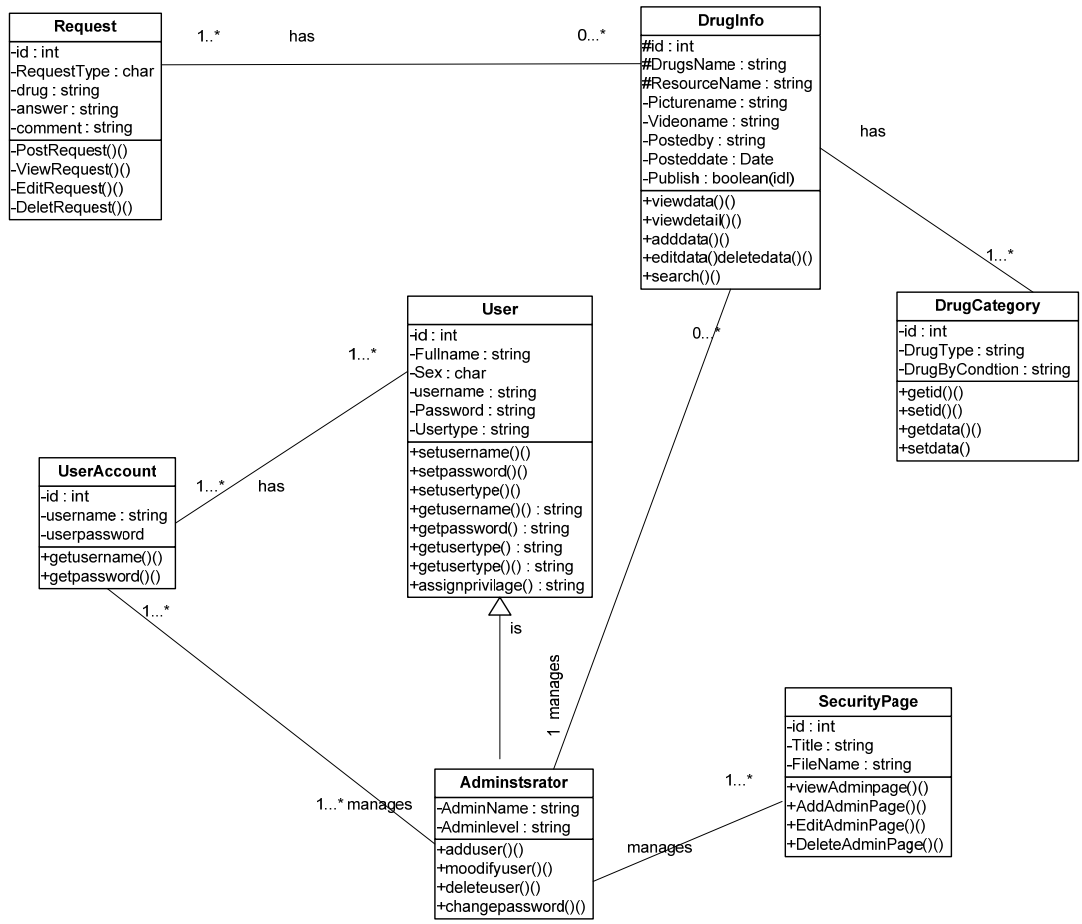


Fig 1: Class Diagram of WBDIS

c) User-interface -- navigational paths and screen mock-ups

Fig. 2 Navigation page

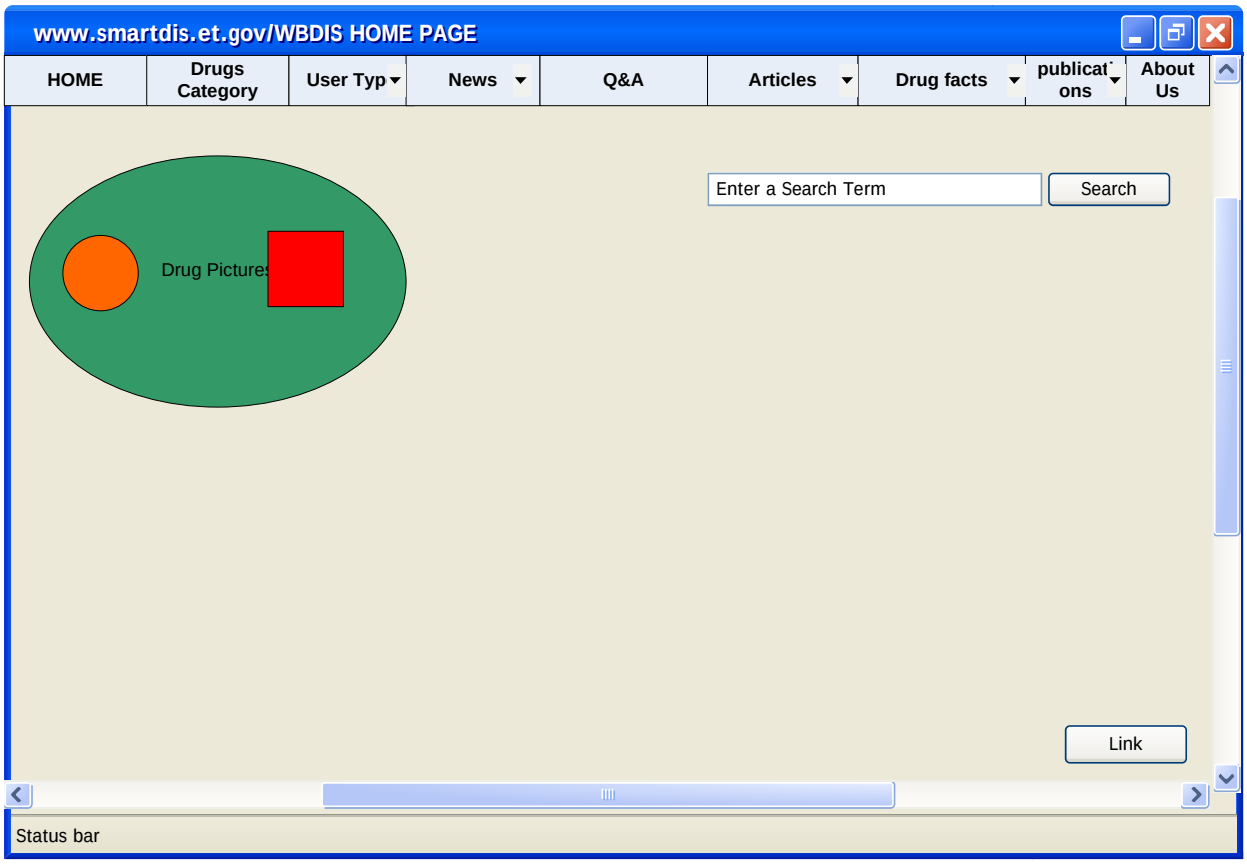


Fig 3: Home Page of WDIS

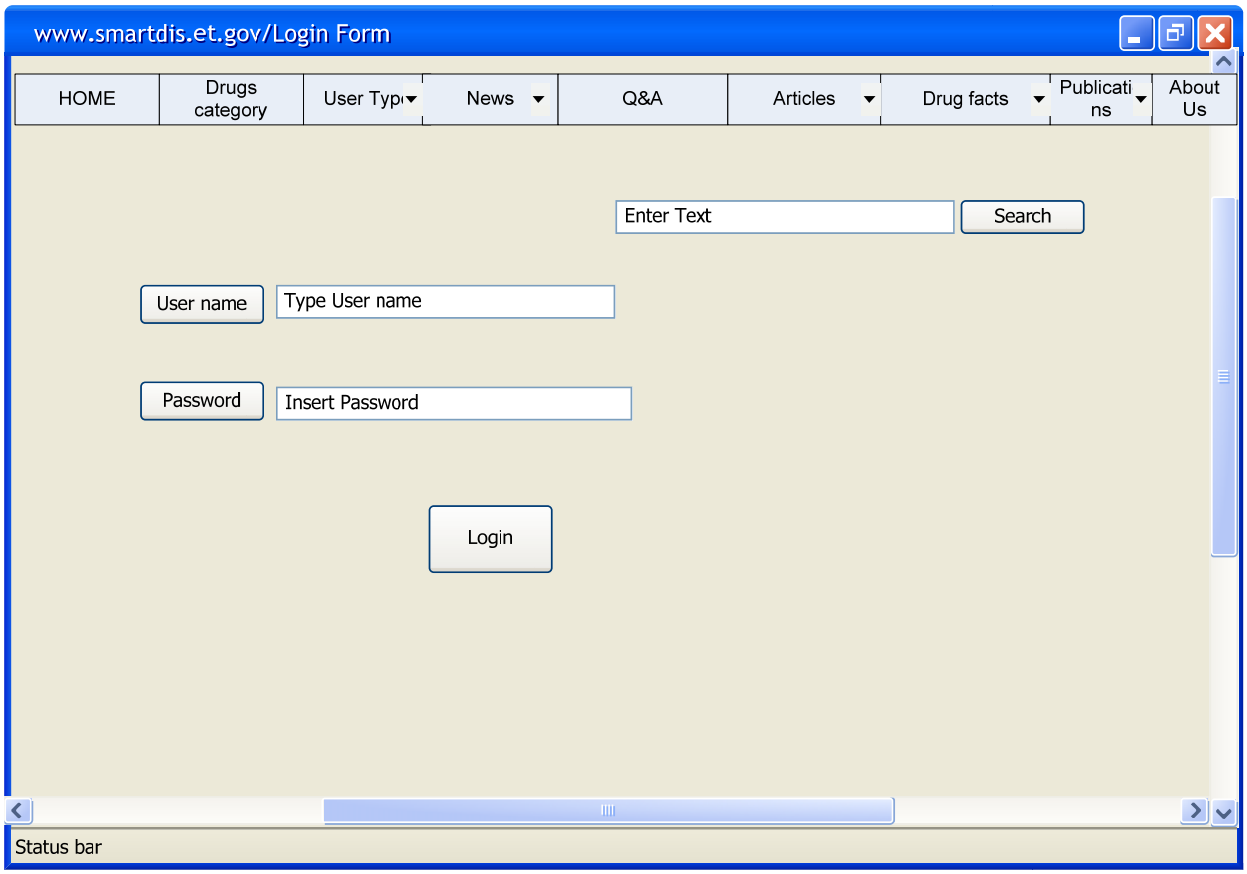


Fig 4: Login form of WBDIS

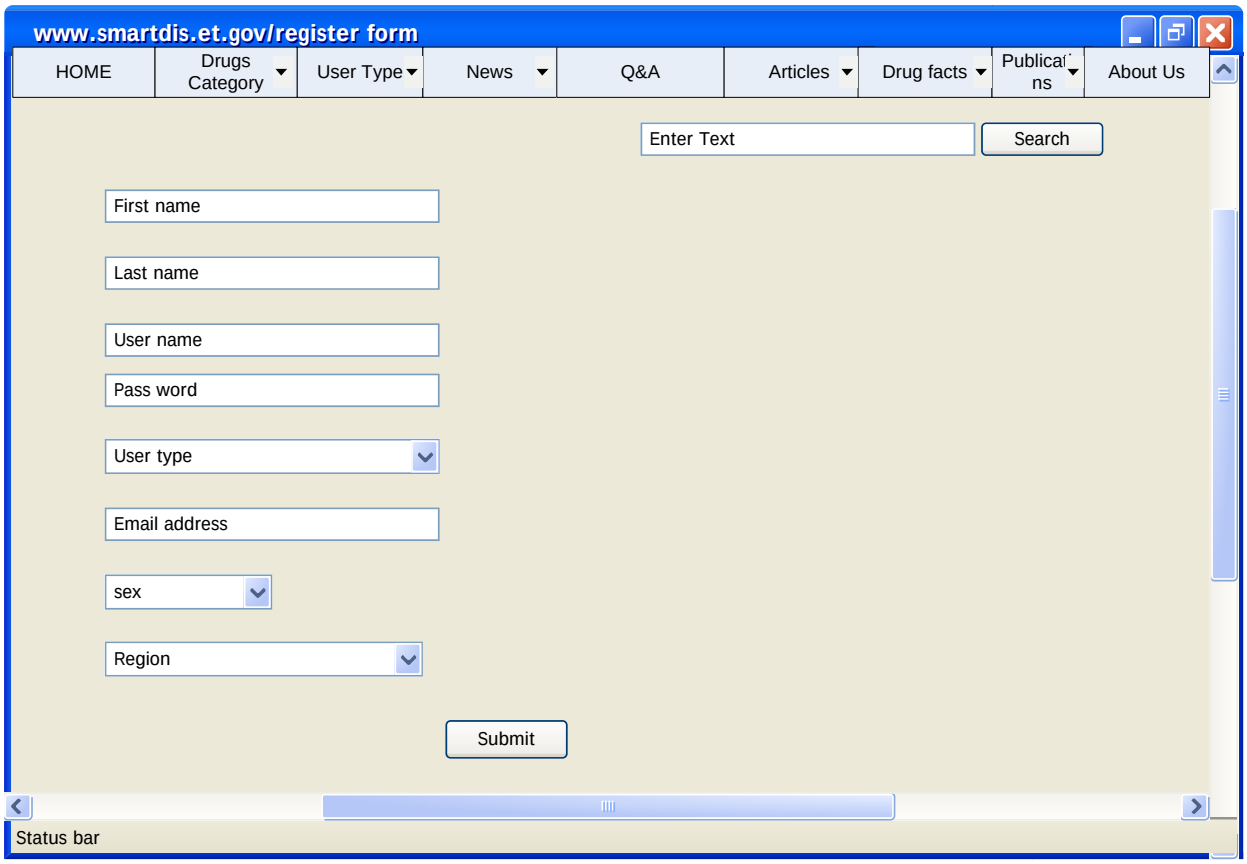


Fig. 5: Registration form for WBDIS

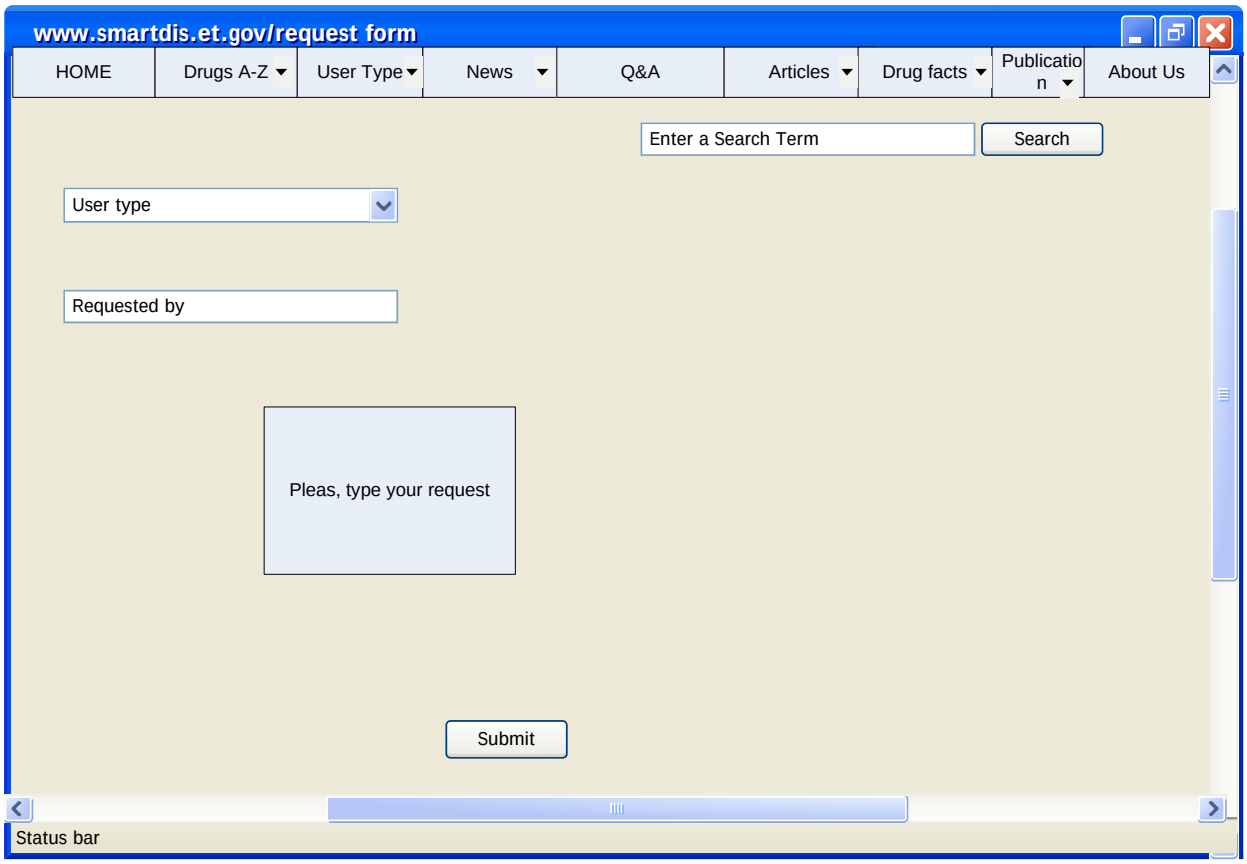


Fig. 6 Request Form

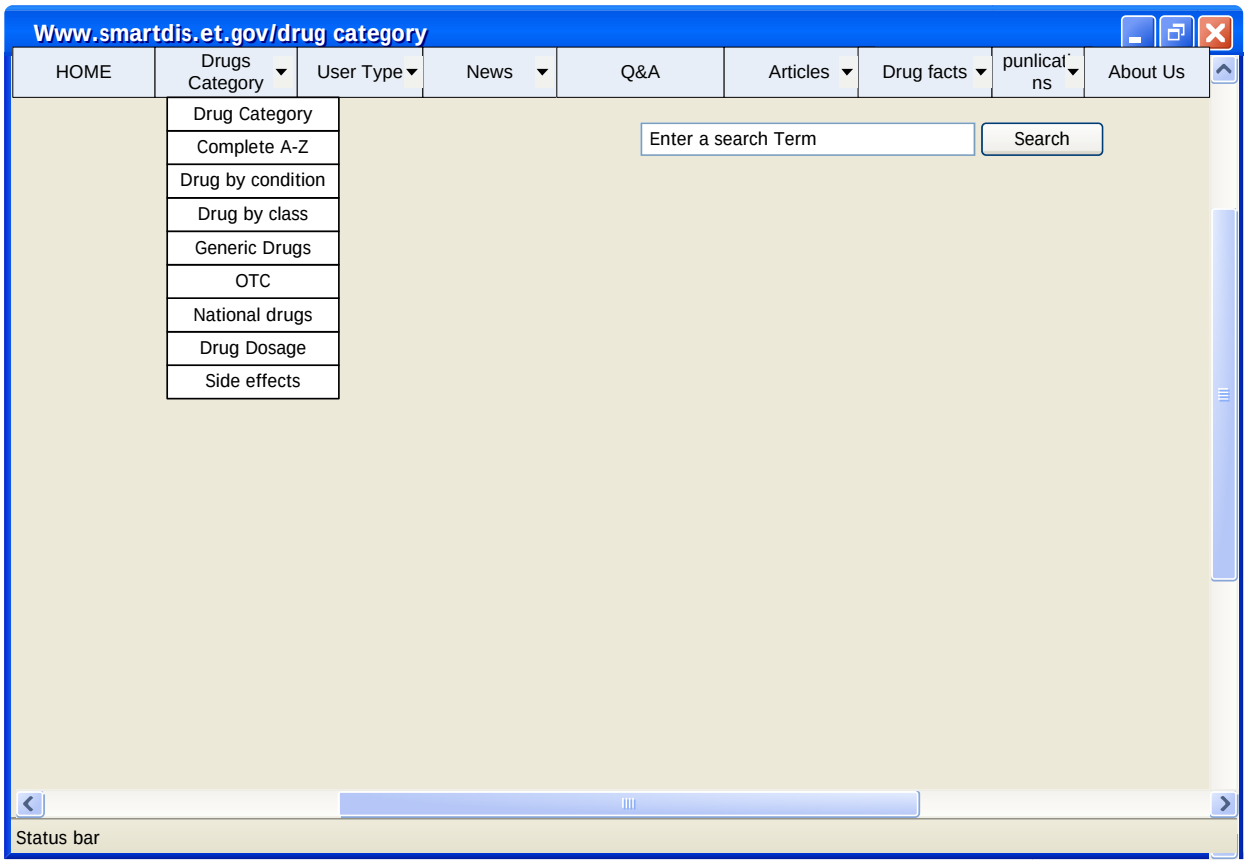


Fig. 7 Drug Category Page

4.4 **Glossary**

SRS: Software Requirements Specification

Annex E-: Design Document Specification (DDS)

The Software Design Specification (SDS) sections provide you with guidelines related to the structure and the contents of SDS document. The Software Design Specification document includes at least these sections.

1. **Introduction**

- **Purpose:** This Software Design Specification (SDS) provides an overview of the proposed Web-based Drug information System (WBDIS) designs. It will encompass in detail the basic outline of our project and represent a basis for the development process. This will also allow critical analysis of the logical and functional aspects of the design before any commitment is made to actual code. I also consider some additional security concerns during the design process.
- **Document over view:** Below is the outline of the each section described in this document.

✓ Document Description
✓ System Overview
✓ Design Considerations
✓ Architectural Strategies
✓ System Architecture (Use Cases from SRS)
✓ Policies and Tactics
✓ Design Documents
o White Box Design (Class Diagram)
o Database Design

- **Scope:** The scope of the design document is to illustrate the functionality of WBDIS. The design document will also show interactions between the web services, between different forms used by both users and administrators who are the main actors in the design. SDS will be used by the project manager and the development team.

- **References**

✓ FMOH:National Drug Policy of Transitional Government of Ethiopia.1993.
✓ FMHACA: Guideline for Establishment of Drug Information Center. 1999.
✓ Stephen R. Schach, Classical and Object-Oriented Software Engineering with UML and Java, 4th editionMcGraw-Hill, 1999.

- **Methodology, Tools and Techniques:** Word document and Visio diagrams are the tools used to create this design document. Use cases and UML diagrams are created to describe the scenarios.
- **Points of Contact:** Ato Endashaew Abera (BSc,Msc), Email: endserled@yahoo.com
- **Definition, Important terms, Abbreviations and Acronyms**

GUI	Graphical User Interface - a visually based application that serves to provide an interactive medium between the user and the application.
SRS	Software Requirements Specification - the explicit requirements definition used to maintain product consistency during the development process
Web site	A hierarchy of linked HTML-encoded text files that display on a web browser as a series of related text pages with embedded graphics and controls

2. System Overview

The projected system of Web-Based Drug Information System (WBDIS) will be obtainable at anytime, anywhere and display the drug information based on the FMAHCA guideline of Drug information Center.

The proposed system is going to:

Provide web-based comprehensive, objective and evaluated information on drugs with a view to enhancing the rational use of drugs and quality health service.

Disseminate automated technical, scientific & objective information to health care providers.

Disseminate computerized appropriate drug information to the general public

Generate, collect, analyze and maintain drug information data electronically.

Display drug information materials electronically.

Give appropriate information on toxicology and poisoning.

Have different means of searching the drug information

Be available online.

Have an easy interface to make a search.

Interact with the System user to post request the drug related queries, comment on the information provided.

Have an administrator page to handle drug data, users, request and security of the system.

Have an administration page to manage major system functionalities that embrace view, add, edit, delete, publish drug data, and manage additional tasks like managing users, managing security, and managing user's request.

3. Design Considerations

This section describes many of the issues which need to be addressed or resolved before attempting to devise a complete design solution.

Assumptions and Dependencies

The diagrams in this document were created through Visio Diagram or by the Enterprise Architect version 6.5.8. Related software or hardware

This program will be coded in PHP and HTML. We will be using Visual basic and MySQL for databases. Preferred operating system is Windows 2003 server. Windows 2000 server creates some exception errors that need to be researched and fixed if this is the preferred environment.

- **End-user characteristics**
  - ✓ User - The users for the WBDIS.
  - ✓ Network – the LAN that exists between the two machines that will be involved in this system.
  - ✓ Administrator – One of the users of the WBDIS. This user creates drug Information.
  - ✓ Internet – the internet connection of the user's machine to be able to use WBDIS.
- **General Constraints**

✓ Hardware or software environment

✓ There is a web server requirement. Windows 2003 is the preferred operating system due to the security requirements. ASP .Net 2.0 Framework needs to be installed.

✓ End-user environment

- o Administrator and user should have network and internet connectivity. They will need to login with their user credentials to be able to use WBDIS.

✓ Availability or volatility of resources

- o This depends on the network and internet connection. Stability and availability can be measured with the number of failures on the internet connection.

✓ Standards compliance

None

- ✓ Interoperability requirements

None

- ✓ Interface/protocol requirements
  - Network connectivity and TPC/IP support are required.
- ✓ Data repository and distribution requirements
  - Data will be stored in the database and Web services will be used to store the encrypted data.
- ✓ Security Requirements (or other such regulations)
  - It is important to have a secure web site, user credentials and secure web servers hosting PTC Web services and online forms.
- ✓ Memory and other capacity limitations
  - 250GB HDD space is required.
- ✓ Performance requirements
  - No internal failures are acceptable. The only known and accepted failures are from the network or Internet connection that is providing the communication between the two machines.
- ✓ Network communications
  - Network should be up all the time as part of the functionality is to be able to use the e-voting tool on the network or internet.
- ✓ Verification and validation requirements (testing)
  - Two machines on the same network are required to be able to test and verify the network and internet functionality.
- ✓ Other means of addressing quality goals

None

- ✓ Interfaces
  - User Interfaces: Online application and user interface will be designed with APS .Net tools available.
- ✓ Hardware Interfaces: Web Server needs to be installed and configured.
- ✓ Software Interfaces: MySQL is required for the databases.
- ✓ Legal, Copyright, and Other Notices

None

- ✓ Applicable Standards

None

Goals and Guidelines

- ✓ Apply The KISS principle ("Keep it simple and straightforward!").

- The eight requirements that identify for a good design which are well structured, simple, efficient, adequate, flexible, practical, implementable and standardized are the guidelines to create this design.

- ✓ Emphasis on speed versus memory use.
- ✓ Working, looking, or "feeling" like an existing web-based application.

4. Architectural Strategies

Architecture is the set of decisions that must be made at the enterprise level before specific applications are designed and built in order to provide conceptual integrity and sanity across the systems. Architecture includes a decomposition of the systems into separate orthogonal viewpoints along with the enforced rules that enable this clean decomposition and isolation of design viewpoints. This is done so functional (application requirements) and non-functional (system qualities) and other aspects of the application system may be defined and built by independent specialists in their specific field. An architecture not only divides the system, it also divides the roles and responsibilities of those who work with the system into separate organizational concerns and disciplines that are conceptually tractable and can be effectively managed.

There are four architectural viewpoints: Behavioral, Constructional, Data Modeling, and Functional. In our project behavioral and functional viewpoints will be used to desing it. Additionally, constructional view point strategy can also be used.

Behavioral forms are essentially concerned with causal issues, connecting an event to a response via any necessary conditions. These forms tend to be far more abstract than the constructional class, which are usually concerned with compliable entities that have definite syntax and semantics. Sequencing aspects can be described fairly well. Fixed-internal descriptions are also fairly tractable, although their use is mainly restricted to particular features of real-time systems. Constraint effects are very difficult to capture and describe using existing forms of description. Behavioral description can be used for both black box modeling roles (considering how the system as a whole will respond to specific events) and white box modeling (describing how the system elements will interact in terms of chains of events and actions). Overall, their importance and use has probably become much more pervasive as systems have become larger and also as constructional forms such as classes and objects have come into more widespread use.

Behavioral notations are dynamic properties where events, states, actions and conditions can be defined. Their relationships are modeled with cause & effect and sequencing & parallelism. Notation examples are state transition diagrams, statechart, UML: Use case diagram or UML: Activity Diagram.

Use cases for the project are provided in this document. They are in the next section where system architecture is defined.

Functional viewpoint shows the main functions of a system and their relations in terms of the flows of information, value or goods between them. The Function viewpoint provides high-level insight in the general operations of the system, and can be used to identify necessary competencies, or to structure according to its main activities.

Constructional viewpoint is mainly concerned about describing how the various software-structuring forms provided in programming languages, markup languages in the systems. Constructional forms described by this viewpoint include: data specifications, threads of execution, packaging constructs, invocation and uses hierarchy which describes the dependencies that exist between classes. For the white box model, additional to the use cases class diagrams will be drawn for the main classes used in this project.

- **Design Pattern Description:** The concept of the design pattern is very much associated with the object-oriented architectural style, although in principle there are no reasons why patterns could not be employed with other styles. The goal of patterns within the software community is to create a body of literature to help software developers resolve recurring problems encountered throughout all of software development. Forming a common pattern language for conveying the structures and mechanisms of our architectures allows us to intelligibly reason about them. Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution over without ever doing it the same way twice. In this project state, strategy and visitor design patterns can be applied. The details of these design patterns will be explained in the following sections.
- **Documentation:** Documented set of procedures used in the system: Documentation of a system is important for both system development and its maintenance. The new team needs to understand the procedures used during the development so that they can implement the changes in the same way. This will keep the changes in the same structure. Also documenting the feature sets and how the game works needs to be done for users.
- **Domain Knowledge:** This needs to be defined**.** This information is needed to find out the type of the problem involved during the design and any implementation features. Experienced designers may often work in an opportunistic manner, but that this practice may be less well-formed and reliable when the designer is less familiar with a problem or its domain. So for the inexperienced designer, or the designer who is working in an unfamiliar domain, the use of a design method may assist with the formulation and exploration of mental methods used to capture the essential features of the design. This way method knowledge may provide a substitute for domain knowledge, where the latter is inadequate or lacking. Additionally, classifying the problem domain will also help to understand the environment more.

In our case network and internet connections are involved in our domain. We need to consider all possibilities about the connection of machines to the network and internet. Users should be able to access easily from the browser and complete the process.

- **Environmental Constraints:** Most software designers believe that effective development of software relies on understanding unique constraints of each problem, and so universal notations are doomed because each provides a notational bias that necessarily makes the notation useless or dangerous for some set of tasks. There can always be constraints that effect the overall implementation and new changes that developer needs to be aware of. So knowing this information and keeping this in mind during the new changes will definitely help the developer to deliver a better product. In our system one of the major constraints is the network and internet connectivity. With the recommended design patterns and the TCP/IP network protocol checks this connection needs to be monitor during the voting process. Additional security checks can also be part of the process to make sure that there are not any outside attackers trying to use the systems.
- **System Architecture:** In this section high-level overview of how the functionality and responsibilities of the system were partitioned and then assigned to subsystems or components are provided. Detail about the individual components themselves will be discussed in the detailed design part of this document.

Use cases from the SRS Document

View Information and/Events

Use Case ID	WBDIS-1
Use Case Name	View Information
Use Case Description	This use case enables the user to view drug information and events
Primary Actor(s)	Users
Pre-Conditions	The user initiates the browser after logging in.
Post-Conditions	View information and events
Basic Scenario	The use case starts when: The user activates WBDIS from his terminal using His/her browser.. WBDIS responds by presenting the home page along with the different menus and tabs as well as link. The user views the information and click on his/her preference tab/link. WBDIS presents the clicked tab/link The use case ends

Alternative Scenario	None
Frequency of Use	throughout the day
Special Conditions	None

Table 2: view information or events use case

Search Drug Data

Use Case ID	WBDIS 2
Use Case Name	SearchDrugData
Use Case Description	It is used to search drug data/ information
Primary Actor(s)	User
Pre-Conditions	The user initiates the browser after logging in
Post-Conditions	Search result
Basic Scenario	The use case starts when: 1) The user clicks on search box from home page. 2) The user enters the text(words) and presses the search button[double click on the word from the list box] 3) The system validates the data and display the result. 4) If the system found the requested word, it displays the result else it displays a message that the word is not found. The use case ends
Alternative Scenario	If the system shows no results at all: 2a) use WBDIS main case scenario (3) to (4).
Frequency of Use	right through the day
Special Conditions	None

Table3: maintain drug data use case

Maintain Post Request Use- case

Use Case ID	WBDIS-3
Use Case Name	**MaintainPostRequest**
Use Case Description	It is used to view, modify or delete user request.
Primary Actor(s)	Administrator

Pre-Conditions	The user successfully logged in The *drug Admin Main Page* is displayed
Post-Conditions	The user request is screened
Basic Scenario	The use case begins while The user chooses " User request" menu item from Admin Main menu. The user clicks on "view user request" link The system displays user request information. The administrator evaluates the user request and presses accept or deny button. **4.1 modify the request when the administrator press accept** 1) the system populates *Add new data Form* based on the user request 2) Administrator performs the required modification, additional information and presses the S*ubmi*t button. 3) The system validates the data and displays confirmation message. **Post condition:** the user request is added to the drug data table(the data base) **4.**2 delete the user request when the Administrator press deny **1)** the system displays confirmation message **Post condition:** the user request is deleted permanently The use case ends
Alternative Scenario	None
Frequency of Use	Right through the day
Special Conditions	If the user request is comment, the administrator will act accor as so requires.

Table4: Maintain Post request table

Maintain user

Use Case ID	WBDIS-4
Use Case Name	**MaintainUser**
Use Case Description	This use case is used to create, modify or delete user's accounts.
Primary Actor(s)	Administrator
Pre-Conditions	The user is successfully logged in The *Drug Admin Main Page* is displayed.
Post-Conditions	The new user account is saved into the user account file.
Basic Scenario	The use case start in when: The user clicks "Users" menu item from *Admin Main Menu.*

	The user clicks on "*Add new user*" link The system displays Add new user Form The user enters full name & account information like username, password, confirm password, status and presses the *Save* button The system validates the data & displays confirmation message. **Modify the record of existing User** The user selects an account from the list of available users. The system populates detail user information such as full name, username, type(user/administrator) in the *Edit User Form* The user performs the required modification and presses the *Save* button The system validates the data & displays confirmation message. **Post Condition**: The record of user account information is modified. **Delete the record of existing User permanently** The user selects an account from the list of available users The user presses the *Delete* button The system displays confirmation message **Post Condition**: The record of user account information is deleted
Alternative Scenario	None
Frequency of Use	Twice a week
Special Conditions	None
Includes	Login
Priority	High
Business Rule	The administrator can activate or deactivate users account and reset the password. However, S/he can`t view user's password. Password cannot be less than 6 characters.

Table5: maintain user use case

Maintain Drug Data

Use Case ID	WBDIS-5
Use Case Name	**MaintainDrugData**
Use Case Description	This use case is used to create, modify or delete drug data.
Primary Actor(s)	Administrator
Pre-Conditions	The user is successfully logged in The *Drug Admin Main Page* is displayed.
Post-Conditions	The new data is saves into the drug database

Basic Scenario	The use case begins while The user chooses "*Drug*" menu item from *Admin main Menu* The user clicks on "Add new data" link. The system displays Add New Data Form The user enter all the required information and presses the *Save* button. The system validates the data & displays confirmation message. **Modify the record of existing data** The user selects a data from the list of drug data/info The user clicks on "*Edit data*" button. The system populates all posted information in the *Edit Data Form* The user performs the required modification and presses the *Save* button The system validates the data & displays confirmation message. delete the record of existing data permanently the user selects a data from the list the user presses the *Delete* button the system displays confirmation message **Post Condition**: The record of user account information is deleted permanently
Includes	Login
Frequency of Use	Once a week
Special Conditions	None

Table6: Maintain drug data

Manage Login

Use Case ID	WBDIS-6
Use Case Name	**ManageLogin**
Use Case Description	It is used to manage login users
Primary Actor(s)	User
Pre-Conditions	The user is successfully logged in The Login Form is displayed.
Post-Conditions	User`s password is changed
Basic Scenario	The use case begins while The user selects *Change Password* menu item from *Drug Admin menu* The system displays *Change Password Form* populated with user id/username The user enters old password, new password, and password

	confirmation information and presses the Save button. The system validates the data and saves the changes. **Login to the System** The user enters the URL of the Drug Admin page The system displays the *Login Form* The user enters the user name and password and presses the login button The system validates the data and redirects the user to system functionality set to the user The administration main menu is dynamically created according to the assigned Access right of the user. **Post Condition:** the user is successfully logged in
Alternative Scenario	None
Frequency of Use	right through the day
Special Conditions	None
Includes	Login

Table7: manage login use case

Manage Security Page

Use Case ID:	WBDIS-7
Use Case Name:	**ManageSecurityPage**
Use Case Description	It is used to administer security page
Primary Actor(s):	Administrator
Pre-Conditions:	The user is successfully logged in The Drug Admin main page is displayed.
Post-Conditions:	The security page is saved.
Basic Scenario:	The use case start in when: The user clicks *Security Page* menu from the administration main menu. The system displays list of security page. The user clicks on "Add new Page" The system displays Add New Page Form The user fill page title that will be displayed as privilege list and the name of file and submit the form. The system validates the data and saves. **Modify the Security page** The user selects the page from the list The system populates detail page information the *Edit Security Page Form* The user performs the required modification and presses the Save button

	The system validates the data and displays confirmation message **Post Condition**: The security page information is modified **Delete the record of the existing page Permanently** The user selects the page from the list. The user presses the *Delete* button The system displays confirmation message The system displays confirmation message Post Condition: the page is deleted permanently
Alternative Scenario:	None
Frequency of Use:	right through the working day
Special Conditions:	None
Includes:	Login

Table8: manage security page use case

Manage Access Privileges

Use Case ID	WBDIS-8
Use Case Name	**Manage Access Privileges**
Use Case Description	This use case enables the administrator to mange access privilege
Primary Actor(s)	Administrator
Pre-Conditions	The user successfully logged in. The Drug Administrator Main page is displayed.
Post Condition:	The new access privilege is saved to the selected user account.
Basic Scenario	The use case starts when: The user chooses Privileges menu from the Administration. The system displays list of users and the list of access privileges The user selects a username from the list and select the access right to the user and presses the submit button The system saves the access privilege
Alternative Scenario	None
Frequency of Use	throughout the day
Special Conditions	None
Includes :	Login

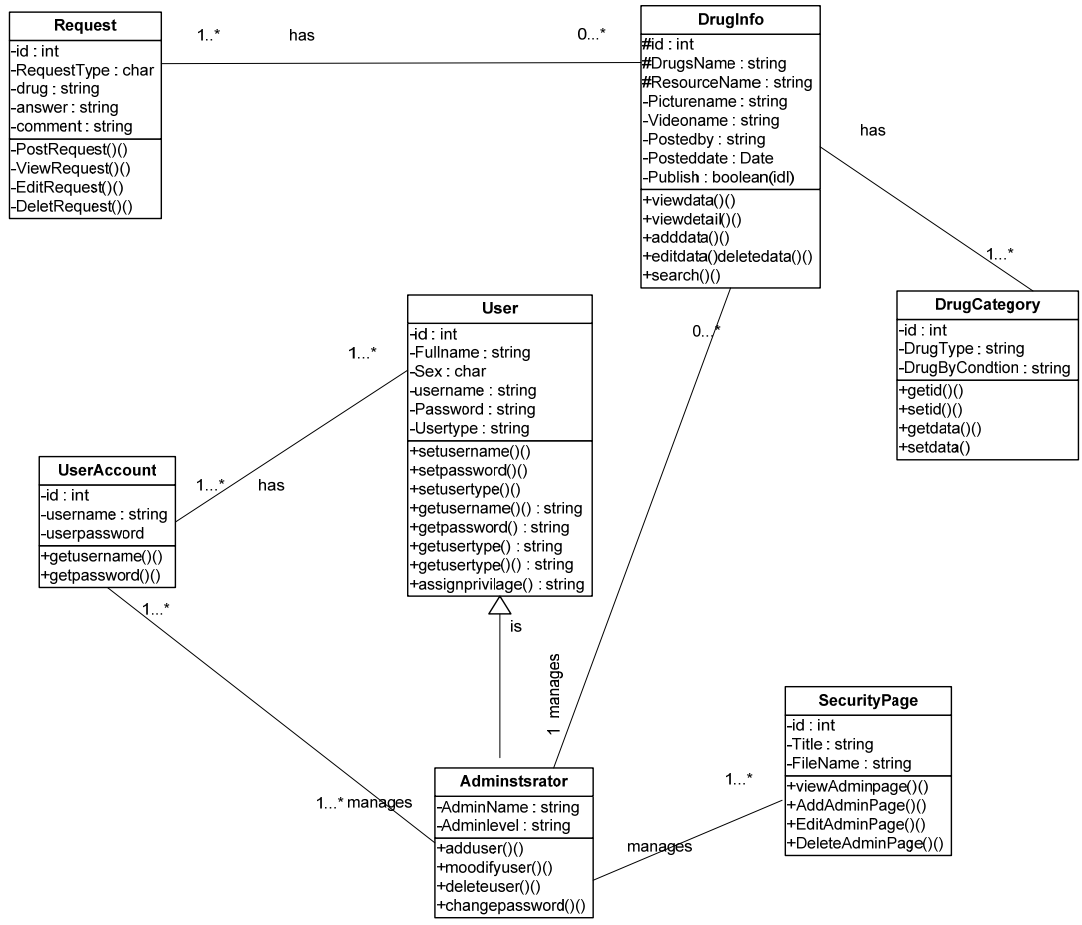
- **Policies and tactics**
  - ✓ Choice of which specific product to use (compiler, interpreter, database, library, etc. ...): It will be coded in ASP .Net Framework 2.0 with Visual Basic. Visual Studio 2005 will be required to compile.
  - ✓ Engineering trade-offs

    None

- ✓ Coding guidelines and conventions: Design Patterns will be used in the development. Visitor and State Design patterns will be applied on some of the modules.
- ✓ The protocol of one or more subsystems, modules, or subroutines: TCP/IP network communication needs to be established for network module design. It will be an online application where internet connection will be required.
- ✓ The choice of a particular algorithm or programming idiom (design pattern) to implement portions of the system's functionality: Visitor and State Design patterns will be applied on some of the modules. Strategy design pattern can also be used.
- ✓ Plans for ensuring requirements traceability: SRS document was provided and all the requirements specified in the document have been applied in the design. Also use cases are created to make sure that all the functionality will be defined in the functions according to the requirements.
- ✓ Plans for testing the software: All the feature set and needed requirements need to be tested with the scenarios created. An additional test document will be provided.
- ✓ Plans for maintaining the software: Every Quarter bugs will be reviewed. Any reported problems will be fixed. This document will need to be updated if there are any new additional requirements involved.
- ✓ Interfaces for end-users, software, hardware, and communications: WBDIS will require end-users to have internet access, user login credentials, PC and a browser.
- ✓ Hierarchical organization of the source code into its physical components (files and directories): Web server will be installed under “c:\InetPub\wwwroot\WbDis” folder. Web Services will be also in the same folder under drug information service folders. They all need to be setup as a virtual web server. More details need to be provided in the setup documents for the users.
- ✓ How to build and/or generate the system's deliverables (how to compile, link, load, etc. ...): Program will be compiled from the development machine and placed into the web server. ASP.Net and PHP is the two main server application required to be able to run this web site.

- **Design Documents**

Class Diagrams from SRS Document



I have chosen Class diagram the design document: The class diagram defines a detailed design of the system. The class diagram classifies the actors defined in the use case diagram into a set of interrelated classes. The relationship or association between the classes can be either an "is-a" or "has-a" relationship. Each class in the class diagram may be capable of providing certain functionalities. Class diagram is one of the forms that can be used to view the white box model which is detailed diagrams for each module in the program.

Glossary

SRS: Software Requirements Specification

SDS: Software Design Specification

GUI: Graphical User Interface

PHP: Hypertext Preprocessor

MySQL: My Structured Query Language

HTML: Hypertext

PC: Personal Computer

Declaration

I, the undersigned, declare that this project is my original work in partial fulfillment of the requirement for the degree master of science in Health Informatics and has not been presented for a degree in any other university before. All sources of materials used for this project and all people and institution who gave support for this work have been duly acknowledged.

Name: **Endashaw Abera (BSc)**

Signature: _____

Place: AAU, Graduate studies School of Public Health and Information Science

Date of Submission: 28th June 2014

This project has been submitted for examination with our approval as the university advisors.

Name of the Advisors:

1) **Dr. Ababi Zargaw(MPh)** **_____**

2) **Ato Workshet Lamenewe** **_____**