Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.13, No.23, 2022

Fast-tracking Healthcare Services for Students through the Design of a Hospital Information System

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Abstract
Students with good health status tend to attain better educational performance with low risk of academic failure unlike students with health issues. The discrepancies in the loss of instructional hours due to unplanned and delayed medical care widens the gap in academic performance between healthy and unhealthy students. Systems with the potential of providing excellent information access to relevant health personnel and eliminating absenteeism and lateness to duty which are paramount to timely healthcare delivery have now become a necessity. The urgent need for such a system, flexibility in the development process and the potential for adding or modifying later requirement specifications influenced the selection of the Rapid Application Development (RAD) Software Development Model for this study. This project designed and implemented a system that offers prompt healthcare delivery to narrow the gap between healthy and unhealthy students.
Keywords: Education, Student Healthcare Delivery, Student Medical Condition, Hospital Information System, System Development, Software Engineering
DOI: 10.7176/JEP/13-23-02
Publication date: August 31st 2022

1. Introduction

Students with medical conditions have the right to the most comprehensive education possible, which includes regular attendance, engagement in all social and broader areas of school life, and participation in courses whenever possible. Because healthy students are better when it comes to learning, an increase in student engagement, reaching of academic potentials and the closing of achievement gaps are attained when positive environments are instituted to ensure healthy and well-prepared students (Cave et al., 2020).

Higher Education Institutions (HEI) are harnessing technological innovations to permit students with medical conditions to access mainstream education. This includes everything from online planning tools to information exchange with important stakeholders, allowing students to participate in lectures and extracurricular activities with their peers and friends despite not really being physically present (Kirkpatrick, 2020; Hancock, 2019).

Healthcare generates large volumes of data which is frequently relied upon to make an analysis on the biostatistics of patients; hence must be well structured to reduce errors. However, the provisions HEI make for students with medical needs is inhibited by timely, complete and up-to-date patient data to clinicians (Eden, et al., 2016). The traditional ways of processing the medical data for students have brought about great challenge because of inconsistency of data, atomicity challenges, integrity issues, difficulty in security levels, concurrency inconsistencies and staff scheduling glitches.

Again, time management for healthcare personnel is vital in healthcare delivery because shifts periods when well-managed leads to the attainment of efficiency and effectiveness. However, most hospitals for HEIs have challenges in scheduling duty for their healthcare personnel leading to a negative impact on job efficiency, effectiveness, and productivity which affects prompt medical care for students (Camiat et al., 2019; Gross, 2018). Healthcare Administrators go through a lot of puzzles to be able to draw shifts for personnel due to the manual processing.

There is the need for awareness of health-related impact on academics and the willingness on the part of educators to offer support to maximize the outcome of students. This project seeks to build a Hospital Information System for Higher Education Institutions to address the challenges of data access and staff scheduling which impede healthcare service for students with health problems.

1.2 Study Objectives

The specific objective of this project is to build a Hospital Information System for Higher Education Institutions that;

- Allows multiple user access to input and output operations
- Enforces permissions and privileges to restricted access
- Can easily adapt to sudden changes in employee shifts.
- Allows management of information on time-off request.

1.3 Scope of Study

The project is designed for Higher Education Institutions, and will be assessed at the Hospital of the University of Education, Winneba to handle out-patient services. These services include: assigning of Master Student Index, daily treatment of students and keeping records about students. Even though, other facilities/units exist such as antenatal unit, the child welfare center, this project will only serve the medical records unit, the nurses' station, consultation unit, laboratory and the dispensary.

1.4 Justification for the Study

Efficiency and effectiveness will be achieved as students' medical needs will be addressed promptly due to easy identification and retrieval of records at different units within the hospital facility. This project will maximize the use of instructional periods because the average student waiting time at hospitals of four hours will be reduced to about thirty minutes thereby reducing over-crowding at the health facility.

The automated staff scheduling feature will help administrators and other workers to manage and access schedule to prevent defaulting at post. Hospital space will be saved as this project will eliminate manual system that requires papers, folders, cabinets and shelves.

The findings from this project will benefit stakeholders in the field of education, health, systems developers and other related fields which should lead to the generation of new ideas for a better implementation of a Hospital Information System.

1.5 Study Methodology

The requirement elicitation as well as evaluation of existing systems will be approached using the Joint Application Design (JAD). The rationale for JAD is to promote teamwork and understanding among all stakeholders in order to gain their full cooperation throughout the entire project. Again, JAD seeks to promote a shared vision among users and system developers of the outcome of the proposed system.

The Software Development Life Cycle (SDLC) is a logical structure used in project management that defines the stages involved in the development of an information system project, from a preliminary feasibility analysis to maintenance.

Rapid Application Development (RAD) is an incremental design model form of SDLC and was used for this study to shorten the duration of development. The rationale for using RAD is as follows;

- Build a completely operational program within very brief periods of time, after understanding requirements well and the project scope constraints
- Provides consistent collaboration in an interactive electronic system.
- It is designed to continue providing access to information, directions and support instantly.
- Provides a selection of tools that allow the design of graphical user interfaces which might usually take a great effort to build.

The tools to be used in the development of the proposed system include;

- MySQL for the Backend database.
- PHP server side programming language.
- JQUERY as a java script library for special effects.
- HTML as complementary programming language

1.6 Study Deliverables

The end product of the project will be as follows;

- A Hospital Information System that allow multiple users to make inputs into patient's records and staff schedules.
- A Hospital Information System that is secure and grants access to authenticated users
- A Hospital Information System that can handle consistent request and changes for staff schedules.
- A Hospital Information System that allows change request for time-off.
- Documentation on its features and how users can perform specific tasks with it.

2. Literature Review

2.1 Definition of Hospital Information System

One of the industries that has seen widespread adoption of information and communication technology is healthcare. Hospital Information Systems have evolved into helpful and essential instruments in the healthcare industry (Olusanya et al; 2015; Grandia, 2016). As a result, an effective hospital management information system, which has become an indispensable component in clinical and non-clinical healthcare services, has been identified as a prerequisite for the provision of cost-effective and high-quality healthcare to clients (Nilashi et al., 2016).

Several scholars have defined the term "Hospital Information System" in different ways in order to provide a clear grasp of it. Olusanya et al. (2015) define it as an automated application of an information management system that manages the administrative, clinical, and financial aspects of a hospital in order to aid in the operation and assessment of activities in the hospital and to enable timely access to medical records and departmental data. Similarly, Mehdipour and Zerehkafi (2013) defined Hospital Information System as a collection of automated systems used to handle patient information and overall hospital administration.

From the above definitions, it can be argued that a Hospital Information System consists of modules for data collection, processing, storage and the generation of relevant outputs with the aim of accelerating and eliminating delays in healthcare delivery system. Furthermore, it can be deduced that a hospital information system is a vital requirement for modern healthcare system as it coordinates all the tasks and services that are rendered by the healthcare system.

2.2 Dimensions of Hospital Information System

The concept “dimensions of HIS” or modules of Hospital Information System work together to guarantee a smooth operation of a healthcare system. In the view of Mehdipour and Zerehkafi (2013), the role played by each department of a hospital influences the modules or components provided by a Hospital Information System. The well-known departmental modules or components includes Clinical, Nursing, Laboratory, Financial, Picture Archiving Communication, Pharmacy, and Radiology Information Systems (Mehdipour & Zerehkafi, 2013).

Clinical Information System has a backend database where data of patients can be retrieved through a frontend application software. Collen and Miller (2015) views Clinical Information System in terms of the goals it is developed to achieve such as improvement in integration, healthcare delivery services and patient satisfaction.

Laboratory Information Systems utilization has increased over two decades. Laboratory Information System improves and ensures quality in the management of laboratory data through the gathering, processing and dissemination of data across units in the healthcare system (Collen & Miller, 2015; Mtonga et al, 2019)

Financial Information System use computers as the medium for processing, management of expenditure and budget (Vawdrey, Walsh & Stetson, 2014). In the hospital context, Financial Information System aid in the planning, implementation, monitoring and evaluation of financial resources.

The increase in network connectivity, coupled with the advancement in technology has spearheaded the development of Picture Archiving Communication System over the decade (Rahmat & Zamrin, 2019). Picture Archiving Communication System boast of a backend database server, RIS interface system, archive server and a file server.

Pharmacy Information System is a vital tool in any healthcare supply chain system especially in the area of planning, decision making and management of information. Alanazi et al. (2018) have outlined the benefits of Pharmacy Information System which includes collection, processing, retrieval and update of drugs in stock as well as drugs dispensed.

Radiology Information System capture and report data of patient as a means of improving the healthcare delivery system. It has been observed that the availability of Radiology Information System ensures a well-organized flow of work in a healthcare system (Rezaei-Hachesu, Pesianian & Mohammadian, 2016)

It must be emphasized that the dimensions outlined must exist and should be successfully integrated to guarantee a vibrant Hospital Information System with the aim of ensuring improved productivity and efficiency. For instance, a non-functional Laboratory Information System will affect, clinical and financial Information Systems. Any point of failure in one dimension impacts negatively on the smooth operation of the remaining modules

2.3 Existing Hospital Information Systems

There are several Hospital Information Systems that assist doctors, nurses and other specialists to offer superior healthcare, both administratively and medically. In this section, the widely used Hospital Information Systems and its internal workings are discussed.

2.3.1 Soft Clinic

The software comes with different modules/dimensions such as Laboratory, Pharmacy, Human Resource, Inventory, and Accounting; thereby digitizing the basic management and record-keeping to make management tasks easier. The features/strength of the system is as follows;

- It is well tested by many clinics and hospitals
- It provides a comprehensive module for a quality service.
- It has a well-formulated financial accounting system.
- It appropriately secures patients’ health records with a good encryption system.

However, the following weaknesses can be identified

- Challenges with cloud services affects quick data sharing.

- It is expensive to operate because of the cloud service usage.
- Lacks an appropriate module for staff scheduling.

2.3.2 Insta HMS

This system helps to automate workflows and enable online booking, electronic medical records, alerts and notifications to enhance healthcare delivery for patients. It also enables online and secure confidential access to operational, financial and clinical records. The features/strengths of the system is as follows

- It provides cloud facilities for the clinics and the hospitals.
- It has an appointment management features that allows patients to book an appointment with Doctors.
- It utilizes a chart system for better presentation of reports.
- It sends voice messages to the patients.
- It has an effective payment system both banking and mobile money.

However, the weaknesses identified include;

- Cloud facility can fail and it is expensive, hence affecting free flow of required data on patients.
- Functionalities fail to work in a module (Managing Taxes, Doctor Payment Module, Channeling Module)
- Difficult to integrate with other systems
- Lacks an appropriate module for staff scheduling

2.3.3 Tirupati Hospital Management

It is a Hospital and Patient care system and hospital management system that provides extremely clear input and output through a user-friendly multi-user program. The major features/strengths of the system are as follows;

- It provides a multi-clinic interconnection
- It allows patients to be transferred to an available department with facilities for treatment.
- It provides details of each department for easy accessibility.
- It has an appointment feature to allow patients to book an appointment with Doctors.
- It provides a quality payment system for the patients.

However, the following limitations has been identified;

- Multi-clinics interconnection can be complex to manage.
- Manual crosschecking is required in billing
- The system lacks scheduling of healthcare personnel.

2.3.4 Adroit Hospital Systems

It is a Hospital Information System that manages all areas of a hospital's operations, including medical, administrative, financial, legal, and service processes. The main features/strengths are as follows;

- It manages all aspects of hospital operations.
- It allows the customization of some of the modules.
- It provides a comprehensive payment reporting system.
- It has an online appointment system that allows patients to book an appointment with Doctors.
- It has an alert system that alerts the pharmacy of a shortage of drugs in the pharmacy shop.

However, the following limitations exist

- It is cumbersome for the administrator to manage the entire modules affecting access to data.
- It can generate errors when customizing.
- It restricts patients from negotiating on bills.
- Lacks an appropriate module for staff scheduling

2.3.5 Availity

It is a Hospital Information System that is useful for both outpatient management as well as inpatient management. The system is credited for its billing operations with its attractive features like claims management, billing and invoicing. The other features/strength apart from its billing functionalities are as follows;

- It allows customizing of the hospital software.
- It provides quick outpatient department recording processes.
- It has notification to patients of their attendance dates.
- It also sends messages to patients the hospital's information.

However, the following limitations can be identified;

- It can generate errors in customizing features.
- Recording patient's information might take time, affecting quick access to needed data.
- Difficult to get an output of patient details
- Lacks an appropriate module for staff scheduling

2.3.6 Medstar HIS

It's a system that connects all HIS systems, processes, and machines to an expert system platform to increase

operational efficiency and help hospitals make better decisions. The features of the system are as follows;

- It provides a paperless operation.
- It integrates cloud service.
- It integrates mobile money payment system.
- It has an online appointment for its patients

However, the following weaknesses can be identified;

- There are security issues that can result in unauthorized access of patient records.
- It takes time to update records if a Doctor makes mistakes in the entries.
- Lacks an appropriate module for staff scheduling

2.4 Summary

The reviewed systems boast of modules that are essential for hospital related tasks and activities. While some features such as financial management, patient booking and cloud access are prominent in those systems, prompt access to data for diagnosis and decision making is lacking because the cloud functionalities and interconnection with other systems are complex, expensive and sometimes non-existence in the reviewed systems. Furthermore, the reviewed systems revealed that scheduling for health personnel is inadequate and hence needs an improvement. It is within this context that the proposed System needs to be developed to address the challenges or weaknesses uncovered in the reviewed Hospital Management/Information Systems.

3. Analysis of the Proposed System

3.1 Overview of the Proposed System

The proposed Hospital Information System is a web-based application that will coordinate the activities at the University of Education, Winneba Hospital. The system will put an end to the manual processes and ensure prompt retrieval at any given time data of patients for diagnosis, management and decision making. Again, a scheduler for medical personnel will be included to allow individual management of shift, thereby improving flexibility and achieving efficiency. The major modules for the system will consist of Out-Patient Department, Consultancy, Laboratory, Pharmacy, Wards, Accounts, Bed and Antenatal.

3.2 Stakeholders

Stakeholders have keen interest in projects because its outcome has an influence on them. The key people or groups of people whose business will be affected as a result of this project or the stakeholders are as follows;

The Vice Chancellor of the University of Education, Winneba will be the main sponsor for the project. He will be tasked with the responsibility of monitoring and control to ensure that the deliverables conforms to standards and is within the agreed specifications.

The Registrar is responsible for ensuring that the use of the project does not go against the status and policy framework of the university.

The Medical Director has the responsibility of ensuring that medical personnel under their office comply and use the system in a manner it has been developed and address challenges encountered in the process of using the system.

Doctors will be using the system during consultancy, diagnosis and prescription activities and are regarded as an important stakeholder.

Nurses and the roles they play in the healthcare delivery system can never be overemphasized and hence a key stakeholder in the development of the HMS.

Students/Patients are always at the receiving end of the services rendered by a healthcare system are therefore a vital stakeholder.

3.3 Requirement Gathering

The Joint Application Design (JAD) tool was used to elicit requirement from the relevant stakeholders. Below were some of the discussed topics during the JAD session.

- What is the consequences if the problem is not solved?
- In what ways will the proposed system solve the problem at hand?
- What components needs to be added in the proposed system to solve the current problem?
- Will the proposed system be installed in-house or outsourced to a third party?
- Will the proposed system use a cloud service?

3.3.1 Functional Requirements

Functional requirements describe what a specific system should do or behave. The proposed Hospital Information System must behave or satisfy the following requirements;

- There should be an interface for authenticating into the system.

- The proposed system should allow access from multiple users from remote locations
- The processing requirement should be minimal to support more mobile devices
- The proposed system should have an administrative interface for controlling/monitoring the system to mitigate security threats and ensure smooth operations.
- The backend Database Management System (DBMS) should use MySQL.
- Web browsers with JavaScript enabled will be able to access the proposed system.
- PHP will be used as the language for server-side scripting, which will be run on an Apache web server.

3.3.2 Non-functional requirements

A non-functional requirement elaborate on the performance characteristics or places constraints on how a system should work. The proposed Hospital Information System must comply with the following non-functional requirements;

- The user interface should be user-friendly and include name, department to define a specific users
- Feedback in terms of success or errors should be well presented to indicate status in the use of the proposed system.
- There should be a mechanisms to guarantee 24 hours, 7 days uninterrupted access to the proposed system.
- There should be daily backup to prevent the loss of data in case of a disaster
- The cost of developing the system should not exceed ¢200,000
- The annual service and maintenance fees should not cost more than ¢20,000
- RSA encryption and SSL version 1.3 should be implemented to secure the contents of the proposed system
- MySQL version 5.6 and above will be used for the proposed system
- Platform independent scripts such as HTML, CSS, and JSP should be used alongside PHP 7.0 as the main server side script.
- Apache version 2 should be used as the main web server software
- A Linux platform should host the proposed system with at least 64GB RAM and 1 terabyte of hard disk space.

3.4 Major Features of the Proposed System

The proposed system seeks to address the problem of manual processing which inhibits prompt access to data and also the inability of heath personnel to schedule routines.

The selected backend MySQL DBMS ensures increased performance and efficiency by leveraging on the secure Linux Operating System it will be running on. MySQL will store consistent and accurate data on Patient details, daily consultancy, Laboratory, daily accounts, dispensary and health insurance to remove any duplications that may affect the integrity of data.

The interactive interface design will make the system fun to work with as necessary feedback are promptly given to end-users to know their status of using the system.

Platform independent programming languages such as PHP, CSS, jquery formed the backbone of the architecture and structural design module to render precise, fast and dynamic contents to end-users of the system.

A jquery library, also known as datatables was used to efficiently enhance the search functionality of the system. It makes searching within the system more easy and demands no button click to execute search indexes or keyworks. Its usage comes in the same format as that of boostrap framework by just provinding a link to its stored files, that is the javascripts files in a named directorate within the systems main or home folder.

The reports generated in the system are all secured by the use of an existing PDF conversion API known as FPDF class. It contains all the needed files or libraries for the coversion of HTML data and pages to PDF. It is used by including the FPDF include files and defining simple page formatting parameters on top of the active HTML to PDF conversion page.

3.5 Advantages of the Proposed System

The proposed Hospital Information System when implemented will enhance the features of the existing design with the following qualities;

- Inclusion of scheduling processes to ease stress, limit the manual processing and reduce the time taken to prepare schedules for health-care personnel
- Improvement in communication across the various departments and among key stakeholders like doctors, nurses, patients to ensure timely access to required data.
- Inclusion of doctor appointment module to allow patients to book appoint across the various departments.
- Fully automated installer for the system without the need to check credentials in source codes

- Excellent report generation for all departmental activities such as daily consultancy and financial reports
- Remote access by stakeholders. For instance patients can access their health records remotely via the internet and forward complaints where necessary.
- A single-click backup and restore for the backend database

The context level diagram of the proposed system is show below in Figure 1.

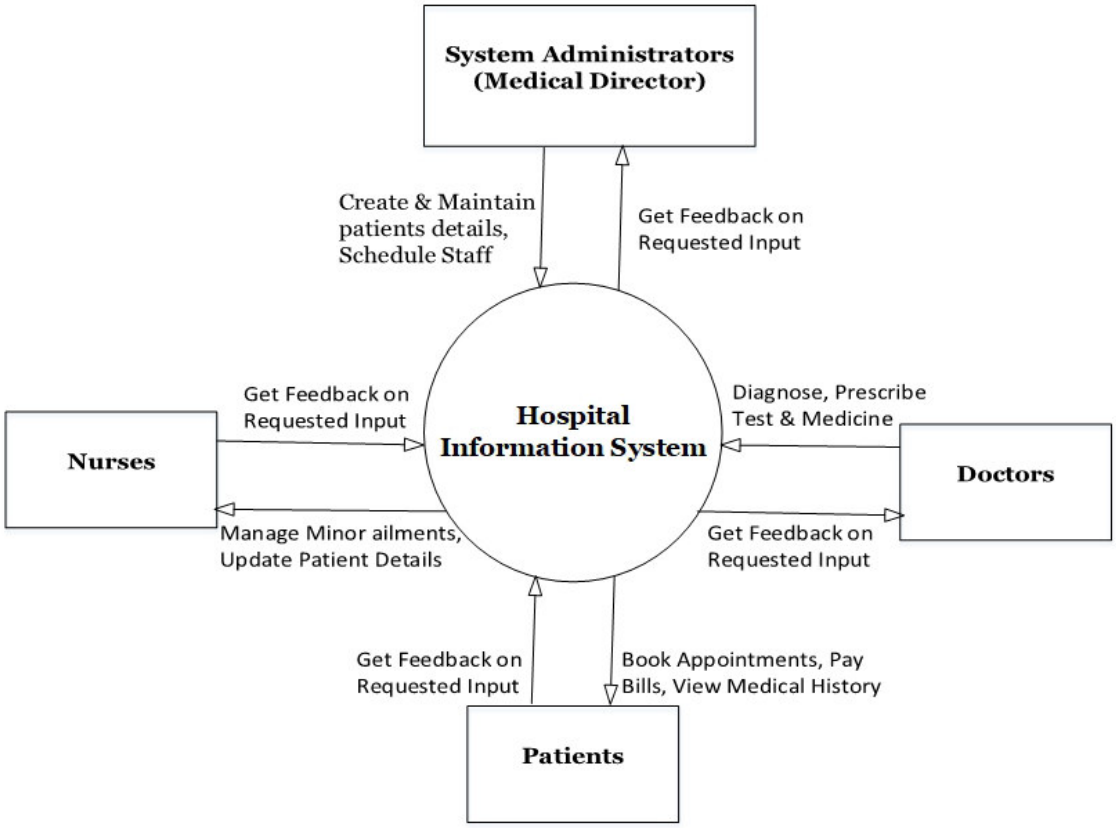

Figure 1. Context level diagram of the proposed Hospital Information System

4. Detailed Design of the Proposed System

The required input, processes and output activities through its models are explained by the detailed design of the system. Additionally, the graphical and diagrammatical view of the system's data structures as well as actors and their defined interaction with the system are represented. System functional processes describes the operations that can be handled or allowed without crashes or halting of a system and are well explained in the detailed design of this proposed system. Examples of functional processes include storing and managing data for staff and patients, consultancy and treatment analysis, laboratory and dispensary request, hospital bill payment and viewing medical history.

4.1 Use Case Diagram

The rationale for use case diagram is to offer a vivid description of actors and the boundaries or scope to which they can interact with a system. The key actors or clients includes doctors, nurses and patients. The medical director is a secondary actor and the service provider is the system developer. The governing bodies include the University Council, Academic board and the Student Representative Council.

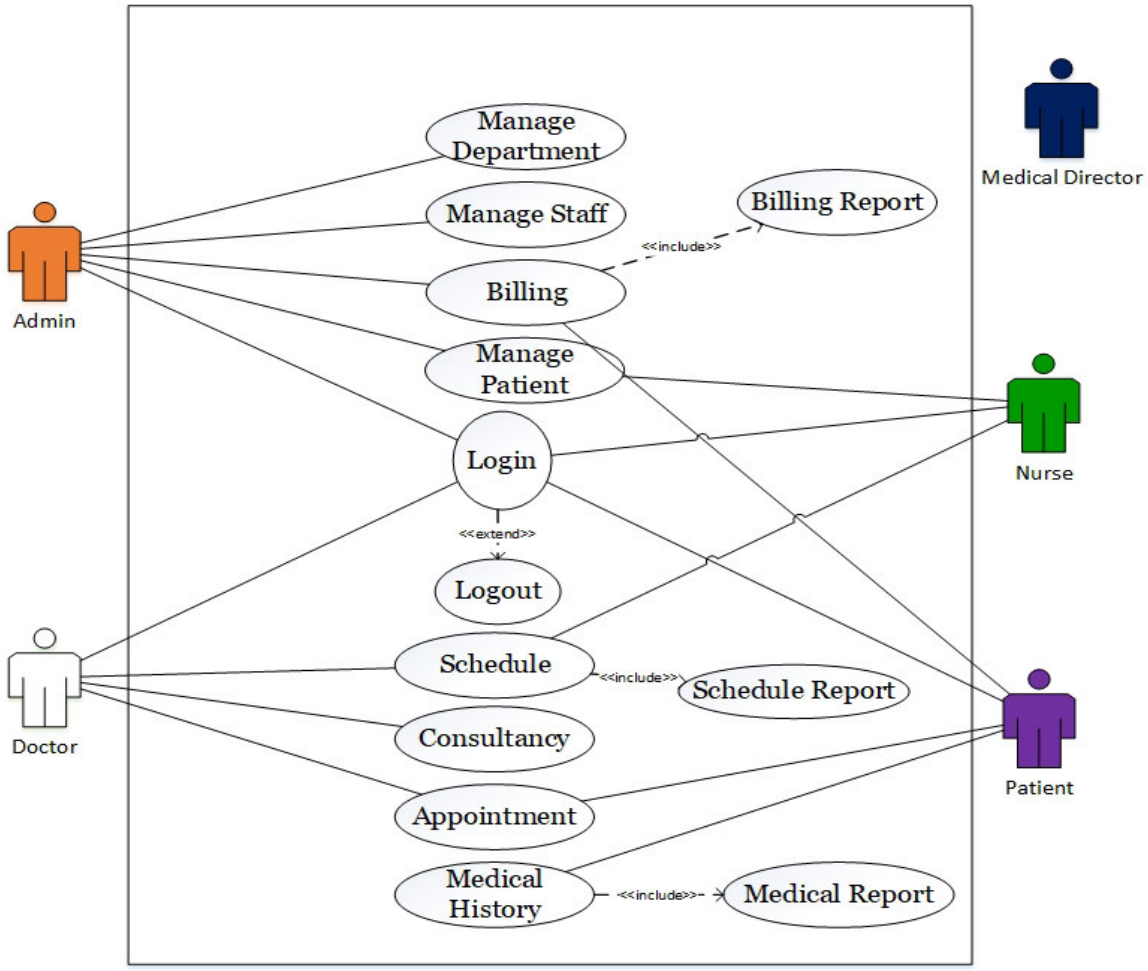

Figure 2. Use case diagram of the proposed Hospital Management System

4.2 Flowchart Diagram

The logical processes for the proposed system are depicted with Flowcharts. The logic for detecting and preventing unauthorized access to the system's portals and contents as well as what assigned roles can perform on the system are shown in the flowchart diagram. The figure 3 below shows how non-administrative users are prevented from accessing administrative portals.

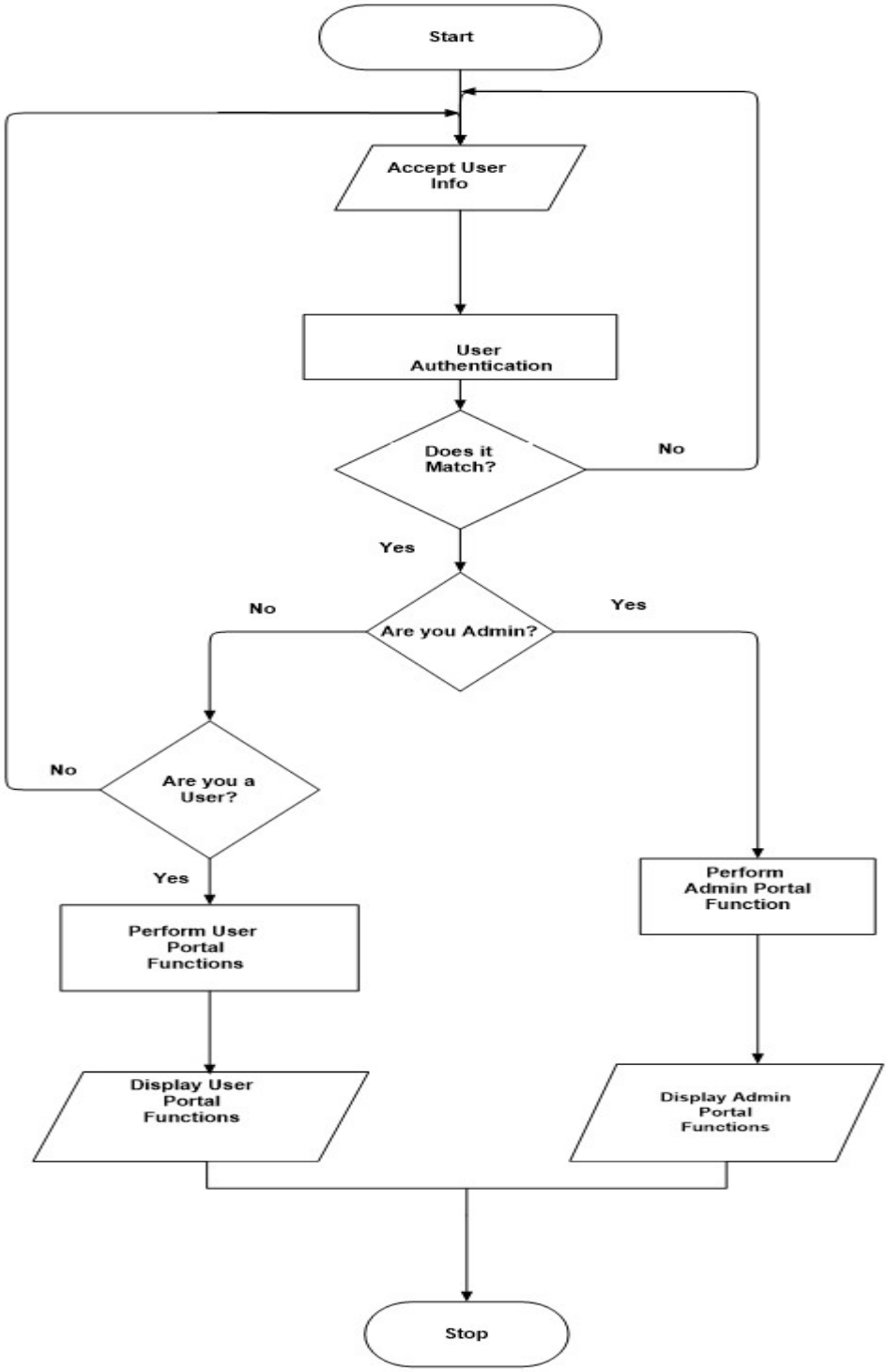

Figure 3. Flowchart diagram of the proposed Hospital Information System

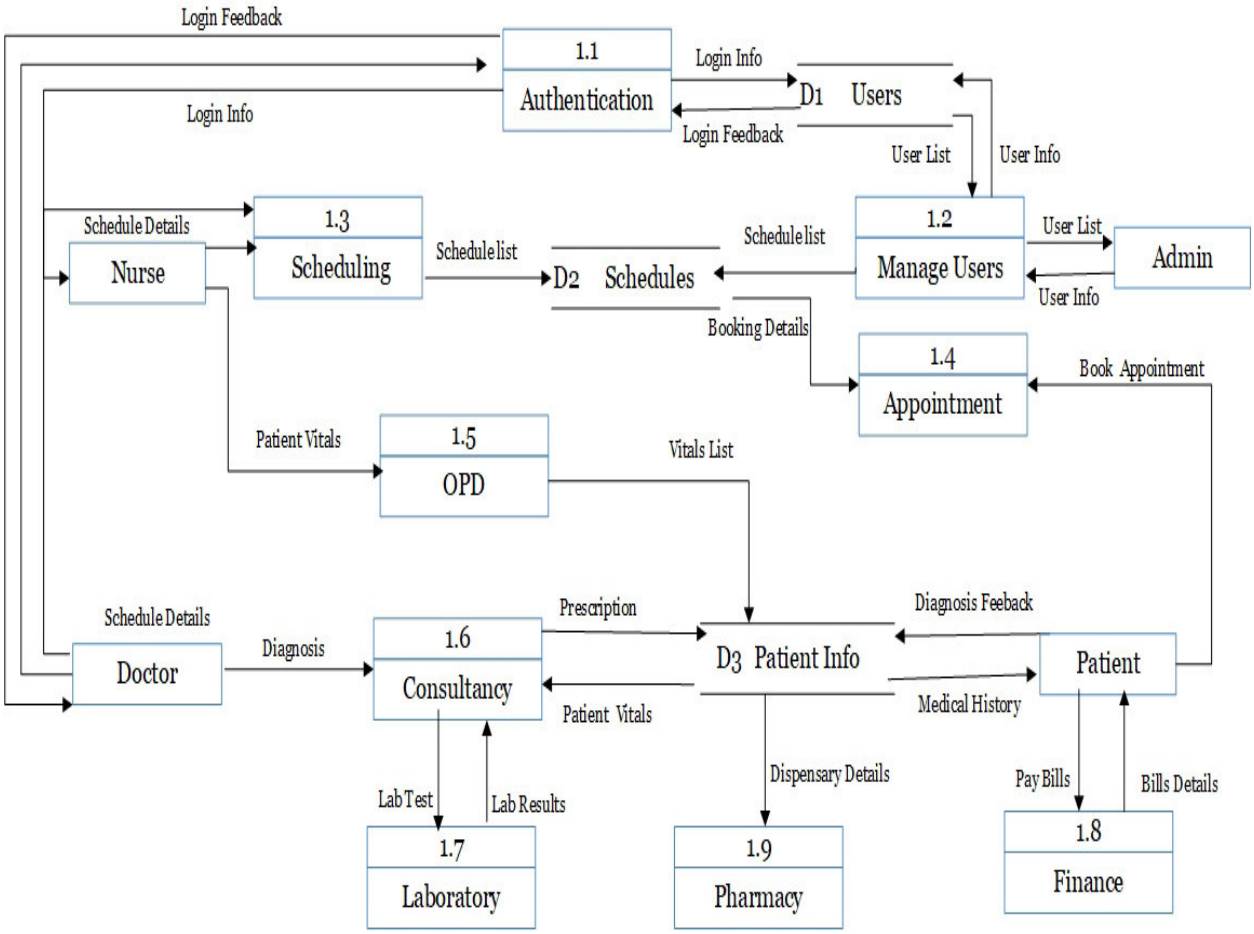

Figure 4. Dataflow diagram, level 1 of the proposed Hospital Information System

4.3 Class Diagram

Class diagrams show attributes, operations and relationships that exists on a system. The prominent classes for the proposed system are the Admin, Doctor, Staff, Patient, Department, Room and Bill classes. The Doctor class for instance has attributes such as DocId, Name, Department, Specialization, PhNo and Address. It has access to the following operations or methods; prescribe Medicine(), View Reports(), Prescribe Test(), Draw Salary() and View Appointment(). The Doctor class is associated with both Patient and Department classes in a One-to-Many relationship because a single doctor can be assigned to treat multiple patients and a Doctor can be assigned to multiple Department where their services are required.

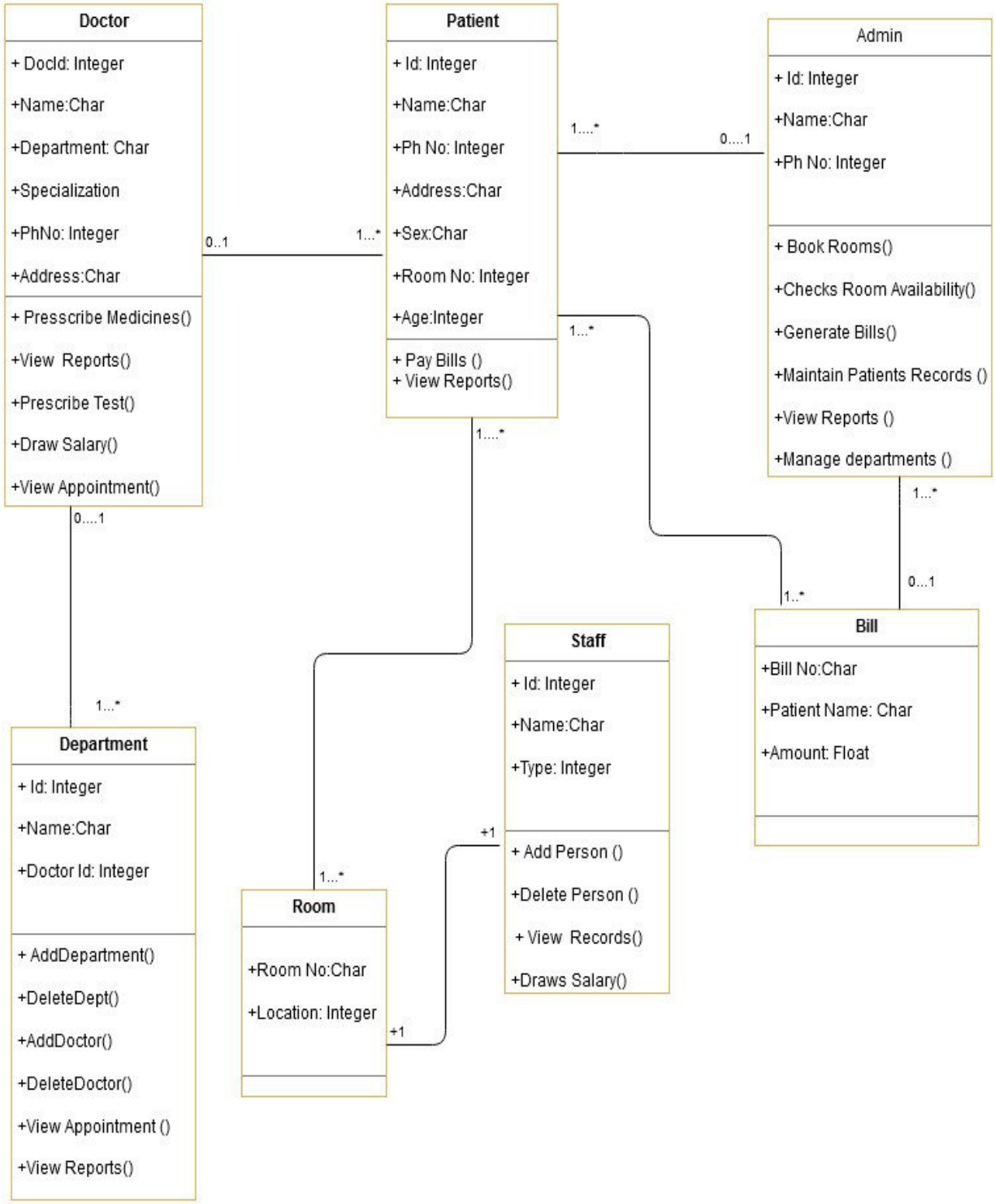

Figure 5. Class diagram of the proposed Hospital Information System

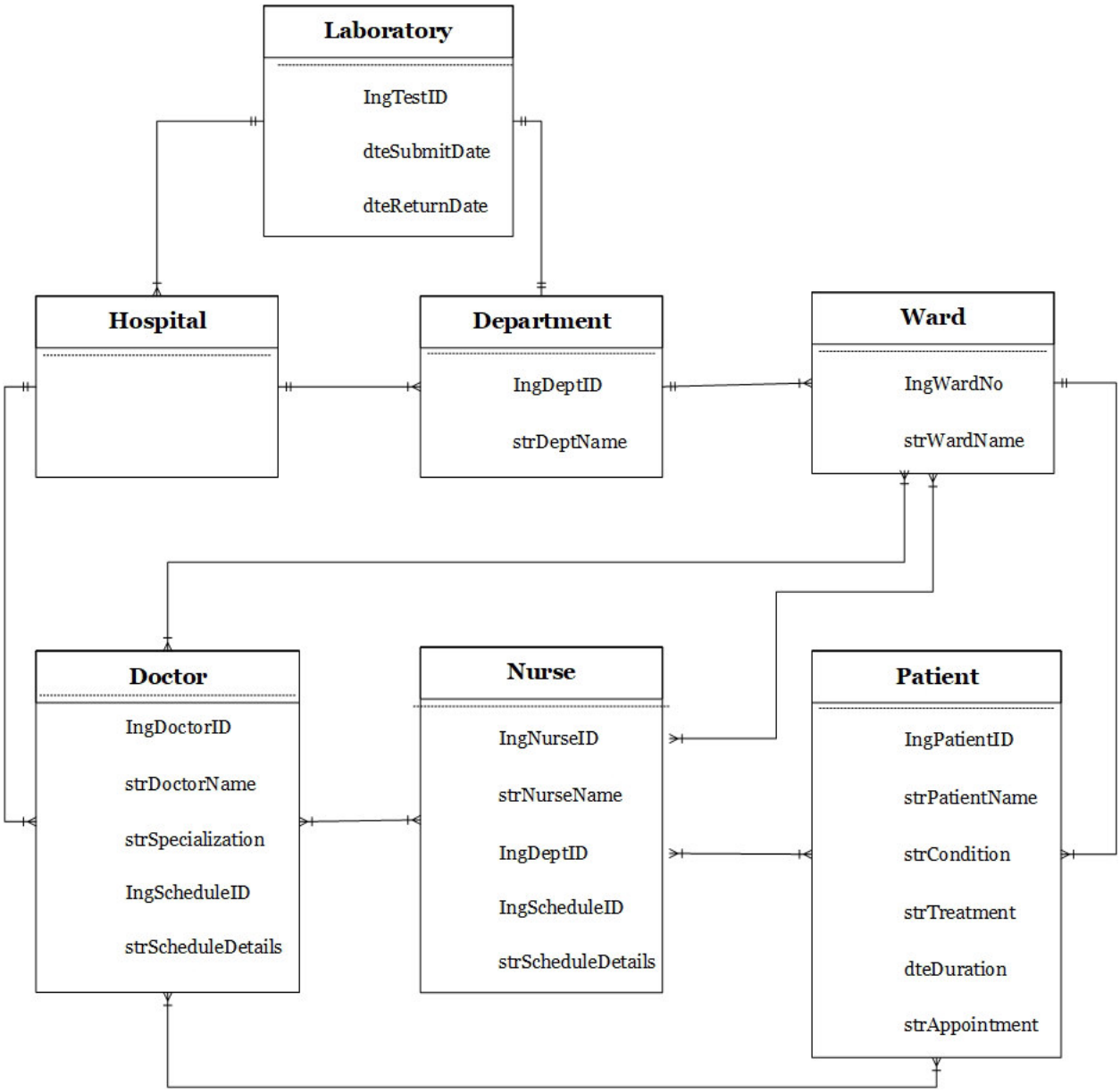

Figure 6. Entity relationship diagram of the proposed Hospital Information System

4.4 Sequence Diagram

A sequence diagram aid in depicting the interaction among processes and are arrange sequentially based on time. Again, the classes and object scenarios as well as messages exchanged in sequence that allows objects to carry out functions are shown in the sequence diagram below.

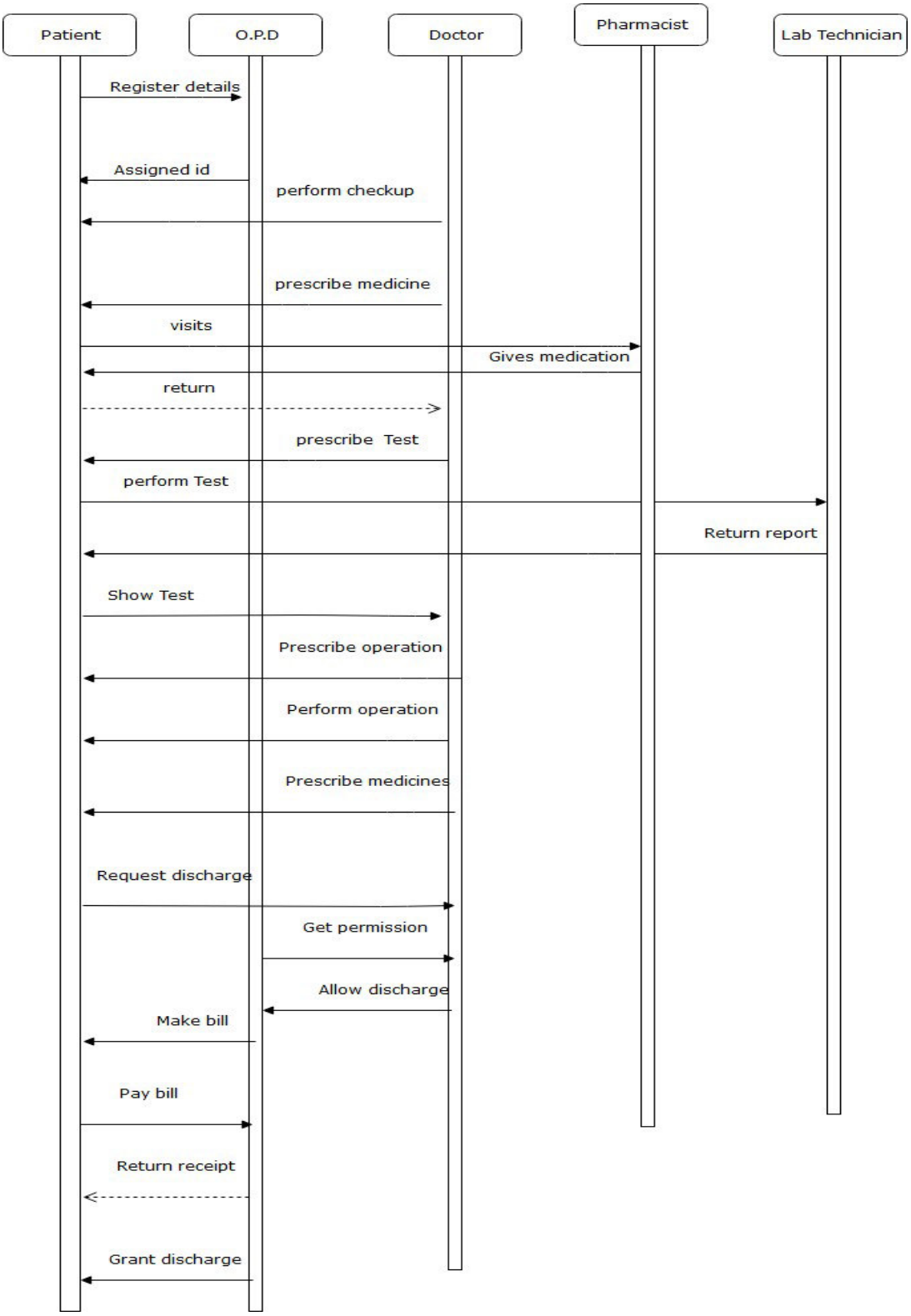

Figure 7. Sequence diagram of the proposed Hospital Information System

5. Implementation of System Design and Testing

5.1 Implementation

System implementation and testing are two major components of the SDLC of a system. A good system implementation prevents performance bugs or inefficiency in systems.The general implementation plan for this system have been categorized into some well defined thermatic areas as elaborated below.

5.2 System Requirements

This section gives the details of hardware and software used to develop and run the application. The hardware requirements are listed in table 1 whiles the software requirements are listed in table 2 below.

Table 1. Hardware requirements

Module	Hardware name	Description
Input device	Mouse and Keyboard	For data input
Display result	Monitor	For showing the interfaces of the application. It should be 1024X768 resolution
Hard copy	Printer	Printing reports from the application
Processing	CPU	In order to speed up processing of data, it should be at least pentium 4 and above
Temporal storage	RAM	RAM-Random Access Memory for increasing the processing capacity in order to facilitate the application's performance. A RAM of at least 4 Gigabyte is recommended
Backup	Pend drive and Hard disk	To back up the database to prevent data loss.
Network	Network card and RJ 45 port	To network all the hospital's department and share a common database.

Table 2. Software requirements

Module	Software name	Description
Interface design	PHP version 7.0, Cascading style sheet (CSS), jQuery and JavaScript.	For designing all the forms and input elements.
Database design	MySQL version 5.6	For designing the tables that store records
Reporting	FPDF class	For generating a hard copy report from the application
Operating system	Windows 7,8,8.1 or 10	This allows the application to be developed and run.

5.3 How to install

- The method of installing the application requires the web application to be hosted live on either a public or a private web server.
- For a local web server, the XAMPP application version 3.2.2 and above which comprise of all the required software can be installed by adhering to its manual
- All the files contained in the application must be extracted and placed in the htdoc/www folder and the appropriate permissions set for it.
- The database along with the required tables must be created whiles ensuring a connection of the application to the database.
- The administrator visits the url for the application to ensure the setup was successful.
- The web application will be ready for use when it has been hosted and installed without challenges.

5.4 Testing

The application's development follows the software development life cycle phases hence must be tested to verify its quality after installing the application.The application has seven units which form the system, and these units have to be tested by the various testing methods. The tests include unit, system, integration, performance, security, volume and stress, and recovery tests.

In the unit testing the program making up the entire system was tested. The bottom-up approach was used to test modules or routines such as consultancy, dispensary, billing and pharmacy to ensure that it functions as intended.

In integration testing, all the units put together should work well as an error in one unit might cause the application to break down entirely. Putting all the units together will ensure a successful application testing. The various modules such as consultancy, dispensary, and finance were all assembled and integrated and their combined functionalities tested.

System testing was done after a successful installation through debugging to ensure that no error will cause the system to fail. In performance testing, the computer resources required to run the Hospital Information System was evaluated and compared to other resources to scrutinize the significant resource on the execution of it.

In security testing, the data in transit and the one in the backend database was tested to prevent unathorized persons from accessing it. Because the Hospital Information System stores health data which are sensistive, a secure algorithm such as RSA was used to encrypt strored and transit data.

A stress and volume test was conducted on the backend MySQL to ensure that the system can withstand massive query and heavy inputs from users. This guranteed that issues related to database concurrency is taken care of.

Since the application has a database, a recovery test was done such that the database backup facility ensures regular backing up of the database to prevent data lost in case of a disaster.

5.5 Implementation Method

The method for implementing this system consist of activities in the development, programming, system review and migration from legacy to the current system. Change over procedure relates to how transition will be made from the legacy or previous practices to the new Hospital Information System.

The direct changeover method is a complete overhaul of an old system in favor of a newly introduced system due to trust and faith in the new system's creation and delivery. The Pilot changeover appoach allows for an isolated testing of new system to assess its operational stability before rolling it across an entire environment. A phased changeover method is gradual conversion to a new system, espercially when lagacy and new systems are identical.

The changeover method used for this Hospital Information System was the parallel method. This allowed concurrent running of the legacy along with the new system to establish ultimum satisfaction with specification of the new system before finally discarding the legacy system.

5.6 Review and Maintenance of the System

It is paramount that the newly installed system be regulary tested to uncover bugs and issues that may hamper smooth operations and to offer advanced schedules for system upgrade when needed. The File maintenance with its routines such as insertion, deletion, arrangement and modification of records will be relyed upon. The index sequential file access process will create an enabling conditions for file management tasks to be executed successfully.

6. System Documentation

6.1 Documentation

In order for the system to be used effectively and successfully, there should be documentation or manuals. The manual for this system aims to achieve the following;

- Educate users/stakeholders on the system's objectives and advantages.
- Educate users/stakeholders on the procedure for undertaking tasks and functionalities on the new system
- Making the system documentations available to users/stakeholders.
- Below are some selected basic tasks that can be accomplished with the system

6.1.1 Launching the Hospital Information System

Please follow these steps to launch the application

- Double click on a web browser icon
- Locate the address bar and type https://localhost/HARMS
- Press on go button or press enter on the keyboard

6.1.2 Login using usernames and passwords

Please follow these steps to provide access credentials for validation.

- Click on login hyperlink
- Locate and enter usernames and passwords in their appropriate fields
- Click on Login button or press enter on the keyboard
- Wait for the credentials to be validated to access the interface.

6.2 Adding/Modifying users

Please follow these steps to add Doctors, Nurses and other users to the system

- Click on 'Add User' hyperlink
- Fill the form that appears by inputting the full name, department, username, password and role (Doctor, Nurse, Lab Technician etc) played at the department
- The entries can be deleted by selecting it from the delete form
- Click on the save button to complete the task

6.2.1 Adding/Modifying Patient Records

Please follow these steps to add a patient to the system

- Click on 'New Entry' hyperlink
- Fill the form that appears by inputting demographic data like full name, gender, date of birth, occupation etc.
- The entries can be deleted by selecting it from the delete form
- Click on the save button to complete the task

6.2.2 Health Personnel Scheduling

Please follow these steps to schedule your swift

- Click on 'Schedule Run' hyperlink
- Fill the form that appears by selecting the month, week, start and end dates, starat and end time, department etc
- Click on the save button to complete the task

6.2.3 View Scheduling

Please follow these steps to view a schedule

- Click on 'View Schedule' hyperlink
- Click and select the number of entries to be displayed
- The search box can be used to search for a specific shedule by either specifying a department or full name.
- Click on View button to display the schedule Information

7. Conclusion and Recommendations

This study seek to provide prompt access to data for diagnosis and decision making as well as enable health personnel to schedule their duty routines which took days to achieve. The system provided relevant stakeholders such as Doctors, Nurses, Students access provided they possess devices capable of joining a network. Due to both online and offline accessibility, students irrespective of their geographical location could seek medical care by booking an appointment with a Doctor. The system created a conducive environment where students felt secured to share their medical needs with doctors. Again health personnel had all the privacy they needed to decide a convenient schedule for duty which ensured punctuality and improved performance outputs. The following have been recommended based on the outcome of this study;

The Health Information System should be extended to other Higher Education Institutions to guarantee access to medical care by student irrespective of their location

Other System Development models such as the Agile should be used to implement requirements at an instance until all required modules are completed

A Health Information System that runs on mobile operating systems should be developed to enhance the mobility of the system. Again, biometric verification algorithms should be implemented to secure the contents of future systems.

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