BED SPACES MANAGEMENT SYSTEM FOR THE LIBYAN PUBLIC HOSPITAL AL-JUMHOURIYA IN BENGHAZI

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Universiti Utara Malaysia 2011

BED SPACES MANAGEMENT SYSTEM FOR THE LIBYAN PUBLIC HOSPITAL AL-JUMHOURIYA IN BENGHAZI

A Project submitted to Dean of Awang Had Salled Graduate School in partial fulfillment of the requirements for the degree Master (Information Technology), Universiti Utara Malaysia

By

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ABSTRACT

Recently, the online services have used widely in different fields for providing and facilitating user needs. Most of these services give the flexibility and easy to access anytime and anywhere without need to waste the time. This study was initialed for the current issues in determining the bed availability in the Libyan public hospital Al-Jumhouriya in Benghazi for pregnant. Thus, this study successful designed and developed the system based on the System Research Process Methodology. The system was developed based on JSP and MySQL tools and tested on local server. The result of the evolution found that the proposed Bed Reservation System (BRS) was easy to use, useful and achieve the uses intention in using it.

ACKNOWLEDGEMENTS

In the Name of Allah, the Most Gracious and Most Merciful

Praise to Allah for his guidance and blessing for giving me the strength and perseverance to complete this project. I would foremost like to thank my parents and my wife, for providing me with the opportunity to pursue my goals and for their love and affection, which has helped me through the most trying times. Equal gratitude goes out to my siblings and brothers. I would like to thank my supervisor: **Associate Professor Dr. Wan Rozaini Sheik Osman** for her guidance and constant motivation that has enabled me to complete my project work. Moreover, I would also like to thank her for the opportunities that she has made available to me.

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CHAPTER ONE

INTRODUCTION

Across the globe, many governments have resorted to the use of ICT applications in healthcare delivery in an effort to increase efficiency with varying degree of success (Hägglund, Scandurra, & Koch, 2010). The European Union as a regional unit in 2004 adopted eHealth Action Plan to facilitate a more harmonious and complementary European approach to eHealth which required member states to formulate tailored national and regional eHealth strategies to respond to their own specific needs (Shohet & Lavy, 2004; Vimarlund & Olve, 2005). This has resulted in a range of projects being implemented or in the process of development in most of these countries, for instance: fully functional ICT infrastructure purposely for eHealth (e.g. Denmark, Sweden, and Norway); Electronic Health Record systems (e.g. Austria, the Czech Republic, Denmark, Estonia, Finland, Romania, Slovakia, Sweden, and Spain); national health portals (e.g. Denmark, Finland, France, Hungary, Luxembourg and Slovakia); forms of eCards (e.g. Austria, France, Germany, Slovenia, and Italy) and ePrescription (e.g. England, Finland, Greece, Portugal, Spain, Sweden and Northern Ireland) (Doupi, Hamalainen, & Ruotsalainen, 2005; Piotti & Macome, 2007).

However, a number of considerations were assigned by different organizations for providing the end users with the suitable facilities to proceed through the e-services. The available functionalities into these systems are capable to carry out a certain needs based on the client requests (Hernández & Blanquer, 2005; Lymberis & Dittmar, 2007; Rahimi & Vimarlund, 2007).

Even though, content management and reservation systems provide a lot of advantages to business, they have certain disadvantages too. Most of the time, the cost of content management and reservation systems are way beyond the financial capabilities of small businesses. On the other hand, research has found a lot of issues with the implementation of ERP systems. ERP systems implementation failures are as high as 40% to 60% (Liang, Saraf, Hu, & Xue, 2007). Also, it has been found that 90% of the content management and reservation implementations are either delayed or overshot the budgets sometimes even leading to bankruptcy proceedings and ligation against IT suppliers (Holland & Light, 2002).

Therefore, there is a clear disadvantage for small businesses to move towards the implementation of content management and reservation systems. So, for small and large size healthcare sectors moving towards automation and computerizations of operations, it is advisable to go for small customized solutions as they would be more cost effective and suit the specific requirements of the businesses. Hence, it is necessary to identify the most important functional area, that are necessary to be computerized as the automation must bring the maximum contribution to the content management and reservation systems in these sectors in terms of cost reduction and productivity improvement.

Healthcare sections that involve large size hospitals hold a wide variety of patients and other virtual clients who start from raw materials, work in progress to final alignment of the services provided that depend on the type of hospital and the provided facilities. The distributors, admins and officers hold the tasks of processing and locating the user requests about specific needs that mostly clarify the relations between client and the management

system of these related to hospital and the other online service system. This illustrate the side of an inventory management towards hospital components that include raw materials /purchased parts, work in progress and finished services that commonly related health care inventory includes distribution/whole sale stocks and retail stocks. Inventory management and control is very crucial to any firm as mismanagement of this could even threaten the very existence of it.

The main function of healthcare inventory management systems are to serve as a buffer against variability. Some variability is stochastic, arising from demand fluctuations, machine breakdowns, quality defects, transportation delays, and other unforeseen problems. Other variability is predictable, stemming, for example, from the efficient batching of production quantities in response to equipment set-up costs. Hence, organizations hold two types of stocks namely, safety stocks and cycle stocks to buffer against these types of variability (Lieberman, Helper, & Demeester, 1999).

The Libyan regions are responsible for the provision of health and medical service to a greater extent resulting in a highly decentralized health care system. Under the terms of the Health and Medical Services Act, regions are required to provide health and medical services of a high standard to all those in the regions. ICT has been recognized as a strategic tool in the delivery of health care to promote efficient, safer, and more accessible health care in Libya. In March 2006, Libya launched the National eHealth Strategy which is a national citizen-centered strategy aimed at achieving improvement for patients, health professionals, and decision makers through the strategic use of ICT. It seeks to establish improved basic conditions for ICT in health care by creating common information structure and technical infrastructure to improve eHealth solutions and adapt them to the

needs of patients while promoting interoperability between national, regional, and local agencies (Doupi, *et al.*, 2005).

From the other sides, large size hospitals now undergo tremendous change due to healthcare development, commercial and residential growth that revealed how technology could change the way of managing these hospitals such as online services, mobile applications, etc. (Fottler, Ford, Roberts, & Ford, 2000). The level of innovation is high and new technologies, devices, applications and services emerge in a rapid manner. The application of content management system can be huge and one of them is reservation system. Reservation system is information intensive and sensitive industry in which components of in expected to play an important role. Reservation system needs well-organized information anywhere and anytime, to ensure pleasant of clients. This reflects the lacking in using the usual methods for conducting the reservation that provided, also it has many limitations such as limited amount of details and environment changed. This study proposed to develop a bed allocation and reservation system for the large hospital in Libya.

1.1 Problem Statement

The growing population of Libya has caused inadequacy in many amenities being provided by the government. This has equally affected the hospital management in terms of amenities and facilities. It was recently reported that there is problem of non-availability of bed spaces for expecting mothers when they deliver in most Libyan government hospitals to the extent that they deliver on stretchers (Health International, 2009). The problem was also reported in other countries in the world (Davis, 2008). Notwithstanding, this has been handled in most developed nations of the world. Knowing well that Libyan as an Arab country does not share the belief of family planning

(Jamison & Bank, 2006) therefore, it becomes necessary to cater for the increasing demands.

From the one hand, the comprehensive execution may enhance the way of conducting the reservation and allocation process for the available beds in the Libyan large size hospitals, but that may be at the expense of one type of patients. This may be unneeded in case that patient should be provided with the online services. However, the comprehensive execution of online services for managing contents may even decrease in case of non-identical standard service multiplication (Bekker, Koole, & Roubos, 2009; Lee & Hong, 2002). Based on the described issues, bed allocation and reservation services of the large size hospitals in Libya are lacking to provide the suitable services to the patients who need to identify the bed availability that fully joining online management system for different types of services, including beds. Finally, it may be difficult to organize large systems, which is considerably easier for smaller units. In this study, developing a space reservation and allocation services is proposed to provide useful alternatives for bed reservation and allocation services. This means that the bed allocation policies should utilize the productivity gain of large hospitals, but avoid the disadvantages indicated above. Particularly, the following alternatives are considered for this study:

- Simple allocation for bed spaces;
- Earmarking beds: Each patient type has a guaranteed number of beds. When the number of patients exceeds the specified number, then the patient can be admitted to a joint ward of overflow;
- Threshold policies: Fully merge the wards, but less valuable patients are refused in case there are only a few more beds are available (which are reserved for the high-valued patients);

- Optimal policy: An arriving patient is admitted or refused depending on the number of each type of patients present.

Online reservation services are very necessary in every organization and this can be fully obtained with the use of information and communication technologies. Thus, in this study, the main interest is to design an automated bed reservation and allocation management system that will allow the hospitals to get prepared for the number of required bed spaces at any point in time. Such awareness can make the hospital management to relocate redundant bed spaces in other units to where they are required even when there are no enough beds in that hospital.

1.2 Research Questions

This research intends to answer the following questions:

- What are the main requirements for the bed spaces management system in the Libyan large size hospitals?
- How can a bed spaces management system can be developed for Libyan large size hospitals?
- How to test the proposed bed spaces management system?

1.3 Research Objectives

The main objective of this project is the development of the bed spaces management system for the Libyan public hospital Al-Jumhouriya in Benghazi, which is intends to:

- To model the requirement of the bed spaces management system.
- To design and develop a bed spaces management system Libyan public hospitals.
- To test the proposed system among definite users.

1.4 Research Scope

The scope of this project work is limited to the development of a Bed Space Management System. This shall be done by the testing of the system prototype. The method that shall be implemented is software engineering methodology while the technique that shall be used in implementation is the use of JSP and MySQL in building the website.

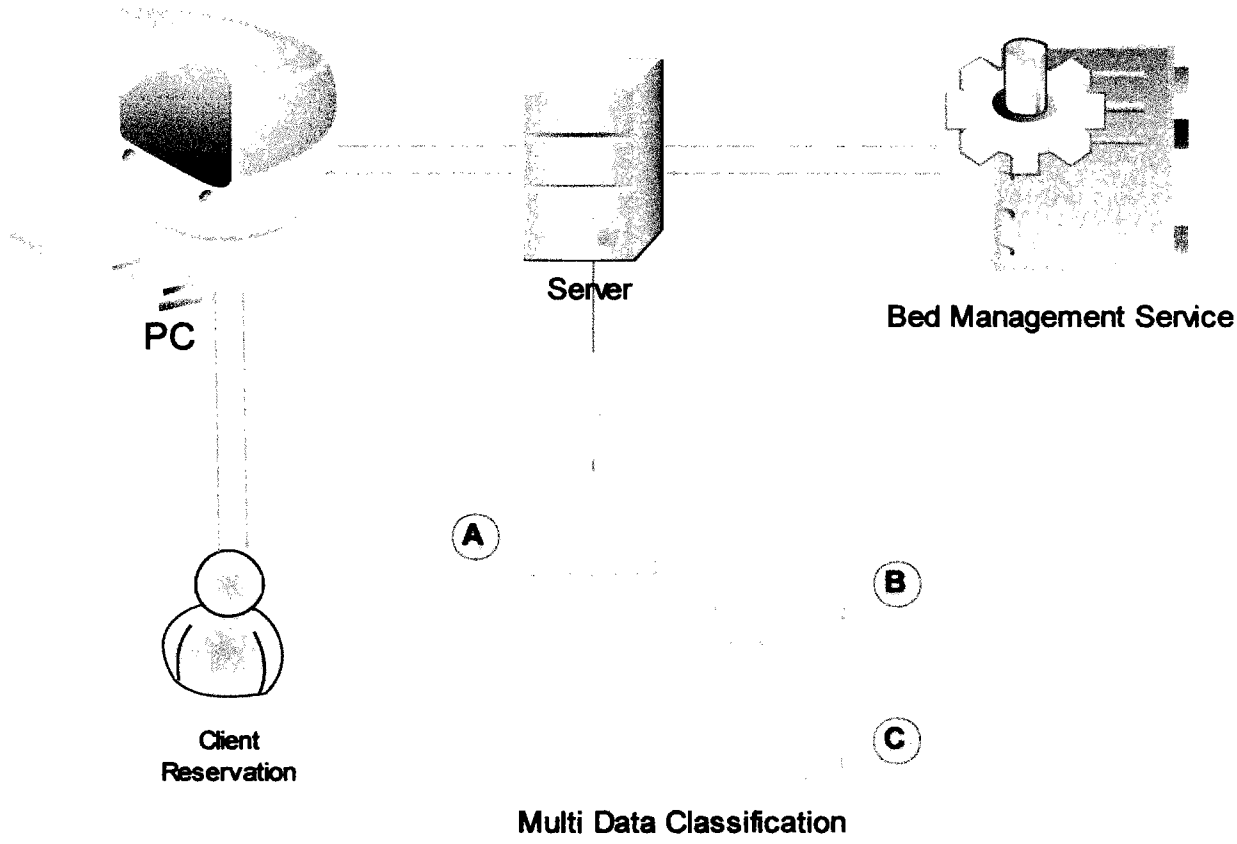

Figure 1.1: Research Architecture

Figure 1.1 presents the proposed bed allocation and reservation system among client, which consists on performing the reservation part of beds based request. The functional

process is conducted along the server to retrieve, process, and perform reservation through online services.

1.5 Report Organization

Chapter One:

Explains and identify the background of the study and the research problems that need to be solved which gives motivation to this study. The objective, scope and its significance has been identified and described well.

Chapter Two:

In this chapter the discuses and the practices of this service are addressed from the related literature reviews to the issue of the allocation and reservation of healthcare components and other content management system in different countries based on web technology.

Chapter Three:

This chapter describes and discusses the research methodology of System Research Process Methodology.

Chapter Four:

This chapter discusses the design, development, and implementation of the proposed system.

Chapter Five:

This chapter provides the proposed system discussion and evaluation based on questionnaire method to measure the user acceptance.

Chapter Six:

The final chapter gives the conclusion to the study. Recommendations and directions of future work are discussed.

1.6 Summary

The research elements of this study have been addressed successfully in this chapter based on the existing bed space problem. This chapter described the motivation factors that lead to the selection of the area studied. It also explains the existing problem that need to solve, research question, objectives of the study, as well as its significances to the real world situation. These elements are important as it ignites the implementation of the project. The next chapter discusses the literature review which elaborates on related works that have been established in the same field.

CHAPTER TWO

LITERATURE REVIEW

This chapter highlights the literature review on the area of project studied related to the adaptation of technology into the healthcare sectors. It conceptually gives an insight or reviews on the previous researches that have been done on the same area. According to the title of the research, this chapter introduced the main management services towards developing inventory healthcare management system for large size hospitals in Libya.

2 Healthcare Management Information Systems

The integration of IT in the medical sector has lead to the increase in the development of Health Information System (HIS) in the developing world. Gething, *et al.* (2007), defines HIS as a system that integrates data collection, processing, reporting, and use of information necessary for improving health service effectiveness and efficiency through better management at all levels of health services. Procter and Brown (1997), point out that this shift to automation by the integration of operations using computer technologies in medical records saves time and improves the reliability of ordering and obtaining results of the tests and therefore a generic system for Orders, Results and Reporting (ORR) was developed. An example of the integration is the Hospital Information Support System (HISS) (Procter & Brown, 1997).

This electronic transfer system was introduced for hospital wards for purposes of ordering of patients' tests and reporting results. Another example of integration of IT in medical sector is the use of handheld devices to collect data, carry information to patients and used

as references. In Ghana and Kenya, the mobile technology has been used successfully in the routine immunization campaign to collect data and analyze results and hence providing healthcare system, as shown in Figure 2.1 below.

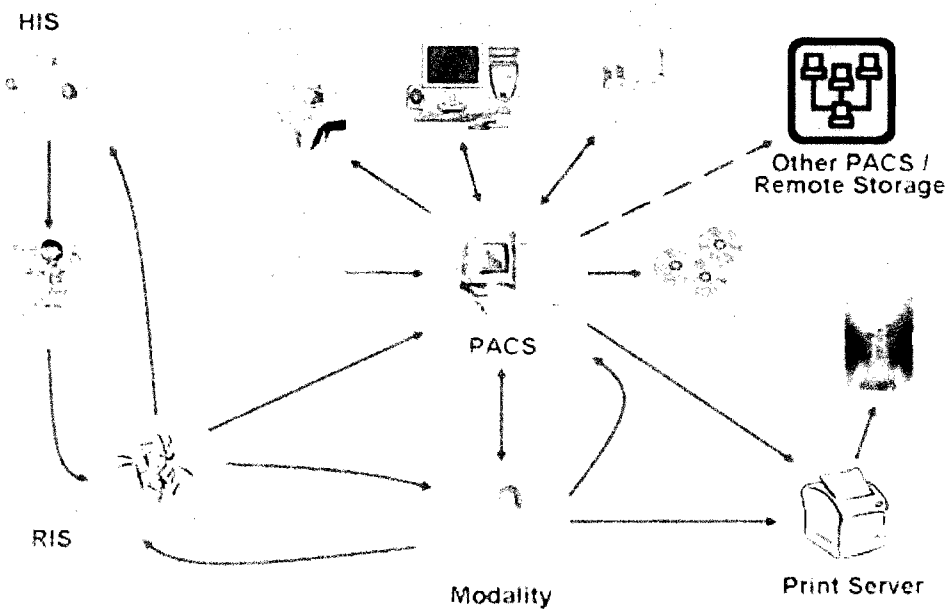

Figure 2.1: Health care Hospital Information Management (Wickramasinghe, Fadlalla, Geisler, & Schaffer, 2005)

Wickramasinghe, *et al.* (2004) state that robust healthcare information system (HCIS) are important in enabling healthcare organizations, address challenges of medical data and that information captured, generated and disseminated is of possible integrity, quality and complaint with regular requirements (Wickramasinghe, *et al.*, 2005).

2.1 Setting up Health Records

Health/medical records must meet a number of criteria. Some of these criteria affect how the system can be accessed as well as how key players may interact with these systems. Stoneburner, *et al.* (2002), point out security requirements, transmission standards, privacy, information integrity and quality as some of the essential criteria (Stoneburner, Goguen, & Feringa, 2002). Essentially security falls into three main categories namely; administrative, physical and technical. The privacy criterion deals with the purpose to maintain strong protections for individual identifiable health information/record.

Wickramasinghe, *et al.* (2004), point out that information flow within the system and between the key participants in the system must exhibit both the attributes and dimensions of information integrity as well as satisfy the quality. Specifically, the information should display the attributes of accuracy, consistency and reliability of content and processes as well as the dimensions of usefulness, completeness, manipulability and usability. Figure 2.2 shows the management process for the healthcare records.

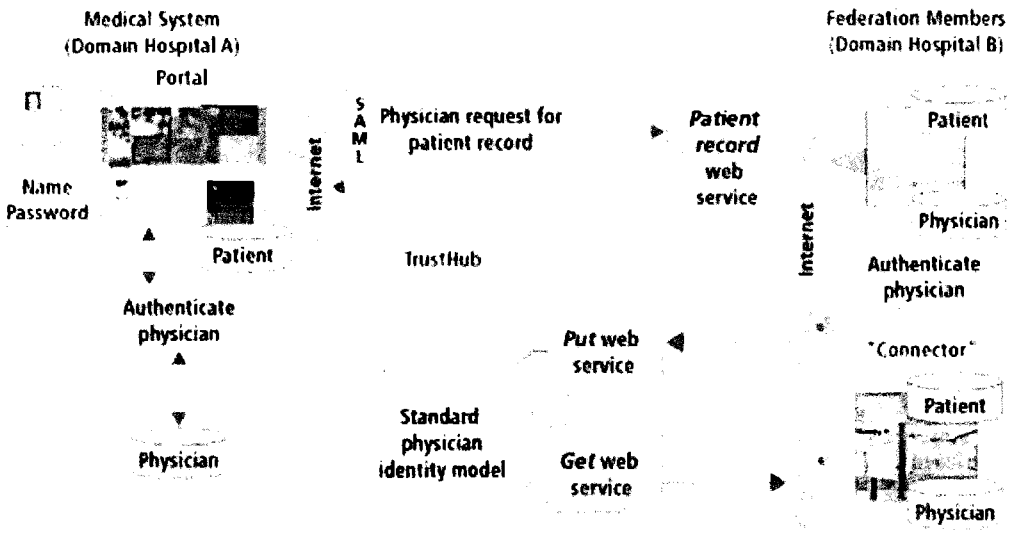

Figure 2.2: Health Care Records Management (Stoneburner, *et al.*, 2002)

2.2 Web Service

Serrano, et,, al, (2008), introduces that the quick progress of the internet based World-Wide Web (WWW) and its constantly growing popularity has motivated many companies to use it as a channel to transacting and servicing the customers (Serrano, Maguitman, Boguñá, Fortunato, & Vespignani, 2007). One of the main goals of the web services is to increase the interaction between organizations and customers, as well as to shorten the time and effort of both the organizations' staffs and the clients. This led the developed countries to ensure the construction of electronic government online services directly to the citizens. Web service aims to improve convenience, accessibility and quality of interaction with citizens and businesses (Milanovic & Malek, 2004).

Web application is any software application which needs the Web to execute correctly. Clearly, software designed specifically for Web delivery, (e.g. Web-based journals) (Gellersen & Gaedke, 1999). It is usually consist of static resource files (e.g. Images), libraries, helper classes and web components. A web browser is commonly used as a slim client therefore all the processing executed on the server. Web applications are typically organized in three-level architecture which are; a user interface level, a functional process logic level, and data storage level (Murugesan, Deshpande, Hansen, & Ginige, 2001). The user-interface level represented by web browser, and the functional level represented by the dynamic web content technology such as CGI, ASP or Java. Data Storage is handled by a database (Yang, Huang, Wang, & Chu, 2002). Figure 2.3 presents the require components for conducting a connection between client and server.

Web applications are an extension of a web server (Armstrong, *et al.*, 2005). Web applications are either service oriented or presentation oriented. A presentation oriented

web application produces interactive web pages containing mark up languages like (XML and HTML) and dynamic content in response to requests. Many of these open sources LAMP (Linux, Apache, MySQL and PHP). A service oriented web application then implements the endpoint of the web service.

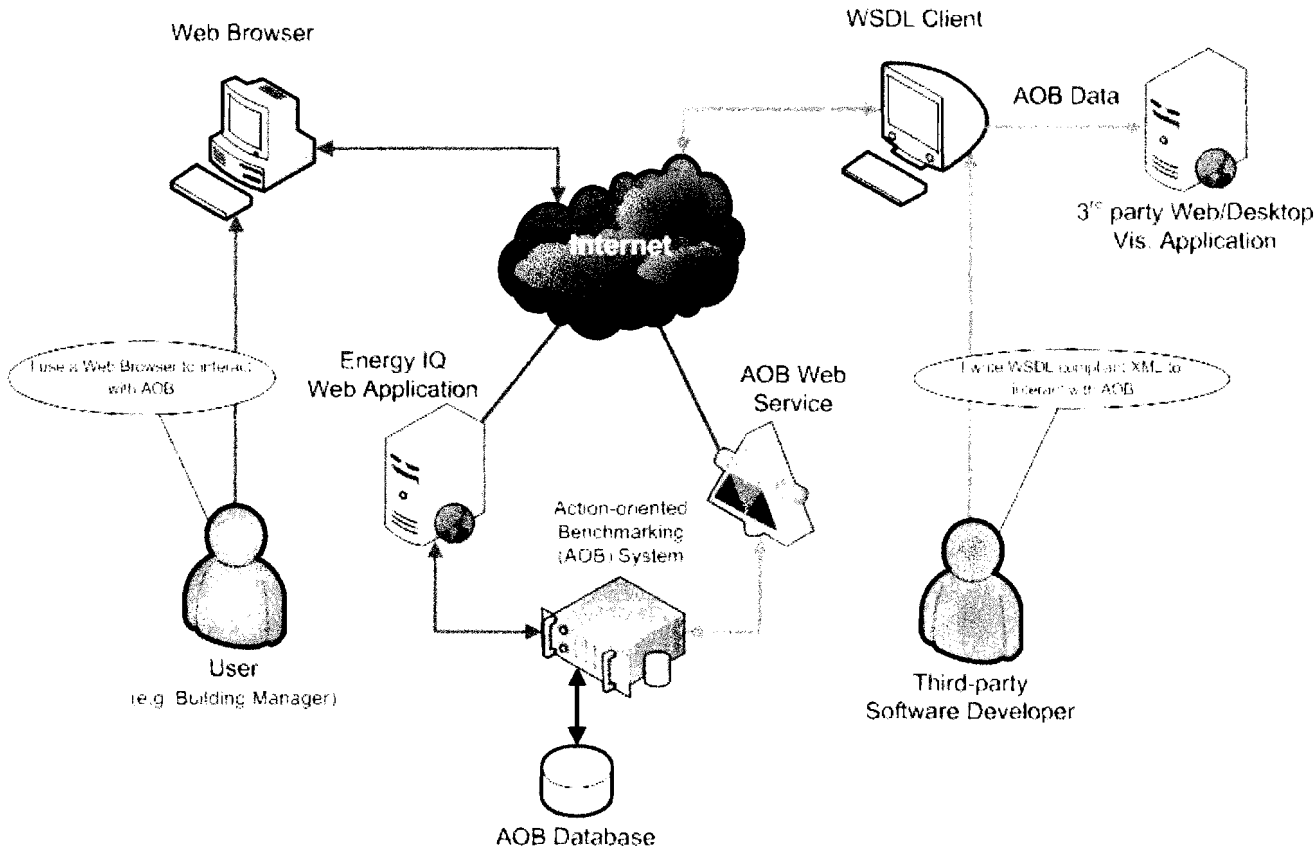

Figure 2.3: Web-based Services among Users (Armstrong, *et al.*, 2005)

2.3 Healthcare Allocation Systems

Healthcare organizations hold a wide variety of inventories starting from raw materials, work in progress to final services depending on the type of organizations. The administrator of these organizations works on usually on managing the organization contents (Sprague & Wacker, 1996).

In the 1990s, the health care industry has increasingly tried to embrace new information technologies as well as software applications, as it searched for opportunities for efficiency and higher quality care (Hunt, Haynes, Hanna, & Smith, 1998). Most notable among them are the Internet technologies and decision support technologies. Health care organizations are recently experimenting with the online services to take advantage of the global reach as well as the potential to react to changes in the healthcare place quickly by gathering and analyzing critical-to-success information. This leaded the concept of e-health to be currently evolving, which refers to the use of Web enabled systems and processes to accomplish some combination of the following aims: cut costs or increase revenues, improve healthcare services and patient satisfaction, and contribute to the enhancement of medical care.

Also during the last decade, health care organizations started to use information systems for clinical purposes to improve patient care (Anderson, 1997; Blumenthal, 1999). Computerized applications, which is targeted at assisting health care providers and administrators with the require managing tasks as information retrieval, allocate available spaces, diagnosis and test, procedure and case management recommendation, has been one of the critical information technologies heavily deplored to transform health care. In spite of these advances made, there are several specific challenges that are being faced relating to the use of information technology (IT) and ICT in health care, such as the complexity of medical data, the absence of industry wide recognized electronic health care record (EHCR) for patients in which medical data and equipments about the patient is recorded and reserved, data entry problems, security and confidentiality concerns, systems integration concerns in clinical practice, and a general lack of awareness of the benefits and risks of traditional services (Bose, 2003).

Most of the allocation systems provide the secure and flexible distribution of various data sources, e.g. intensive care monitoring, software applications and graphics, to multiple workplaces. Essential information is distributed among the users. This can substantially reduces costs for IT infrastructure, software, licensing fees, maintenance and changes. However, allocation systems can be installed regardless of network technology, hardware and software platforms. Health care professionals receive real-time data with the highest picture quality as shown in Figure 2.4.

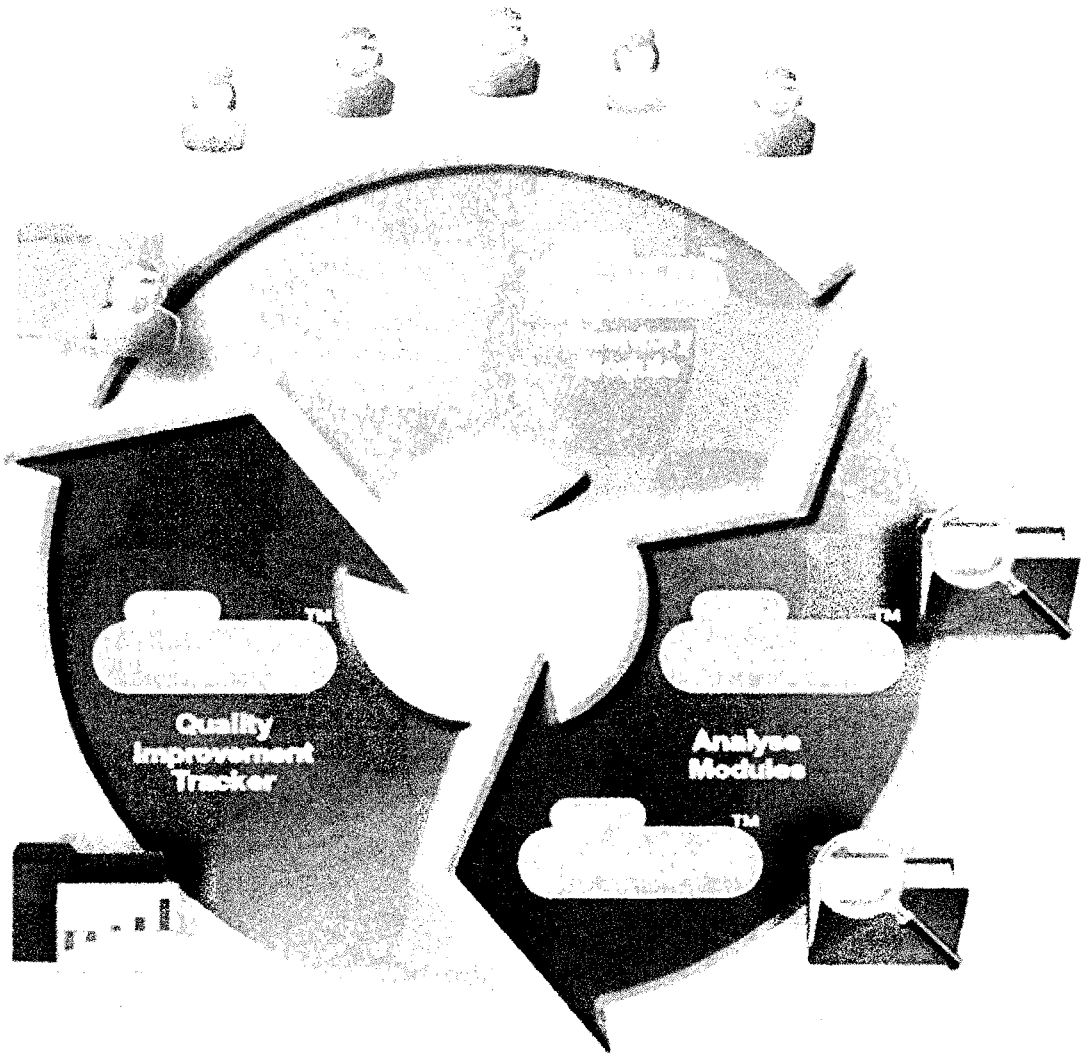

Figure 2.4: Healthcare Management System (Ngai, Poon, Suk, & Ng, 2009)

2.4 Related Works

According to Bekker *et al.* (2009) stated the importance of managing the healthcare contents remotely based on economies of scales for the large size of clinical wards, the reason back to that they can conclude a high occupancy rate under a reasonable number of refused admissions. Nevertheless, allocation the bed sizes and numbers is not always beneficial or desirable to be indicated by the patients. This might be the case when the difference in average length of stay between patients is large or when one type of patient should be prioritized. Bekker *et al.* intended to determine the specific needs for merging wards, including bed reservation policies for the large size clinics. The study result was compared with merging (bed pooling) and with the optimal policy minimizing the weighted number of refused admissions (Bekker, *et al.*, 2009).

While, Roberts, *et al.* (1991) introduced the development of a system to collect and verify the name of a patient's referring physician and link that to the automatic production of a referral letter and discharge summary. The study justified the main issues that are facing the current Hospital Information Systems (HIS) that intended to be more clinical and administrative/financial functions. Meanwhile, the study introduced the main problems in managing the hospital information that have specifically or historically chosen to separate. Thus, the study aimed to develop a hospital support system for assisting administrator about the management procedures for the hospital needs through online that clinical concern and administrative or financial needs often can utilize the same database to mutual benefit (Roberts, Dreese, Hurley, Zullo, & Peterson, 1991). Figure 2.5 presents the proposed hospital support system architecture.

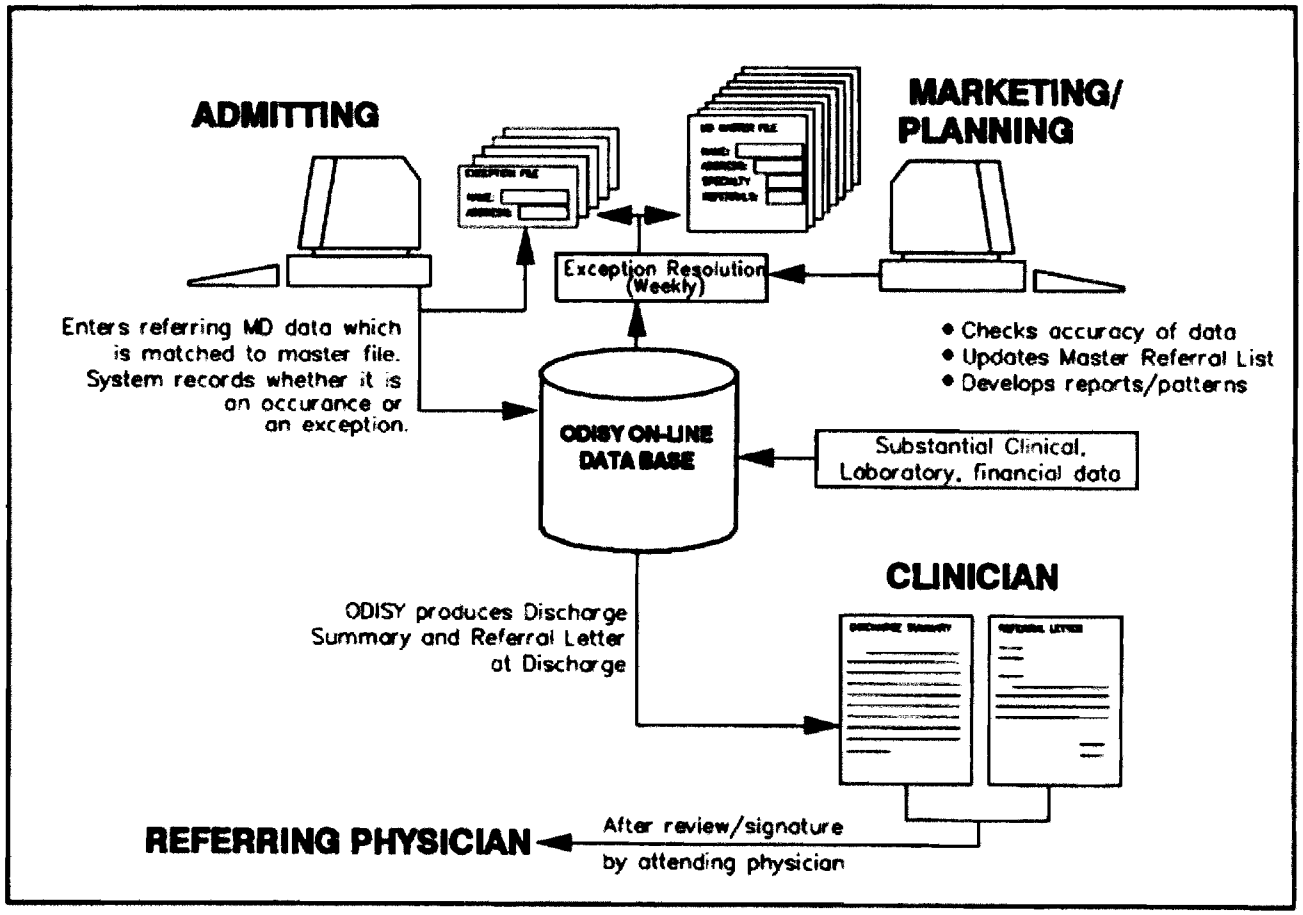

Figure 2.5: Hospital Support System Architecture (Roberts, *et al.*, 1991)

However, Eugene (2006) presents the most critical challenges for Health Care providers today that illustrated the patient discharge process in the acute care setting. As well, the research indicate the lacking in different healthcare institutions that found to be unable to manage the huge number of patients number and they require equipment that simplify the planning and assigning patients to beds and increased costs through alternative placement of patients when beds are not ready and available when needed. The research was highlighted the current functionalities for managing the hospital information records in Downey Regional Medical Center uses ArcGIS - specifically ArcView, ArcIMS, and ArcSDE running on SQLServer, which also focused on integrate the admitting and patient

registration information system with other systems for bed management (Eugene, 2006). Figure 2.6 presents the modified bed management process flow.

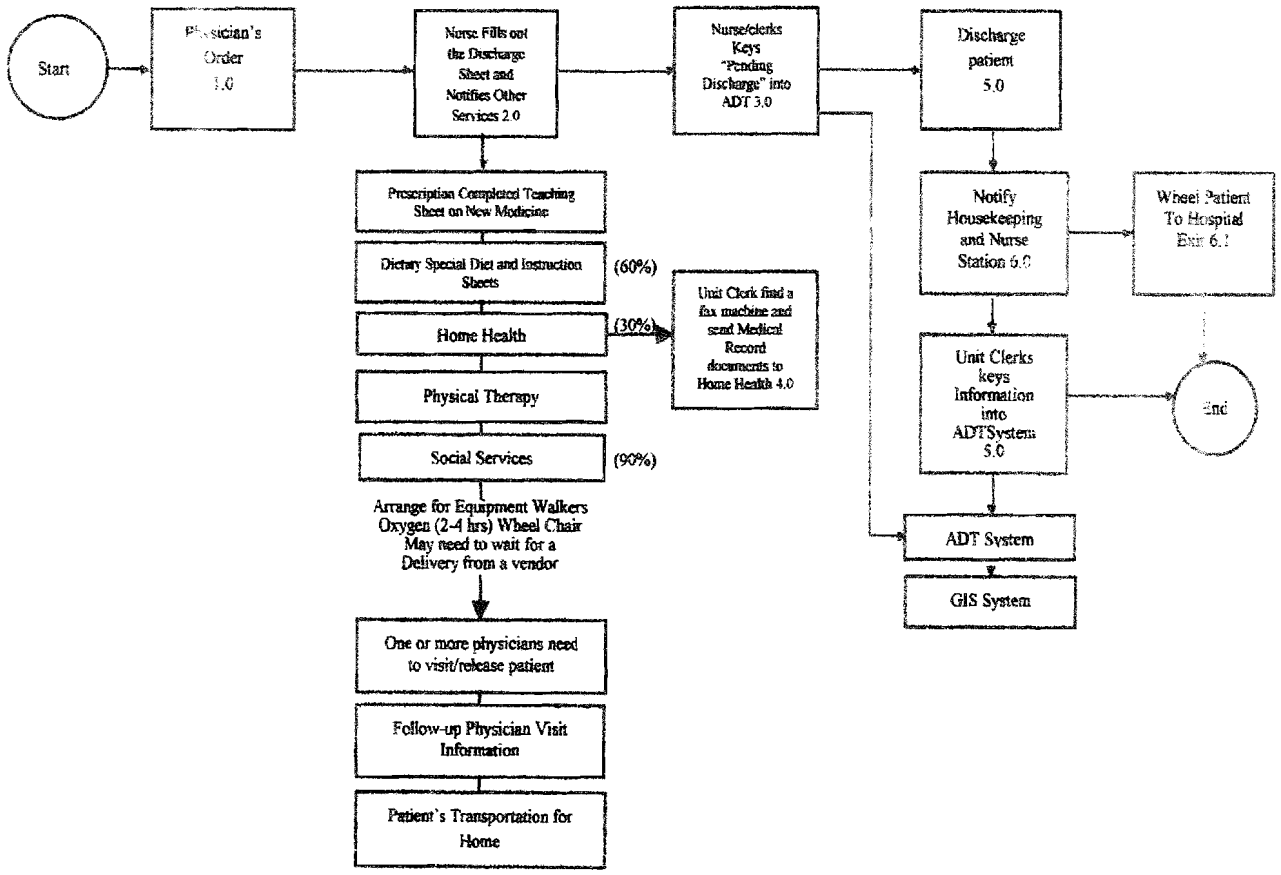

Figure 2.6: Modified Bed Management Process Flow (Eugene, 2006)

Delot, *et al.* (2009) addressed the exchanging events in a vehicular ad hoc network for allocating the suitable place for parking cars in the available places. The study adopted the using of several techniques to manage and process the parking records in different places. The study mainly intended to allocate the available space for parking car Otherwise in vehicular ad hoc networks and avoids the competition among the vehicles. Moreover, VESPA was used along with the proposed system to share information in VANETs (Delot, Cenerario, Ilarri, & Lecomte, 2009).

Another study by Nicholls and Young (2007) introduced an efficient bed allocation management GIS based system tool. They reviewd the current development within the hospital environment to meet the health industry's patient management protocols and to address community concerns. They also addressed the inefficiencies and continuing difficulties in management of available and appropriate beds within hospitals that have not been overcome and continue to be a source of practical, financial and management frustration. Nicholls and Young used a geographical format, the data displayed is in a visual layout, in real-time, of the exact location of each bed within a room, ward or floor. It also has the capability to permit examination of a bed's attached patient records as existing hospital software applications can be efficiently and seamlessly integrated into eBeds. The system also complements the spatial industry expansion into other medical related areas, such as ageing population, community health and emergency services as shown in Figure 2.7.

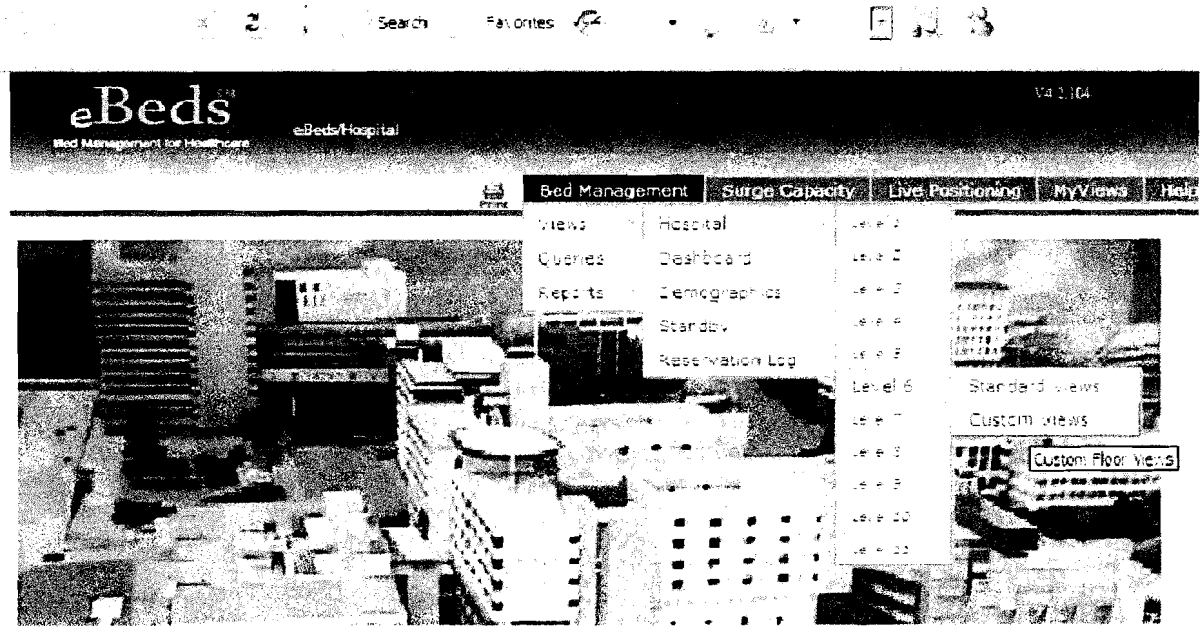

Figure 2.7 : eBeds System (Nicholls & Young, 2007)

Finally, Zhou and Chusho (2009) introduced the utilization of the different services of web application in different field of managing records over the Internet. Zhou and Chusho developed a domain specific framework for reservation based on a meeting room reservation system. Then, the framework is applied to two types of reservation systems, an online book store system and a soccer ticket reservation system, and its reusability is evaluated. The result of the study found that 62% and 65% respectively, high reusability of the framework has been confirmed. While another framework for time-based reservation was developed, and the trade-off relationship between the range of the domain and the reusability has been confirmed. Additionally, the visual tool is developed to generate the source code for the database access transaction (Zhou & Chusho, 2009). Figure 2.8 shows the proposed system process.

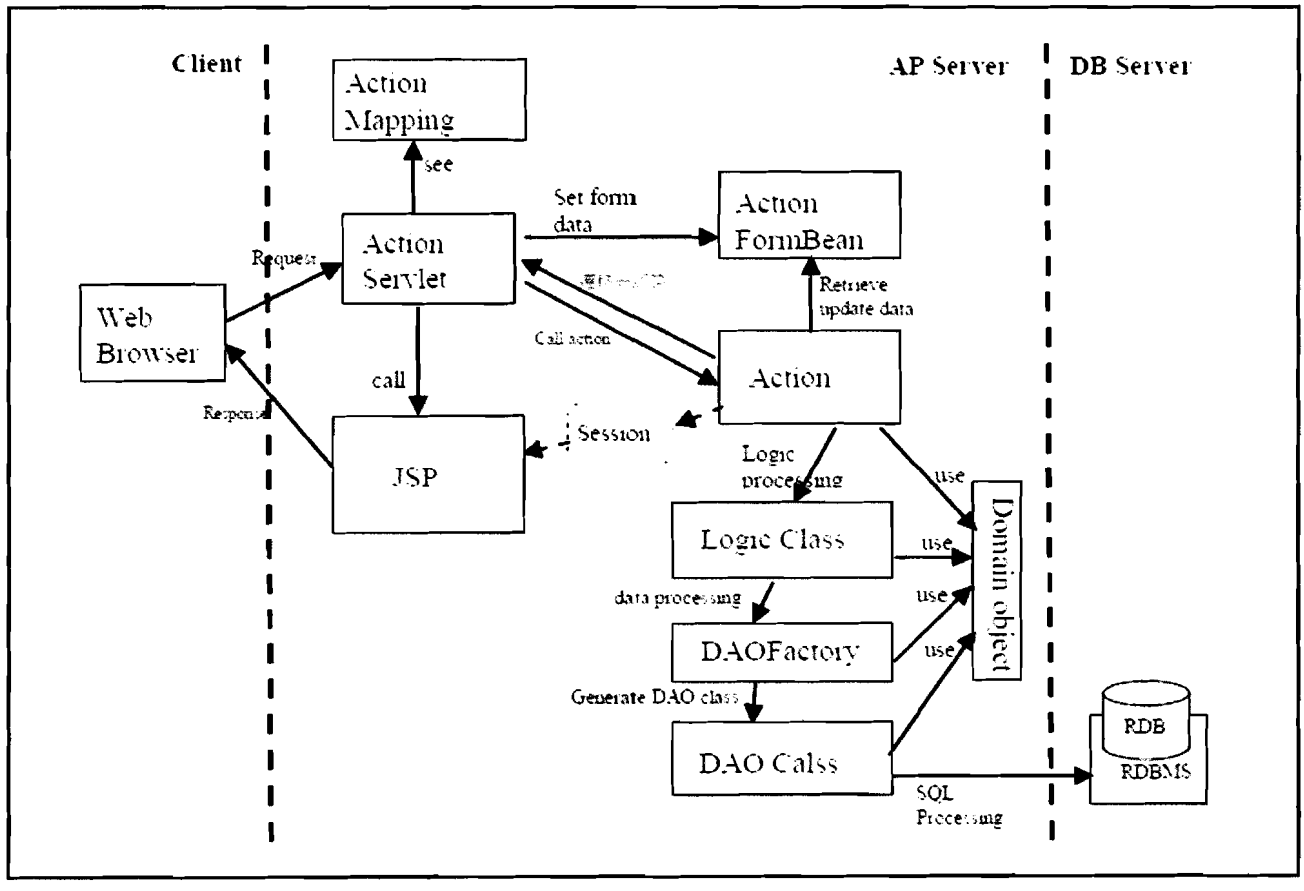

Figure 2.8 : System Process (Zhou & Chusho, 2009)

2.5 Summary

This chapter introduced the healthcare management system based on applying various techniques to serve the hospitals needs. Moreover, this chapter described the steps for setting up a health care system for managing the patient information and records through online. Finally, literature reviews were also addressed regards the space allocation and management services in the healthcare sections.

CHAPTER THREE

RESEARCH METHODOLOGY

The third chapter explains the methodology adopted in this research. This chapter provides the require overview and describe the details of the System Research Process Methodology in designing and developing the proposed web based space allocation and management system for large size hospitals in Libya. In the following subtopics, all phases of the methodology are discussed accordingly with reference to the case of the research.

3.1 Introduction

This chapter mainly discusses the research methodology that applied in this project. Methodology used to ensure a reliable approach which applied to all phases of a project (Hoffer, George, Valacich, McFadden, & Prescott, 1999). To conduct the outlined objectives in this research, the researcher carried out a detailed to understand the current trend in patient's bed space management system and to collect the requirements in developing this application. The gathered requirements are to form the basis design for the patient's bed space management system. The research methodology adapted in this study is development methodology from System Research Process Methodology proposed by (Nunamaker & Chen, 1991). The research methodology contains four main steps as shown in Figure 3.1.

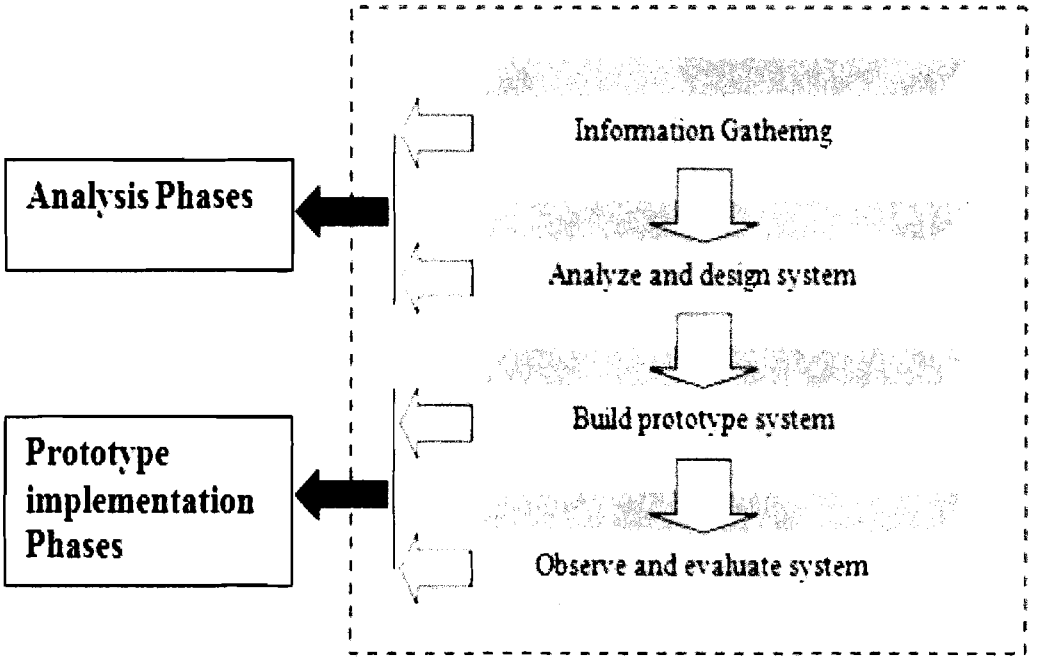

Figure 3.1: Research Steps (Nunamaker & Chen, 1991)

3.2 Analysis Phases

This phase present a comprehensive study for concluding the main research activities towards the proposed system. At the beginning of this phase, a determination for the research components was indicated in terms of cost estimation, risk analysis, work breakdown that have been carried in the literature review. During the literature review phase ideas, information, issues and problems related to the web-based system were gathered from proceedings, journals, white papers, reports and news. This phase defined how the current system works, determine & analyze facts and documents how system should work to better support. This phase mainly involves two sub-phases namely: information gathering and the system analysis and design phase.

3.2.1 Information Gathering

The information gathering was conducted from the previous studies in the area of space allocation and management for healthcare sectors. The information gathering for this research was addressed basically into functional and non-functional requirements towards the proposed system functionalities, which described in the next chapter. Based on the collected requirements in previous stage a detailed design for the proposed system implementation was reported towards the space allocation and management system for beds. In the case of this study, Unified Modeling Language (UML) was adopted and verified based on the research needs.

3.2.2 System Analysis and Design

This phase comprised and discussed the base architecture of the patient's bed space management system. A design approach also included in this sub-phase which illustrate and present patient's bed space management functional requirements system with the use of UML that applied to involve general use cases such as (a) use case diagram: this diagram used to show the system components and the user retaliations (b) use case specification: this diagram used to give the details about the use cases that introduced in the previous step (c) sequence diagram: this diagram used to show how the system work based on the use case diagram (d) collaboration diagram: this diagram used to illustrate the main components of the sequence diagram and the relation between them. All of these diagrams are drawn using Rational Rose 2000.

In this phase the researcher intended to determine the requirements for designing the proposed space allocation and management system to be utilized in the large size hospitals

3.3 Prototype Implementation Phase

This phase contains two sub-phases which are implementation of the prototype system and the Evaluation sub-phase. The Hardware (H/W) and Software (S/W) Specifications are shown in Table 3.1.

Table 3.1: Hardware and Software Specifications

Purpose	**H/W.S/W Requirements**
Programming Language	JSP
Operating System	Microsoft Windows Operating System (Win95/Win98,Windows2000,WindowsME, Windows XP)
Hardware	Monitor, CPU, RAM (16MB and above), Disk Space (minimum 12MB)

- **MySQL**

MySQL database is a tool for designing and structuring the data into tables that assigned under a certain ID. MySQL used widely in various applications that deploys locally or through server. The effectiveness of utilizing MySQL database in this research has addressed to be a simple and flexible tasks, the reason back to the fast performance, and high reliability during the execution. This research structured the database tables by putting in account the number of users and actions for each execution. Meanwhile, the research identified the main rows for each table for saving and retrieving data among clients (Widenius, Axmark, & DuBois, 2002).

- **JSP**

The development process for any system is requiring an indication for the main tools and resources in order to design and develop system components (Bergsten, 2003). The development of a system has been reported as a transformation of a certain design of into the executable application, which can be deployed and modified from time to time. The process of developing web page aims to initial the system functionalists and the programming language that need to be used. This research used Java Server Pages (JSP) language for developing the proposed web based application by carrying out the prime aspects to manage and process user queries.

Java Server Pages (JSP) defined as an exceptional formation for developing the Web applications. JSP enables developers to build the main elements of their code to be linked with other pages sequentially by following certain patterns that provide a custom tag library (Geary, 2008). JSP works on detecting and tracking the changes during system development by addressing the nature of the problem and suggests several possible solutions as shown in Figure 3.3.

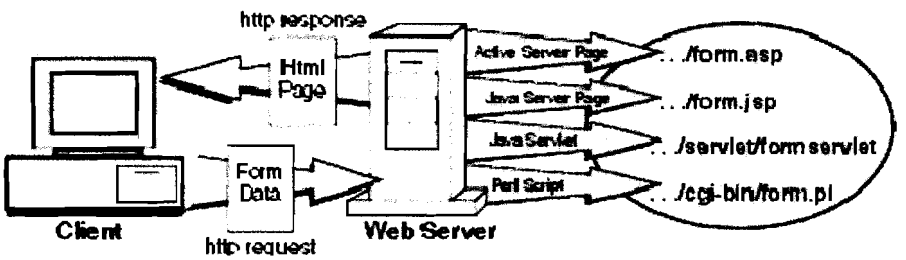

Figure 3.3: JSP Execution

Nevertheless, JSP page presents a combination of HTML pages that combined a number of elements to display the execution result in form of dynamic web page. The adaptation

of JSP could extend to include JavaBeans, JDBC objects, Enterprise Java Beans (EJB), and Remote Method Invocation (RMI) objects that can be simply initialed with JSP.

The separation of page elements in JSP page helps to provide a suitable authorization of tasks among client as a developer and server as an environment. Furthermore, JSP helps system developers to develop an adaptable code that can comfortably be improved and modified. The conceptual representation of the code classification based JSP, enables developers to reuse and customize the code easily. Thus, using JSP in coding web-base application considered to be a flexible way of initiating dynamic web contents than Java Serves (Kirkegaard & Møller, 2006).

This research used JCreator Pro 4.5 (IDE for JSP), PHPAdmin 3.4 (MySQL database administration tool), Microsoft Front Page 2003, and PreniumSoft Navicat project for designing and developing the proposed web application. JCreator Pro 4.5 is IDE was used as an environment for JSP coding, (MySQL database administration tool) and PreniumSoft Navicat were used to create the database tables. Finally, Microsoft Front Page 2003 was used to design the web pages.

3.3.1 The Prototype Implementation

In this phase the project designer evaluate the proposed system and iterate the proceeding steps to achieve the final system and construct the final system. In the development or build step, all requirements and suggestion from end user which is needed to fulfill in this study identified. A prototype of the patient's bed space management system was conducted in this sub-phase; through the use of the JSP in the coding part and the MYSQL for allocate the backend data store.

3.3.2 Evaluation Sub-Phase

Evaluation of the prototype system carries out after to implementation. At this phase the prototype developed was tested using in a real world environment using experienced users as testers, through the usability test method adopted from (Davis, 1989). Concerning the usability test a survey method was adopted so a questionnaire of questions was also adopted from different format (Lewis, 1995; Lin, Choong, & Salvendy, 1997; McNurlin & Sprague, 2001). This application was evaluated by 30 students from College Arts & Science UUM. It is the final test before the system is taken over by the students. Finally, user's feedback was generated from the distributed questionnaire. Questionnaires have advantages over some other types of surveys in that they are cheap, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data.

All data was gathered from questionnaire and analyzed by using the Statistical Package for the Social Sciences (SPSS) program.

3.4 Summary

Methodology is essential in every project to proper guide for achieving a study's objectives. The methodology for this study is adapted from Nunamaker and Chen (1991). A prototyping approach has been used in the third phase of the adapted methodology in order to design requirements model. The next chapter presents the details design of the proposed requirement model using UML diagram and interface design.

CHAPTER FOUR

ANALYSIS AND DESIGN

This chapter elaborates the design and development procedure for the proposed bed spaces reservation and allocation management system for Libyan public hospitals. Also the system requirements are formulated by justifying the functional and non functional requirements, followed by the use case diagram, sequence diagram, and collaboration diagram. The system is known as Bed Reservation System (BRS).

4.1 BRS Requirements

4.1.1 Functional Requirements

Listed below are the functional requirements as shown in Table 4.1. and non-functional as shown in Table 4.2 requirement of the BRS.

In the priority column, the following short hands are used:

- M – mandatory requirements (something the system must do)
- D – desirable requirements (something the system preferably should do)
- O – optional requirements (something the system may do)

Table 4.1: BRS Functional Requirement

No.	Requirement ID	Requirement Description	Priority
1	**BRS_01**	**Login**	
1	BRS_01_01 (Login)	Provides users (Admin, doctors, and pregnant) with the full access into the BRS user pages by entering their username and	M

		password.	
2	BRS_01_02 (Logout)	Enables users to logout from the BRS and redirected to the login page	
2	**BRS_02**	**Search**	
1	BRS_02_01 (Search)	Enables BRS user to search the BRS contents info in terms of profile, reservations, and users.	M
3	**BRS_03**	**Reserve Bed**	
1	BRS_03_01 (Reserve Bed)	Enables BRS pregnant to reserve the available bed by identifying the suitable equipments and the dates.	
2	BRS_03_02 (Confirm Reserve)	Enables BRS pregnant to confirm the bed reservation details after obtaining the selection.	M
4	**BRS_04**	**Manage Doctors**	
1	BRS_04_01 (Manage Doctors)	Enables BRS admin to manage the doctor's information by adding, updating, and deleting the doctor's info.	
2	BRS_04_02 (Add Doctors)	Enables BRS admin to add a different number of doctors by entering their info.	
3	BRS_04_03 (Edit Doctors)	Enables BRS admin to edit a different number of doctors by changing their info.	M
4	BRS_04_04 (Delete	Enables BRS admin to delete a different number of doctors by selecting the doctor	

	(Manage Pregnant)	information by adding, updating, and deleting the pregnant details.	
2	BRS_07_02 (Add Pregnant)	Enables BRS doctor to add different number pregnant information by adding the pregnant details.	M
3	BRS_07_03 (Edit Pregnant)	Enables BRS doctor to edit the pregnant information by changing the pregnant details.	
4	BRS_07_04 (Delete Pregnant)	Enables BRS doctor to delete the pregnant information by selecting the desire pregnant and remove is from the BRS database.	

4.1.2 Non-functional Requirements

Table 4.2: BRS Non-Functional Requirements

No.	Requirement ID	Requirement Description	Priority
8	**BRS_8**	**Reliability**	
1	BRS_8_01	For a single user, the system should crash no more than once per 3 hours.	D
2	BRS_8_02	If the systems crash, it should behave perfectly normal when reloaded again.	M
3	BRS_8_03	The system should be receiving a real time update for information.	M

9	BRS_9	Usability	
1	BRS_9_01	Users can easily use the system.	M
2	BRS_9_02	Users can easily manage their personal info.	M

4.2 BRS Use Case Diagram

The drawing of the use case diagram can address the way to illustrate the system actors and the use cases which this system enabled to the users (Admin, doctors, and pregnant), the BRS present three actors; the administrator who have the authorized to manage the doctors, reservation, profile, and search the available contents from the system database. However, the doctor is assigned to manage the pregnant details after a success login to the system. In addition, the pregnant is capable to indicate the suitable date to reserve the bed as shown in Figure 4.1.

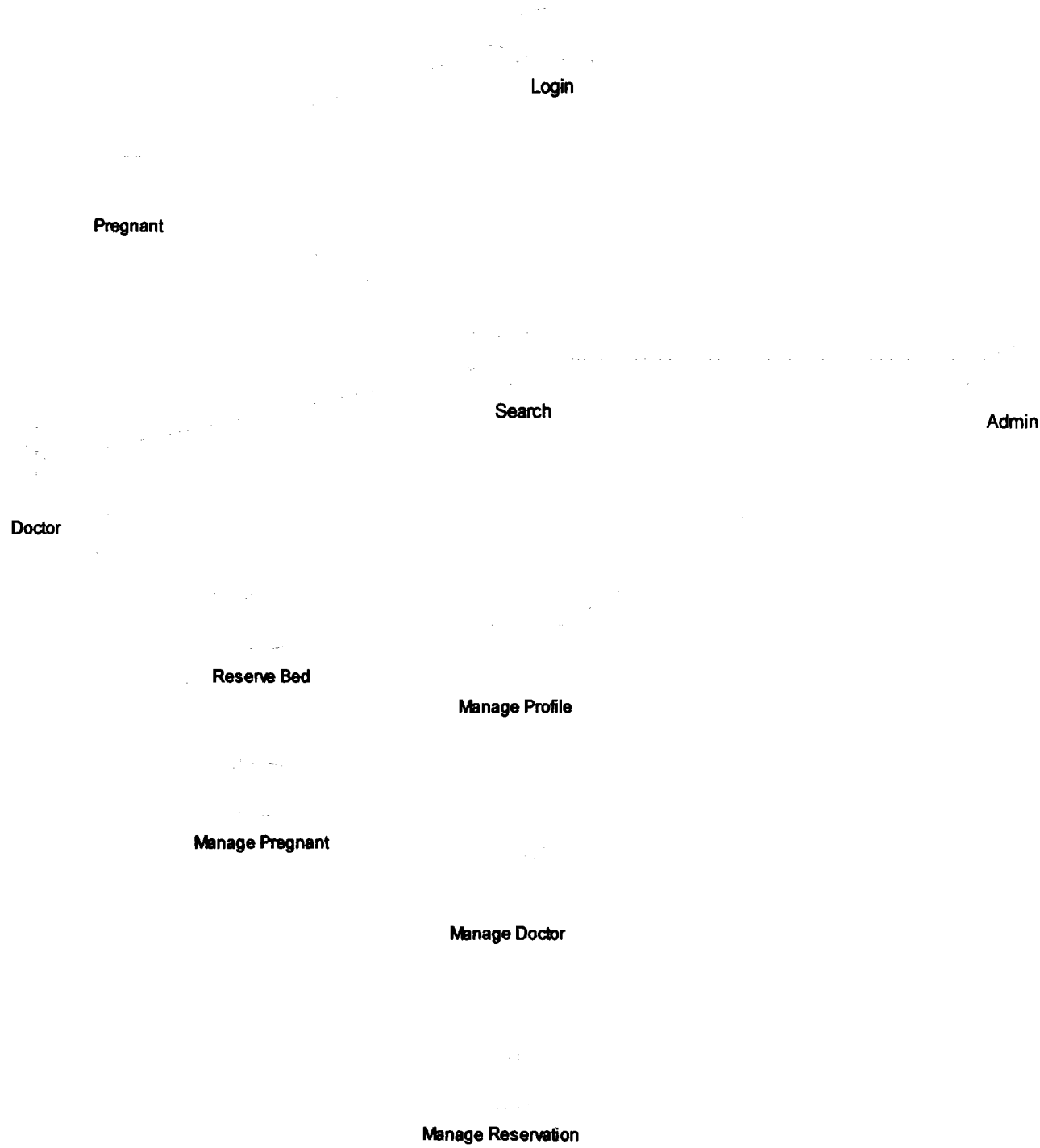

Figure 4.1: Use Case Diagram for BRS

4.3 BRS Sequence and Collaboration Diagram

4.3.1 Sequence & Collaboration Diagram for Login

This sequence diagram is assigned to the BRS users whom able to access their pages after providing a valid username and password. Users will be allowed to proceed through their functionalities without a further login as shown in Figure 4.2 and 4.3.

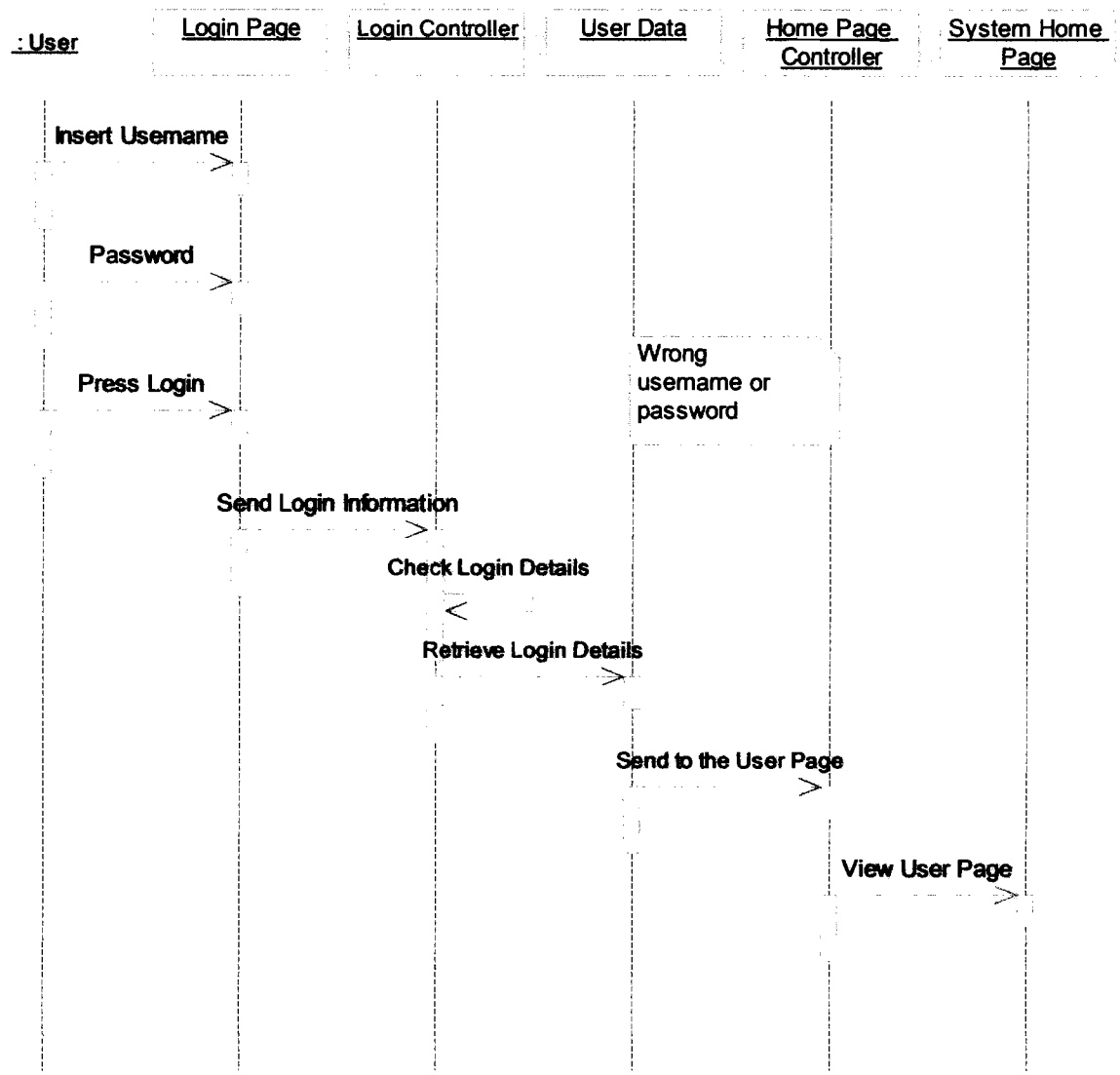

Figure 4.2: Sequence Diagram for Login

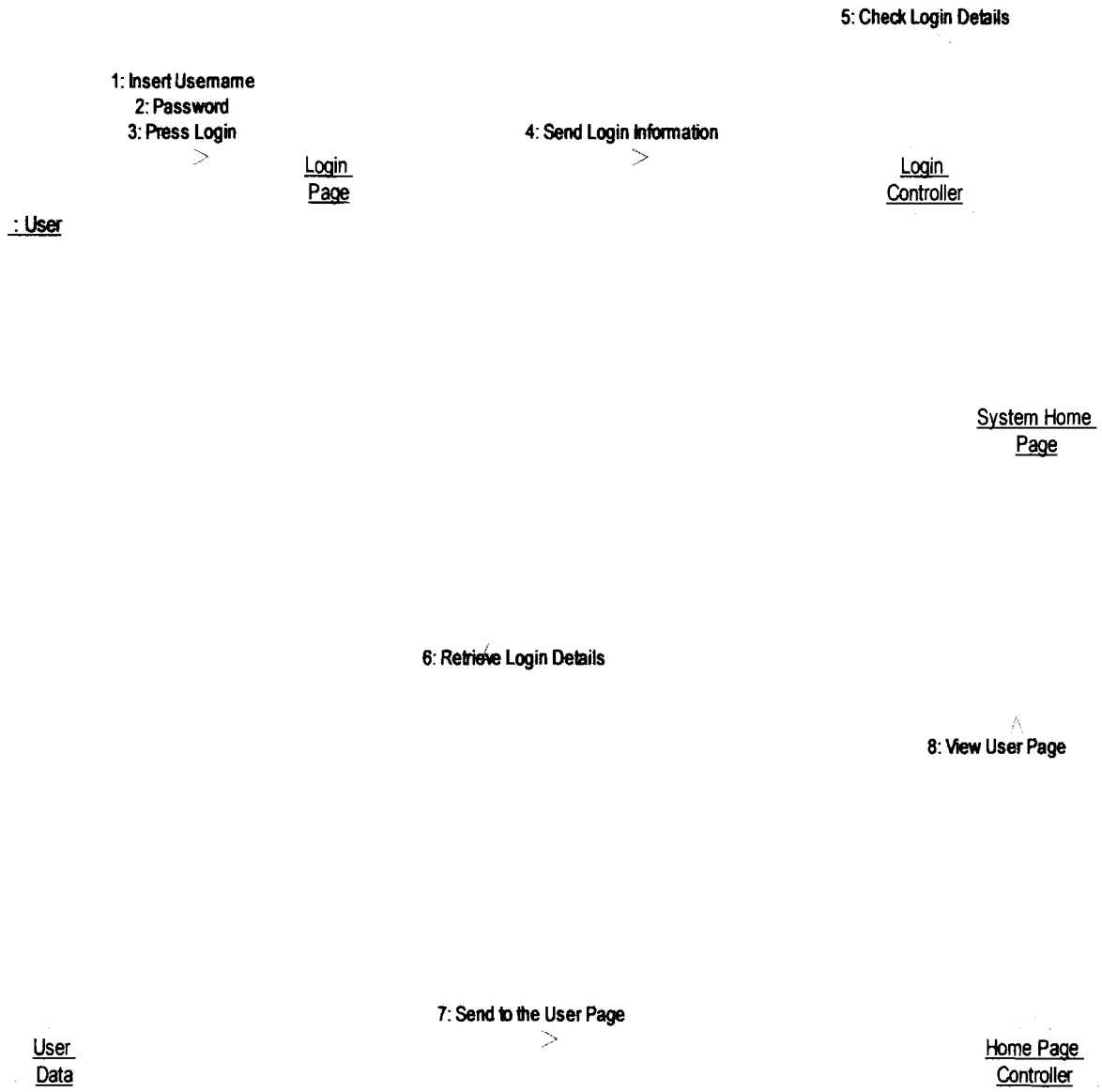

Figure 4.3: Collaboration Diagram for Login

4.3.2 Sequence & Collaboration Diagram for Search

This sequence diagram is assigned to the BRS users whom able to access their pages after providing a valid username and password. Users will be allowed to search about the desire user, reservation, and profile details from the BRS database by providing the correct keywords as shown in Figure 4.4 and 4.5.

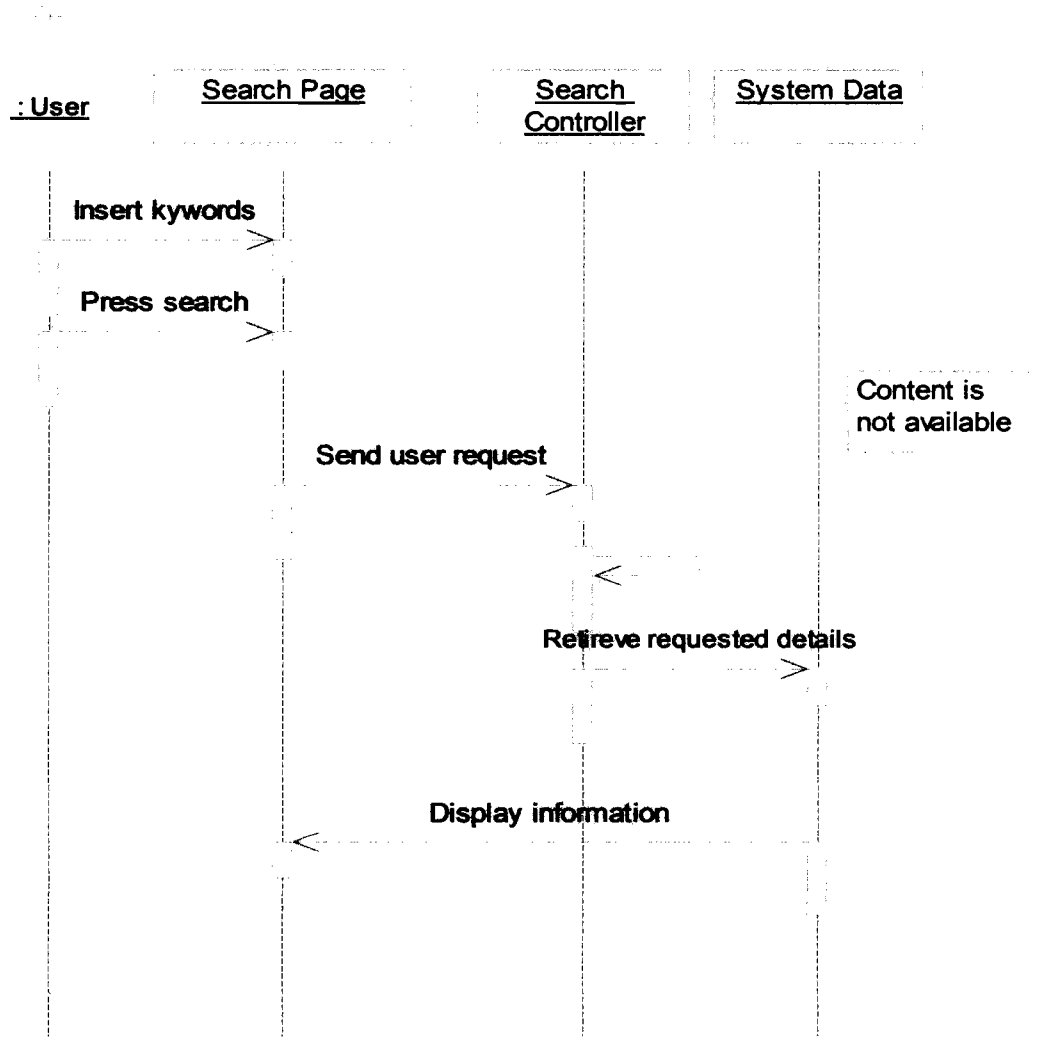

Figure 4.4: Sequence Diagram for Search

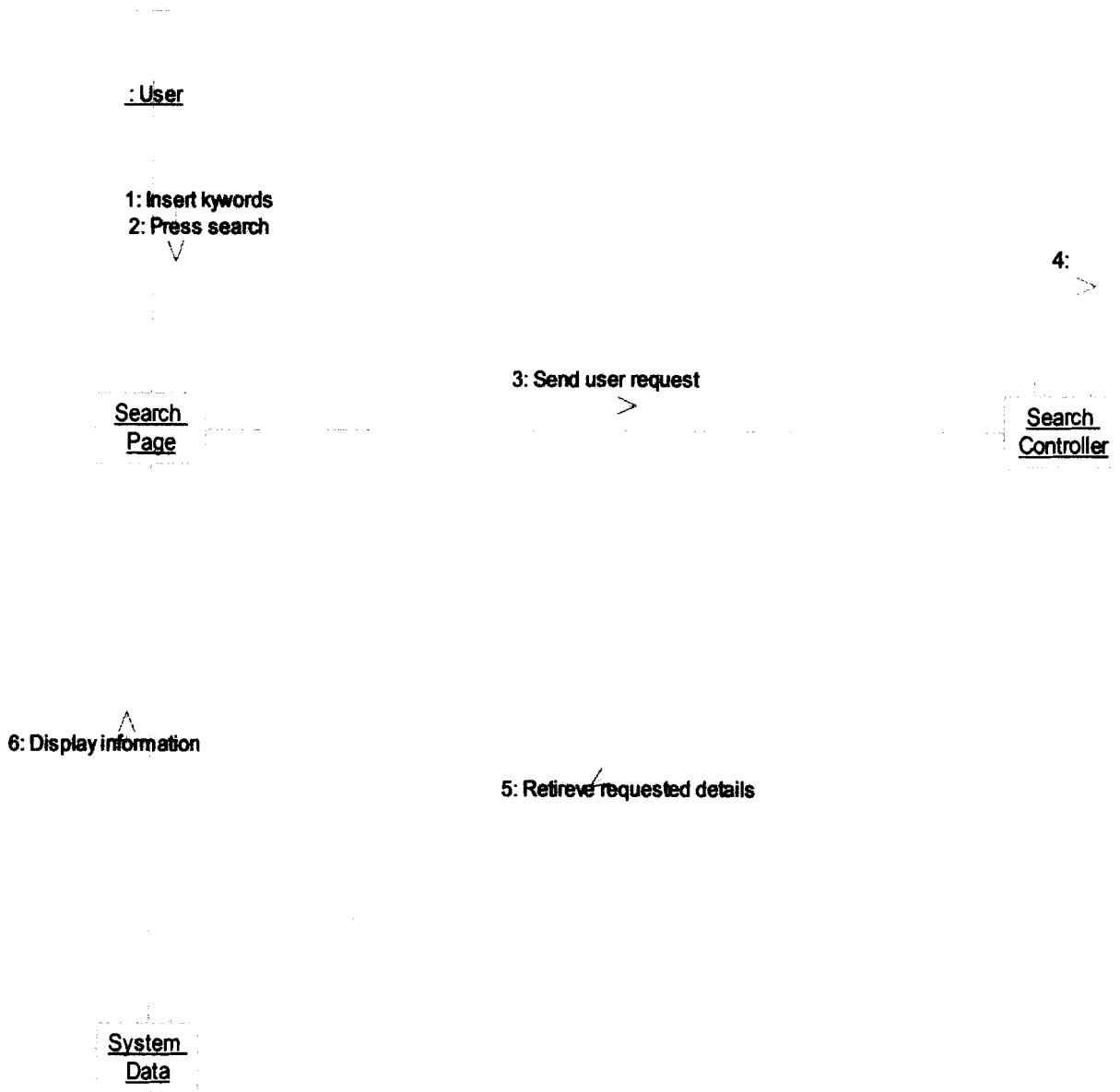

Figure 4.5: Collaboration Diagram for Search

4.3.3 Sequence & Collaboration Diagram for Reservation

This sequence diagram is assigned to the BRS pregnant whom able to access their pages after providing a valid username and password. Pregnant will be allowed to reserve the available bed from the BRS database after indicating they require equipments and dates as shown in Figure 4.6 and 4.7.

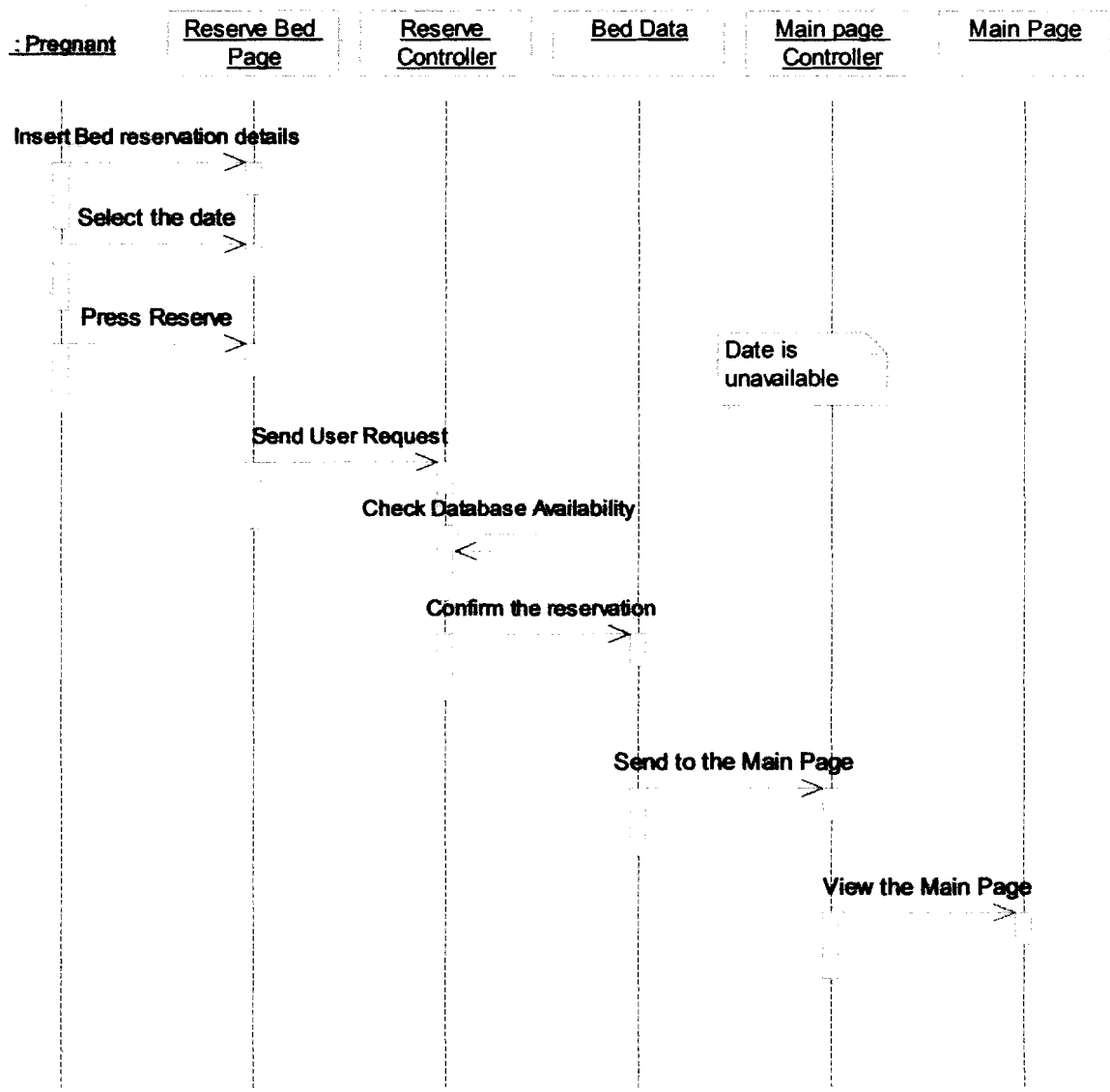

Figure 4.6: Sequence Diagram for Reservation

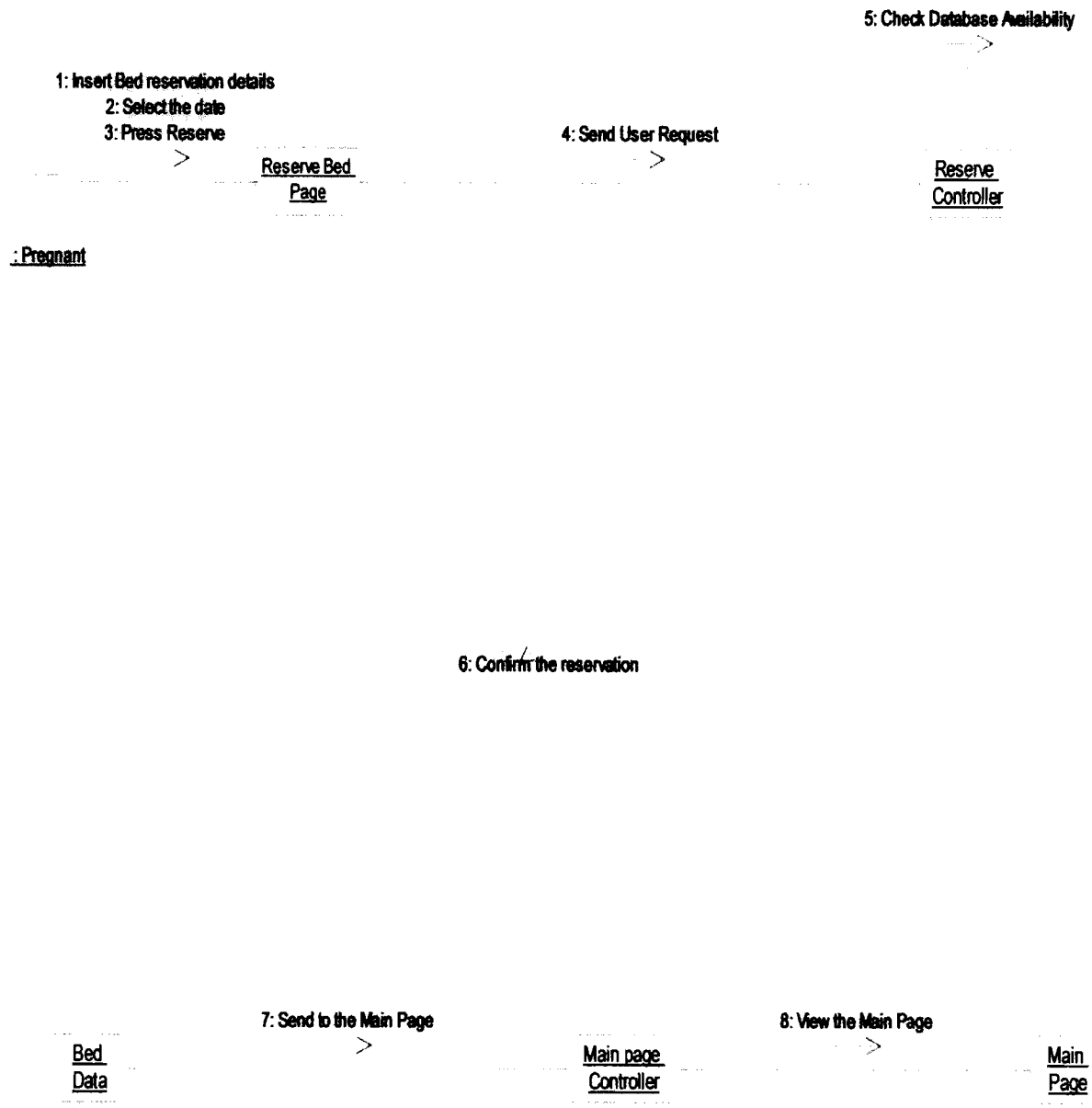

Figure 4.7: Collaboration Diagram for Reservation

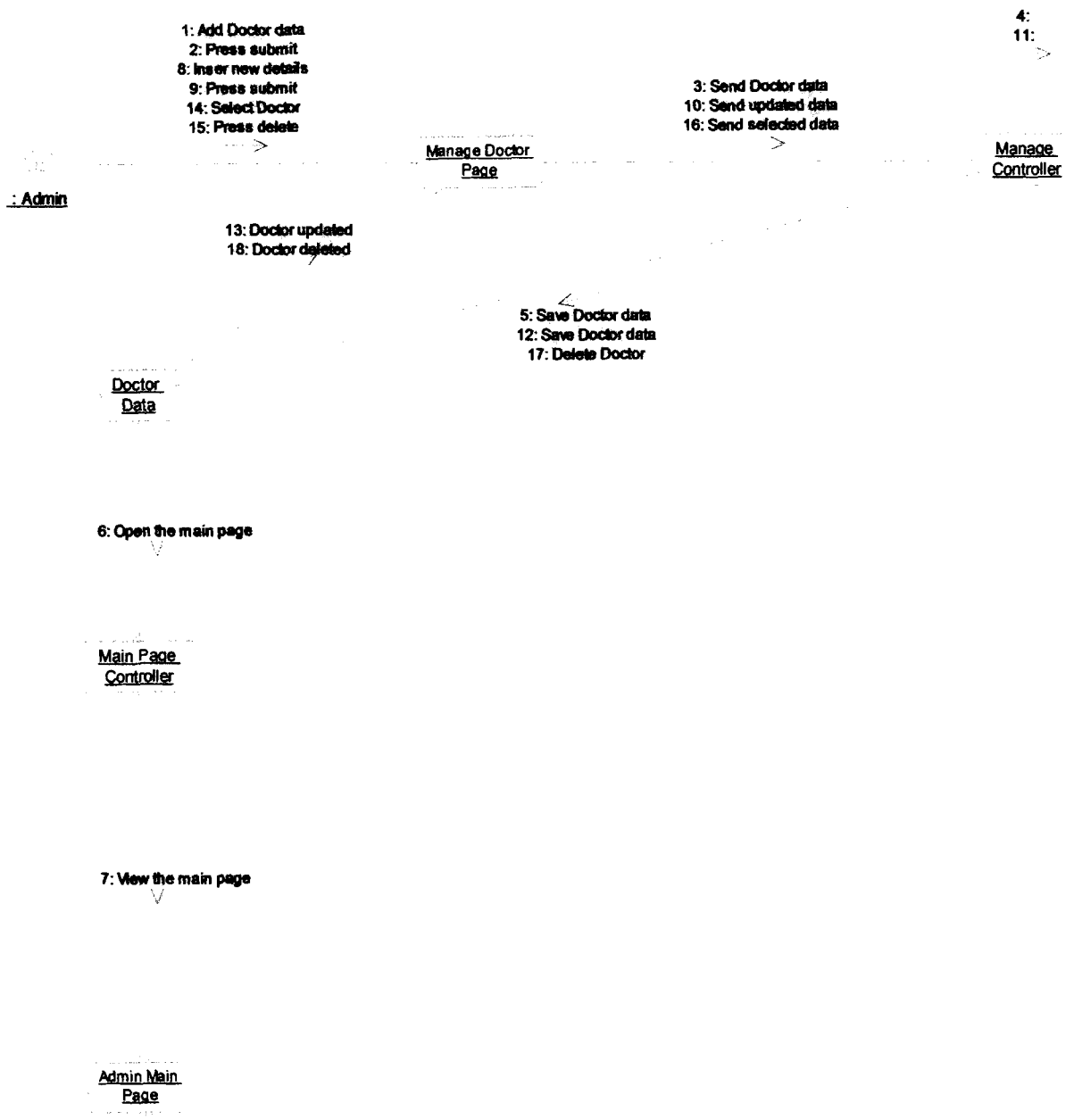

Figure 4.9: Collaboration Diagram for Manage Doctors

4.3.5 Sequence & Collaboration Diagram for Manage Reservation

This sequence diagram is assigned to the BRS admin whom able to access their pages after providing a valid username and password. Admin will be allowed to manage the reservation details by adding, updating, and deleting the existing reservation from the BRS database as shown in Figure 4.10 and 4.11.

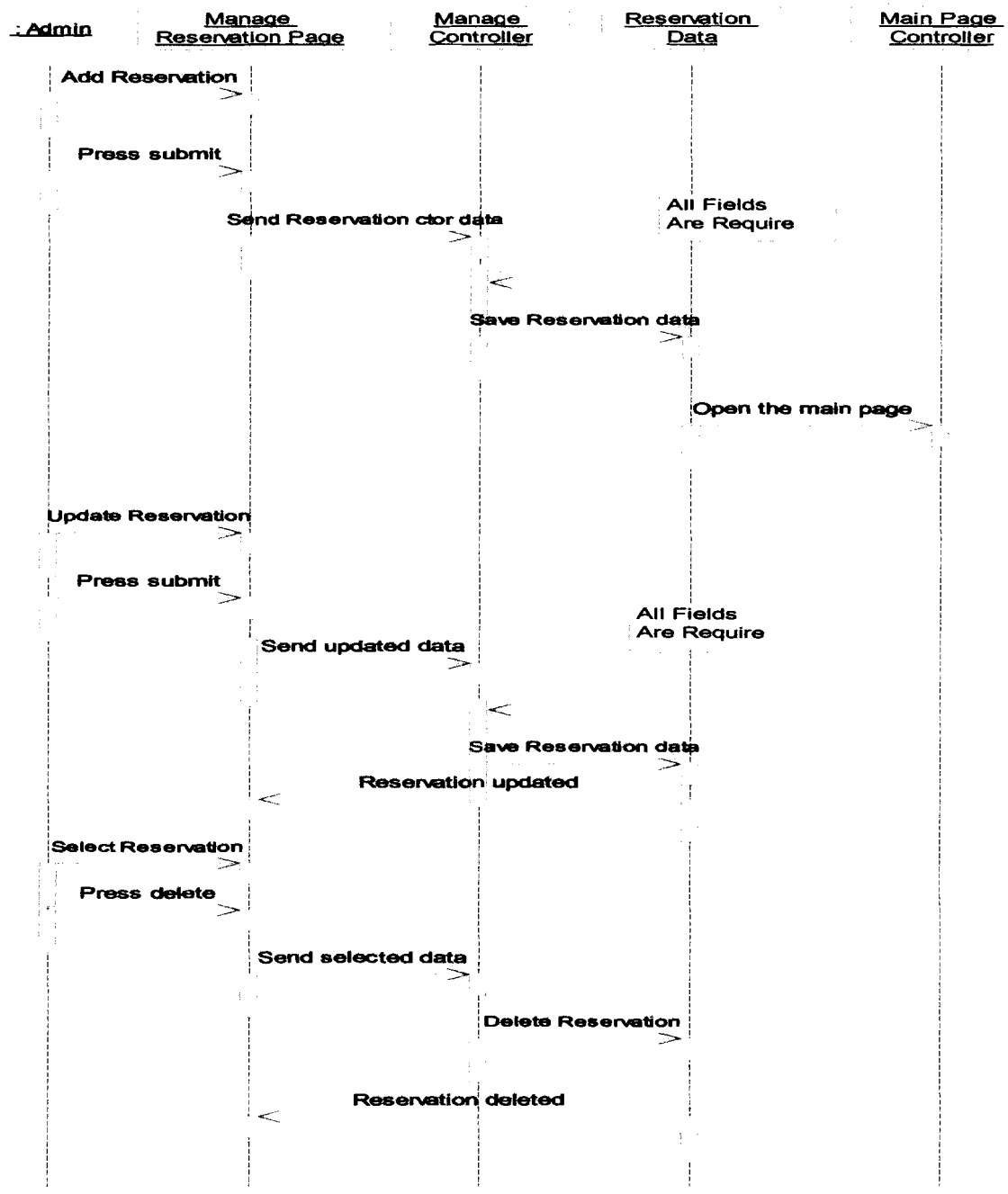

Figure 4.10: Sequence Diagram for Manage Reservation

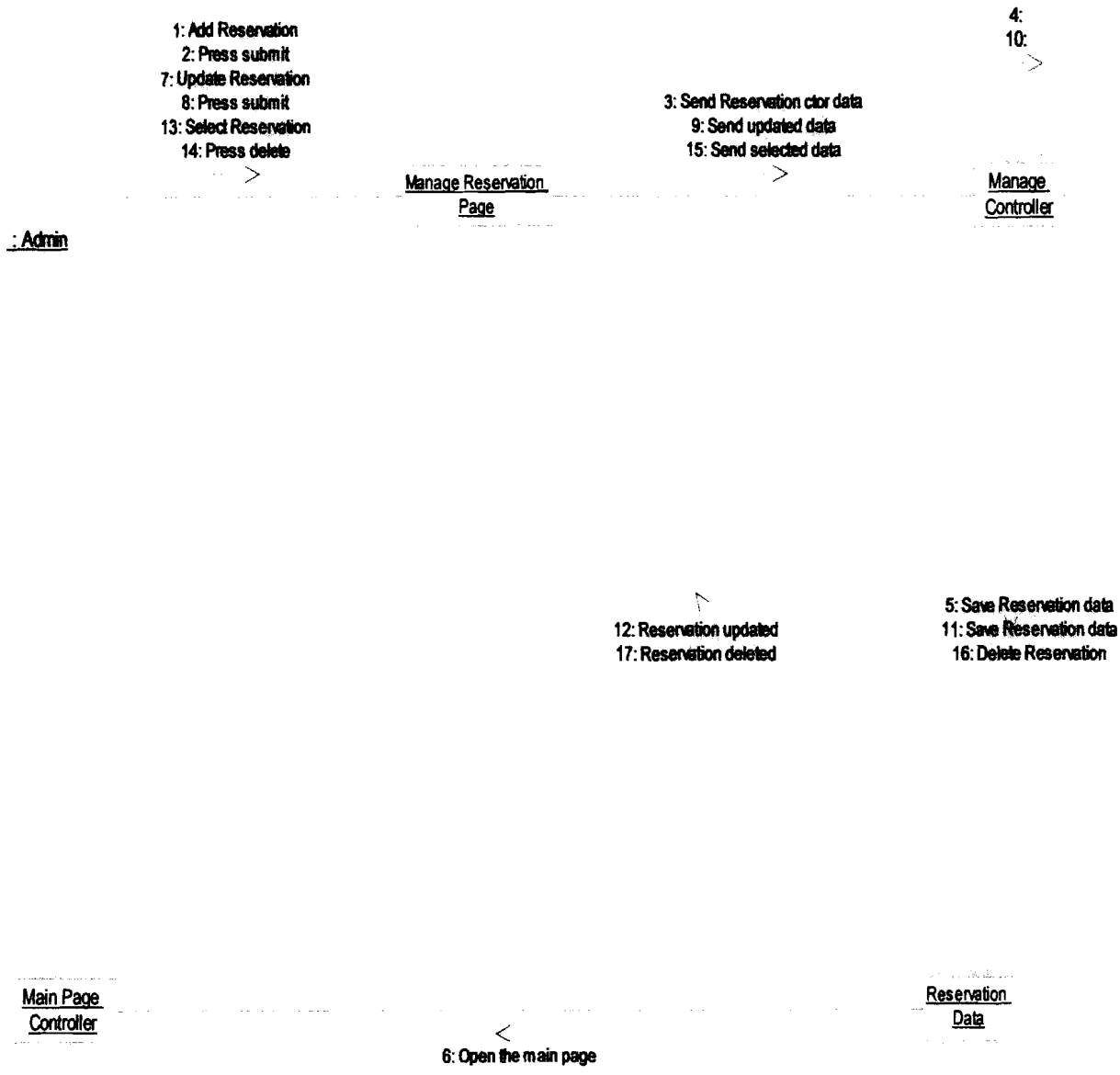

Figure 4.11: Collaboration Diagram for Manage Reservation

4.3.6 Sequence & Collaboration Diagram for Manage Pregnant

This sequence diagram is assigned to the BRS doctor whom able to access their pages after providing a valid username and password. Doctor will be allowed to manage the pregnant details by adding, updating, and deleting the existing shown from the BRS database as shown in Figure 4.12 and 4.13.

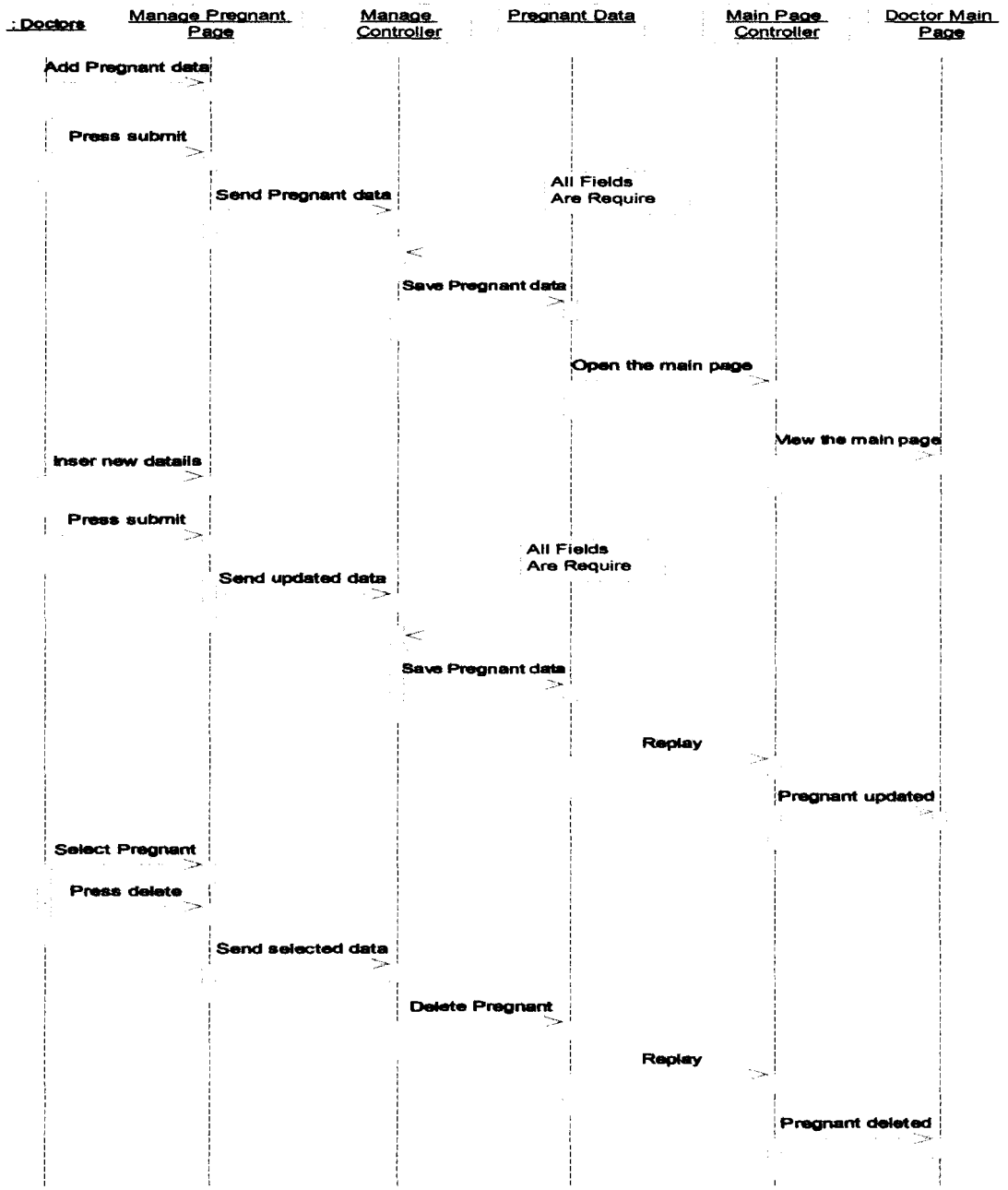

Figure 4.12: Sequence Diagram for Manage Pregnant

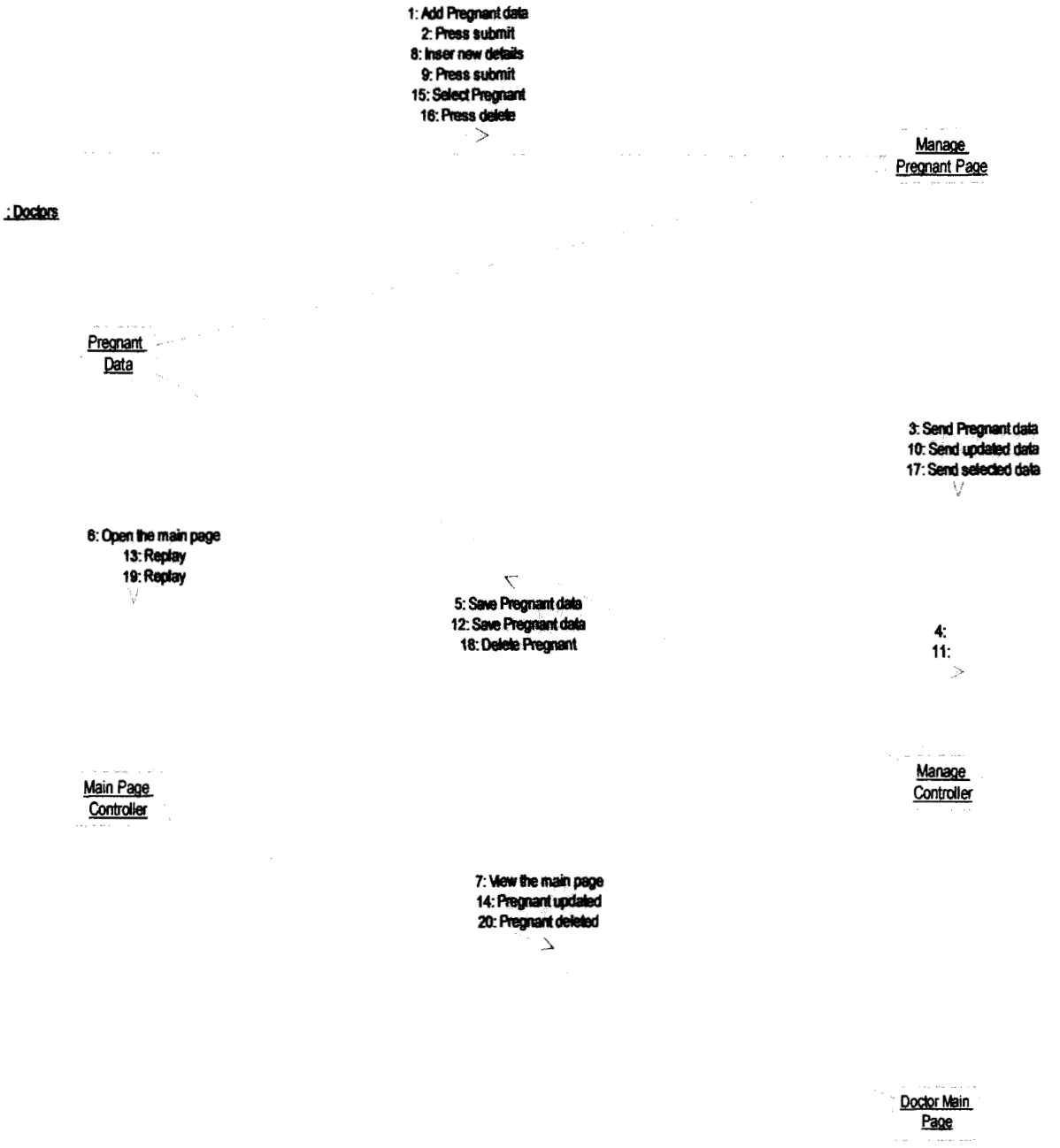

Figure 4.13: Collaboration Diagram for Manage Pregnant

4.3.7 Sequence & Collaboration Diagram for Manage Profile

This sequence diagram is assigned to the BRS users whom able to access their pages after providing a valid username and password. User will be allowed to edit and delete their profile details as shown in Figure 4.14 and 4.15.

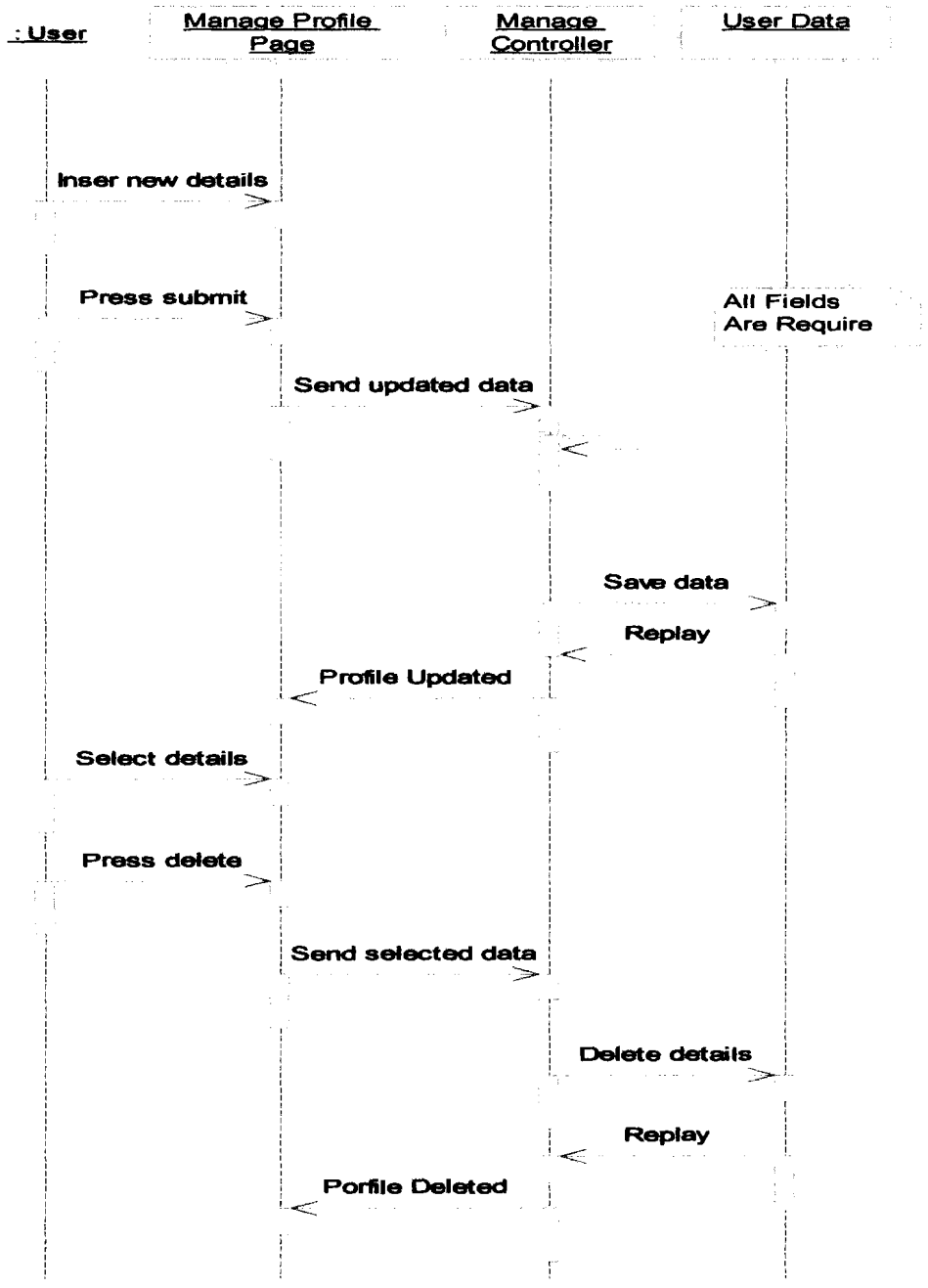

Figure 4.14: Sequence Diagram for Manage Profile

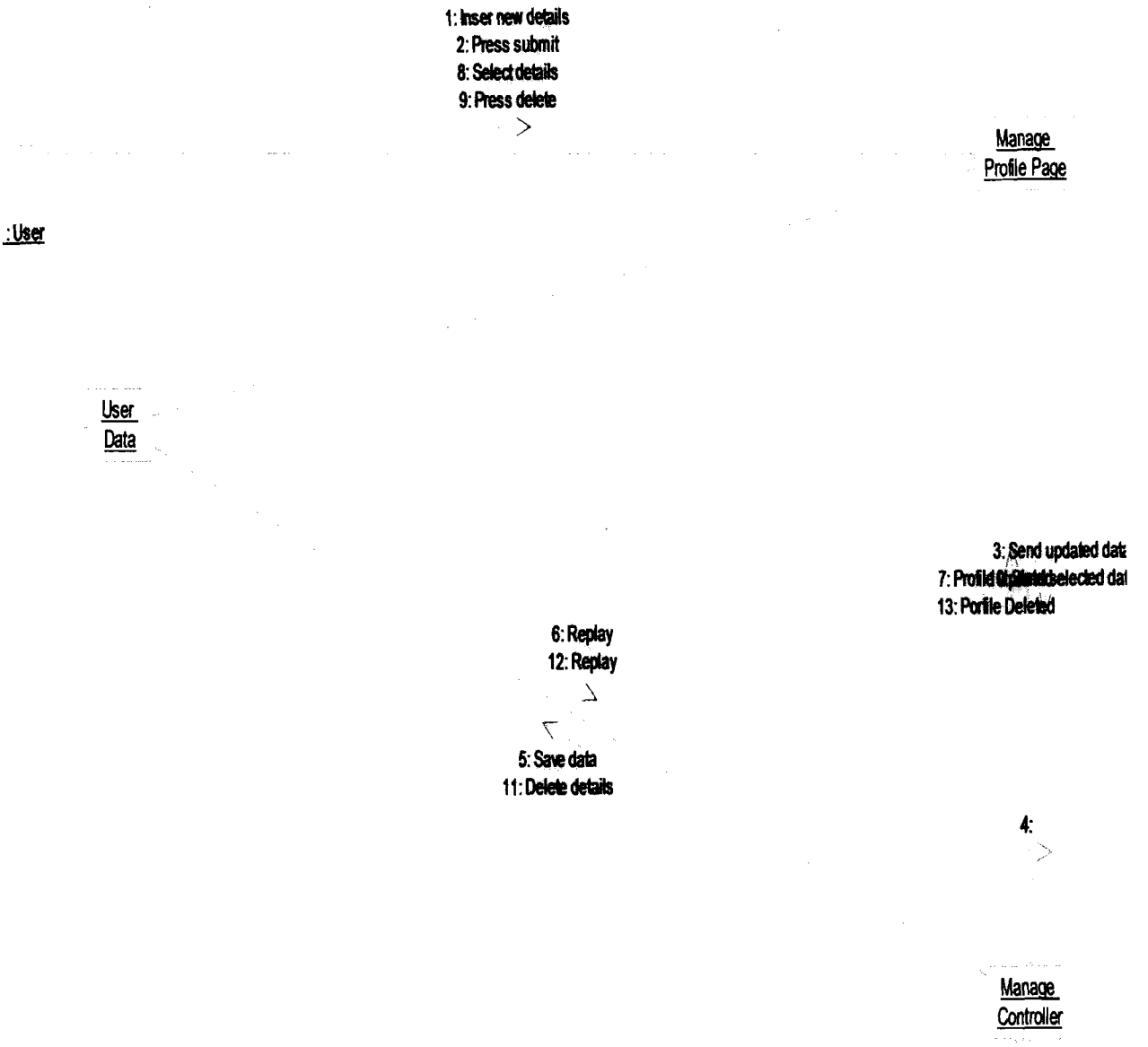

Figure 4.15: Collaboration Diagram for Manage Profile

4.4 BRS User Interface

4.4.1 BRS Home Page

This page includes the functionalities for all of pregnant, doctor, and administrator. Users are required to login first to access their pages as shown in Figure 4.16.

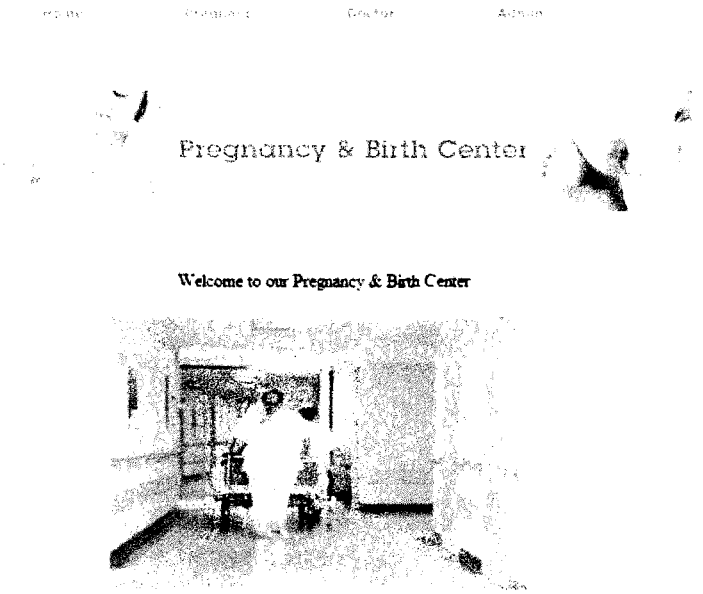

Figure 4.16: BRS Home Page

4.4.2 Admin Login Page

Figure 4.17 shows the login process for the BRS administrator, administrator is require to provide a valid username and password to access his or her home page for managing doctors, reports, cancel reservation, and logout as shown in Figure 4.18.

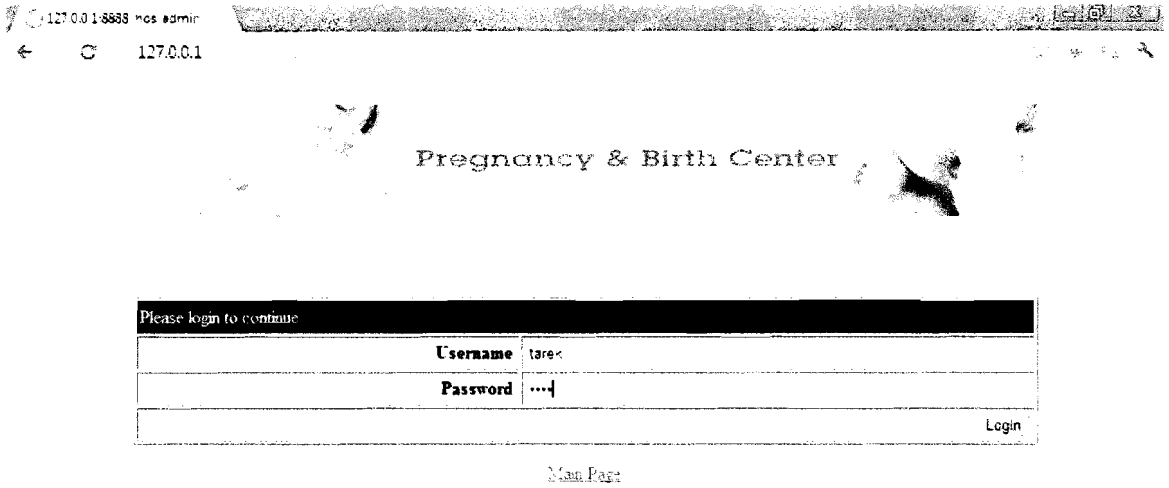

Figure 4.17: Admin Login Page

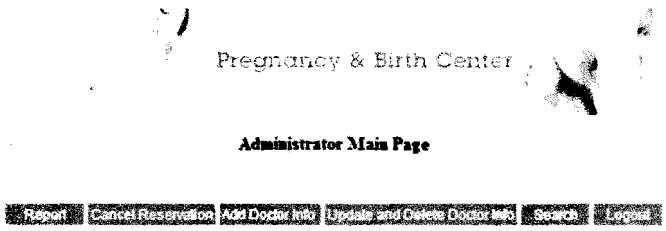

Figure 4.18: Admin Home Page

4.4.3 Admin Report Page

Figure 4.19 presents the reports that BRS administrator is applicable to generate from the system database after a successful login.

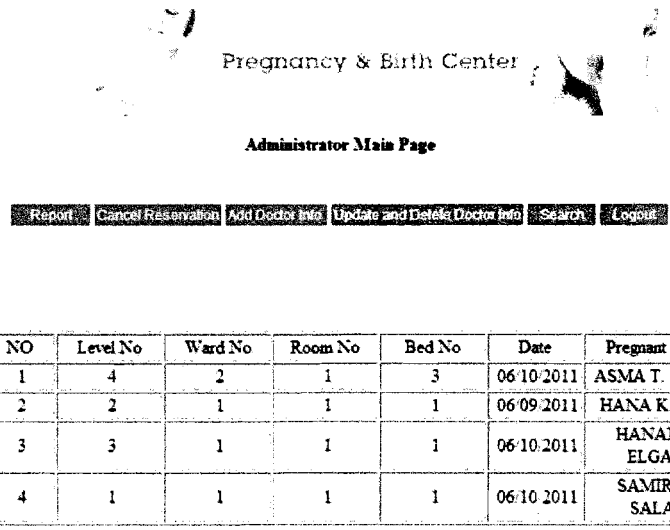

Figure 4.19: Admin Report Page

4.4.4 Admin Manage Doctor Page

Manage doctor page illustrates the managing procedure for the doctors from the BRS database, administrator can be able to manage the doctor info by adding, deleting, and updating the doctor ID, name, gender, specialization, email, tell, address, and password as shown in Figure 4.20.

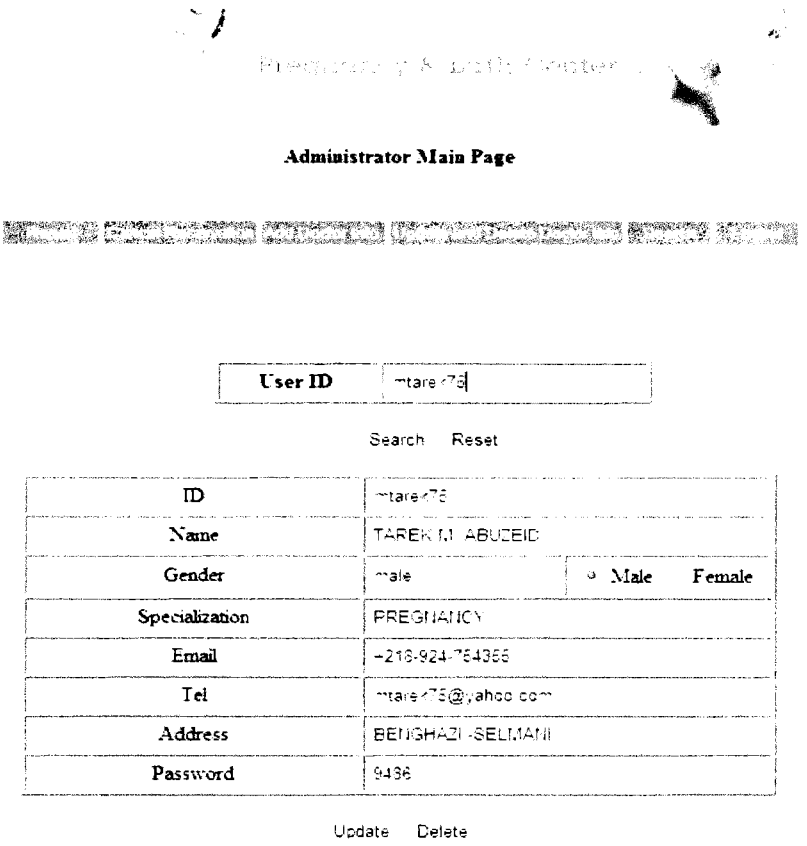

Figure 4.20: Admin Manage Doctor Page

4.4.5 Admin Search Page

Figure 4.21 presents the search procedure for the available details that stored in the BRS database. The process involves proving the user ID to search about the pregnant details or reservation, otherwise reset the process.

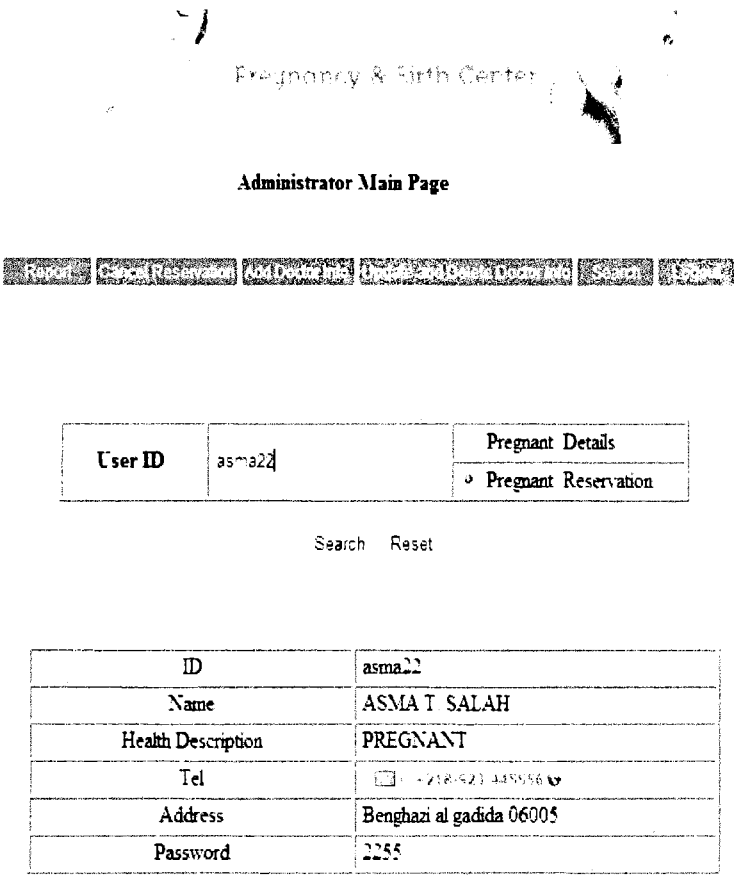

Figure 4.21: Admin Search Page

4.4.6 Admin Cancel Reservation Page

Figure 4.22 presents the main procedure for canceling the pregnant reservation by the system administrator, the administrator is requiring to provide suitable information about the level, ward no., level no., bed no., and date or reset.

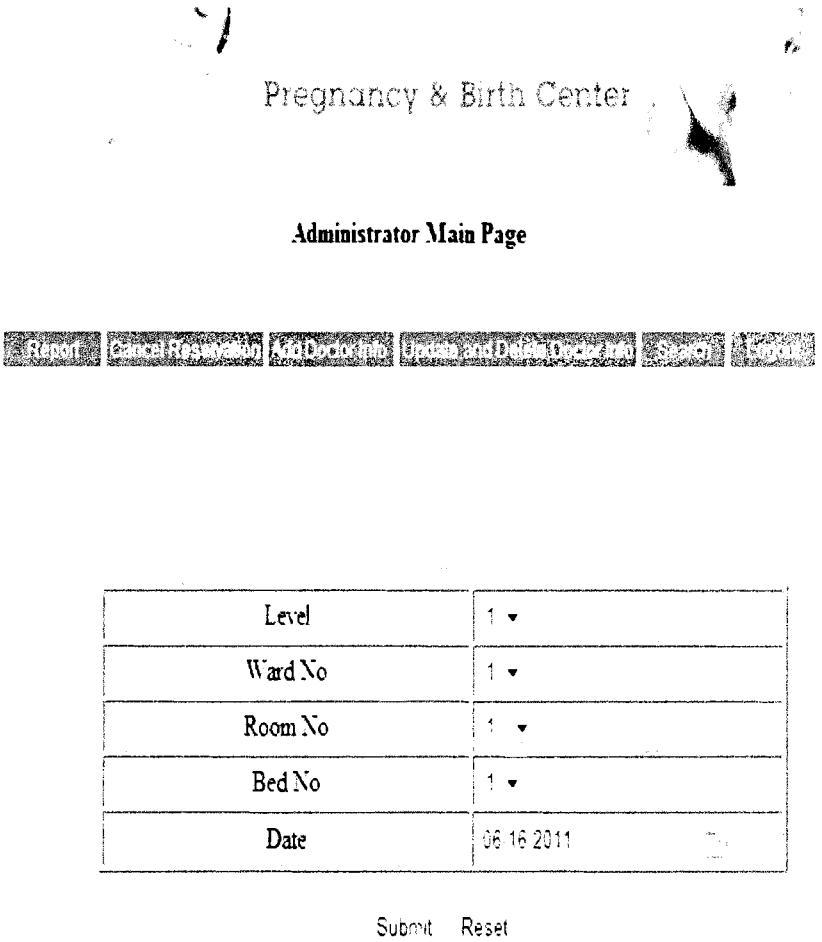

Figure 4.22: Admin Cancel Reservation Page

4.4.7 Doctor Login Page

Figure 4.23 shows the login process for the BRS doctor, doctor is require providing a valid username and password to access his or her home page for managing pregnant, profile, search, and logout.

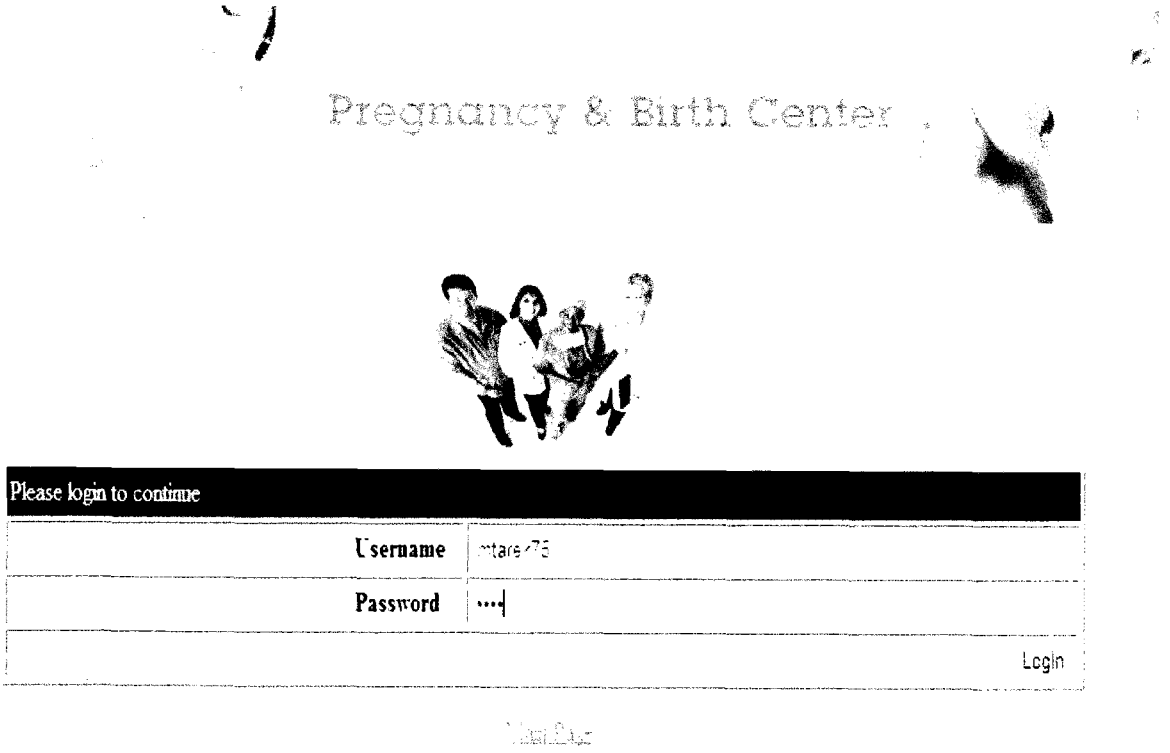

Figure 4.23: Doctor Login Page

4.4.8 Doctor Home Page

This page shows the main doctor functionalities that enable BRS doctors to view profile, search, manage pregnant, and logout as shown in Figure 4.24.

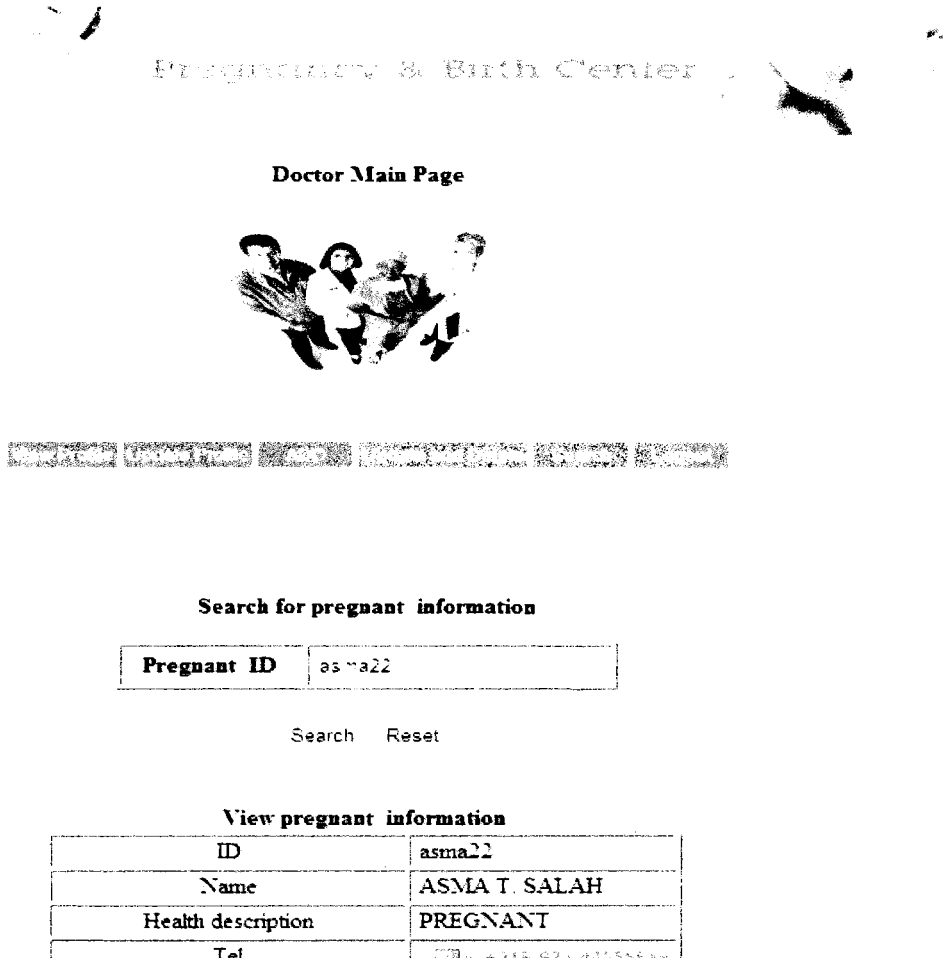

Figure 4.24: Doctor Home Page

4.4.9 Doctor Manage Profile Page

Doctor can be able to update his or her profile info, doctor needs to login firstly before proceed through this process. As well, doctor can modify the doctor ID, name, gender, specialization, email, tell, address, and password or either delete it as shown in Figure 4.25.

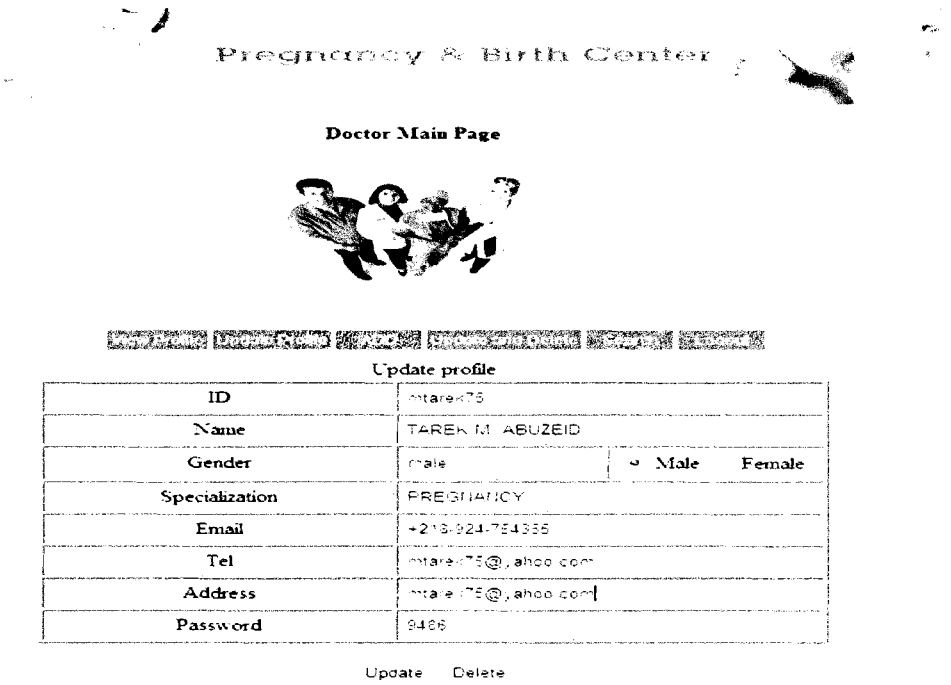

Figure 4.25: Doctor Manage Profile

4.4.10 Doctor Manage Pregnant Info Page

Manage pregnant page illustrates the managing procedure for the pregnant info from the BRS database, doctor can be able to manage the pregnant info by deleting, and updating the pregnant ID, health description, tell, address, and password as shown in Figure 4.26.

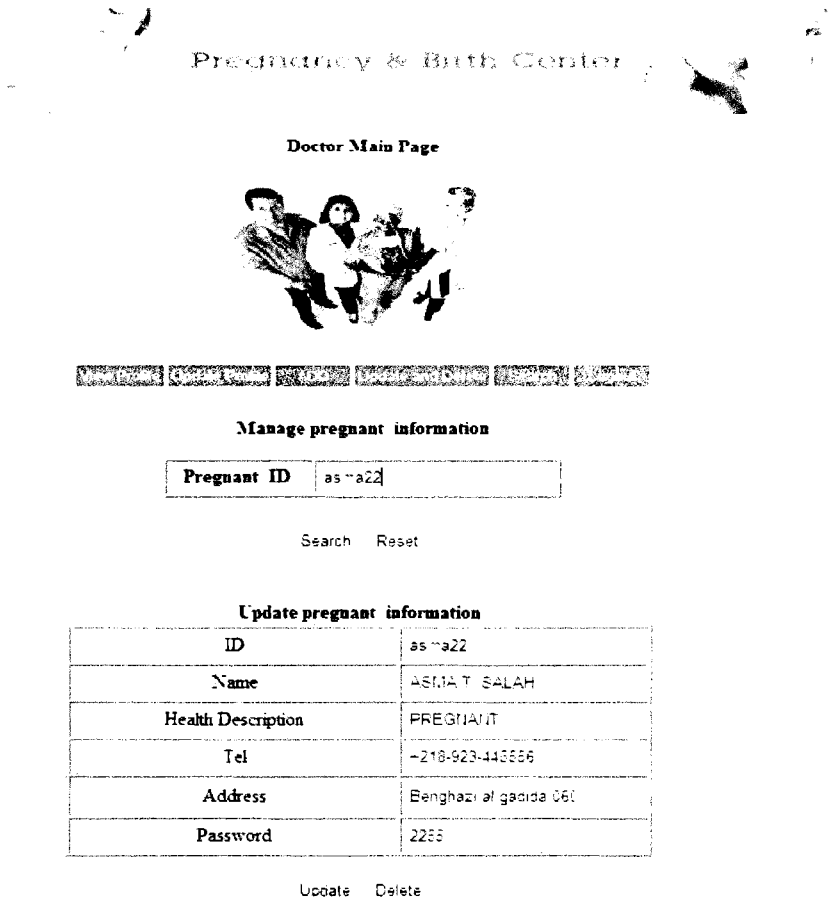

Figure 4.26: Doctor Manage Pregnant Info Page

4.4.11 Doctor Add Pregnant Page

This page illustrates the adding procedure for the pregnant info, doctor can be able to add any number of pregnant by inserting the pregnant ID, health description, tell, address, and password as shown in Figure 4.27.

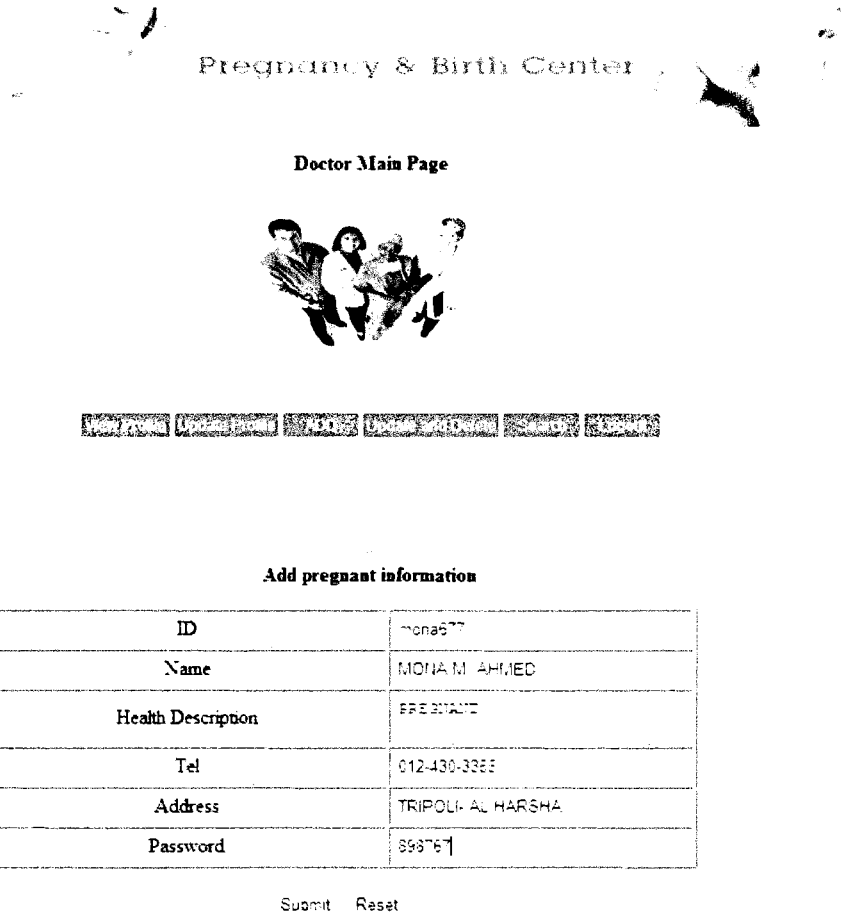

Figure 4.27: Doctor Add Pregnant Page

4.4.12 Pregnant Login Page

Figure 4.28 shows the login process for the BRS pregnant, BRS is require providing a valid username and password to access his or her home page for view profile, update profile, reserve bed, and logout. However, Figure 4.29 shows the view profile page for pregnant through illustrating the pregnant ID, name health description, tell, address, and password.

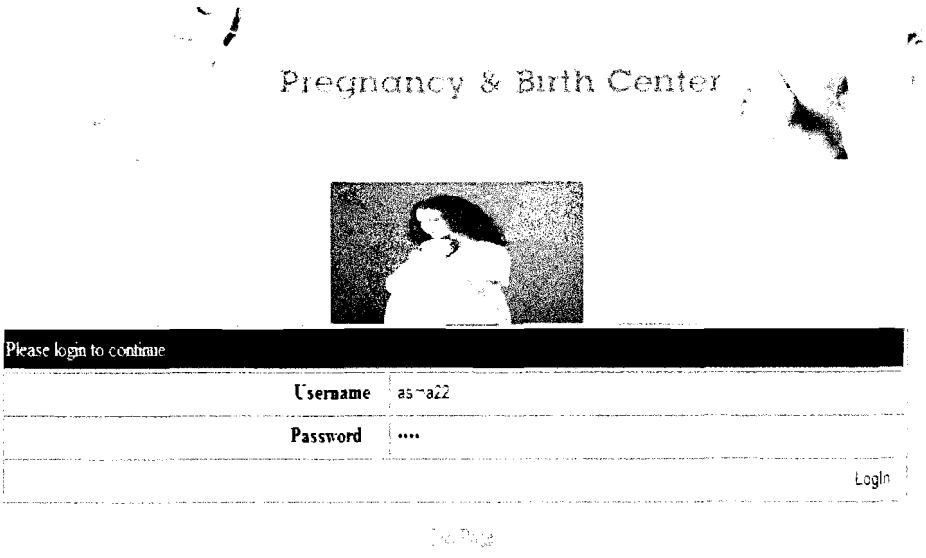

Figure 4.28: Pregnant Login Page

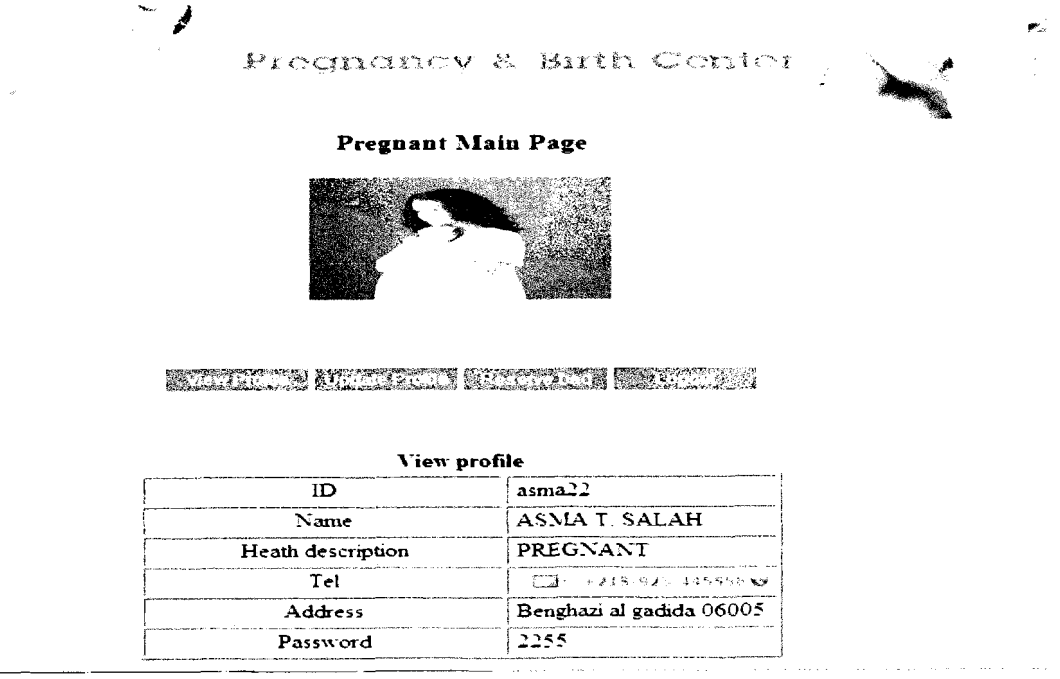

Figure 4.29: Pregnant View Profile Page

4.4.13 Pregnant Update Profile Page

This page presents the updating procedure for the pregnant info through modifying the pregnant ID, name health description, tells, address, and password as shown in Figure 4.30.

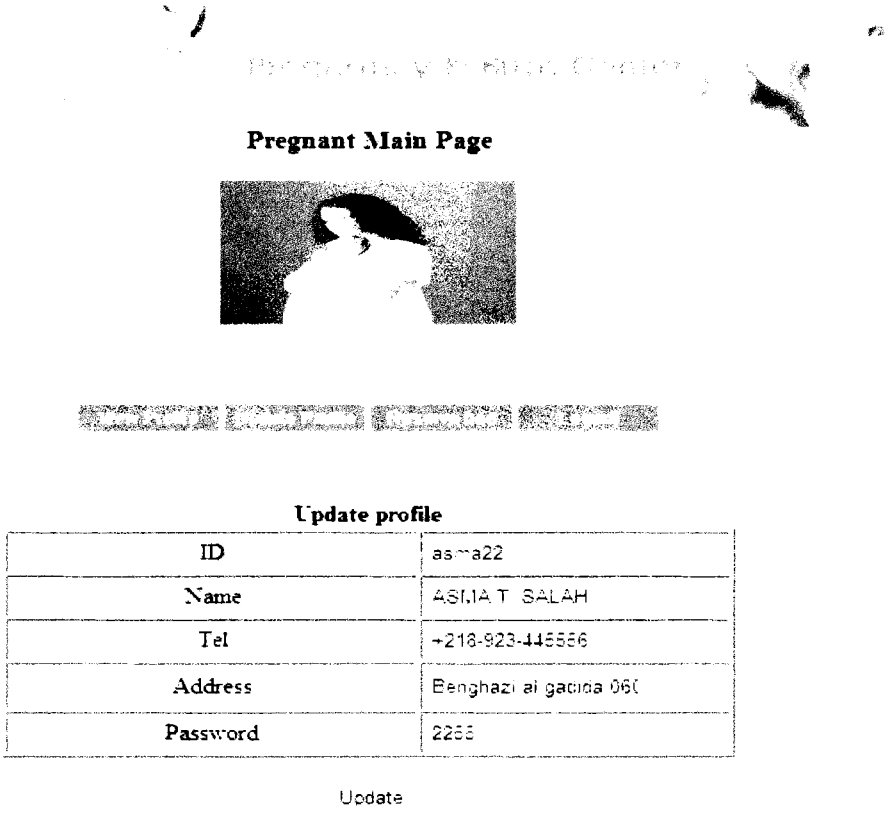

Figure 4.30: Pregnant Update Profile Page

4.4.14 Pregnant Reserve Bed Page

Figure 4.31 shows the pregnant bed reservation page, pregnant requires to provide the suitable details about the reservation level, ward no., bed no., room no., and date. Otherwise pregnant may reset the process.

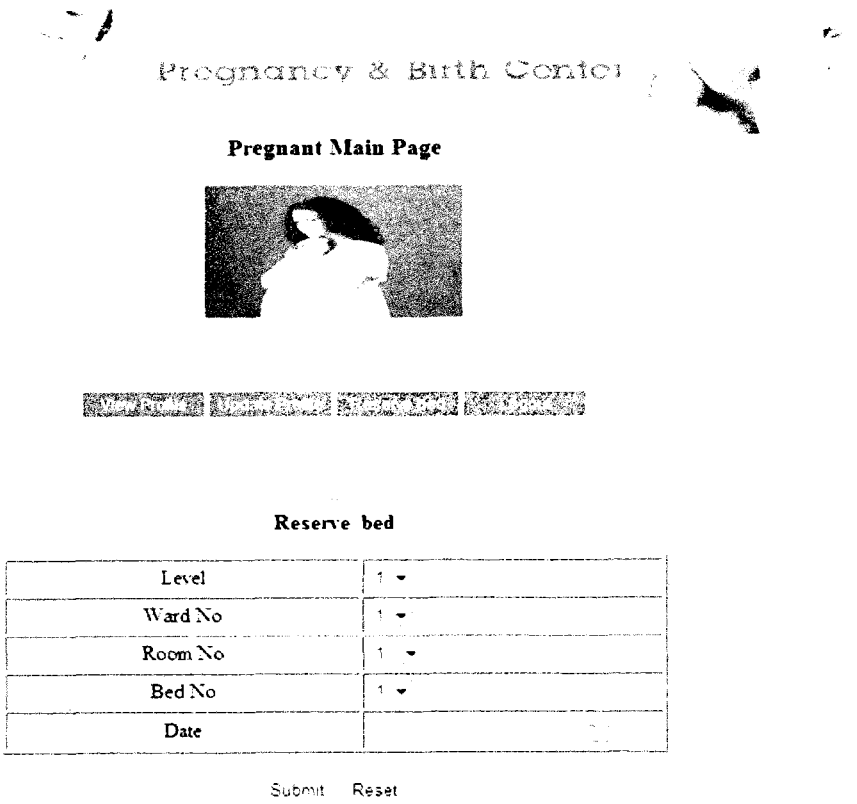

Figure 4.3.1: Pregnant Reserve Bed Page

CHAPTER FIVE

EVALUATION

5.1 System Evaluation

This stage presents the most level in this research to conclude the BRS usefulness, ease of use, and behavioral intention, as well, this chapter involves the usability of the proposed BRS and the user solidification determined. The proposed BRS was tested by running the system on Internet explorer with local host server. The user evaluation of the prototype was conducted with 30 international students from UUM; each of them was given brief explanation regarding the ease of use, usefulness and their intention towards BRS.

The questionnaire adopted from (http://www.questionpro.com/academic/online-survey-research-User-Acceptance-Survey.html) consists of one section: the user satisfaction. The Statistical Package for Social Sciences (SPSS) version 16 used to determine the frequencies of each question, however, the histogram provided in this evaluation.

5.2 Descriptive Statistics for Usefulness

Table 5.1 presents the descriptive statistics for the usefulness towards the using of BRS among participants. The majority of participants (30) found that using BRS makes it easier to them to complete their task easily (Mean= 4.75 & STD = .500), while other participant believed that BRS helped to increase the work productivity of the participants during the anticipating (Mean = 4.50 & STD =1.000) based on the obtained result, its indicated that most of the participants are strongly agreed that BRS is useful to use. Refer to the Appendix (A) for questionnaire items.

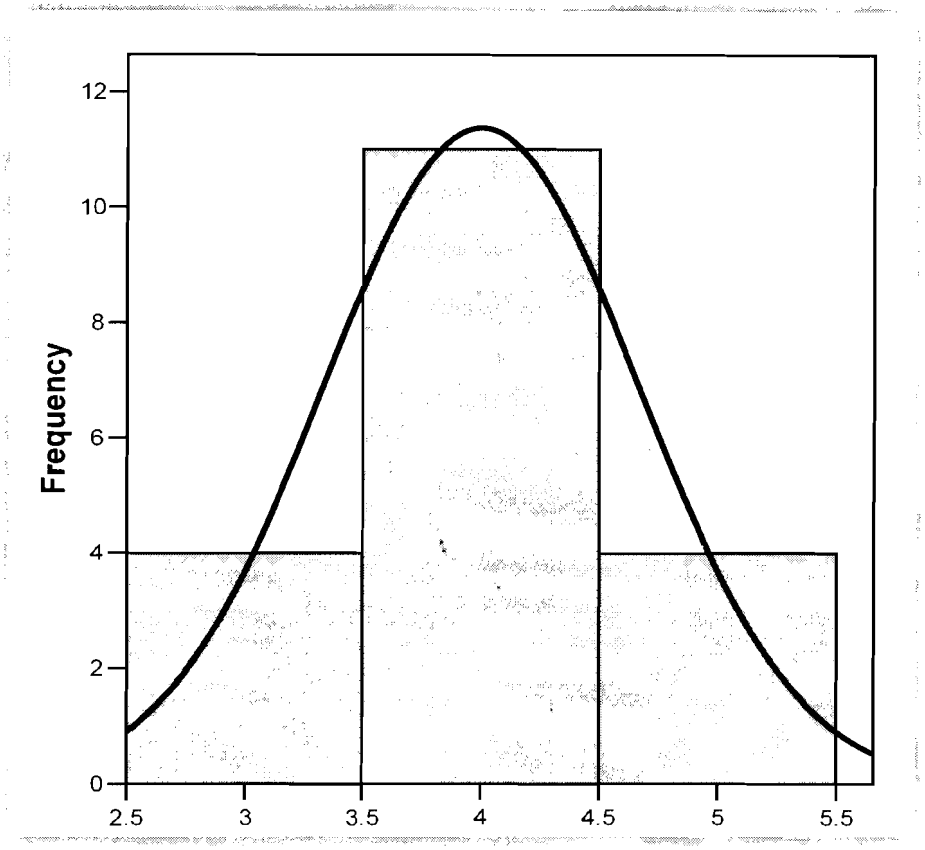

Figure 5.1: Average of Usefulness Histogram

5.3 Descriptive Statistics for Ease of Use

Table 5.2 presents the descriptive statistics for the ease of use of BRS among participants. The majority of participants found that using BRS was easy to deal with by the participants (Mean= 4.50 & STD = 1.000), while other participant believed that BRS was easy for the participants to get what they want during the participant anticipating (Mean = 4.25& STD = .500) based on the obtained result, its indicated that most of the participants are agreed that BRS is ease to be used. Refer to the Appendix (A) for questionnaire items.

Table 5.2: Descriptive Statistics for Ease of Use

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	30	2	4	4.50	1.000
Q2	30	4	5	4.25	.500
Q3	30	3	5	3.10	.817
Q4	30	4	5	4.15	.420
Q5	30	2	5	3.75	1.500
Q6	30	2	4	3.20	.818
Valid N (listwise)	30				

Meanwhile, the lowest agreement was initialed for the ability of BRS to enable participants to interact with and provide the suitable understanding (Mean = 3.10 & STD= .817). In addition, Figure 5.2 shows the overall ease of use of using BRS among participants.

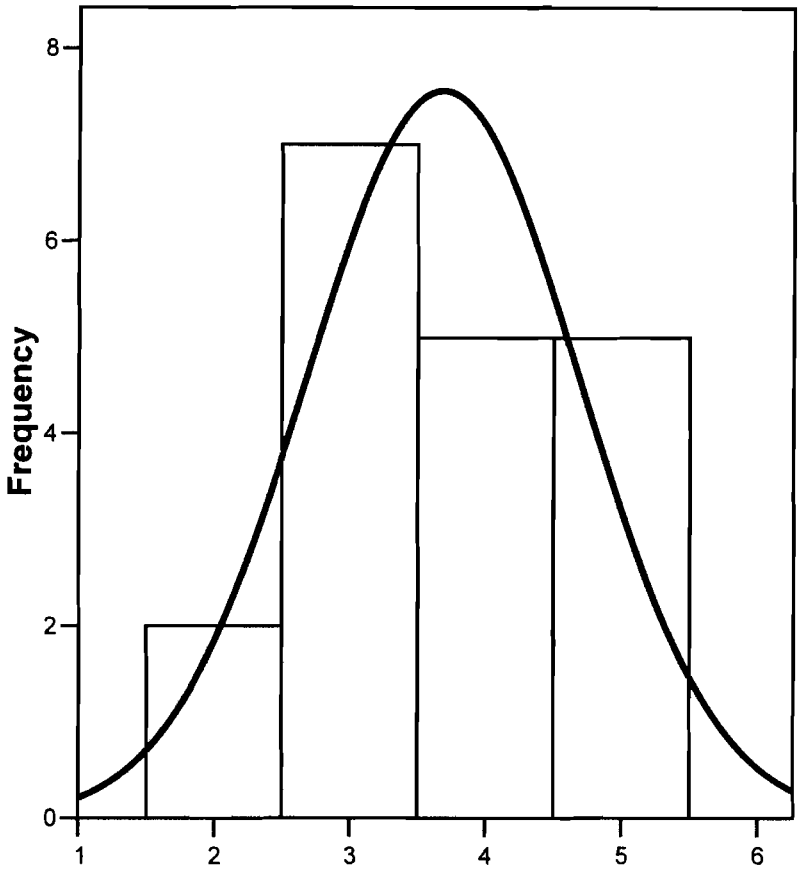

Figure 5.2: Average of Ease of Use Histogram

5.4 Descriptive Statistics for Behavioral intention to Use the BRS

Table 5.3 presents the descriptive statistics for the participant's intention towards the use of BRS in conducting their tasks. The majority of participants found that using BRS in many time helps to simplify the process (Mean =4.65 & STD = .500), while other participant believed that using BRS in future could help to perceived their intention to the system functionalities (Mean = 4.50 & STD = 1.000) based on the obtained result, its indicated that most of the participants are agreed that BRS is perceived their intention during tasks performing. Refer to the Appendix (A) for questionnaire items.

Table 5.3: Descriptive Statistics for Behavioral intention to use the BRS

	N	Minimum	Maximum	Mean	Std. Deviation
Q1	30	3	5	3.50	.816
Q2	30	4	5	4.65	.500
Q3	30	3	5	4.50	1.000
Q4	30	3	5	4.25	.500
Q5	30	2	5	3.75	1.500
Valid N (listwise)	30				

As well, the lowest agreement was initialed for the ability of participants to use the BRS to do a task whenever it has a feature to help me perform it (Mean = 3.50 & STD= .816). In addition, Figure 5.3 shows the overall intention of using BRS among participants.

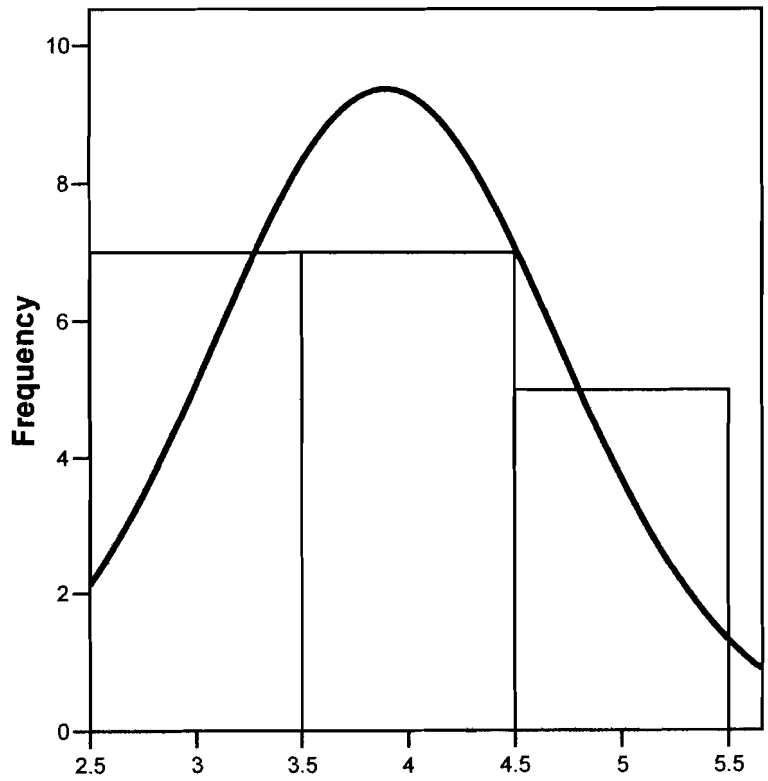

Figure 5.3: Average of Intention Histogram

This study concluded that using BRS among participants was easy to use, useful, and achieved their perceived intention towards their tasks.

CHAPTER SIX

CONCLUSION

This chapter aims to highlights the study conclusion and recommendation of this study. The conclusion elaborates the main procedure of how this study achieved the goals, according to the research objectives and problem statements in developing a bed spaces reservation and allocation management system for Libyan public hospitals. Finally, brief recommendations are introduced in order to emphasis the own opinion for enhancing the propose BRS.

6.1 Introduction

The main objective of this study was to develop a bed spaces management system for the Libyan public hospital Al-Jumhouriya in Benghazi, which succeed to model the requirement of the bed spaces management system, design and develop bed spaces management system Libyan public hospitals, and test the proposed system among participants from UUM. Furthest more, this study indicates the BRS usability testing, user satisfaction result and recommendation.

6.2 Conclusion

This research has designed and developed a bed spaces management system for the Libyan public hospital Al-Jumhouriya in Benghazi based on PHP and MySQL technology that were customized using UML diagrams such as use case diagram , sequence diagram, and collaboration diagram to analyze and design the proposed. The study evaluation result indicated that BRS was ease to use, useful, and perceived the user intention.

6.3 Limitations and Recommendations

The problems for the BRS development are due to the limitation in providing more facilities to occupy the bed reservation services, which could be done through mobile applications. This study was also consisted on the lacking in determining the other sources that BRS looking for as an alternative way.

The prototype was tested using local host server, namely Internet Information Services (IIS). However, with limited financial resources no actual web server can be employed in testing the prototype.

The system was successfully developed and the system utilization was completely optimized on the local host, which carry out some recommendations in terms of:

- Enable the BRS to be browsed anytime and anywhere from real server.
- The prototype developed for and tested on the local host with Internet Explorer 6 version, therefore some of the test and illustration may be inconsistency on others web browsers types that require different additional, such as Netscape Navigator 4.0 and Opera 6.0 and the Firefox that need to identify the system components requirement.

6.4 Future Work

Some efforts can be spend to enhance the BRS functionalities in terms of availability, security, reliability, and flexibility towards integrating other services and tools, which appeared because of the time frame that is not sufficiently enough to assure the entire functionalities of the system, future works can be carried out to fill in the deficits that came upon during the work of this project. It would be more suggestive to advice the one

who needs to pursue some future works to follow every single step included in the project. Developing bed spaces management system for the Libyan public hospital Al-Jumhouriya in Benghazi can initially involves the following:

- Provide pregnant with the flexibility to access the BRS port through mobile.
- Provides direct, simple access to the history of other profile sin the system.
- Information regarding this system is trimmed page-to-page navigation down to a minimum and hyperlink buttons are used to navigate back and forth within the pages/ screens.
- Reduces the amount of vertical scrolling by simplifying the text to display.

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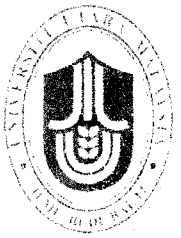
Appendix A
(Questionnaire)



BED SPACES RESERVATION AND ALLOCATION MANAGEMENT SYSTEM FOR LIBYAN PUBLIC HOSPITALS.

The main objective of this project is the development of the bed spaces management system for the Libyan public hospital Al-Jumhouriya in Benghazi, which is intends to:

- To model the requirement of the bed spaces management system.
- To design and develop a bed spaces management system Libyan public hospitals.
- To test the proposed system among definite users.

Thank you very much for your time cooperation.

Sincerely,

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Section A

Gender

- Male [ ]
- Female [ ]

Age [ ]

Experience

- Number of years using the computer

  < 5 years [ ]
  > 5 years [ ]

- Number of years using the internet

  < 1 year [ ]
  1-5 year [ ]
  >5 years [ ]

Section D

Behavioral intention to use the BRS

Questions	SA	SD	N	A	SA
1. I always try to use the BRS in as many cases	1	2	3	4	5
2. I always try to use the BRS in as many cases	1	2	3	4	5
3. I plan to use the BRS in the future	1	2	3	4	5
4. I intend to continue using the BRS in the future	1	2	3	4	5
5. I expect to use the BRS in the future	1	2	3	4	5

Thanks