HOSPITAL INFORMATION SYSTEM

By

SAMAH SAYED TALIB OSMAN MOHAMMED

Supervisor

Prof. Sami Sharif

A REPORT SUBMITTED TO

University of Khartoum

In partial fulfillment of the requirement for the degree of B. Sc

Faculty of Engineering

Department of Electrical and Electronics

Software Engineering

July 2009
DECLARATION OF ORIGINALITY

I declare that this report entitled “Hospital Information System for University of Khartoum” is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

Signature: ______________________

Name: _______________________

Date: ________________________
ACKNOWLEDGMENT

To My Father

For his continuous encouragement and blessings

To my Mother

Hoping that I have succeeded to achieve some of her great wishes for me

To my supervisor

For giving me the honor to supervise my graduation project
Abstract

Development and implementation of Hospital Information Systems (HIS) is described in this paper. It provides insight into the most important issues relating to the design and development of HIS (e.g. software engineering aspects, medical data dictionaries, communication and networking, and decision support functions), presenting examples of the application of decision support functions and illustrating their potential impact on the quality of care and health care costs. The paper also provides an exemplary description when successfully applied medical information systems, and illustrates the options provided with newer computing technologies in order to migrate to modern HIS environments.
المستخلص

وضع وتنفيذ أنظمة المعلومات في المستشفي قد تم شرحه ويرد في هذه الورقة. وهو يقدم فكرة عن أهم القضايا المتعلقة بتصميم وتطوير البيئة الإلكترونية للمستشفيات بصورة عامه (مثل كل جوانب هندسة البرمجيات التي استخدمت في المستشفى، الجوانب الطبية، قواميس البيانات، الاتصال والتواصل، ووظائف دعم اتخاذ القرار) ، وتقديم أمثلة على التطبيقات التي استخدمت لدعم وظائف المشروع وتبين أثرها المحتمل ملاحظتها على نوعية الرعاية وتكاليف الرعاية الصحية. كما توفر هذه الورقة وصفًا مثالياً عند تطبيقها بنجاح على البيئة الإلكترونية بصورة. 

TABLE OF CONTENTS

DECLARATION OF ORIGINALITY

DEDICATION

ACKNOWLEDGMENT

ABSTRACT

المستخلص

TABLE OF CONTENTS

LIST OF FIGURES

Chapter 1: Introduction

1-1 Overview 1
1-2 Thesis’ layout 1
1-3 Projects’ theme 2

Chapter 2: HOSPITAL INFORMATION SYSTEM ENVIRONMENT

2-1 Brief idea 3
2-2 Facts finding 4
2-2-1 Information collecting 4
2-3 Development & Future of Hospital Information System 12
2-4 Advantages of Hospital Information System 13

CHAPTER 3: DESIGN & LAYOUT

3-1 Methodology and Tools 15
3-1-1 DB Creating/Main Tables Scheme 15
3-1-2 Interface Crating/Virtual Tables Scheme 18
3-2 VB/ .NET 22
3-3 ADO .NET 22
3-3-1 Architecture: 23
Chapter 4: RESULTS

4-1 Introduction 26

4-2 Implementation, Testing & results obtained 26

4-3 Results Discussion and Interpolation 36

Chapter 5: DISCUSSION AND CONCLUSION

5-1 Discussion and Conclusion 37

5-2 Future Works 37

References

Appendices

❖ Appendix A-I 30 IEEE Bus Data .................................................................60
❖ Appendix A-I 30 IEEE Load Flow Result ..................................................63
❖ Appendix B Load Flow Result for different Load Conditions .................65
❖ Appendix C MATLAB Code.................................................................73
<table>
<thead>
<tr>
<th>Figure number</th>
<th>Title</th>
<th>page no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table (2-1)</td>
<td>Difference of naming in database relational scheme and SQL terminology</td>
<td>7</td>
</tr>
<tr>
<td>Table (3-1)</td>
<td>Interface passwords</td>
<td>15</td>
</tr>
<tr>
<td>Table (3-2)</td>
<td>Patient information table</td>
<td>16</td>
</tr>
<tr>
<td>Table (3-3)</td>
<td>Doctor information</td>
<td>16</td>
</tr>
<tr>
<td>Table (3-4)</td>
<td>Test information</td>
<td>16</td>
</tr>
<tr>
<td>Table (3-5)</td>
<td>Drug information</td>
<td>17</td>
</tr>
<tr>
<td>Table (3-6)</td>
<td>Diagnostic report</td>
<td>17</td>
</tr>
<tr>
<td>Table (3-7)</td>
<td>Test results</td>
<td>17</td>
</tr>
<tr>
<td>Table (3-8)</td>
<td>Rooms availability</td>
<td>18</td>
</tr>
<tr>
<td>Figure number</td>
<td>Title</td>
<td>Page no.</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>(2-1)</td>
<td>1 to 1 relations</td>
<td>6</td>
</tr>
<tr>
<td>(2-2)</td>
<td>Terminology of relational</td>
<td>6</td>
</tr>
<tr>
<td>(2-3)</td>
<td>Shows the layout of the .NET application</td>
<td>10</td>
</tr>
<tr>
<td>(2-4)</td>
<td>Workstation oriented with centralized patient records</td>
<td>13</td>
</tr>
<tr>
<td>(3-1)</td>
<td>Password and user name interface</td>
<td>18</td>
</tr>
<tr>
<td>(3-2)</td>
<td>Reception interface connected to the patient table by its primary key</td>
<td>19</td>
</tr>
<tr>
<td>(3-3)</td>
<td>Laboratory interface to tests must done</td>
<td>19</td>
</tr>
<tr>
<td>(3-4)</td>
<td>Doctor interface for diagnostic reports</td>
<td>20</td>
</tr>
<tr>
<td>(3-5)</td>
<td>List of desired tests</td>
<td>20</td>
</tr>
<tr>
<td>(3-6)</td>
<td>Prescription interface</td>
<td>21</td>
</tr>
<tr>
<td>(3-7)</td>
<td>Laboratory interface for adding new test</td>
<td>21</td>
</tr>
<tr>
<td>(3-8)</td>
<td>Emergency interface for assigning patients</td>
<td>22</td>
</tr>
<tr>
<td>(4-1)</td>
<td>Password fields’ interface</td>
<td>26</td>
</tr>
<tr>
<td>(4-2)</td>
<td>DB manager interface for adding a new user</td>
<td>27</td>
</tr>
<tr>
<td>(4-3)</td>
<td>Password changing interface</td>
<td>28</td>
</tr>
<tr>
<td>(4-4)</td>
<td>The main iteration for all interfaces</td>
<td>28</td>
</tr>
<tr>
<td>(4-5)</td>
<td>Shows patient registration with all events related to it</td>
<td>30</td>
</tr>
<tr>
<td>Figure (4-6)</td>
<td>Shows the desired tests list</td>
<td>30</td>
</tr>
<tr>
<td>Figure (4-7)</td>
<td>Shows the doctors interface with diagnostic reports</td>
<td>31</td>
</tr>
<tr>
<td>Figure (4-8)</td>
<td>Shows the laboratory interface for needed tests</td>
<td>31</td>
</tr>
<tr>
<td>Figure (4-9)</td>
<td>Shows laboratory interface so as to add new test</td>
<td>32</td>
</tr>
<tr>
<td>Figure (4-10)</td>
<td>Shows interface to add a new details to the test information</td>
<td>32</td>
</tr>
<tr>
<td>Figure (4-11)</td>
<td>Shows registering patient that will be assigned to room</td>
<td>33</td>
</tr>
<tr>
<td>Figure (4-12)</td>
<td>Interface for rooms’ expansion</td>
<td>33</td>
</tr>
<tr>
<td>Figure (4-13)</td>
<td>Interface for rooms’ availability</td>
<td>34</td>
</tr>
<tr>
<td>Figure (4-14)</td>
<td>Shows interface for modifying the drug table</td>
<td>35</td>
</tr>
<tr>
<td>Figure (4-15)</td>
<td>Shows the pharmacy interface associate with prescription</td>
<td>35</td>
</tr>
<tr>
<td>Figure (4-16)</td>
<td>Reception interface associated with patient’s information search</td>
<td>36</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>HIS</td>
<td>Hospital information system</td>
<td></td>
</tr>
<tr>
<td>HIV</td>
<td>Hospital Information Environment</td>
<td></td>
</tr>
<tr>
<td>DDL</td>
<td>Data Definition Language</td>
<td></td>
</tr>
<tr>
<td>RAD</td>
<td>Rapid Application Development</td>
<td></td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
<td></td>
</tr>
<tr>
<td>VB</td>
<td>Visual Basic</td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td>Data Base</td>
<td></td>
</tr>
<tr>
<td>DML</td>
<td>Data Manipulation Language</td>
<td></td>
</tr>
<tr>
<td>NW</td>
<td>Network</td>
<td></td>
</tr>
</tbody>
</table>
Abstract

In the last few years, society have witnessed the installation of an ever increasing number of telecommunication base stations as a necessity for handling new capabilities and services to the large number of users.

Exposure levels in areas accessible to the public in the vicinity of base stations are varying by several orders of magnitudes. This is likely due to differences in the input power of the antenna, different types of antennas, variation of location of the measuring position in respect to the antenna and different environmental or shadowing factors.

This project aims to measure the power density of the radiation from telecommunication base stations at Khartoum state -this was accomplished by coordinating with the National Telecommunication Corporation (NTC) - and then analyze these measurements statistically in order to describe the behaviour of the power density according to the change of distance from the antenna and the change of the antenna height.

The measurements were taken using RF EMF strength meter, which is a broadband device for monitoring high-frequency radiation in the range of 10MHz to 8GHz.
المستخلص

في السنوات القليلة الماضية، شهد المجتمع الترتيب بعدد متزايد من محطات الاتصالات اللاسلكية، وذلك في سبيل توفير الخدمات لعدد كبير من المستخدمين.

أثرت التعرض في المناطق التي يمكن وصول الجمهور إليها في المنطقة المجاورة لمحطات التغذية المتداولة بصورة كبيرة. السبب في هذا التباين هو: وجود اختلاف في مدخلات الطاقة إلى الهوائي، باستخدام أنواع مختلفة من الهوائيات، التباين في مواقع إخذ القياسات بالنسبة للهوائي بالإضافة إلى العوامل البيئية المختلفة.

هذا المشروع يهدف إلى قياس كثافة القدرة من إشعاع محطات الاتصالات اللاسلكية في ولاية الخرطوم. تم إنتاج المشروع من خلال التنسيق مع الهيئة العامة للاتصالات، ومن ثم تحليل هذه القياسات إحصائياً في سبيل وصف اسلوك كثافة القدرة وفقاً لتعزيز البدع عن الهوائي وتغيير ارتفاع الهوائي.

أخذت القياسات باستخدام جهاز قياس كثافة الموجات الكهرومغناطيسية، وهو جهاز يوازي الموجات لرصد الإشعاعات عالية التردد في نطاق 10 MHz إلى 8 GHz.
1-1 Overview

Both hospitals and hospital patients are bearing a massive cost as a result of the occurrence of medication prescribing errors in the public health system. In this paper suggested that poor information systems may be a contributing factor in the occurrence of these errors. We research this issue in an HIV ward of a large public hospital through interviews and a survey instruments. It had been found that in a significant number of instances prescribing errors are linked to situations where information is unavailable or inaccessible. This link, between problems in information delivery and prescribing errors, is a link whose extent has not been measured previously. It is, however, a link which exposes all stakeholders in the hospital system, the patient, the clinicians, the hospital departments, and medications to possible loss and damage and indicates a need for the implementation of more effective systems in this area. From this point hospital information system (HIS) had been occurred as a solution to paper based hospitals that improves the management decision making, by providing accurate and up-to-date information about the key aspects of organizational performance.

1-2 Thesis Layouts

Chapter two gave a brief idea about data and its management throughout all its cycle inside the hospital environment, and then in the next section it had been discussed facts collecting and its categories. Next it gave a definition of the servers and software requirements that had been used within the HIS construction. Then chapter three came to discuss the core of the project by taking methodologies & tools, data security and testing & verification as a topics for discussion.

When the HIS tested it gave the desired result, by interring random data it worked in a good and as expected. By Debugging the code that is attached at the end of this project allowed us to verify the model. The system
accepted data when it passed for it as a testing data and saved is as it is by assigning it to the compatible table. Also the system had the ability to search data and get it from the DB environment that had been constructed. Later in chapter four it had monitored the output of the whole system and gave a discussion of the results that obtained after testing the code. Finally chapter five gave the summary of all work done and what results had been expected and future work that can improve the system if added.

1-3 Project dataflow
2-1 BRIEF IDEA

Data is the raw material that gives information after being analyzed. Information is a meaningful collection of facts/data. Knowledge when information is communicated it becomes knowledge.

Data $\rightarrow$ Information $\rightarrow$ Knowledge

Data after being changed to information is highly essential for the effective management of any organization. Information on the delivered service, on the available resource and on the problems encountered is vitally important in monitoring the progress of the organization and in planning future action. In the same way, at the health sector is as discussed in this project, the availability of information is essential for:

- Determining the continuing and future care of a patient at all levels of healthcare.
- The evaluation and monitoring of the health service.

In Sudan, hospitals need to be completely changing their system. Because it is a developing country it must attach this system to all of its on-going hospitals constructing plans so as to develop and improve the overall health care.

This will give the reason to create a robust electronic records system that streamlines hospital workflow, increases staff productivity, and helps the hospital improve patient care. Digital medical histories help us evaluate and increase the effectiveness of treatment, plus we have decreased the number of hour’s hospital doctors spend on paperwork. Knowing that paper based hospitals suffers a lot of mess specially in the patient records, many records in the archive is not necessary and it had been kept for more than 20 years as an example also it may contain records for died people. It also slows down patient processing and complicates the management of patient histories. Additionally, the hospital is unable to produce reports of medications or expendable medical materials used by each patient.
From this point the importance of the HIS accrued so that to solve the paper based hospital’s problems.

Hospital management was well aware of technological advances in modern hospital record keeping, so they began looking for an electronic records system that could provide the following functionality:

- Digital medical histories, with personalized summary of each patient’s treatment costs
- Automated medical reports creation
- Measurements of the effectiveness of treatment, based on patient indices

The aim is to solve the paper based hospital information problems, that is:

- Slowness of records flow throughout all patient cycle in the hospital.
- The ability of patient’s record to be lost.
- The ability of the patient’s report to be lost.
- Time consuming in writing the diagnostic reports.
- The ability to misidentifying which record is assigned to a desired patient.
- The ability to swap the health history or diagnostic report papers between more than one patients record.
- Fire flames, burglars and phenomenon disasters may occur and destroy the whole archive.

**2-2 Facts Finding**

Note that in the HIS there is a pack up for the whole system that is kept outside the hospital environment to ensure availability and reliability of the system. In this section the outlines of gathering data is discussed and illustrated in the following points,

**2-2-1 Information collection:**

Collecting information split into two categories according to the main departments of the hospital needs.
i. **Category one**

It is the date that had been collected, it is about the departments that contained in the hospital environment, leaded to collect of each of the following:

- **Registration data:**

  Helps in registering information about patients. A unique ID is generated for each patient after registration. This helps in implementing customer relationship management and also maintains medical history of the patient.

- **Pharmacy data:**

  Deals with all medical items. This module helps in maintaining Item Master, Receipt of Drugs/consumables, issue, handling of material return, generating retail bills, stock maintenance.

- **Phlebotomy data:**

  Caters in maintaining test requisitions, sample collection status and various procedures for collection of sample for the tests prescribed.

- **Ward management data:**

  It deals with the maintenance of the wards, inter- and intra-ward transfers.
  
  - Room Transfer
  
  - Doctors Recording
  
  - Doctors information records.
  
  - Other Services
  
  - Diagnostic records.

ii. **Category two:**

Collecting information about what software environment that will be used:

a. **SQL:**

Uses a structured collection of records or data that is stored in a computer system. The structure is achieved by organizing the data according to a database
model. The model that is most commonly used today is the relational model. Other models such as the hierarchical model and the network model use a more explicit representation of relationships.

A relational database is a database that groups data using common attributes found in the data set. The resulting "clumps" of organized data are much easier for people to understand. Figure (2-1) showed an example of relational database scheme.

Figure (2-1) shows 1 to 1 relationship

It was originally defined and coined by Edgar Codd at IBM Almaden Research Center in 1970. Figure (2-2) shows the terminology of the relational database scheme.

Figure(2-2) terminology of relational DB
Relational database theory uses a set of mathematical terms, which are roughly equivalent to SQL database terminology. The table below summarizes some of the most important relational database terms and their SQL database equivalent. Table (2-1) explains the difference of naming in two methods that we are comparing.

Table (2-1) difference of naming in database relational scheme and SQL terminology.

<table>
<thead>
<tr>
<th>Relational term</th>
<th>SQL equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>relation, base relvar</td>
<td>table</td>
</tr>
<tr>
<td>derived relvar</td>
<td>view, query result, result set</td>
</tr>
<tr>
<td>Tuple</td>
<td>row</td>
</tr>
<tr>
<td>Attribute</td>
<td>column</td>
</tr>
</tbody>
</table>

SQL uses two types of languages here is a detailed idea about each:

i. **Data Manipulation**

First, there are the standard Data Manipulation Language (DML) elements. DML is the subset of the language used to add, update and delete data:

- INSERT is used to add rows (formally tuples) to an existing table,

Example (2-1):

```sql
INSERT INTO My_table (field1, field2, field3) VALUES
```
• UPDATE is used to modify the values of a set of existing table,

Example (2-2):

UPDATE My_table
SET field1 = 'updated value'
WHERE field2 = 'N';

• DELETE removes zero or more existing rows from a table,

Example (2-3):

DELETE FROM My_table
WHERE field2 = 'N';

• MERGE is used to combine the data of multiple tables. It is something of a combination of the INSERT and UPDATE elements.

ii. Data Definition

The second group of keywords is the Data Definition Language (DDL). DDL allows the user to define new tables and associated elements. Most commercial SQL databases have proprietary extensions in their DDL, which allow control over nonstandard features of the database system. The most basic items of DDL are the CREATE, ALTER, RENAME, TRUNCATE and DROP statements:

• CREATE causes an object (a table, for example) to be created within the database.
• DROP causes an existing object within the database to be deleted, usually irretrievably.
• TRUNCATE deletes all data from a table in a very fast way. It usually implies a subsequent COMMIT operation.
ALTER statement permits the user to modify an existing object in various ways—for example, adding a column to an existing table.

Example (2-4):

CREATE TABLE My_table

(

my_field1 INT,

my_field2 VARCHAR(50),

my_field3 DATE NOT NULL,

PRIMARY KEY (my_field1, my_field2)

);

b. Visual Basic:

VB is also considered a relatively easy to learn and use programming language, because of its graphical development features and BASIC heritage.\[^2\]

The Microsoft .NET Framework is a software framework that can be installed on computers running Microsoft Windows operating systems. It includes a large library of coded solutions to common programming problems and a virtual machine that manages the execution of programs written specifically for the framework. It includes a large library, .NET Framework is a software framework that can be installed on computers running Microsoft Windows operating systems of coded solutions to common programming problems and a virtual machine that manages the execution of programs written specifically for the framework. The NET Framework is a key Microsoft offering and is intended to be used by most new applications created for the Windows platform. The framework's Base Class Library provides a large range of features including user interface, data and data access, database connectivity, cryptography, web application development, numeric
algorithms, and communications. The class library is used by programmers, who combine it with their own code to produce applications.

The framework's Base Class Library provides a large range of features including user interface, data and data access, database connectivity, cryptography, web application development, numeric algorithms, and communications. The class library is used by programmers, who combine it with their own code to produce applications. Programs written for the .NET framework execute in a software environment that manages the program's runtime requirements. Also part of the .NET Framework.

![figure(2-3) shows the layout of the .NET application](image)

Visual Basic was derived from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using Data Access Objects, Remote Data Objects, or ActiveX Data Objects, and creation of ActiveX controls and objects. Scripting languages such as
VBA and VBScript are syntactically similar to Visual Basic, but perform differently. [3]

A programmer can put together an application using the components provided with Visual Basic itself. Programs written in Visual Basic can also use the Windows API, but doing so requires external function declarations. The final release was version 6 in 1998. Microsoft's extended support ended in March 2008 and the designated successor was Visual Basic .NET (now known simply as Visual Basic). Like the BASIC programming language, Visual Basic was designed to be easy to learn and use. The language not only allows programmers to create simple GUI applications, but can also develop complex applications.

Programming in VB is a combination of visually arranging components or controls on a form, specifying attributes and actions of those components, and writing additional lines of code for more functionality. Since default attributes and actions are defined for the components, a simple program can be created without the programmer having to write many lines of code.

A Visual basic had been used instead of C language because of the following characteristics:

- Multiple assignments available in C language are not possible.
- Logical and bitwise operators are unified. This is unlike some C-derived languages, which have separate logical and bitwise operators.
- Relatively strong integration with the Windows operating system.
- Integers are automatically promoted to real in expressions involving the normal division operator (/) so that division of an odd integer by an even integer produces the intuitively correct result.
- By default, if a variable has not been declared or if no type declaration character is specified, the variable is of type Variant.
2-3 Development & Future of Hospital Information Systems

Early hospital computer systems developed from business computing systems in the late 1950s and early 1960s, and were used for accounting, billing, inventory and similar business-related functions. Others were developed during the 1960s primarily for storing patient information to be used by medical staff.

These types of systems have been slow to integrate. Surveys of hospitals since 1980 have shown that less than half of community hospitals have full HISs, mainly because few were available to integrate all the functions needed.

Information kept in the system is:

- Basic patient, employee and doctor information.
- Diagnostic information.
- Medication data.
- Emergency section reports.
- Testing notes.
- Discharge plans.

The Divisions of HIS are:

- Reception.
- Pharmacy.
- Administration.
- Laboratory & radiology.

Note that HIS come in many ways, depending on whether they are based on...

- centralized or decentralized plans
- software that was originally business-oriented or patient-oriented
- terminals or workstations
In this project terminals or workstations had been used as the plan of work. Terminals are electronic devices that connected with the HIS communication network except computers. Workstations are computers designed for professional use by one person at a time. They are fully functional computers on their own. The term workstation can refer to any personal computer, but is often applied to especially powerful microcomputers.

![Diagram](image.png)

Figure (2-3) Workstation oriented with centralized patient records.

From the perspective of the medical caregiver, Hospital Information Systems are tools for storing and retrieving patient information.

2-4 Advantages of Hospital Information Systems

- Increased time nurses spend with patients and decrease information access time.
- Improved quality of documentation and patient care.
- Improved communications.
- Reduced errors of omission.
- Reduced medication errors.
- Reduced hospital costs.
- Increased nurse job satisfaction.
- Development of a common clinical database.
- Improved patient's perception of care.
- Enhanced ability to track patient's record.
- Enhanced ability to recruit and retain staff.
- Improved hospital image.
3-1 Methodology and tools

Steps that are used to construct the design will be shown as follow:

- Make an advantage of data that had been collected as much as possible so as to create the main database (tables) for the HIS environment. This had been discussed in section 3-1-1.
- Use Visual Basic (VB) .NET so as to create a graphical interface as explained in section 3-2.
- ADO .NET had been used so as to create an access to the DB which is in the hard disk from the VB application that deals only with the memory. And this had been discussed in detail in section 3-3.
- DB security: it must be included to the design of HIS, it had been discussed in section 3-4

3-1-1 DB Creating/Main Tables scheme

This section discussed the methodology of creating maintaining manipulating and modifying DB. Creating DB methods refers to which kind of server is used, there is a previous idea about what kind of schemes had been used. Creating this database will be by using the SQL server 2000 that had been met the project needs that is concerned with data availability, consistency, integrity and availability and the most important is the security issue.

Talking about DB creating is the same as a fully description for the main tables that had been used in saving data and it will be described as follows:

The first and most important table is the table that contains all usernames and passwords that allow the user to get into the HIS. Table (3-1) cannot be modified or accessed for anyone but the authorized person, most probably will be the HIS manager.

Table (3-1) shows interface passwords

<table>
<thead>
<tr>
<th>User name</th>
<th>Password</th>
</tr>
</thead>
</table>

15
Table (3-2) explains what necessary information about the patient that should be kept in the database tables. It has a primary key that is the patient ID that is assigned by the hospital for each patient. It identifies the patient uniquely throughout the whole HIS. Primary key will be explained as bold underlined phrase or word.

Table (3-2) shows patient information table.

<table>
<thead>
<tr>
<th>Patient ID</th>
<th>Patient name</th>
<th>Address</th>
<th>Phone number</th>
<th>Present occupation</th>
<th>Employer</th>
<th>Age</th>
<th>Sex</th>
<th>Marital status</th>
<th>Diagnostic report</th>
<th>Doctor’s name</th>
<th>Health history</th>
</tr>
</thead>
</table>

After a patient table had been constructed a doctor information table had been created so as to keep the important information of the doctor, which allows the hospital to contact doctors directly in emergency cases. This table contains doctors ID as its primary key, this key is also given by the hospital’s it manager as it seen in table (3-3).

Table (3-3) shows doctor information.

<table>
<thead>
<tr>
<th>ID number</th>
<th>Name</th>
<th>Visit number</th>
<th>Specialization</th>
<th>Sickbay fees</th>
</tr>
</thead>
</table>

There are also many important tables involved in the DB environment. According to data collected, table (3-4) played the role of the testing table that contains all information held by the test with its primary key test number/test ID.

Table (3-4) shows test information.

<table>
<thead>
<tr>
<th>Test ID number</th>
<th>Test name</th>
<th>Price</th>
<th>Duration</th>
<th>Sample</th>
<th>Test type</th>
</tr>
</thead>
</table>

Now we had table (3-5) built so as to cover the drug region given its all data related to any inserted drug to the pharmacy. It’s used to simplify and less time consuming in searching a specific drug’s availability and also to add new types as much as the pharmacy expand.
The primary key is the drug number/drug ID, knowing that the benefit of the primary key is that to connect its table to other tables using it as a link, it can be a foreign key in other tables that it had been connected to.

Table (3-5) shows drug information.

<table>
<thead>
<tr>
<th>Drug #</th>
<th>Drug name</th>
<th>Price</th>
<th>Availability</th>
</tr>
</thead>
</table>

Also we had an important table which is related to the patient information but it’s better to be kept individual from the patient table, table (3-6) is the diagnostic table which describes the diagnostic report that had been written by doctors. Primary key can be the visit number; since the visit number increases by one each time a patient occurs at the hospital.

Table (3-6) shows diagnostic report.

<table>
<thead>
<tr>
<th>Doctors name</th>
<th>Patient name</th>
<th>Visit number</th>
<th>Diagnostic Report</th>
</tr>
</thead>
</table>

Table (3-7) described that testing report for each patient that assigned to the laboratory to do some tests, this table had the visit number as its primary number with the test number and test report, test report is written by specialist people giving all necessary information about the test on it.

Table (3-7) shows test results.

<table>
<thead>
<tr>
<th>Test number</th>
<th>Test result</th>
<th>Visit number</th>
</tr>
</thead>
</table>

Finally we had the rooms availability table, this table is one of the most important tables in the HIS environment because it allow the reception to check the room availability for a certain patient. Table (3-8) goes under this description; it contained the number room as its primary key and room availability.
domain/column and it accepts only Boolean value (Y/N) to see if it’s available or not and if its occupied will save the patient that is using it.

<table>
<thead>
<tr>
<th>Room number</th>
<th>Availability</th>
<th>Patient name</th>
</tr>
</thead>
</table>

Table (3-8) shows the room availability.

**3-1-2 Interface Crating/Virtual tables scheme**

An interface creation that is supported by the VB had a direct relationship to the DB main tables mentioned above. Need to create an interface means need to access to the related tables to that interface this will be discussed in this section in aid of diagrams to simplify understanding of this technique. The discussion will be generalized to HIS entire interface environment except for the welcome screen for each department i.e. all virtual tables will be concerned with DB tables except for the welcome screen saver.

Figure (3-1) shows the username and password entering to allow the access to the HIS that related to the reception department. It will compare the combination of the set that had been passed to it with each combination in table (3-1) above so as to ensure system security.

Figure (3-1) shows the password and user name interface.

Figure (3-2) shows the first interface that displays the patient information needed to be registers at the hospital. If the patient is already registered the information concerned with it will be directly appears in the screen, else it saves the
patient data according to table (3-2), then the result can be sent to the sickbay if needed or to the laboratory. Also this interface allows us to search for a patient.

<table>
<thead>
<tr>
<th>اسم</th>
<th>الرقم</th>
</tr>
</thead>
<tbody>
<tr>
<td>التواصل</td>
<td>العنوان</td>
</tr>
<tr>
<td>مكان العمل</td>
<td>المهنة</td>
</tr>
<tr>
<td>الحالة</td>
<td>الجنس</td>
</tr>
</tbody>
</table>

Patient table | patient ID

Figure (3-2) reception interface connected to the patient table by its primary key.

Figure (3-3) shows the tests list specified by the doctor for a patient, it is a combination of the patient name and the necessary tests that he must take. Passing only the visit number, automatically fills in patient’s name from table (3-2) the test number spaces from table (3-7) if there is a test list, it will directly passed through the test number field bringing all its information from table (3-5). The result of this interface is sent to the laboratory by saving it in table (3-7), or even gets the testing results from this table if the visit number is already in the table.

<table>
<thead>
<tr>
<th>المجموع</th>
<th>اسم الفحص</th>
<th>تعداد الفحص</th>
<th>رقم الفحص</th>
<th>اسم الفحص</th>
<th>تعداد الفحص</th>
<th>رقم الفحص</th>
<th>اسم الفحص</th>
<th>تعداد الفحص</th>
<th>رقم الفحص</th>
</tr>
</thead>
<tbody>
<tr>
<td>المجموع</td>
<td>اسم الفحص</td>
<td>تعداد الفحص</td>
<td>رقم الفحص</td>
<td>اسم الفحص</td>
<td>تعداد الفحص</td>
<td>رقم الفحص</td>
<td>اسم الفحص</td>
<td>تعداد الفحص</td>
<td>رقم الفحص</td>
</tr>
</tbody>
</table>

Patient name | Test ID | Visit Number

Test ID number | Test name | Price | Duration | Sample | Test type

Figure (3-3) shows the laboratory interface to tests must done.
Figure (3-4) shows the waiting list of patients and the visit number that will be automatically inserted from the system and the doctor information with a field for writing the report. We used the patient table to get its information and table (3-3) to get the doctors information and save the result (patient report) in table (3-6) as a reference if needed. This result can saved in table (3-6) or print it.

<table>
<thead>
<tr>
<th>تشخيص</th>
<th>التاريخ</th>
<th>الاسم</th>
<th>الرقم</th>
<th>اسم الطبيب</th>
<th>رقم الزيارة</th>
<th>الانتظار</th>
<th>المرضى</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Visit number</th>
<th>Diagnostic Report</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Doctors name</th>
<th>Patient name</th>
<th>Visit number</th>
<th>Diagnostic Report</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ID number</th>
<th>Name</th>
<th>Visit number</th>
<th>Specialization</th>
<th>Sickbay fees</th>
</tr>
</thead>
</table>

Figure (3-4) shows the doctor interface for diagnostic reports.

Figure (3-5) shows how to get or set (save) the tests results associated with the patient in table (3-7), if the patient is already registered his information will be immediately appeared when passing the visit name.

<table>
<thead>
<tr>
<th>رقم الزيارة</th>
<th>الاسم</th>
<th>الفحوصات</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Test number</th>
<th>Test result</th>
<th>Visit number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Doctors name</th>
<th>Patient name</th>
<th>Visit number</th>
<th>Diagnostic Report</th>
</tr>
</thead>
</table>

Figure (3-5) shows the list of desired tests.
Figure (3-6) shows the prescription associated with each patient, this table lists all drug names that had been wrote by the doctor. This table contains the patient name, drug name, price and the summation of all drug prices so as to get the bill.

<table>
<thead>
<tr>
<th>رقم المريض</th>
<th>الجهة</th>
<th>الفاتورة</th>
<th>تاريخ الفاتورة</th>
<th>الكمية</th>
<th>سعر الفاتورة</th>
<th>المجموع</th>
</tr>
</thead>
</table>

**Patient table**

| Drug # | Drug name | Price | Availability |

Figure (3-6) shows the prescription interface.

Figure (3-7) shows the details addition, modification and even adding a new test to table (3-7) by pressing button related to each event mentioned. This is when expanding the laboratory.

| الرمز | الآمن | المجموع | السعر |

**Test table**

| Test ID number | Test name | Price | Duration | Sample | Test type |

Figure (3-7) shows laboratory interface for adding new test.

Figure (3-8) shows how to register an emergency patient. It saves the patient information normally as shown in table (3-2) and register him as an emergency patient by pressing the button associated by this event, it achieved by passing value one or zero two the patent’s information table in the value domain.
3-2 VB/ .NET

In this project Visual Basic used is .NET 2005. This Framework is included with Windows Server 2008 and Windows Vista. The current version of the framework can also be installed on Windows XP and the Windows Server 2003 family of operating system. [3]

3-3 ADO .NET

It’s a set of computer software components that can be used by programmers to access data and data services. It is a part of the base class library that is included with it is commonly used by programmers to access and modify data stored in relational database systems, though it can also be used to access data in non-relational sources. ADO .NET is sometimes considered an evolution of ActiveX Data Objects (ADO) technology, but was changed so extensively that it can be considered an entirely new product.
3-3-1 Architecture:

ADO .NET consists of two primary parts:

i. **Data provider**

These classes provide access to a data source, such as a Microsoft SQL Server. Each data source has its own set of provider objects, but they each have a common set of utility classes:

- **Connection**: Provides a connection used to communicate with the data source. Also acts as an abstract factory for command objects.
- **Command**: Used to perform some action on the data source, such as reading, updating, or deleting relational data.
- **Parameter**: Describes a single parameter to a command. A common example is a parameter to a stored procedure.
- **Data Adapter**: A bridge used to transfer data between a Data source and a Dataset object.
- **Data Reader**: Used to efficiently process a large list of results one record at a time. It allows records to be accessed in a read-only, forward-only mode, i.e., records have to be accessed in sequential order; they can neither be randomly accessed nor can a record which has been processed previously be accessed again.

ii. **Data set**

Data Set objects, a group of classes describing a simple in-memory relational database. The classes form a containment hierarchy:

- A Data Set object represents a schema (either an entire database or a subset of one). It can contain tables and relationships between those tables.
- A Data Table object represents a single table in the database. It has a name, rows, and columns.
- A Data Column represents a column of the table, including its name and type.
• A Data Row object represents a single row in the table, and allows reading and updating of the values in that row, as well as retrieving rows that are related to it through a primary-key foreign-key relationship.

• A Data Relation is a relationship between tables, such as a primary-key foreign-key relationship. This is useful for enabling Data Row's functionality of retrieving related.

• A Constraint describes an enforced property of the database, such as the uniqueness of the values in a primary key column.

3-3-2 ADO .NET and Visual Studio .NET

Functionality exists in the Visual Studio .NET IDE to create specialized subclasses of the Data Set classes for a particular database schema, allowing convenient access to each field through strongly-typed properties.

3-4 Data security

Database security denotes the system, processes, and procedures that protect a DB from unintended activity. Security is usually enforced through access control, auditing, and encryption.

• Access control ensures and restricts who can connect and what can be done to the DB.

• Auditing logs what action or change has been performed, when and by whom.

• Encryption: Since security has become a major issue in recent years, many commercial database vendors provide built-in encryption mechanisms. Data is encoded natively into the tables and deciphered when a query comes in.

3-5 Testing and Verification

Testing is illustrated by passing data to the system’s DB and gets the response of it; many of data had been passed to the built tables and the results are to save it had been achieved. Saving values by data insertion with respect to the DB restriction;
allowed the system to modify, manipulate and updates the HIS as fast as possible as it appeared.
4-1 Introduction

By the mean time the reader had a full idea of the project structure advantages of HIS, why this project is had been chosen by the designer and what goal is about to achieved. It’s not

This chapter discussed the project output and how it can be tested; section-2 described implementation and represents results that obtained. Section 4-3 described result discussion and interpolation.

4-2 Implementation, Testing & results obtained

This topic discussed running to the verification plan as it built. When the software debugged in the computer the output that appeared will be as shown in figure (4-1). This figure is the password and username box, when passing these two values will connect it to the DB table that contains the password and username and makes a comparison between them to insure security of the HIS. Password appears as encrypted characters i.e. ****.

Figure (4-1) the password fields’ interface.

When authentication is done, if the password and username combination matches one of the DB table combinations the output will be illustrated in figure (4-2). Also changing password continuously is needed for more security, figure (4-3) shows the interface for doing this changes. As the hospital environment expanded
with time the HIS needed to expand so as to achieve the compatibility issue i.e. to add a new department’s interface. As a new interface is added there must be a new password and username for it and that is illustrated in figure (4-4).

Figure (4-2) shows DB manager interface for adding a new user.
Figure (4-3) shows password changing interface.

Figure (4-4) the main iteration for all interfaces.
When the first button is clicked, the output shape was as shown in figure (4-5) this interface allows the receptionist to register patient’s information by passing its data through the associated fields in the interface.

There are two options after registering the patient information, it can be sent to the laboratory interface shown in figure (4-6) to do tests needed, after the results appeared it can be saved in figure (4-8), or to the doctor’s waiting list as shown in figure (4-7) that it can be save the diagnostic report or just print it. After pressing the button associated with save then send it to the desired destination. After that a button that associated with search is pressed and gave the information related to the patient. After that the test identification button is pressed so as to save it in the patient history.

As shown in figure (4-9) when a new test types had been added to the laboratory its values saved immediately in the DB table associated with the tests data. The user interface that had been shown in figure (4-10) is used to add new details to test table.
Figure (4-5) shows patient registration with all events related to it.

Figure (4-6) shows the desired tests list.
Figure (4-7) shows the doctors interface with diagnostic reports.

Figure (4-8) shows the laboratory interface for needed tests.
Figure (4-9) shows laboratory interface so as to add new test.

Figure (4-10) shows interface to add a new details to the test information.
Figure (4-11) shows registering patient that will be assigned to room.

Figure (4-12) gets the number of rooms within the hospital. It can be added new rooms according to the expansions of the hospital by time; this is achieved by pressing a specified button that adds a new row to the rooms’ availability table.

Figure (4-12) interface for rooms’ expansion.
Figure (4-13) checks the list of room availability by getting all rooms that have a value Y from table (3-8) to the reception so as to accept the patient as sooner as possible, also allow discharging and reserving information according to the button pressed by the receptionist. Pressing discharge will change row of room availability in table (3-8) to Y according that is associated with patient name that had been entered in the name domain, and reservation will change row associated with the room number desired to N.

As mentioned before as a hospital expanded HIS must be expanded yield to pharmacy expansion. Figure (4-15) showed when interface that accessed by the pharmacist that had the authorities to modify the drug table, it achieved by adding a new drug to the available list or modify the amount available in the pharmacy by modifying or subtracting from the old one and then save the result of the operation. Finally, figure (4-16) shows the prescription details that associated with the patient that’s represents the main pharmacy interface table i.e. the main pharmacist interface.

Figure (4-13) interface for rooms’ availability.
Figure (4-14) shows interface for modifying the drug table.

Figure (4-15) shows the pharmacy interface associate with prescription.
Figure (4-16) shows reception interface associated with patent’s information search.

4-3 Results Discussion and Interpolation

The results that appeared satisfied the HIS requirements, data that passed to the HIS had been successfully registered in the DB tables so as to make an advantage of it for interface that is created according to the needs of this interface. Results that achieved had satisfied about 70% of the project objectives.
5-1 Discussion and Conclusion

The output of this project had matched the desired output as in the HIS creating plan, there is no late in data setting and getting yield to less time consuming in saving or searching for any information within the system. Also there is no limits for number of cases that should be saved in the DB of the system yield to system reliability, as this system contains password and username that means the HIS is secured. By creating a pack up to the system an outside computer this will insure that the system supports disaster recovery that leads to a reliable system.

This project acts as an important topic that must be under the government consideration for the health improvement plan, because hospital in Sudan is in totally mess and unorganized, so the HISs must be attached to all the hospitals as to get rid of the paper passed information systems that its disadvantages reflected in the health environment in the country.

5-2 Future Work

It’s recommended to continue in this project so as to add more details that concerned with the financial issues such as connecting the finance department to the HIS. Also the network that the system was attached to it can be connected to the internet to insure communication and data exchange with international hospital or doctors. It can also be added an ambulance department so as to facilitate patients transport.