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Responsive Real-time Information System for Managing Patient's Medical Records: A Case Study of Juba Teaching Hospital

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ABSTRACT

Information is a very important aspect in our day-to-day activities to ensure effective communication. As result of this, Information Communication Technology plays a great role to guarantee efficient and effective communication within and among different institutions and organizations. In response to this, each organization/institution strives to make sure that there is a secure means of disseminating, storing and retrieving of information within their boundaries. This calls for an information system that is capable of handling all these tasks without fail. The outpatient department of Juba Teaching Hospital has been used as a case study. With the use of computer database systems, it becomes easier to run and effectively coordinate the operations of the department bearing in mind the environment under which it operates (vast inhabited national referral hospital). Consequently, in this project, we have displayed database development using the system development lifecycle to come up with a good database design for ease of operations within the department, using Microsoft Access and Microsoft Visual Studio (VB.Net).

Keywords: Information system, Database design, ICT, Effective communication.

INTRODUCTION

According to [1,2,3] information system refers to any organized combination of people, hardware, software, communication and data sources that disseminate information in an organization. According to [2,4,5] information system refers to all components that work together to process data and produce information.

Information system is the arrangement of people, data, processes and interfaces that interact to support and improve day-to-day operation in business as well as problem solving and decision making needs of management and users [3, 6,7]. According to [4]. An information system is an arrangement of people, data, processes, information presentation and information technology that interact to support and improve day to day operations in a business as well as support the problem solving and decision making needs of management and users.

The following are classes of information system applications.

- Transaction processing systems.
- Management information systems.
- Decision support systems.
- Expert systems.
- Office automation and workgroup systems [8,9,10].

The term Information Technology (IT) represents the various types of hardware and software used in an information system including computer and networking equipments [5,11,12]. It is a contemporary term that describes the combination of computer technology with telecommunications technology. It significantly expands the power and potential of most information systems. According to [3], IT refers to the contemporary terms that describe the combination of computer technology (data, image and voice network).

According to [2], Management information system (MIS) refers to the use of computer for planning, controlling decision making and problem solving, rather than just reporting transactions MIS is a strategy that provides periodic information about such a topic and operational corporate database and processing it according to [6,13,14,15]. Therefore, MIS refers to a

computer based information system that is use to provide information for planning, controlling decision by extracting it from a cooperate database and processing according to user's interests.

According to [7], a database system is basically a computerized record keeping system. The database itself can be regarded as a kind of electronic filing cabinet that is, a repository or container for a collection of computerized data files. According to [6], database refers to the collection of interrelated data organized to meet the need and structure of an organization and can be used by more than one person for more than one application like; ORACLE, VB.Net and VB 6.0. In relation to the two definitions, database refers to the collection of a computerized interrelated data organized to meet the need of an organization.

Juba Teaching hospital (JTH) is a government hospital in the category of regional hospitals started up in the early 1990's as a health center by the town council of Juba that was to handle. It was started up as a treatment center that handled minor illnesses that needed not serious attention and incase of any emergencies, they offer first aid and then have the patient referred to an advanced big hospital. With a population of 20,000 persons, it was realized that there was an increase in the inflow of patients both from within and outside the town as well as a rise in the malaria cases and other health cases that was claiming a lot of lives. Due to this, the government of Sudan through the township council of Juba saw the need of having the health center expanded so that it could handle a bigger number of patients and offer advanced medical services that cater for other serious cases. This expansion therefore took some time for it to be completed and by 1993, Juba teaching hospital was in place fully furnished with all the facilities and qualified personnel's to handle any health related cases.

Being the regional largest hospital, the hospital realized an annual average of about 10,000 in-patients and attends to over 9,000 out-patients in the assessment centre, general out-patients clinics, specialist's clinics, the accidents and emergency departments annually and delivers about 8,000 mothers per year. The bed capacity is 3,500. It provides specialists' and super specialists' services in surgery, internal medicine, pediatrics, obstetrics and gynecology.

For purposes of this study, attention was focused on the hospital's outpatient department. The outpatient department is the most active department in the hospital and it serves the hospital with services of capturing the patient's information, diagnosing, and offering first aid to emergencies and offers the rightful medication as per the doctor's prescription. Faced with these, rather unpredictable trends of events, there's need to invest money and resources in order to establish and develop the rapidly emerging and changing technology that is to help in addressing the challenges posed by increased activities in the department.

Statement of the problem

Medical data have always been exchanged between care providers and the patients. Traditions methods checking in the files which are kept in drawers and partially automated system which is not reliable to handle the number of patients who visit the hospital. This method is inferior to fully computerized communication methods in ease of use, speed of access, cost, improved data security, provision of backup and recovery, provision of reports and reliability. The development computer-based system has made medical data exchange simple and quick.

Justification of the project

Due to changes in technology on both the local and global scale, the health check field is becoming more and more reliant on ICT. ICT has played a very significant role to many companies on lying down their strategies and in their quest to acquire modern technology. This has proved to be a great investment that results in quick financial returns and enhance better performance geared towards efficient communication technology. A well-designed and

implemented database and information system enables information to be quickly retrieved and processed, and has provided a one stop system in which important information resides and is shared.

Aim of the study

The aim of this study was to design a computer-based information system that helps to record and store patient's medical records so as to ease use, speed of access, cost, improve data security, provide backup and recovery, as well as issuing reports and reliability, minimize the cost, manual effort and amount of processing time.

Specific objectives

Specifically, the objectives of the study were:

a) Carry out a detailed study of the case study with an aim of learning how the current system runs, identify weaknesses and strengths.
b) Analyze data gathered and develop a design document to which a customized application suiting the case study will be developed to tackle most if not all the problems mentioned
c) Implement the developed system using Visual basic as the application and Microsoft access as the backend.
d) Ensure security of the new implemented system is in place.

METHODOLOGY

Procedure of the study

The research entailed seeking permission from the case study's management to carry out the research at their premises. Granted, the researchers went ahead and implemented questionnaire and interview methods as data collection tools that would hence lead to eventual analysis.

Research technique

The research techniques which were employed were both quantitative and qualitative methods. The quantitative technique was based on numbers and used statistical measures. On the other hand a qualitative technique used explanations and was used to answer questions such as "how effective is an application for creating a database and automating records at the outpatient department of JTH affects the institution's performance"?

Target population

The target population was all the staffs of the subordinate workers, who have close dealings in the automation and the creation of the department's database. Apart from the staff of the outpatient department, other target populations were the patients visiting the hospital.

Units of inquiry

These were the members and non-members of the institution who participated in the research process. The researcher took the whole staff members of the outpatient department of JTH who had close dealings with the creation of the department's database and the automation of the documents. Also the researcher took the non-members of the department. These non-members were the patients visiting the hospital from different parts of the county and beyond.

Sampling techniques

Simple probability sampling method was employed to get the people interviewed. Under this method each member of the population who had close link with the outpatient department of JTH and its patients had an equal chance of being selected.

Data collection methods.

The following methods were applied in the collection of the data namely: Interview, questionnaire, Observation, and document examination and analysis.

Development Tools

The development tools in the research that were used to implement the system are as follows:

Microsoft Visual Basic Programming Language (VB)

A computer program is an organized list of instructions that, when executed, causes the computer to behave in a predetermined manner. Without programs, computers are useless. Programming is designing or creating a set of instructions to ask the computer to

carry out certain jobs which normally are very much faster than human beings can do. In order to do programming, we need to use certain computer language to communicate with the computer. There are many computer languages, some of the examples are Visual Basic, VB.Net, Java, C++, C, and so on.

According to the website [8] Visual basic is an event driven language that responds to users' actions. The language interfaces between the user and the database. Patient's records are to be stored in database and accessed through visual basic interface.

Visual basic has in-built function and code fragments that assist the programmer to write the codes effectively as objects independently and then called to form a complete project.

Operating systems

Windows 7, NT or XP operating system is the most widely used and most versant with users than any other operating system and therefore it is most appropriate operating system to use for this system to work.

SYSTEM DESIGN

Analysis of the current system

According to the research, the outpatient department of JTH information system is mainly paper-based. There are several computers in the department spread over the different units. Two at the ICT unit, one at the senior nursing superintendent, one at the nursing staff chambers, the other in the treatment chambers. The computers are used for data entry and information storage.

When data is received (data concerning the patient and the treatment measures taken), it is recorded in the computer to ensure easiness in the retrieval of data (information). This is done by the nurses in charge and the subordinate staff under the direction of the doctor. The concerned nurses and the subordinate staff encounter difficulties with following up all the required information since at times the information is incomplete. Thus, it may take them a number of days to capture all the required information concerning the patient and the treatment measures taken. On the other hand more copies of the same item may be recorded on different computers thus, causing data inconsistency when the records are being updated. This is because one copy might be updated while the rest may not. In such a case, contradiction crops up.

Strengths of the current system

Despite the system being paper-based, the following was achieved.

- Data retrieval by the staff.
- Storage of the data received.
- Security was maintained even though at a low standard.
- Data was shared by the different units.
- Data was updated quarterly (once every three months).

Weaknesses of the current system

- There was demand for storage space for paper work. This space could be utilized to accommodate other activities such as offices or for expansion of the hospital.
- Inaccurate data capture and recording resulting from the collecting of incomplete manifests and other relevant data hence unreliable data which may result in processing of wrong information.
- Loss in productivity because staff members spend valuable time moving from place to place in search of data to be analyzed.
- Too much reliance on clients who may at their own discretion deliberately or unknowingly conceal vital information.
- A lot of paper work involved which can result to errors and inconsistent results.
- The paper-based system used gives little opportunity to share data across the units in the department. This is because each unit has its own files with contents relevant to it.
- Same data kept on the subject in different files may be inconsistent and therefore lacks integrity and may be unreliable.
- Retrieval of information is tedious and time wasting. It is therefore

necessary to automate the system so as to overcome the various shortcomings associated with the current system.

DESIRED SYSTEM

Functional requirements

These are the statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situations. They explain what the system should do and what it entails:

- Produce reports on the most commonly diagnosed disease in a given period of time.
- Produce reports on the percentage of patients that were diagnosed with a common disease in a given period of time.
- Retrieve patients recorded information on request.
- Query the data in the database.
- Update, delete, refresh, exit and add are some of the functionalities that the system will have.
- The system shall provide appropriate views for the user to read documents in the document store.
- There is need for sufficient hard disk space to manage the system, at least 60GB.
- Enough memory (RAM) is needed to ensure quicker and better responsiveness, at least 512MB.
- There will be need for a medium that offers fast and efficient communication transmission that has a minimum error performance

Non-Functional requirements

These are systematic qualities that defined the system properties and constraints. They include the following:

Performance: The system will be expected to have good response time in order to successfully perform data manipulation.

Security: The system will be expected to have security functionalities like the user name and password to avoid unauthorized users from accessing the system.

Accessibility: Efficiency, reliability, speed and retrieval of information needed will be made easier for the system users.

User friendly: The system uses commands, for system navigation that the user will find it easy to learn, because of reduced complexity.

Versatility: The system will be designed to fit on other types of operating systems such as window 7 vista, XP, Linux, etc.

Availability: Access to the system is a bit simplified to allow users to be able to start work as smoothly as possible. Maintenance by system administrator should be done regularly to keep the system available to the users

System specification

This specifies the functionality of the system and the constraints in its operation. System specifications are intended to establish what services are required from the system and the constraints on the system's operation and development. This stage is very delicate because errors at this point inevitably lead to later problems in the system design and implementation.

In this research study, the researcher observed the following on system specification:

- An estimate of whether the identified user needs may be satisfied using the current software and hardware technologies and whether the proposed system is cost effective.
- Deriving system requirements through observing the existing system, discussing with potential users and procurers.
- Defining a set of requirements and recording it to produce a requirements document.
- Checking the requirements for realism, consistency and completeness. Errors in the requirements document are inevitably discovered thus correcting them. The systems requirements document, also known as the functional specification, should be precise. It may serve as a contract between

the system buyer and software developer.

System development Life Cycle

This is the process that provides software developers with the required information and guidelines on how to develop systems software. In this research, we considered System Development Life Cycle (SDLC) as the choice for this study. Different models provide useful abstractions which can be used to explain different approaches to software development. SDLC is the oldest methodology for building an information system. Every system goes through a process of birth, growth, maturity and decline. The following diagram illustrates the steps which must be followed in system development life cycle.

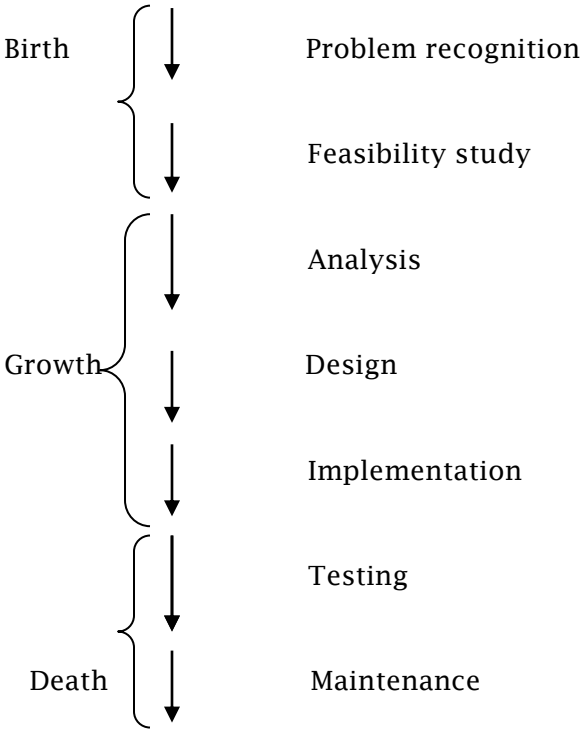


Figure 1: System Development life cycle

Problem recognition

This is the initial stage. It involves identifying the exact problem and the system to be developed out of all the new systems that could be developed. Once the problem has been recognized and acknowledged by the management, the users and the system analyst (in this case the researchers), the work of implementing a new system is assigned to the system analyst.

Feasibility study

Here the problem definition is brought into a sharper focus. Feasibility study is also known as preliminary investigation. The specific system objectives are set and aspects of the problem that will be excluded from the system clearly noted. The analyst ought to estimate the costs and benefits of the system with greater accuracy. This calls for a cost-benefit analysis study of the proposed system. The cost analysis indicates whether the proposed system is feasible or not.

Feasibility study contains these aspects:

- *Technical feasibility:* This is a measure of the practicality of a specific technical solution and the

availability of technical resources and expertise.

- *Economic feasibility:* This is a measure of the cost effectiveness of a project or solution. This is often called *cost-benefit analysis.*
- *Operational feasibility:* This is a measure of how well the solution will work in the organization. It is also a measure of how people feel about the system/project.
- *Schedule feasibility:* This is a measure of how reasonable the project timetable is.

Analysis

After the feasibility study is approved, the system analyst works in conjunction with the user to develop a logical model of the system. There must be understanding between the user and the analyst to avoid failure of the project. Use of technical language is avoided so that the user can comprehend and in return contribute as well. This can be done by use of diagrams, elementary data dictionary and rough descriptions of the relevant diagrams which must be revised by both the user and the management.

Design stage

Here the analyst answers the question, how is the problem going to be solved? Logical design is incorporated to ensure that everything runs smoothly. It also ensures that premature termination does not occur. Then we have the detailed design where programs are coded to solve the problem. This answers the question, how should the system be implemented?

Implementation

Here the new system is put into use. When implementing a new system various ways can be adopted. These include:

- *Direct change over:* - this is a complete replacement of the old system by the new system in one bold move.
- *Parallel running:* - this involves processing of current data on both old and new __systems in order to cross-check the results.
- *Pilot running:* - data from one or more previous periods is first run on the old system and then on the new system. The new results are then compared.
- *Phased change over:* - this is where the system is introduced piece by piece.

Testing

Before any system is brought into use, it is essential to ensure that it carries out all its intended functions within the established limits. On both logical and physical designs, the computer system and its environment must be tested to the satisfaction of the analyst and the user.

Maintenance

The main objective of maintenance is to keep the system functioning at an acceptable level. Maintenance functions mainly include:-

- Correcting errors due to problem bugs
- Changing parameters and algorithms used to develop the original programs.
- Changing procedures
- Hardware and software maintenance
- Making any enhancements as new technology comes.

Final system

From the research and documentation that was done, the researcher was able to develop the proposed system.

Detailed analysis and Design

It's also known as the logical or physical design. Here the researcher looks at how the proposed system:-Responsive real-time record management system shall deliver the general capabilities in the problem definition.

Conceptual Design

This includes a conceptual data model which is a detailed model that captures overall structure of organizational data, while being independent of any data base management system or other implementation consideration. A conceptual data model includes the relevant entities, relationships and attributes as well as rules and constraints that define how data are used. The conceptual data model may be expressed in one of the several forms: - the most common are detailed entity relationship diagrams or object oriented models. In this research, the researchers considered

the Entity Relationship Model (E-R Model) which is described below.

The key elements of the Entity Relationship Model (E-R Model)

These are entities, attributes, identifiers and relationships.

Entity

In reference to [9], an entity is something that can be identified in the users' work environment, something that the users want to track. In this case the following are the entities.

- Examination
- Patient's
- Staff

Attributes

Entities have attributes, also called properties that describe the entity's characteristics. Examples of attributes are Patient's name, Patient's id and so on. They are printed on both capital and small letters.

Identifiers

Entity instances have identifiers which are attributes that name or identify entity instances. Examples, patient's instances could be identified by Patient's name or Patient's id the identifier of an entity consists of one or more of the entity's attributes. An identifier may either be *unique* or *non-unique* whereby the value of a unique identifier will identify one and only one entity instance while that of a non-unique identifier will identify a set of instances. Identifiers that consist of two or more attributes are called composite identifiers.

Relationships

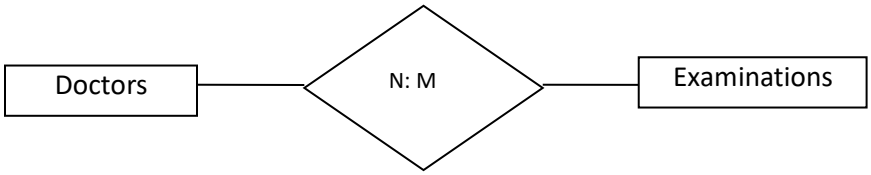
A relationship is an association between entities according to [9]. An E-R Model consists of both relationship classes and relationship instances. Relationship classes are associations among entity classes and relationship instances are associations among entity instances.

A relationship can include a number of entities; the number of entities in a relationship is the *degree* of the relationship.

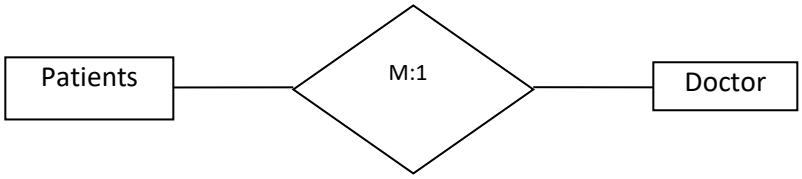
Types of relationships

i. *One-to-one relationship:* - A single entity instance of one type is related to a single entity instance of another type.
ii. *One-to-many relationship:* - A single instance of one type is related to or relates to many instances of another type.
iii. *Many-to-many relationship (N: M)*: - Many instances of one type relate to many instances of the other type.

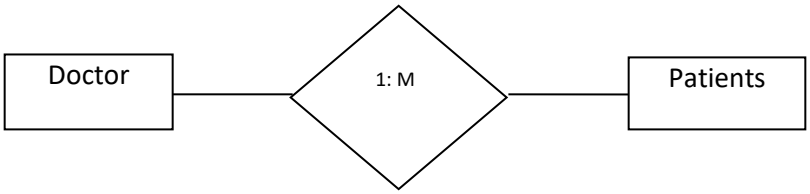
The numbers between the relationships diamonds show the maximum number of entities that can occur on one side of the relationship such as constraints are called the relationship's maximum cardinality as observed by [9].



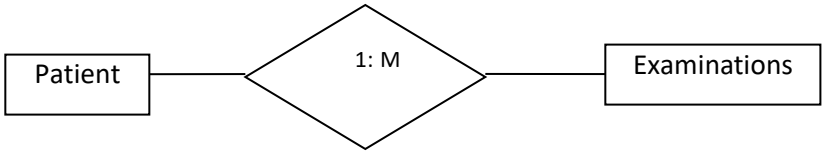
This is a many –to –many relationship. Many doctors can carry out many examinations.



This is a one – to – many relationships: - Many patients' can see one doctor.



This is a one – to-many relationship: - a patient can visit many doctors.



This is a one – to- many relationships: - a patient can carry out many examination tests.

Figure 2: Relationships and Cardinality

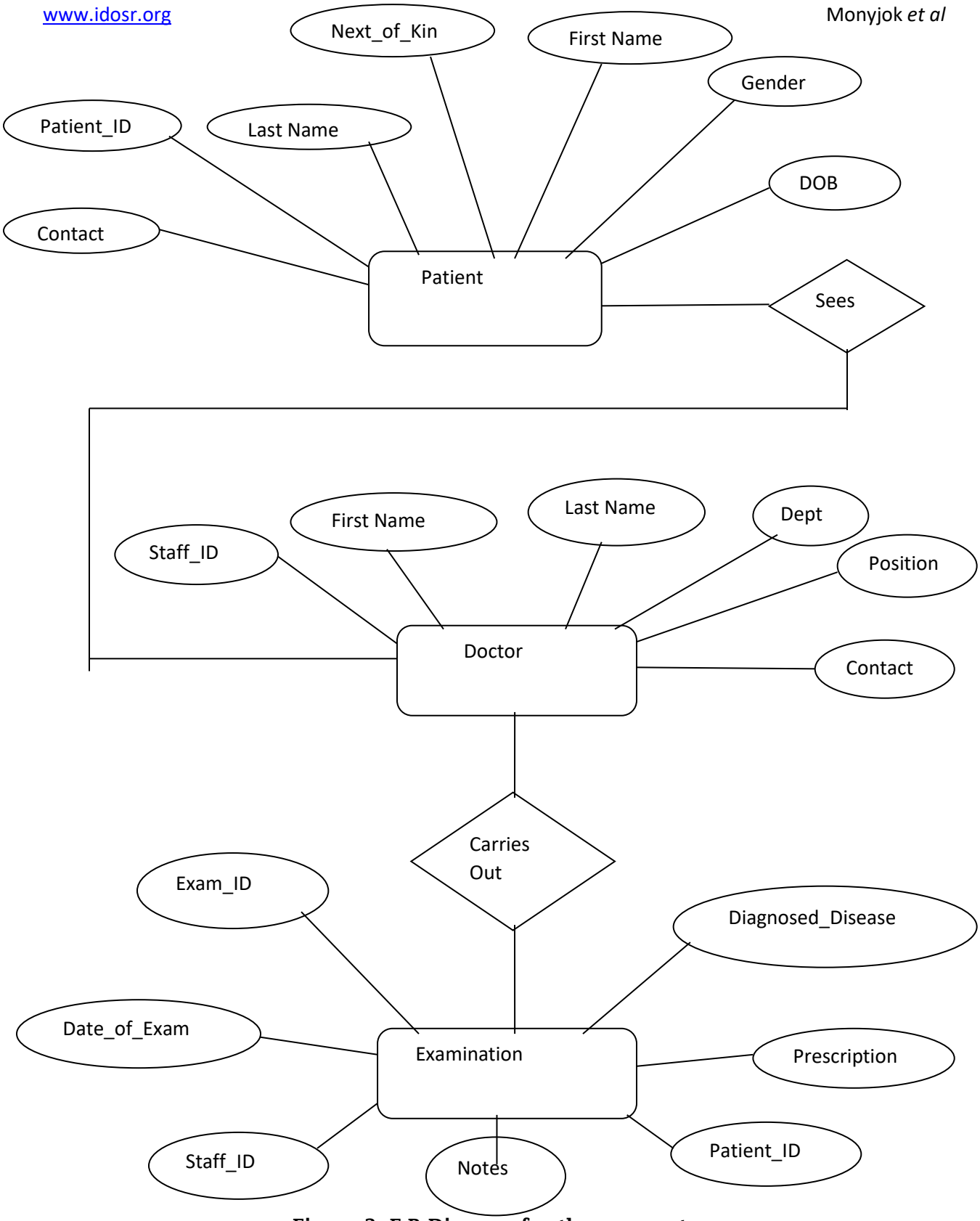


Figure 3: E-R Diagram for the new system

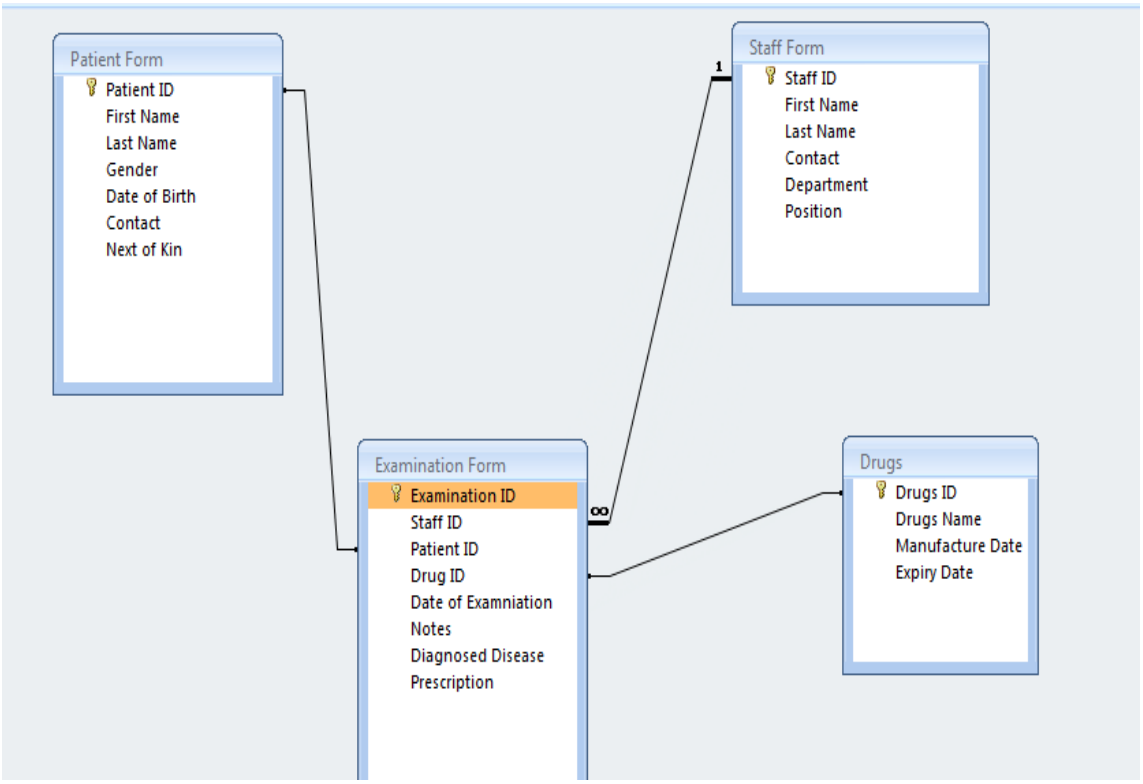


Figure 4: Relationship among entities

Logical design

This is the process of mapping the conceptual data model to the structures that are specific to the target DBMS. If the target environment is relational DBMS, then the conceptual data models are mapped to normalized forms.

The logical design process is concerned with transforming the conceptual data model (in this case the E-R Model) to a logical data model (Relational Data Model). It includes the following steps:

- *Represent entities:* - Each entity type in the E-R diagram is represented as a relation in the Relational Data Model. The identifier of the entity becomes the primary key of the relation and other attributes of the entity type become non-key attributes of the relation.

Table 1: Examination Table showing the examination tests conducted on a patient

Field name	Data type	Size	Constraints	Key
Exam-ID	Text	10	Not null	Primary key
Patients-ID	Text	10	Not null	Foreign key
Staff-ID	Text	10	Not null	Foreign key
Drug-ID	Text	10	Not null	Foreign key
Date-of-Exam	Date/time	Short Date	Not null	
Notes	Memo	50	Not null	
Diagnosed-disease	Text	20	Not null	
Prescription	Memo	50	Not null	

Table 1: Patient's Table capturing the patient's details.

Field Name	Data Type	Size	Constraints	Key
Patient-ID	Text	10	Not null	Primary key
First Name	Text	10	Not null	
Last Name	Text	10	Not null	
Gender	Text	8	Not null	
Date of Birth	Text	10	Not null	
Contact	Text	10		
Next of Kin	Text	20	Not null	

Table 2: This shows details concerning the staff members of the department.

Field name	Data type	Size	Constraints	Key
Staff-ID	Text	10	Not null	Primary key
First Name	Text	10	Not null	
Last Name	Text	10	Not null	
Department	Text	20	Not null	
Position	Text	20	Not null	
Contact	Text	10		

Table 4: This shows details concerning the drugs.

Field name	Data type	Size	Constraints	Key
Drug-ID	Text	10	Not null	Primary key
Drug name	Text	10	Not null	
Manufacturer Date	Text	10	Not null	
Expiry Date	Text	10	Not null	

According to [9], a relational data model is a data model that represents data in the form of tables or relations.

A relation is a named, two dimensional table of data. Each relation consists of a set of named columns and an arbitrary number of unnamed rows.

Physical design

This is the last stage of the design process. Its major objective is to implement the database as a set of stored records, files, indexes and other data structures that will provide adequate performance and ensure database integrity, security and recoverability. Physical database design must be performed carefully since decisions made during this stage have a major impact on data accessibility, response time, security, user friendliness and similar factors. The following are the major inputs to physical design.

- Logical data structures that were developed during the logical design like the relational data models.
- User processing requirements that were identified during requirements definition including size and frequency of use of the database.
- Characteristics of the database management system (DBMS) and other components of the computer operating environment.

Components of the physical database design

- **Data volume and usage analysis**: - The size and usage patterns of the database are estimated. Estimates of the database size are used to select physical storage devices and estimate the storage costs. Estimates of usage paths or patterns are used to select file organizations and access methods to plan for the use of indexes and plan a strategy for data distribution.
- **Data distribution strategy***:* - There are different distribution strategies. In this research *hybrid data distribution strategy* was considered. In this strategy, the database is portioned into critical and non-critical fragments. Non-critical fragments are stored at one site while critical fragments are stored at multiple sites.
- **File organization***:* - This is a technique for physically arranging the record of files on secondary storage devices. The following were put into consideration: - constraints including physical characteristics of the secondary storage devices, available operating system and file management software and user needs for storing and accessing data. Indexed non-sequential method whereby records are stored non-sequentially and full index required is the selected file organization technique.

The selected file organization for the new system is expected to provide the following:

- Fast access for retrieval.
- High throughput for processing transactions.
- Efficient use of storage space.
- Protection from failures or data loss.
- Minimizing need for reorganization.
- Accommodating growth.
- Security from unauthorized use.

Indexes*:* - Most database manipulations require locating a row that satisfies some condition. An index is a table or other data structures that are used to determine the location of rows in a table that satisfy some condition. Indexes may be defined on

both primary key values and non-key attribute values.

Integrity constraints*:* - These are specifications that preserve the integrity of the database. Referential constraints as such are business rules in a database to some other objects in the database.

SYSTEM IMPLEMENTATION

Project implementation

Project implementation is putting into effect a piece of research work.

To implement the system the following were done:

- Acquire the installation of requirements e.g. hardware, software.
- Data collection.
- Planning analysis and project writing
- System design and user training
- System testing and review
- System implementation and report writing

System implementation

Systems implementation is the delivery of that system into production (meaning day to day implementation). The implementation phase delivered the production system into operation. The functional system from the construction phase was the key input to the implementation phase of the system. The deliverable of the implementation phase was the operational system, the operation and support stage of the life cycle.

System implementation involves: conducting a system test, preparing a conversion plan, and installing the database.

The new system was now put into operation. The functional system from the construction phase was the key input to system implementation. The users were trained using various manuals, files and the database was loaded and the final testing was performed. System users provide continuous feedback as new problems and issues arise.

The system begins by loading a splash screen that is indicated below then loads the login page.

Figure 5: Splash Form

Security Requirement

All the users have to first log in with a correct username and password to gain access as shown below.

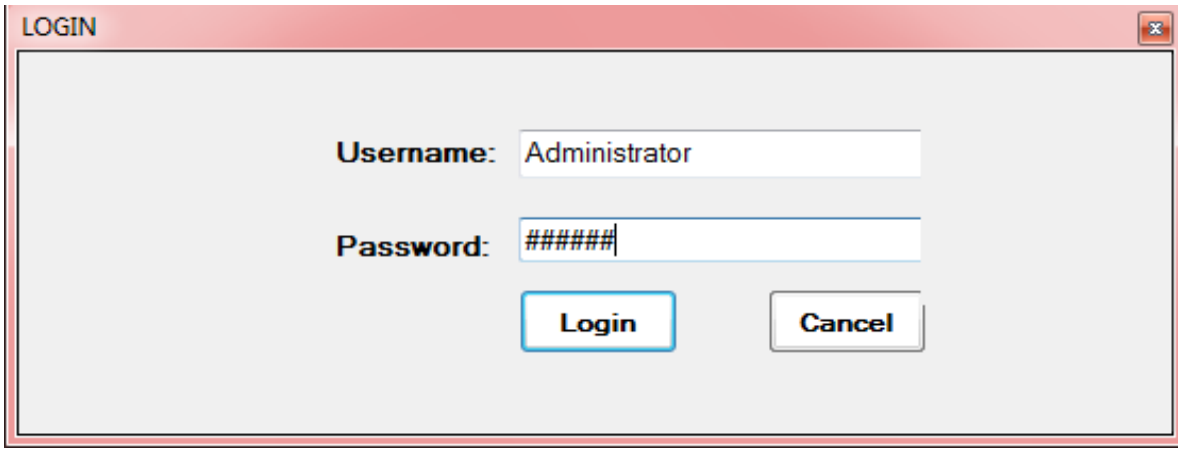


Figure 6: The Login Form

If the user enters the wrong password, a message box appears informing the user that the password is invalid as shown below.

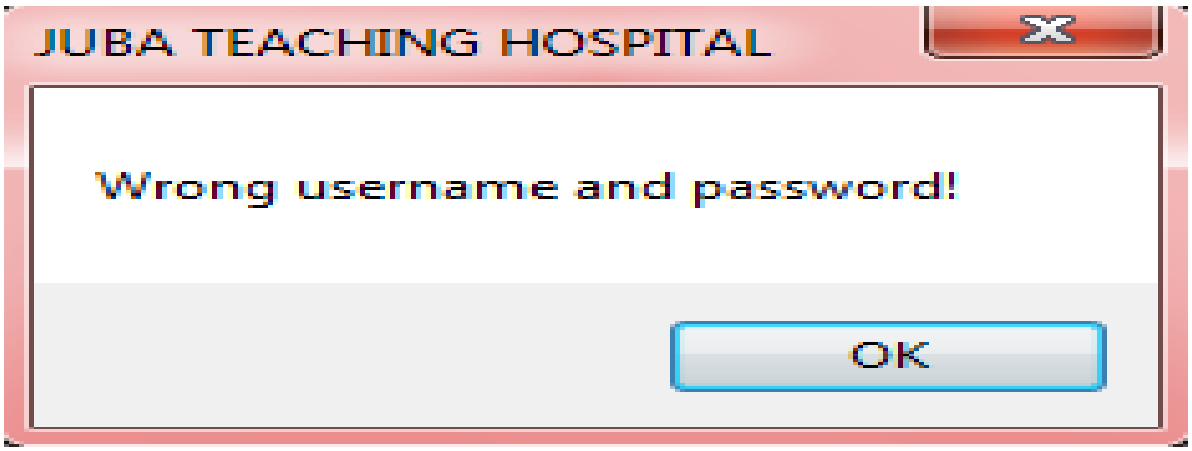


Figure 7: Invalid Password Entered.

Sample form designs

Some forms used in the system for data entry are indicated below.

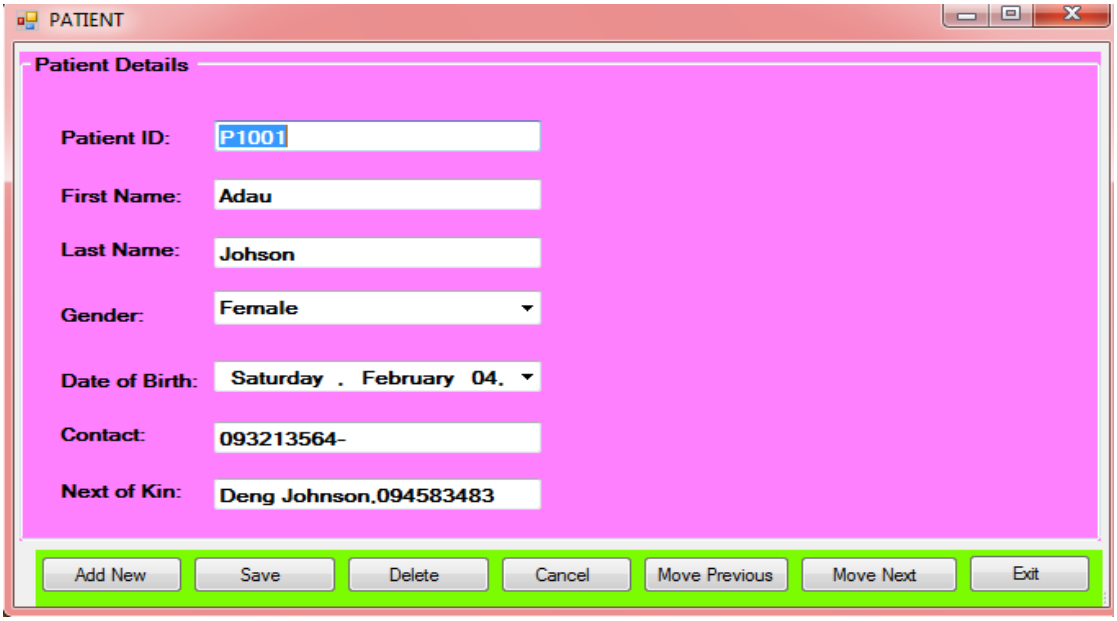


Figure 8: Patients Form

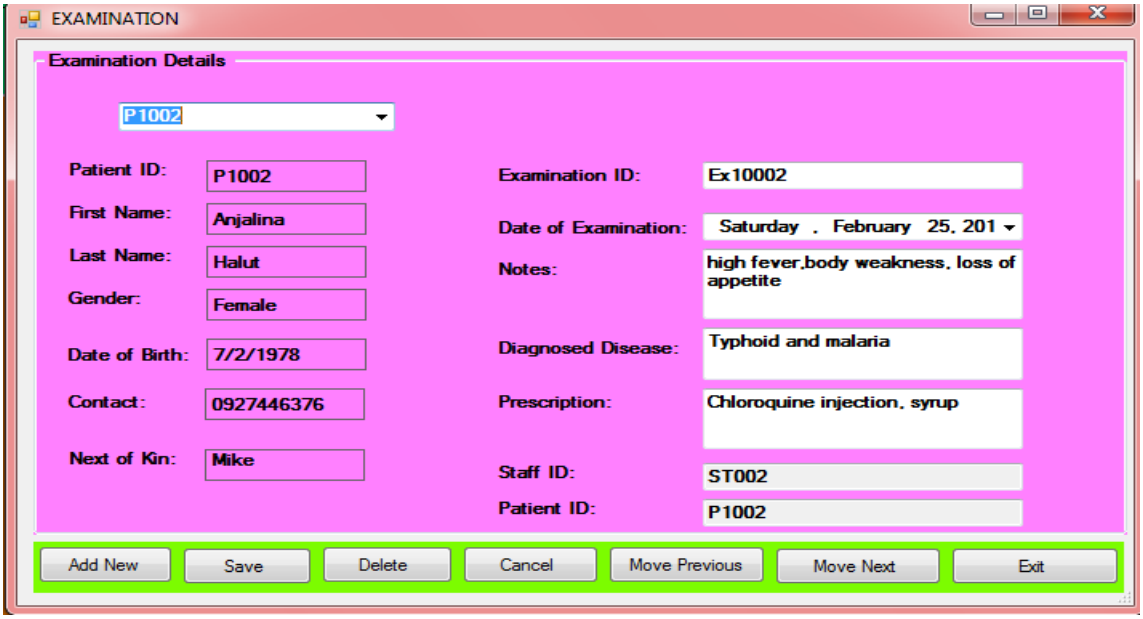


Figure 9: Examination Form

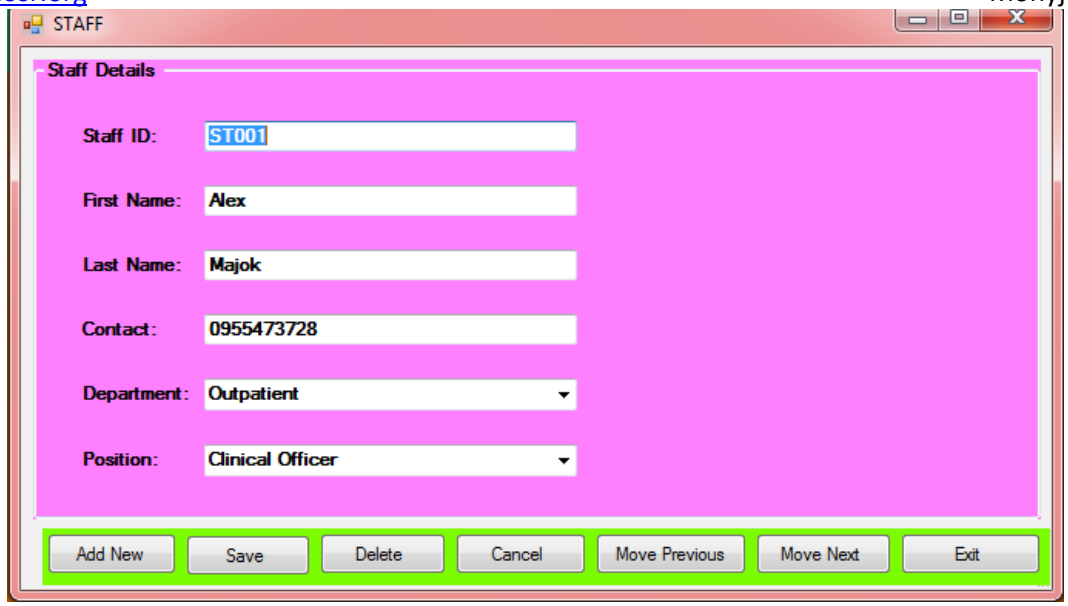


Figure 10: Staff Form

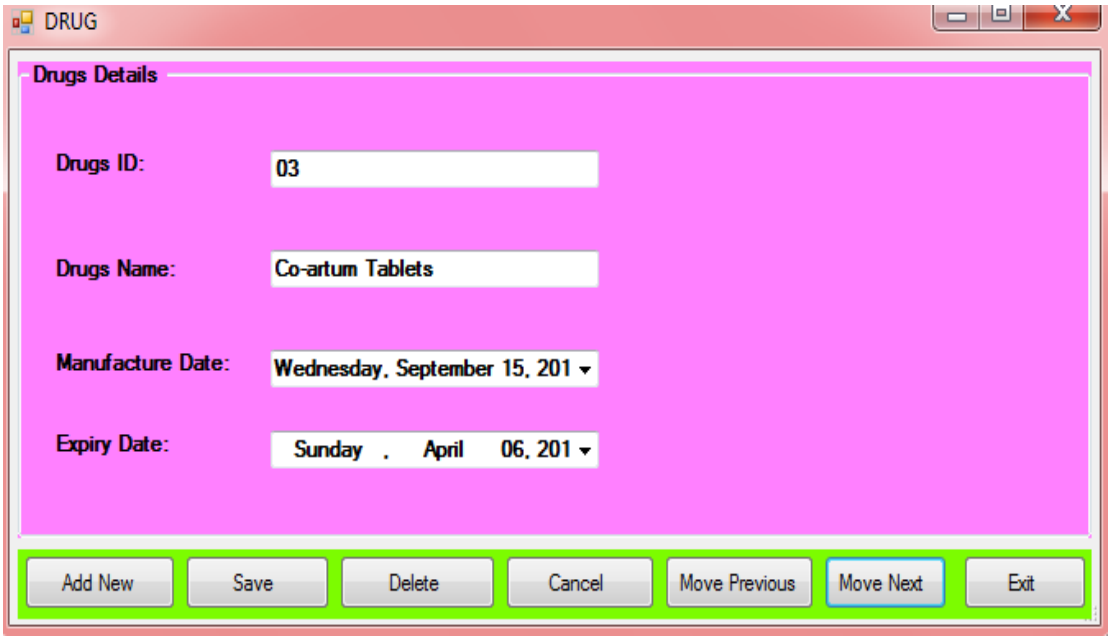


Figure 11: Drug Form

In the above forms, the user can add, delete, and update the data in the database. The user can as well view the previous and the next records in the database. A report can be generated to give a detailed report of the transactions that have taken place within a given period of time.

Sample reports

Some reports produced by the system are described below.

`Displays the list of the staff members

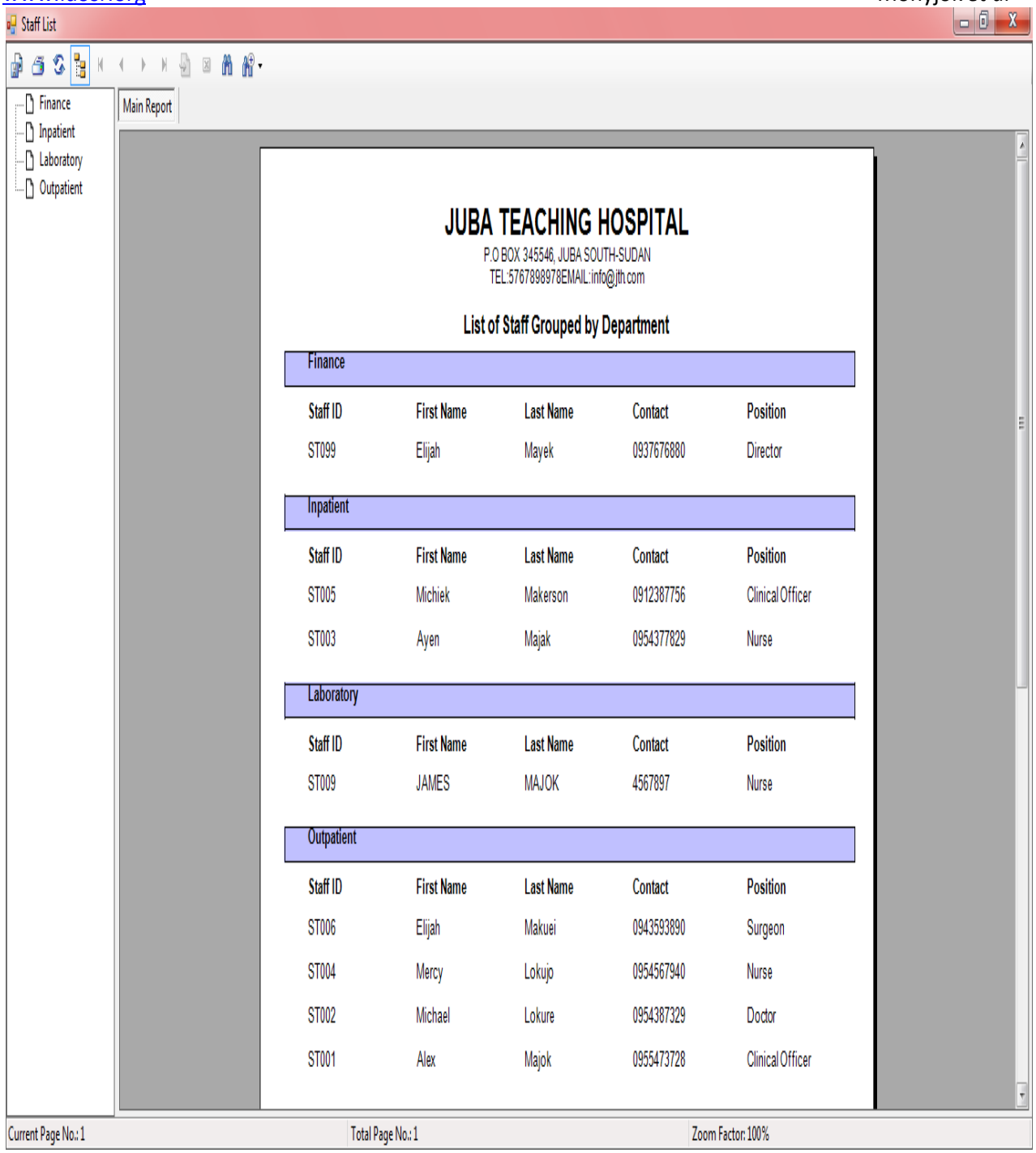


Figure 12: Staff Report

Displays the patient's general Examination details report

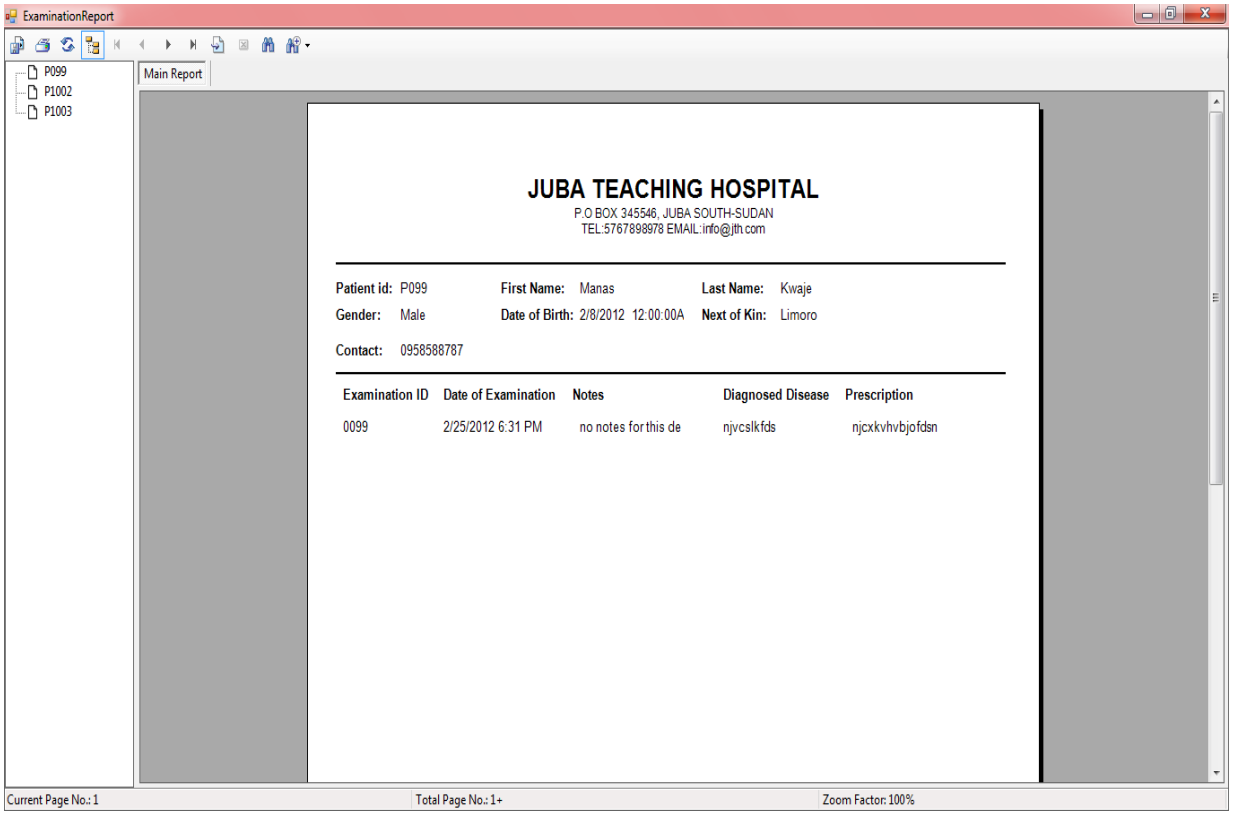


Figure 13: Exam Report

Program testing

This was intended to ensure that the system conforms to its specification and that the system meets the expectations of the users. Large systems, as the new system, are built out of sub-systems which are built out of modules which are composed of procedures and functions. The testing process proceeded in stages where testing was carried out incrementally with system implementation. The following were the stages followed:- Unit testing, module testing, sub-system testing, system testing and acceptance testing.

System Specification

The system specification states the features of the computers that will be used to run or interact with the application that is, input, output, and processing and control specification

Software Specification

The software to be used in system implementation is:

Visual Basic for developing the User Interface and Microsoft Access will be used to develop the database application. Both form the Database Management System.

The choice of software was used because of some reasons not limited to, but including;

- Capability
- Flexibility
- Familiarity
- Popularity
- User friendliness

Hardware Specifications

The hardware components necessary for implementing the application should be in position of being easily replaceable if need arises.

The computer that the database sits on should have the following features;

- At least 80 GB of hard disk space
- At least 1024 MB of RAM
- At least 2.4 GHz of processing power

- At least 533 MHz of front side bus (FSB)
- A gigabit Ethernet adapter
- A laser jet printer for printing reports
- A 17' LCD or CRT monitor,

However, all this can be foregone by having an Internet Service Provider (ISP) to provide the service of data storage and backup

System Testing and Limitations

The system was tested during the design stage and during the implementation. The main users were involved all through the development.

CONCLUSION

The patients record based management system was designed to respond to the needs of the outpatient department of JTH and provide adequate information and reports to monitor and review the progress of the hospital from time to time with respect to the patient's that visit and are attended to.

The system has been developed with scalability in mind and can be re-developed or updated to new requirements. This system can be updated to include other requirements that may come up as the system requirements expand.

Project limitations

i. The researcher did not analyze all documents that would be used in the system investigation. Samples of several of these documents were used to give reasonable insight into the various aspects of the system under study considering the time constraints, which had to complete the project.

ii. To enable a reasonable deduction to be made in the analysis, aspects that required further detailed analysis were observed though it would have been better to carry the investigation to its logical conclusion.

iii. The success of the project to a large extent depended on the cooperation of between the researchers and the system users in order to provide conducive environment for those approached to avail the required documentation of which some were reluctant to provide detailed information.

RECOMMENDATIONS

Since the system is under operation for it to be implemented with fewer problems, it is recommended for it to be run on Windows 7 operating system, hard disk size of at least 60GB and RAM size of at least 1024MB. The researcher recommends that before the application is put into full use, it should be tested in a sample field to estimate any bugs that may not have been identified at the time of development. Password levels may be increased to higher levels depending on the confidentiality of the stored data. The current system password level is basically low-level. Once in conversion stage, it is recommended for other departments to adopt the same system to ensure efficiency and effectiveness in data sharing, storage and retrieval.

Areas for Further Work

Since the system is under operation, the researcher will have to be involved in system support which includes the following activities:

i. Program maintenance
ii. System recovery
iii. Technical support
iv. System enhancement

If opportunity allows, the researcher hopes that the features that have not been implemented in this application but were originally desired features will be taken into consideration in order to improve on the efficiency, reliability and user friendliness of this system.

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