بسم الله الرحمن الرحيم

Sudan University of Science

and Technology

College of Graduate Studies

Computerized Central Blood Bank Management System

(CCBBMS)

نظام حاسوبي لإدارة بنك الدم المركزي

A Thesis Submitted in partial fulfillment for the Requirement of M.Sc Degree in Biomedical Engineering

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بسم الله الرحمن الرحيم

قـــال تعـــالى :(ومــنْأحيـــاها فكــأنمـا أحيـــا النَـــاس جميـــعا")

الاية (32) سورة المائدة

Dedication

To a strong and gentle soul who taught me to trust in Allah, believe in hard work and that so much could be done with little, my Mother. To my first teacher, guidance, promotion, who teach me to trust on myself, my Father, 'Mom & Dad, you are the reason for the person I have become today'. To those whose love flows in my veins and heart, my brother and sisters specially 'Sarah'. To my dear aunt 'Dr. Khadiga' for being my guardian during my educational career, To my friends who wave my life with strings of love and happiness. To my dear uncle Adeel El Amen.

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Abstract

Blood is a vital constituent in human body that is indispensable for human life, it supplies nutrient and oxygen to all body cells, because of this essential role, blood bank was introduce in this research to help in collecting, separating and storing blood by using computerized information system to organized and maintain information about donors, and blood groups.

Manual systems as compared to computerized systems are time consuming and costly, in addition to human errors.

A computerized central blood bank management system was developed to assist in managing donor records, monitoring blood screening and storing, moreover provide secure medical reports to improve medical service delivery.

The system was designed and implemented as web-based using MySQL data base , PHP programming languages and bar-code technique.

The outcome was obtained as screens that made the recording process of donor's data and blood easer so as to ensure the efficiency of transfusion process.

The system was tested in the National Blood Transfusion Center NBTC of Khartoum-Sudan, it contributed to solve errors of manual system, time-consuming and retrieve data, as well as met users' acceptance.

المستخلص

يمثل الدم اهم مكون حيوي في جسم الانسان الذي لاغنى عنه للحياة ، حيث يقوم بنقل المواد الغذائية والاكسجين لكل خلايا الجسم ، ونسبة لهذا الدور الاساسي فقد تم ذكر بنك الدم الذي يلعب دور مهم في المساعدة في جمع وتخزين فصائل الدم المختلفة التي يتم نقلها للمرضى في حالات الطوارئ.

ونسبة لقصور الانظمة التي تعتمد في ادائها على نظام السجل الورقي الذي يؤدي الى زيادة الزمن اللازم لاداء المهام وزيادة التكلفة المادية والايدي العاملة ، فقد تم تطوير نظام حاسوب يساعد في ادارة معلومات المتبرع وخطوات فحص فصائل الدم ومراقبة طرق تخزينها المثلى ، كما يساعد هذا النظام على على حفظ سرية التقارير الطبية وتحسين اداء الخدمات الطبية.

تم تصميم هذا النظام باستخدام لغة PHP للبرمجة ، كما تم استخدام my SQL لبناء قاعدة البيانات و نظام ال Bar-code كتقنية حديثة في النظام .

النتائج المتحصل عليها جاءت في شكل نوافذ سهلت عملية تسجيل بيانات المتبرع ، نتائج اختبار الدم، كما انها ساعدت في ضمان وصوله للمستفيد (المريض).

تم تجريب البرنامج في بنك الدم المركزي واعطى نتيجة مقبولة في حل مشكلة نظام السجل الورقي بحيث تم حل مشكلة الاخطاء الناتجة عن تسجيل البيانات يدويا ، كما تم تقليل الزمن اللازم لادخال البيانات وكتابة التقارير واسترجاع المعلومات ، اضافه الى ان البرنامج قد حقق نتيجة جيدة في رضاء المستخدمين.

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Abbreviations

AIDS	Acquired Immunodeficiency Syndrome
BBMS	Computerized blood bank management system
BC	Buffy coat
BTS	Blood Transfusion Service
CD	Computer Desk
CPU	Central Processing Unit
Cryo.p	Cryo precipitate
ELISA	Enzyme Linked Immuno-Assay
GB	Gaga Byte
HBsAg	Hepatitis B
HCV	Hepatitis C
HIV	Human Immunodeficiency Virus
HTML	Hyper-Text Markup Language
IAT	Implicit Association Test
ICTC	Integrated Counselling and Testing Centre
IICD	International Iinstitution for Communication and Development
IJERA	International Journal of Engineering Researcher and Application
IP	Internet Protocol
MBBS	Bachelor of medicine ,bachelor of surgery
MIS	management information system
MOH	Ministry Of Health
MySQL	My Structured Query Language
NBTC	National Blood Transfusion Center
PC	Package Cell
PCV	packed cell volume
PHP	Hypertext Preprocessor
PLT	Platelet
PRP	platelet rich plasma
QR	Quick response
RAM	Random Access Memory
RBCs	Red blood cells
RH	Rhesus
ROM	Read Only Memory
RPR	Rapid Plasma Reagin
SIBAS	SistemaIntegrado de BAncosdeSangue
TCP	Transmission Control Protocol
TPHA	TreponemaPallidumHemagglutination
TTI	transfusion-transmissible infectious
URI	Uniform Resource Identifier
URLs	Uniform Resource Locator
URTI	Upper Respiratory Tract Infections
VDRL	Venereal Disease Research Laboratory
WBCs	White blood cells
WHO	World Health Organization
ZNBTS	Zambia Blood Transfusion Service

Chapter One

Introduction

Chapter One

Introduction

1.1 Introduction

The requirement for the blood is an important factor in contemporary medicine and healthcare. For every second there will have an individual who needs blood to save life.

Blood transfusion is a life–saving intervention that has an essential role in the total patient management within health care systems. The provision of safe and efficacious blood and blood components involves a number of steps, from the selection of blood donors, appropriate blood collection procedure, processing and testing of blood units, compatibility tests on the patient's sample, issue and its administration to the patient, often termed as 'transfusion chain'. There is a risk of error in each step in this "transfusion chain" that can have serious implications to the recipients of blood and blood products, particularly the transmission of blood borne infections.[1]

The primary responsibility of a Blood Transfusion Service (BTS) is to provide a safe, sufficient and timely supply of blood and blood products. In fulfilling this responsibility, the BTS should ensure that the act of blood donation is safe and causes no harm to the donor. It should build and maintain a pool of safe, voluntary non-remunerated blood donors and take all necessary steps to ensure that the products derived from donated blood are efficacious for the recipient, with a minimal risk of any infection that could be transmitted through transfusion. [2]

The screening of all donated blood for transfusion-transmissible infectious TTI agents prior to release for clinical use is a fundamental activity for any blood transfusion service. The development of a reliable and effective blood screening component of the blood transfusion service is therefore a key strategy for the provision of safe blood supply.[1]

Management of blood and blood transfusion services in Khartoum is carried out by the National Blood Transfusion Center NBTC at the Khartoum, which processes blood and then distributes it to hospitals located all over the Khartoum. Although each hospital

maintains its own records, there does not exist a central location from which records from the various banks can be accessed.

A situation is frequently encountered where some hospitals have more demand than they can satisfy which means there are no synchronized records of blood availability in Khartoum at any given point in time and the procedure of undergoing blood transfusion in Khartoum is not an easy one since most patients have to source for blood in the event the hospitals lack blood of their type. Most patients have been forced to source for blood from family replacer donors.

There is always the undeniable possibility of having a blood bank lack sufficient volume of some blood groups leaving patients stranded and some lives have been lost this way. The short shelf life of blood and blood related products necessitates up to date synchronized records that can be accessed from a national level. The effects of these challenges manifest themselves in the pronounced shortage.[3]

Blood bank storage and management involves keeping records of blood available as well as information regarding the donors of the blood and also hospitals and patients that are in need of the blood. Blood donation is a very delicate process and therefore, it should be managed and controlled with high caution. Managing this process has a very little margin for error, if it has any. Blood is classified into four main types, each with its negative and positive variations. Other information relevant data like blood sugar content, antibodies, and so on are also necessary to while matching a donor to a recipient. Hence, there is an absolute need for these data and information to be stored and maintained with high security and integrity. Other relevant information include the donors primary test results.[4]

Present day blood bank storage is file based. This means that data and information regarding blood, donors and recipients are kept in spreadsheets, papers and files arranged in alphabetical or numeric order. This makes data and information retrieval hard and time consuming. Donors test results are recorded on papers too. This makes the data susceptible to errors and human mistakes which in turn puts human lives in danger. Another problem with this system is the poor efficiency. The process of retrieving blood, donor or recipient information is a tedious process and takes a lot of time. Considering the hospitals' and

recipients' needs and the urgency usually involved, this makes it hard for the hospitals and put the recipient's life in danger.[4]

Data Safety, security and backup is also poor as the papers and files can be easily stolen, lost or destroyed. This makes it an unreliable system.

Computerized blood bank management systems (BBMS) had been developed in previous years but are highly inadequate. The existing BBMS's are more storage systems that are mostly unusable by the blood bank's workers. They focus more on storage rather than coordinating management and operational activities and therefore are still yet to be accepted by the establishments. As you go into this study, you will be introduced to a new solution that we offer after a careful study of relevant information and documents.[4]

1.2 Problem Statement:

One of the most serious problems is the lack of blood during emergency and operating, In addition to that, the imperative needs to transferring blood require proper management to determine which blood group is found in a certain bank or hospital.

The second problem that leads to this idea is that the information about donor, blood grouping, tracing the data base is complicated and time consuming when it maintained manually, which lead in turn to error.

More over the manual system requires a lot of manpower and lack of data security, in addition to that Retrieval data takes a lot of time and report producing is also time consuming

1.3 Objective:

An objectiveof this research hasbeendivided into two divisions:

1.3.1 Main Objective:

Themain objective is to design a system for central blood bank management that provide real time information about blood component, grouping, donor information from collection to testing and use of blood product.

1.3.2 Specific Objectives:

1. Facilitate the distribution of blood in various hospitals in Khartoum and other states in Sudan.
2. Enhance the donation process by reducing human error when using computerized system in compare to manual records.
3. Decrease work time and report creation time.

1.4 Methodology:

The first step will be studying of the current system and determine the limitations found.

The second step will be create a central database of blood donors details ,blood groups and testing , blood stock and blood transfusion movements using database software and bar-code system.

1.5 Thesis Layout:

The research was divided into six chapters:

Chapter one is an introduction to the blood bank and blood bank management system, in which we identify the problem statement and specify our objectives and how it will be achieve.

Chapter two is the literature review of previous studies that we benefit of in our research.

Chapter three is general view about blood and blood bank,donors, programming langue ,database and barcode techniques that we used .

Chapter four is mainly deal with methodology that we used, the design and implementation of system.

Chapter five is the results that we obtained which fulfill our objectives that mentioned above,conclusion that described the idea of the system briefly

Chapter six is recommendations that can be done in the future work and discussion.

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1Literature Review

In 1994 the city of Alameda in California developed what's believed to be among the earliest blood management system. The James famer report (1982) states that the system was an inventory control program. Since then a number of computerized systems have since been developed for blood bank s and regional blood donor services.[5]

The report by Dr.SharadMaheshwari in the International Journal of Engineering Researcher and Application (IJERA) , stated that in India , the blood bank management information system MIS is an integrated blood automation system .

The web based mechanism interconnects all the blood banks of each state into a single network , The of blood bank refers all acquisition , validation , storage and circulation of various live data and information electrically regarding blood donation and transfusion service. The system is able to assemble heterogeneous data into legible reports to support decision making from effective donor screening to optimal blood dissemination in the field. It provides the criteria of city wise and group wise search of the blood (a person who need blood). After that when a search command is given then the MIS of blood bank will result the donor name from its data base. A person or hospital can request the blood from the blood bank when they need. For this ,the blood bank keeps the name of patient , a blood group, which the blood needed, name of the hospital where the blood will be sent, address of the hospital , name of the doctor who demands for blood, data and time when the blood the blood will required , contact name, contact email id, contact phone number, address, city, state of person who need the blood in their MIS.[9]

SIBAS , the acronym of " SistemaIntegrado de BAncosdeSangue " is a blood bank information system running in Macau blood transfusion center (Li et al. , in press). It has been specially optimized for blood donation service at Macau blood transfusion center and equipped with many advanced technologies , for example , electronic donor cards (Li & Dong, 2006), the ISBT 128 barcode technology (Li, Chae, & Dong, 2006), and so on.

As to computerized decision making support, two kinds of par diagrams are adopted in SIBAs : rule-based expert system and quantitative statistical analyses .

Both kinds of decision making support modules are distributed in SIBAs so as to support the decentralized affairs in that blood center. Finally, the decision making support modules in SIBAs provide analytical result and operational suggestions only. Any decision should be validated and relevant blood bank staff.

Baharat Blood Bank: The MIS of Baharat blood bank which was launched in September 2005 is a wed portal that brings blood donors and recipients throughout India under a common online platform. Blood recipient or those who are in need of blood visit the site and view the list of blood donors near their locality.Baharat Matrimony Group (2006) state that the system keeps the name of the donor , unique id and pass word through which the donor can access this account , date of birth of the donor , gender , status , blood grouping , weight , mobile number , email , address , city , state , date of last blood donation , information about Hepatitis B , C , AIDS , Cancer , Kidney disease , Heart disease (if a donor suffered from this diseases) when a new blood donor register himself as a blood donor with Baharat blood bank [6].

The Indian Institute of information technology and management –Kerala developed a web –based portal to facilitate the co-ordination between supply and demand of blood. Their earlier system hard all blood banks attached to a hospital.

Each hospital has its own system and limitation and the coordination between blood banks from other hospital has practically impossible. They later proposed a system were blood banks from other hospital were able to communicate [7]

The Zambia Blood Transfusion Service (ZNBTS) with help from the International Institution for Communication and Development (IICD) has developed a computerized system that has digitalized registration of donor and send SMS message to blood donor reminding them that they can donate blood Again (2009).In addition to that the software make easier to reach blood donors by register their information and save it online in data base to be accessible from every office of the ZNBTS [8]

PahEssah and Said AbRahman (2011) proposed a development of a management information system to manage blood bank based on information of donor, recipient and blood.

Their system has three modules: the donor module, patient module and blood module. However some crucial issues are left aside in this approach, for instance who is responsible for administration of the system.

An interesting approach by JeroenBenien and Hein Force (2012) is that of supply chain management for blood and blood products terming the process as irregular and the demand for blood stochastic. This is of great implications if the management of blood banks were to become effective.

All previous studies stated that blood bank had been developed since more years, some of them concern in managing donor records to facilitate the process of donation, the other interconnected blood banks to each other in one system and one database, some of them used modern technology such as electronic card and barcode system.

In this research we selected the modern technology barcode system to implement our computerized blood bank system to improve the current system and fulfill optimal medical services.

2.2 The current situation in Sudan:

National blood transfusion services in Khartoum apply service for the private hospital mainly and for government hospital partially in emergency cases, since each government hospital has its own blood bank that cover the needed service.

The current situation in the National Blood Transfusion Center NBTC in Sudan is a paper based system, lack of central data reference, which result in many challenges and problems that can be described in the following points:

1. Recording of data is complicated and time consuming.
2. Lack of data security.
3. Retrieval data is also complicated and time consuming.
4. Human error.
5. Lack of alarming system.
6. Most of data getting lost.

The sequenceof researchordering can be described in three divisions thatinclude blood physiology information, blood bank information about donation process, and computer information including programming language as we are going to mentionsequentially.

Chapter three

General View

Chapter three
General View

3.1 Definition of blood:

Blood is a type of connective tissue that consists of cells and intracellular substance (plasma). [13]

3.2 Blood components:

Blood is composed of a protein rich fluid called the plasma, in which cellular elements circulate: red blood cells, white blood cells, and platelets..[14]

The percentage of blood occupied by cells is called packed cell volume (PCV) or haematocrit . Most of this percentage is occupied by RBCs.[13]

Normally; the total volume of circulating blood is about 8% of the body weight, about 55% of the blood volume is plasma.[14]

3.2.1 Red blood cells (erythrocyte):

The main function of RBCs is transportation of hemoglobin which carries oxygen from lungs to tissues, and carbon dioxide from tissues to lungs. Haemoglobin also functions as a major buffering system of the blood.

Normal RBCs are biconcave discs, with about 7-8 micrometers in diameter, and thickness of 2.5 and 1 micrometers at periphery and center of RBC respectively.

RBCs have an average volume of about 90-95 micrometers. Average number of RBCs is about:

4.8-5.8 million cell/cubic millimeter in males.

4.2-5.2 million cell/cubic millimeter in females.

The average amount of haemoglobin in the whole blood is as follows:

14-16 grams/deciliter in adult male.

13-15 grams/deciliter in adult female [15]

3.2.2White blood cells (leukocytes):

These are the mobile units of the body.

There are six types of WBCs namely:

1. Polymorph nuclear nutrophils 62% of total WBCs.
2. Polymorph nuclear eosinophils 2.3% of total WBCs.
3. Polymorph nuclear basophils 0.4% of total WBCs.
4. Monocyte 5.3% of total WBCs.
5. Lymphocyte 30% of total WBCs.
6. Plasma cells.[15]

3.2.3Platelet:

Platelet are the minute round or oval discs formed by fragmentation of the parent cell (megakaryocyte). Normal platelet count is 150,000 – 300,000 / micro liter. Platelet have no nuclei. They function in haemostasis. [15]

3.3Blood Groups:

It had been discovered that there are different antigens and immune properties in blood of different people. This is due to presence of antigens on the surface of RBCs and antibodies in the plasma.The most commonly envolved antigens group in transfusion reactions are A-B-O Antigens and Rhesus system.[15]

3.3.1A-B-O Antigens (Agglutinogens):

Tow antigens -A and B- occur on RBCs surface. Depending on their presence or absence, four major groups are classified:

1. Both A+B antigen are present …………………blood group AB.
2. Only A antigen is present……………………..blood group B.
3. Only B antigen is present ………………………blood group A.
4. Neither A nor B antigen is present………………blood group O.

An antibody develops in the plasma against the antigen which is not found on RBCs surface. This causes transfusion reactions.

In mismatched transfusion; the antibody (agglutinin) binds the antigen causes agglutination of the blood. Haemolysis may occur also.[15]

3.3.2Rhesus (RH) blood types:

Differs from A-B-O system in that antibodies that mediate the transfusion reaction are not found normally in the plasma before the exposure to blood containing antigens.

There are six types of Rh antigens: C, D, E, c, d, e.

The person who has (D) will not has(d)where as who is missing (D) will always has (d).

D antigen is the most important one. Any person who has D is called Rh +ve; where as anyone who does not have D is called Rh –ve.

Anti-Rh antibodies (lagglutinins) are formed when a Rh-ve person is transfused with a blood from a Rh+ve one. Antibodies develop slowly and may cause mild reaction in the firsttransfusion. Reaction is exaggerated in subsequent transfusions. [15]

3.4 Definition of Blood Bank:

The term blood bank typically refers to division of hospital where the storage of blood product occur and where proper testing is performed (to reduce the risk of transfusion related adverse event).However ,it sometimes refers to a collection center, and indeed some hospitals also perform collection.Blood banking process that takes place in the laboratory to ensure that donated, or blood products, are safe before they are used in blood transfusions and other medical procedures.[12]

3.5 Blood donation:

Blood donation is a process through which a blood donor has a specified amount of blood drawn for the purpose of storage in a blood bank and for subsequent blood transfusion. Blood donation may be done in a blood bank or in blood donation camps. The process of blood donation involves selection of blood donors by screening, actual donation of blood, and a brief recovery period after blood donation.General steps for collection of donor blood are shown below:
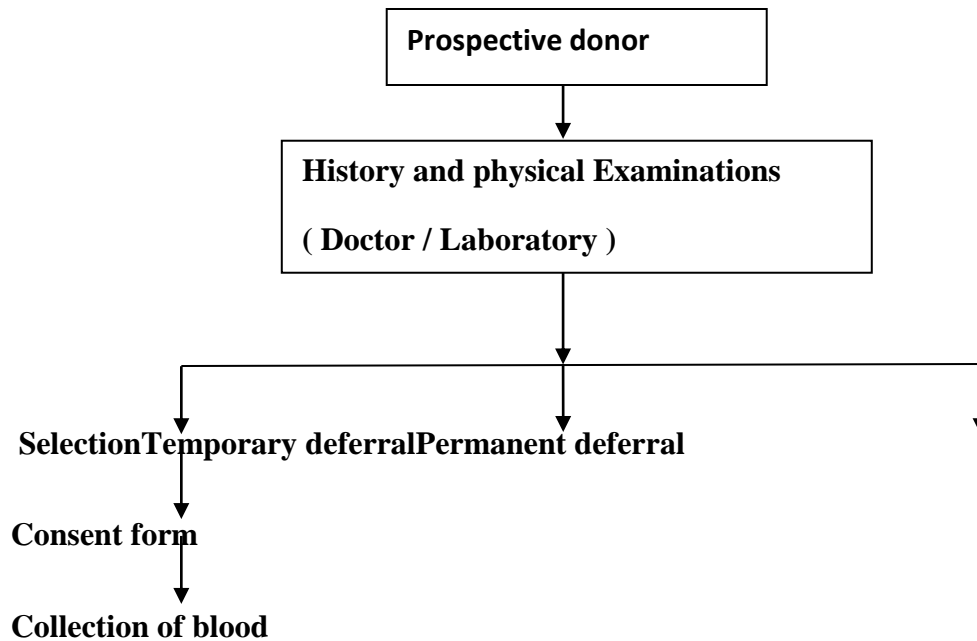
```
         ┌─────────────────────────┐
         │   Prospective donor     │
         └────────────┬────────────┘
                      │
                      ▼
         ┌─────────────────────────────────┐
         │ History and physical Examinations│
         │                                  │
         │ ( Doctor / Laboratory )          │
         └────────────┬────────────────────┘
                      │
        ┌─────────────┼──────────────────────────┐
        ▼             ▼                           ▼
```

 SelectionTemporary deferralPermanent deferral

Consent form

Collection of blood

Figure3.1: General steps before collection of donor blood[17]

The safe transfusion practice starts with proper selection of blood donors; if donors are not properly screened, blood can become a medium of transmission of infections like human immunodeficiency virus, hepatitis B and C virus, syphilis, and malaria.
There are three main types of whole blood donors:

1. Voluntary.
2. Professional (Paid)
3. Replacement.
4. Direct donor[17].

3.6 Donor Selection:

There are several criteria for selecting and acceptingdonor, these include many steps that can be described as following:

3.6.1 Donor Recruitments:

Blood should be accepted only from voluntary, non-remunerated, low risk, safe and healthy donors.A questionnaire should be prepared in local languages which is simple and easy to understand to be answered by the donor. For donors who are illiterate, assistance should be given by donor registration staff. Medical officer with MBBS qualification should be responsible for reviewing the donor's health conditions and performing physical examination of the donor. Demographic details such as name and address of donor, date and time of donor selection and donation should be registered. Consent should be obtained in writing from the donors after explaining the procedure, potential adverse reactions as well as the tests carried out on the donated blood.[18]

3.6.2 Criteriafor Selectionof Donors:

Thereareseveral guidelines to determine that the blood donation will not be detrimental to the donors /recipients include physical examinations to certify that the donor is fit for donation.

Theprospective donor should appear in good health, and has an age between $18 - 65$ years. The hemoglobin should be not less than 12.0 gm/dl or the packed cell volume (haematocrit) should be not less than 36%, and the screening carried out should use appropriate and validated methodology. Blood collection from donors weighing 45-55 Kg should be 350 ml bloodand from those weighing 55 Kg and above should be 450 ml, the systolic blood pressure should be between 100 and 160 mm ofmercury and the diastolic pressure should be between 60-90 mm ofmercury, the temperature should not exceed 37.50C/ 99.5oF. The donor plus should be between 60 to 100 beats per minute and regular, examination of respiratory system, cardiovascular system and abdomenshould be carried out if necessary.[18]

3.7 Medical History:

The suitability of donor to donate is based on the previous guidelines that mentioned above.

A detailed medical history should be taken, using a structured donor questionnaire and interview, this is aimed at identifying and deferring, either temporarily or permanently, any donor with a medical condition that may predispose the donor to immediate or long-term harm, affect the safety or quality of the product derived from the blood or compromise patient safety.[2]

3.8 Conditions that affect safety of donors:

Donor should be asked some questions to determine that the he is in normal health and is not suffering from any serious illness e.g. malignant disease, epilepsy, bronchial asthma, diabetes, excessive menstrual bleeding, cardio-vascular conditions, renal disease, allergic diseases, abnormal bleeding tendency. For female prospective donor should not be accepted during period of pregnancy and till twelve months after full term delivery and also during lactation. Any donor who appears to be under the influence of alcohol or any drug abuse and who does not appear to be providing reliable answers to questions on their medical history should not be accepted.Any donor on antibiotic therapy or other medications should be deferred after evaluating his/her suitability as donor.[18]

3.8.1 Infectious disease:

Donors having history of malaria should be accepted after three months, and for those who have history of jaundice should be deferred up to one year.

Donors having history of being HIV, HBsAg / HCV antibody positive should be permanently deferred, and who having intimate contact with HIV, HBsAg / HCV antibody positive individual should be deferred for one year.Donors having history of measles/mumps/chickenpox should be deferred for eight weeks, and who have history of influenza and URTI (Upper Respiratory Tract Infections) should be deferred till one week after treatment, donors having history of diarrhea in preceding week particularly if associated with fever should be deferred.[18]

3.8.2 Surgical Procedures:

Donors who have a major operation should be accepted one year after the recovery, and who have minor operations should accept after six months of recovery. The interval between two blood donations should be at least twelve weeks.

3.9 Information Provided To The Donors:

Prior to blood donation, the consent of the donor should be obtained in writing with donor's signature or thumb impression after the procedure is explained and the donor is informed regarding testing of blood for all mandatory tests for safety of recipients. The donor should be provided an opportunity to ask questions and refuse consent. Donors should be given advice regarding post-phlebotomy care and cautioned as to possible adverse reactions. The donor should inform about any sero-reactive result of transfusion transmitted infection(TTI). Donors who are HIV sero-reactive should be referred to an IntegratedCounseling and Testing Centre (ICTC) for post donation confirmation and counseling.[18]

3.10 Collection of Donor Blood:

In the blood bank, donor blood is collected in a well ventilated, well-lighted, and air-conditioned room. Blood is drawn by qualified physician or by an assistant who is well trained and is working under his supervision.[17]

3.10.1Equipments and Materials:

1. Blood bag containing anticoagulant-preservative solution: Blood from a donor is collected in a closed system of sterile, disposable plastic bag (triple bag with 450 ml capacity.
2. Sphygmomanometer, weighing scale, blood weighing balance, sealing clips, artery forceps.
3. Iodine, spirit, sterile cotton swabs, adhesive tape.
4. Emergency drugs and equipment.

5. Pilot tubes for collection of blood for testing (grouping, cross matching, screening for infectious diseases).[17]

3.11 Testing of Donated Blood

Before collecting blood from donor it must be tested for blood group and infectious diseases.ABO group should be determined by testing red cells with Anti-A, Anti-B, Anti-AB reagents and by testing serumor plasma for expected and unexpected antibodies with known type A, Band O pool cells , panel cells if available. For each group a pool of three different cells should be used. The blood should not be released untilany discrepancy, if found, is resolved. TheRh(D) type should be determined with Anti-D reagent from twodifferent sources using a validated method.   .

Test for Syphilis Each donation of whole blood should be subjected toa serological test for syphilis by VDRL / RPR Method / TPHA. Test for Viral Hepatitis A test for hepatitis B (HBsAg) and hepatitis C(anti-HCV) by ELISA/Rapid test which is a validated method should bedone on each unit of blood. Test for Malaria All blood units should be tested for malarial parasitesusing a validated and sensitive antigen test.[18]

3.12 Quarantine Storage:

The whole blood or components should not be issued for transfusion, till the mandatory tests are completed and reported as non-reactive. In order to ensure this procedure, the untested blood should be kept in quarantine storage. The units which test reactive in any test should be segregated immediately and kept in a separate quarantine area till sent for disposal. It is preferable to use biohazard labels.[18]

3.13 Platelet Concentrate (Random Donor Platelets):

Platelet concentrate should be prepared by centrifugation of a single unit of whole blood collected with a smooth venepuncture and a continuous flow of blood it should be separated from whole blood within 6-8 hours of collection by centrifugation at 220C + 20C using either platelet rich plasma (PRP) or Buffy coat (BC) method, which is validated.Platelets should be suspended in approximately 50 ml of plasma andstored at 220C + 20C. Continuous gentle agitation (60-70 oscillations / per min) using

horizontalagitator or a rotor with 5 – 10 cycles/minute should be maintained throughout the storage period varying from 3-5 days depending on the nature of plastic of the bag in use considering day of blood collection as day zero.[18]

3.14 Fresh Frozen Plasma

Fresh plasma should be separated from the whole blood not later than 6 - 8 hours of collection and frozen solid at –300C or lower as early as possible. It should be thawed rapidly at 30-370C in a water bath with shaker and used within 6 hours.[18]
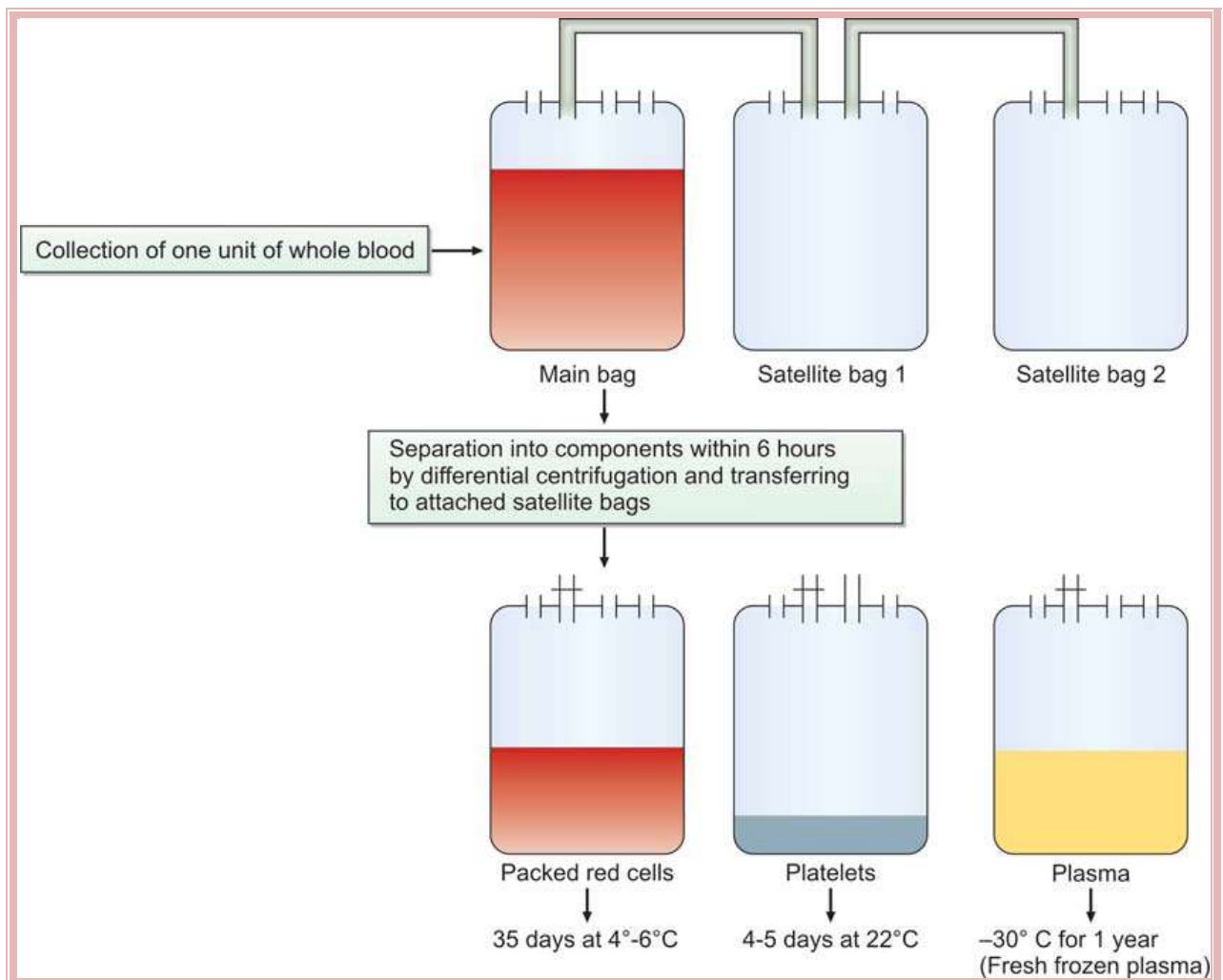
Figure 3.2 Principle of preparation of blood components from one unit of whole blood [17]

3.15 Cryo poor plasma or Factor VIII Deficient Plasma

This is plasma from which cryoprecipitate has been removed. It should be stored at -300C and once thawed should be used within 6 hours.

The general process after collecting blood is shown infigure 3.3:

```
                    ┌─────────────────────────┐
                    │ Selection of blood donor │
                    └─────────────────────────┘
                                 │
            ┌────────────────────┴────────────────────┐
            │                                          │
┌───────────────────────────┐          ┌───────────────────────────┐
│ Collecting of blood in blood │        │ Collecting of blood in pilot │
└───────────────────────────┘          └───────────────────────────┘
            │                                          │
┌───────────────────────────┐          ┌───────────────────────────┐
│ Preparing of components     │        │ ABO group, Rh typing,        │
│ storage                     │        │ testing for infection        │
└───────────────────────────┘          │ diseases.                    │
            │                           └───────────────────────────┘
    ┌───────────────┐                         │
    │   Storage     │              ┌──────────┴──────────┐
    └───────────────┘              │                     │
            │              ┌──────────────────┐  ┌──────────────────┐
            │              │ Ready for issue  │  │ Discard blood if │
            │              │ if test of       │  │ test of          │
            │              │ infectious       │  │ infectious       │
            │              │ disease is       │  │ disease is       │
            │              │ negative.        │  │ positive.        │
            │              └──────────────────┘  └──────────────────┘
┌──────────────────────────────────┐
│ Whole blood or packed red cells:  │
│ 2-6°c for 30-35 days.             │
│                                   │
│ Platelet concentrate: 20-24°c     │
│ for 5 days.                       │
│                                   │
│ Fresh frozen plasma: below -25°c  │
│ for 1 year.                       │
└──────────────────────────────────┘
```

Figure 3.3: General procedure after collection of donor blood.[17]

3.16 Transfusion guidelines and protocols:

Each blood bank should implement national transfusion guidelines to ensure uniform standards and safe practices. These should include:

1. Clinical and laboratory indications for the use of blood products and alternatives to transfusion.
2. System for requesting blood for transfusion in routine and emergency situations and use of a standard blood request form and blood ordering schedules for elective surgery.
3. Use of standard operating procedures to ensure consistency and reliability in the transfusion process[10]

3.17 Transfusion in the clinical area:

While responsibility for the decision to transfuse ultimately rests with the attending doctor, patient safety in blood transfusion is the responsibility of all staff involved in the clinical transfusion process. This requires:

1. Systematic assessment of the clinical need for blood transfusion
2. Avoidance of unnecessary transfusions through the use of replacement fluids, pharmaceuticals and medical devices, where possible
3. Rational use of blood products on the basis of patients' clinical needs
4. Checking patient identity at the time of sample collection and prior to blood transfusion
5. Collection and accurate labeling of patient blood samples
6. Sending blood samples to blood bank with completed blood request forms
7. Receipt, correct storage and handling of blood units in the clinical area
8. Checking the integrity of blood units before transfusion
9. Final bedside identification check of patient, documents and each blood unit before commencing transfusion
10. Timely administration of blood products, including correct use of blood warmers and filters
11. Recording of transfusion in patients' notes, including the identities of the prescriber and the person administering the transfusion

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12. Careful monitoring of patients before, during and after transfusion and follow-up

13. Rapid management and reporting of adverse transfusion events.[10]

3.18 Management information system

Management information system assists managers as computer understands the problem of the managers and they are capable of solving the problem of the managers. This results the breakthrough in the management information system. By using the concept of management information system leads to develop much application specific software which provide the solutions to the managers. It also helps the end users as the common men who are using the solution provided by the management information system helpful in the retrieval of the information as well as the speed of the information retrieval are also increased. Because of this end user gets the desired results or output with the specific time interval. Managers use computer based information system to make decisions to solve problems, and information is used in making these decisions.[20]

There are several programming languages use to develop an information systems such as oracle, PHP, and other languages that used to design a soft ware systems.

3.19 PHP programming language:

PHP is a server-side scripting language. This concept is not obvious, especially if you're used to designing pages with just HTML and JavaScript. A server-side scripting language is similar to JavaScript in that it allows you to embed little programs (scripts) into the HTML of a Web page. When executed, such scripts allow you to control what appears in the browser window more flexibly than straight HTML. The key difference between JavaScript and PHP is simple. JavaScript is interpreted by the Web browser once the Web page that contains the script has been downloaded. Conversely, server-side scripting languages such as PHP are interpreted by the Web server before the page is even sent to the

browser. And, once it's interpreted, the results of the script replace the PHP code in the Web page.[11]

3.19.1 Basic Syntax and Commands:

PHP syntax will be very familiar to anyone with an understanding of C, C++, C#, Java, JavaScript, Perl, or any other C-derived language. A PHP script consists of a series of commands, or statements. Each statement is an instruction that must be followed by the Web server before it can proceed to the next. PHP statements, languages, are always terminated by a semicolon (;).

Variables in PHP are identical to variables in most other programming languages. For the uninitiated, a variable can be thought of as a name that's given to an imaginary box into which any value may be placed.

PHP is a loosely typed language. This means that a single variable may contain any type of data, be it a number, a string of text, or some other kind of value, and may change types over its lifetime. Variables may be used almost anywhere that use an actual value.[11]

3.19.2 User Interaction and Forms:

The ability to interact with users who view a Web page is essential for many applications of PHP. Veterans of JavaScript tend to think in terms of event handlers, which let you react directly to the actions of the user, for example, the movement of the cursor over a link on the page. Server-side scripting languages such as PHP have a more limited scope when it comes to user interaction. As PHP code is activated when a page is requested from the server, user interaction can occur only in a back-and-forth fashion: the user sends requests to the server, and the server replies with dynamically generated pages. The key to creating interactivity with PHP is to understand the techniques we can use to send information about a user's interaction along with his or her request for a new Web page. PHP makes this fairly easy.[11]

PHP, just like any other programming language, provides facilities that allow us to affect the flow of control in a script. That is, the language contains special statements that permit you to deviate from the one-after-another execution order.

3.20 Definition of Database :

A database server (in our case, MySQL) is a program that can store large amounts of information in an organized format that's easily accessible through scripting languages like PHP.[11]

3.20.1 Publishing MySQL Data on the Web:

There are two powerful tools: the PHP scripting language, and the MySQL database engine. It's important to understand how these will fit together.

The whole idea of a database-driven Website is to allow the content of the site to reside in a database, and for that content to be pulled from the database dynamically to create Web pages for people to view with a regular Web browser. So, on one end of the system you have a visitor to your site who uses a Web browser to request a page, and expects to receive a standard HTML document. On the other end you have the content of your site, which sits in one or more tables in a MySQL database that understands only how to respond to SQL queries (commands).[11]
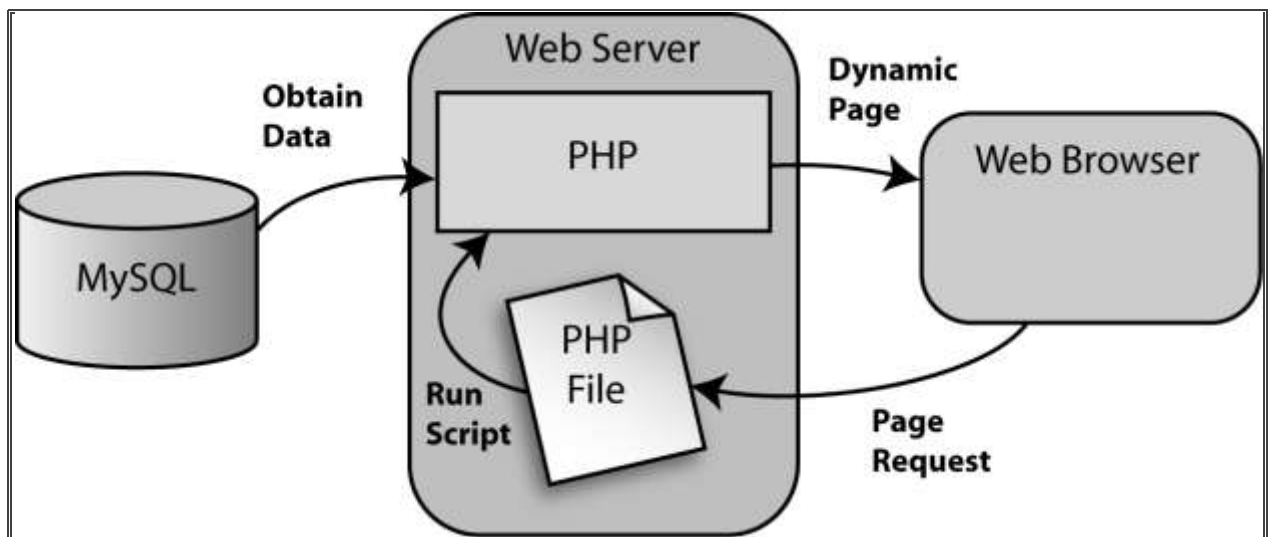
Figure 3.4: PHP retrieves My SQL data to produce Web pages

As shown in figure 2.4, the PHP scripting language is the go-between that speaks both languages. It processes the page request and fetches the data from the My SQL database, then spits it out dynamically as the nicely-formatted HTML page that the browser expects. With PHP, you can write the presentation aspects of your site (the fancy graphics and page layouts) as "templates" in regular HTML. At the points at which content belongs in those templates, you use some PHP code to connect to the My SQL database and using SQL queries.

This is what will happen when someone visits a page on database-driven Website:

1. The visitor's Web browser requests the Web page using a standard URL.

2. The Web server software (Apache, IIS, or whatever) recognizes that the requested file is a PHP script, so the server interprets the file using its PHP plug-in before responding to the page request.

3. Certain PHP commands connect to the My SQL database and request the content that belongs in the Web page.

4. The My SQL database responds by sending the requested content to the PHP script.

5. The PHP script stores the content into one or more PHP variables, then uses the now-familiar echo statement to output the content as part of the Web page.

6. The PHP plug-in finishes up by handing a copy of the HTML it has created to the Web server.

7. The Web server sends the HTML to the Web browser as it would a plain HTML file, except that instead of coming directly from an HTML file, the page is the output provided by the PHP plug-in.[11]

3.20.2 Connecting to MySQL with PHP

Before connect out of MySQL database for inclusion in a Web page, it must be known how to establish a connection to MySQL from inside a PHP script. PHP has no need of any special program, however; support for connecting to MySQL is built right into the language. The built-in function mysql connect establishes the connection:

Mysqlconnect(address, username, password)

Here, address is the IP address or host name of the computer on which the MySQL server software is running ('localhost' if it's running on the same computer as the Web server

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software), and username and password are the same MySQL user name and password that used to connect to the MySQL server, once a connection is established, the next step is to select the database with which you want to work.

With a connection established and a database selected, we're ready to begin using the data stored in the database.[11]

3.20.3Sending SQL Queries with PHP

The connection to the MySQL database server use a program called mysql that allowed us to type SQL queries (commands) and view the results of those queries immediately. In PHP, a similar mechanism exists: the mysql query function.
Mysql query (query [, connection id])

Here query is a string that contains the SQL command we want to execute. As with mysql select db, the connection identifier parameter is optional.
What this function returns will depend on the type of query being sent. For most SQL commands, mysql query returns either true or false to indicate success or failure respectively.

For DELETE, INSERT, and UPDATE queries (which serve to modify stored data), MySQL also keeps track of the number of table rows (entries) that were affected by the query.

For most SQL queries, the mysql_query function returns either true (success) or false (failure).

For SELECT queries, this just isn't enough. It should be recall that SELECTqueries are used to view stored data in the database. In addition to indicating whether the query succeeded or failed, PHP must also receive the results of thequery. Thus, when it processes a SELECT query, mysql query returns a numberthat identifies a result set, which contains a list of all the rows (entries) returnedfrom the query. False is still returned if the query fails for any reason.[11]

3.21 The Barcodes

As far back as the 1960s, barcodes were used in industrial work environments. Some of the early implementations of barcodes included the ability identify rail road cars.

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In the early 1970s, common barcodes started to appear on grocery shelves. To automate the process of identifying grocery items, UPC barcodes were placed on products. Today, barcodes are used for identification in almost all types of business. [16]

The type of barcode to use for a particular situation depends upon:

1. The actual application.
2. The data encoded in the barcode
3. The printability of the barcode

There are several different types of barcode standards for different purposes, which are called symbologies. Each type of symbology is a standard that defines the printed symbol and how a device - such as a barcode scanner - reads and decodes the printed symbol. When multiple parties or companies are involved in the ID process.[16]

The best type of the used barcode depends on the environment, requirements, application, and printer. Regarding barcode fonts, there are two types:

• fonts that require encoding with use of a font tool (Code 128, UPC, Data Matrix, Code 93);

• fonts that do not require encoding. Self-checking fonts (Code 39, Codabar).

For fonts that require encoding such as Code 128, Data Matrix, UPC, and Code 93, a font tool must be used. A font tool is a product that is used to format data for a barcode font. This may include calculating start/stop characters, a check character, and in some cases prepare data so that it can be altered for the specified barcode symbology. It should be noted, if somebody is not a technical user or programmer, try to use self-checking barcode fonts such as Code 39 or Codabar. Self-checking fonts have checking code built-in, so there is no need to calculate check characters. Check characters are used in more dense symbologies, so the barcode scanner can verify it and reads the barcode correctly.[16]

Determining the best product to use for printing depends on the environment, requirements, application and printer. Several methods for printing barcodes are as follows:

1. barcode Fonts,
2. applications,
3. components,
4. hosted Services (Dynamic Barcode Generator Service or XML Barcode Webservice). [16]

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3.21.1Reading barcodes

One of the most common tools for reading barcodes is the hand held barcode scanner. All of the barcode scanners recommended and sold by IDAutomation have built-in decoders that can read several different bar code types. There are some low priced scanners available on the market, but they require complicated decoders. In the long run, after ordering and programming a decoder, more time will be spent using the decoder than if ordering a scanner with a built-in decoder.[16]

3.22 The QR codes

Quick response code (QR code) is a type of two-dimensional (2D) barcode that can be read using a QR barcode reader or camera enabled smart phone with QR reader softwareFig: 2.5.A QR code is able to carry information in both the vertical and the horizontal direction, which is why it is called a 2D barcode.

QR Codes are popular with mobile phone users as the barcode can be used to store addresses and URLs. With a camera-enabled smart phone, users can scan the QR Code which has been coded to do things like display text, provide contact data or even open a webpage in the browser on the smart phone.

The QR Code specification outlines data types or services for this information. By using the standards it ensures QR Code software can correctly read the code.

QR Codes can be printed and displayed anywhere a mobile phone user might scan the code such as in a magazine or displayed at a cash register. It can be displayed also online.

There are a number of online services that will generate a QR Code based on the information is specified when mapping the QR code.[16]

Figure 3.5: QR Code sample.[16]

QR Codes are now used over a much wider range of applications. These are the followings: included commercial tracking, entertainment and transport ticketing. It can also be used in storing personal information for use by government Many of these applications target mobile-phone users. Users may receive text, add a vCard contact to their device, open a Uniform Resource Identifier (URI), or compose an e-mail or text message after scanning QR Codes. They can generate and print their own QR Codes for others to scan and use by visiting one of several pay or free QR Code-generating sites or apps.

QR Codes storing addresses and Uniform Resource Locators (URLs) may appear in magazines, on signs, on buses, on business cards, or on almost any object about which users might need information. Users with a camera phone equipped with the correct reader application can scan the image of the QR code to display text, contact information, connect to a wireless network, or open a web page in the telephone's browser.

The amount of data that can be stored in the QR Code symbol depends on the data type, version and error correction level. [16]

As it is stated in this chapter, the idea of the research has mainly three axis: physiological background, donation background, and computerized background. From all information that mentioned about three axis we are going to apply all information to design our new system using all needed details to implement our computerized management system.

Chapter Four

Methodology and System Design

Chapter Three

Methodology and System Design

4.1   Methodology

Research methodology was built up with observations, study, problem definition, data gathering, an experimental design, and finally conclusion. According to the targeted domain, observations have been done by visiting the National Blood Transfusion CenterNBTC of Khartoum with expectation of identifying real scenario. Here, an interview had been conducted with the staff members of blood bank, The procedure of the blood donation has been described as step by step. Donor registration, donor information and testing, donation of blood, blood screening and blood stock management and stock movements are the main activities of the blood bank and currently there is a manual system to maintain the records of Donor registration and blood screening which has a lot of problems and errors. Also it had been tried to acquire some of the forms they use in collecting information of donors. The collection data has been evaluated and analyzed and then the needed information was extracted.

Management Information System that solved the above problem has been designed by using PHP language and Microsoft My SQL database that was ran on windows based operating system, the proposed system has eight screens that represent the main departments of blood bank, here data base was created and divided into tables based on the proposed screens of the new system, each table contains the information about one screen of the system, then PHP codes was used to connect the data base with system' screens. The bar-code techniques was used and the system was able to create a bar code that save the essential donor information that will be read in each donation steps, Here the mobile application QR Code reader was used to read the text number of bags as an alternative techniques of bar-cod reader.

The following flowchart describes the main steps of donationprocess:
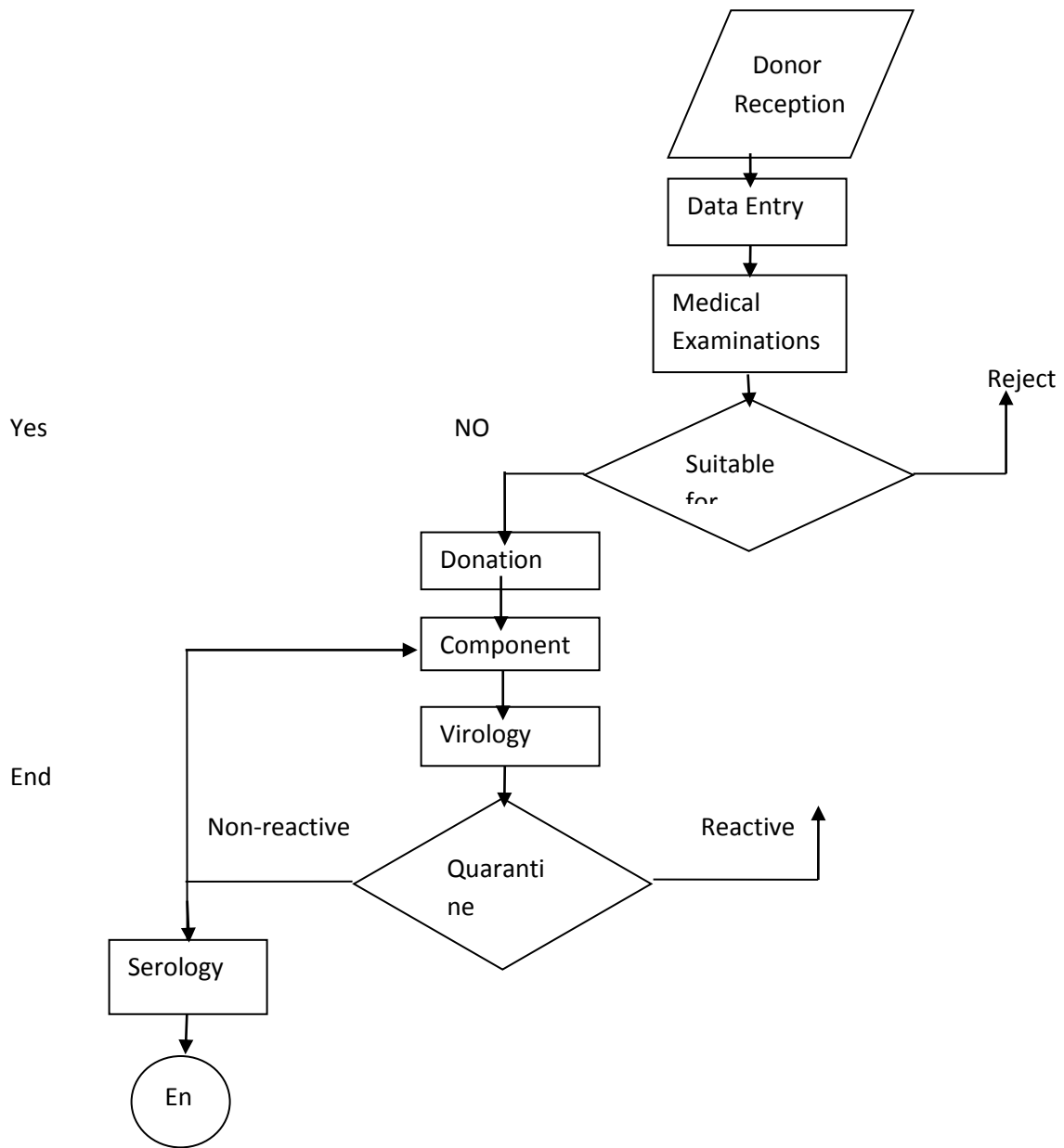
Flowchart 4.1: Blood donation process

4.2 The proposed system block diagram:
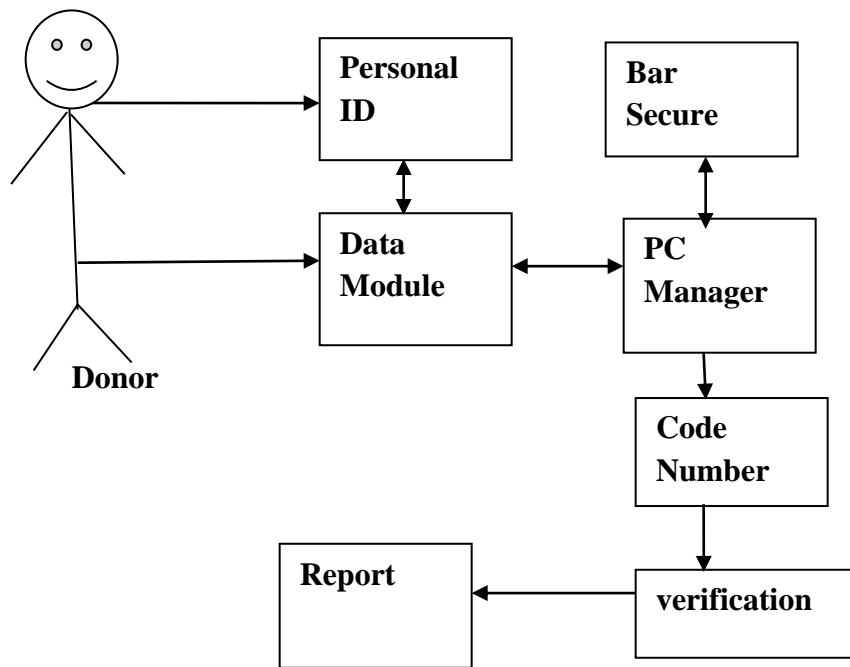
Block diagram 4.2: computerized management system

As illustrated in system block diagram, the donor has a personal ID that identified him uniquely, the information of donor saved in a database module that controlled in a PC manager as a software screens, the bar secure is essential in each step in controlling data to verify the real information of donor, then reporting the results.

4.3 System Requirements:

System requirement is to specify the needs assessments to implement new system, the system requirements is identified from the information gathering during the collection of data. It can be divided into functional and non-functional requirements.

4.3.1 Functional Requirements:

The functional requirements is related to functions that needs to be supported by the new system such as inputs to the system, outputs of the system, and the data which must be managed by the system. The system should enable the administrator to create, delete, and update user setup enable the user to register blood donor's profile, enable the user to store blood details and records discarded blood details. The system should be protected from unauthorized users and access,and generate standard reports. [19]

4.3.2 Non functionalRequirements:

The non-functional requirements describe how well the system supports the functional requirements, this includes: The system should provide appropriate error message when the user enters unexpected/ wrong data, system should be available for 24 hours a day and 7 days a week, should have a very simple and user friendly interfaces for everyone to understand the functionalities easily.

4.4 Application features:

1. Access is protected with login by username and password.
2. Automatic reminders for the expiration of blood components.
3. Keeping a detailed history of medical examination and other records for each donor.
4. Document management system for all necessary documents like donor test results
5. Printing medical reports

4.5 Design and Implementation:

As it stated in methodology, the proposed system was divided into eight screens, which represent the main departments in blood bank.The system is used to maintain whole information about donor, bloodand transfusion process in the laboratory departments, theproposed system use a central database to storeallinputdetails including donor information, blood stock, and blood group information.Theproposed system screens are:

1. Admin
2. Data entry
3. Doctor
4. Fitness
5. Component
6. Virology
7. Quarantine
8. Serology

Each screen has its own table in the data base that contains all inputs of screen; also each one of them has its own PHP code that connects it with the database.

To implement the above screens practically, firstly, data was collected and studied carefully so as to extracting the desired information that need to be an input of the new system.

According to the given information we determine which information is suitable to be our input. The second step was creating of data base tables based on the suggestion inputs, thenconnected with PHP programming langue, as we are going to describe.

4.5.1Admin:

Admin screen focus on all blood bank departments' screens each department screen is given a user name and password which identified ituniquely.In this module admin can maintain all details,update, edit, change password and logout. the database table was divided into four columns that represent the inputs which are: number of user, user name, password, and the type of each user that identified him, then it connected with php code:
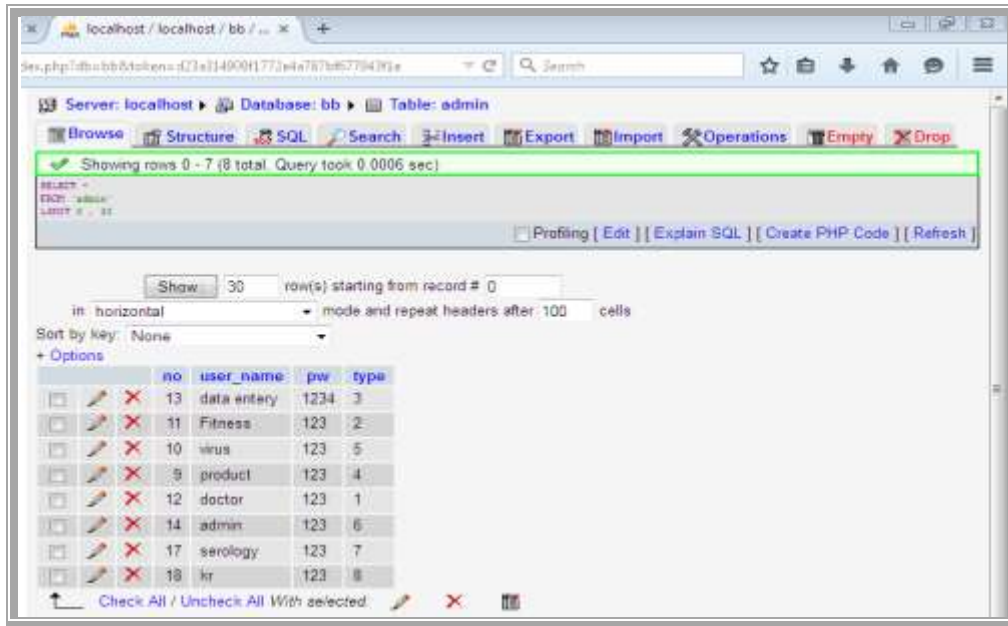
Figure4.3: database table of admin screen.
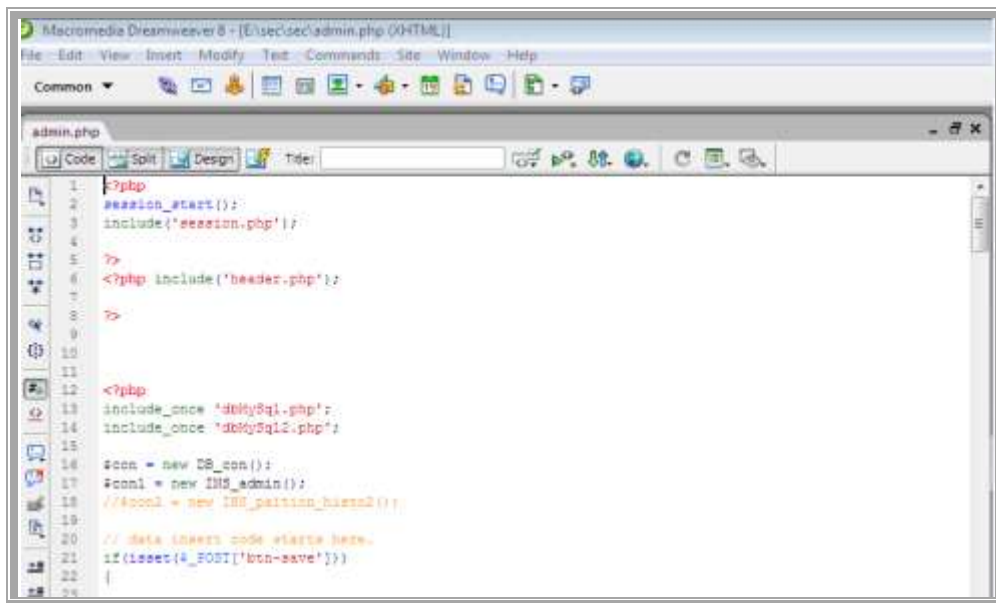
Figure4.4: PHP code of admin screen.

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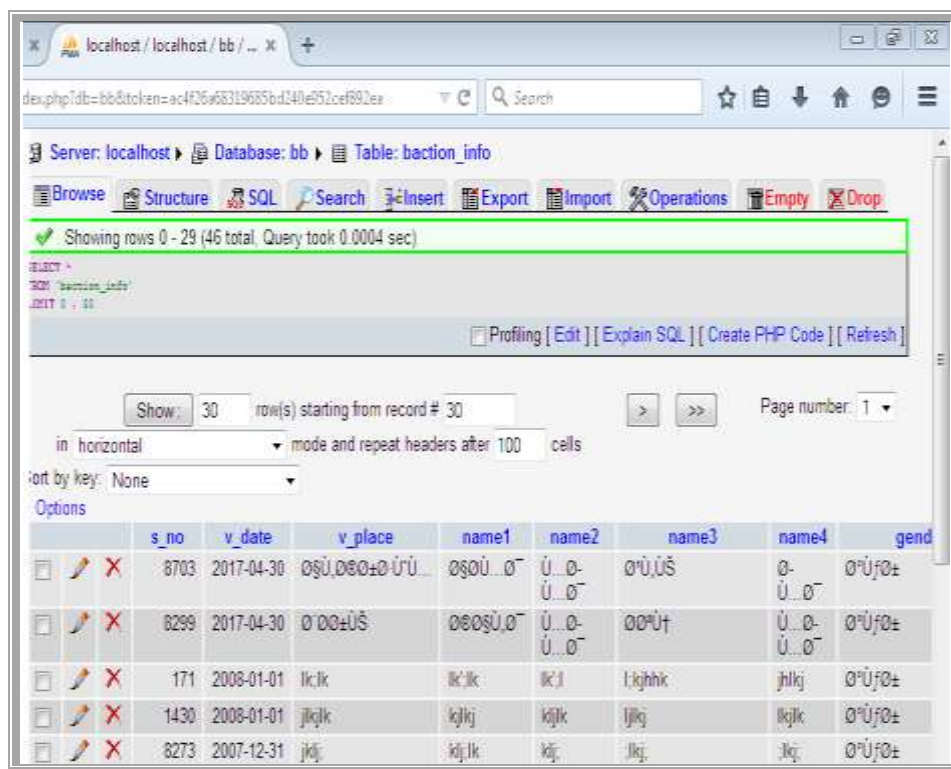
4.5.2 Data entry:

The first step for donor to fill his information in order to determine either he will be accept or reject before medical examination. The main inputs of data entry screen include the essential donor information and medical history,in this module the user is given his own user name and passesword,he can add or edit information about donorand logout.

The system has an ability to alert user if one of inputs is not correct, and also display a messageif a donor cannot able to donate.

The layout of data entry screen has been divided into five subdivisions.

According to subdivisions, database was also divided to sub tables containinputs of the subdivision:

Figure4.5: database table for data entry- sub1

Figure4.6: database table for data entry-sub2

Figure4.7: database table for data entry-sub3

Figure4.8: PHP code –essential information

Figure4.9: PHP code- type of donation
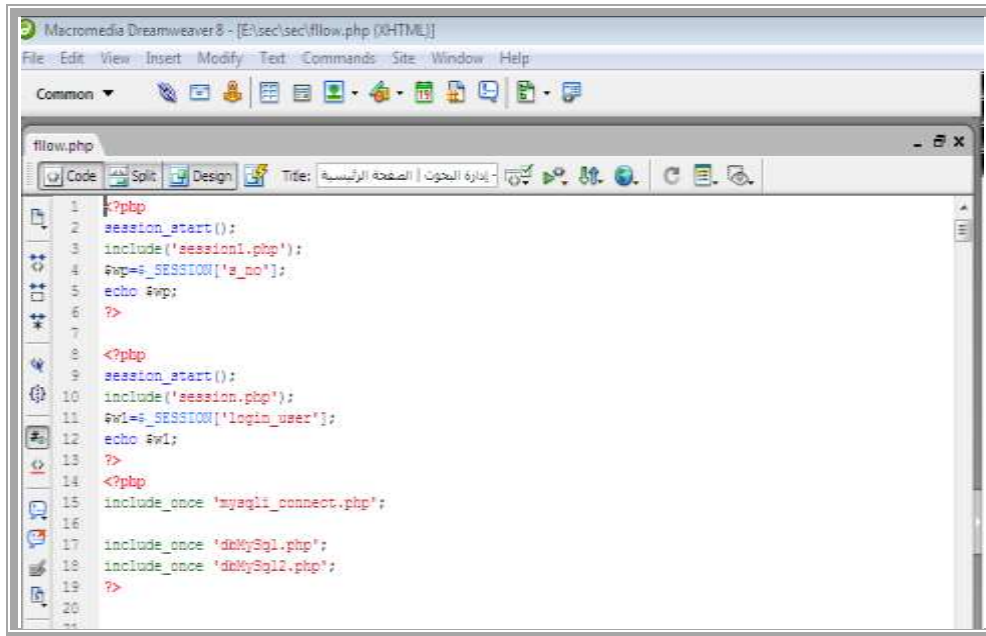
Figure4.10: PHP code for data entry- commitment

Figure4.11: PHP code for data entry-disease history

Figure4.12: PHP code for data entry-donation form.

4.5.3 Doctor:

This module focus on donor health state ,the doctor is given his own username and password, he receive the pre information about donor that sent from data entry and add examination details such as :weight, pressure and pulse, and determine either this donor able to donate or not, in addition to logout.

Database creation table contain the physical examination details, in addition to permission of donation or postpone, as it illustrated bellow:
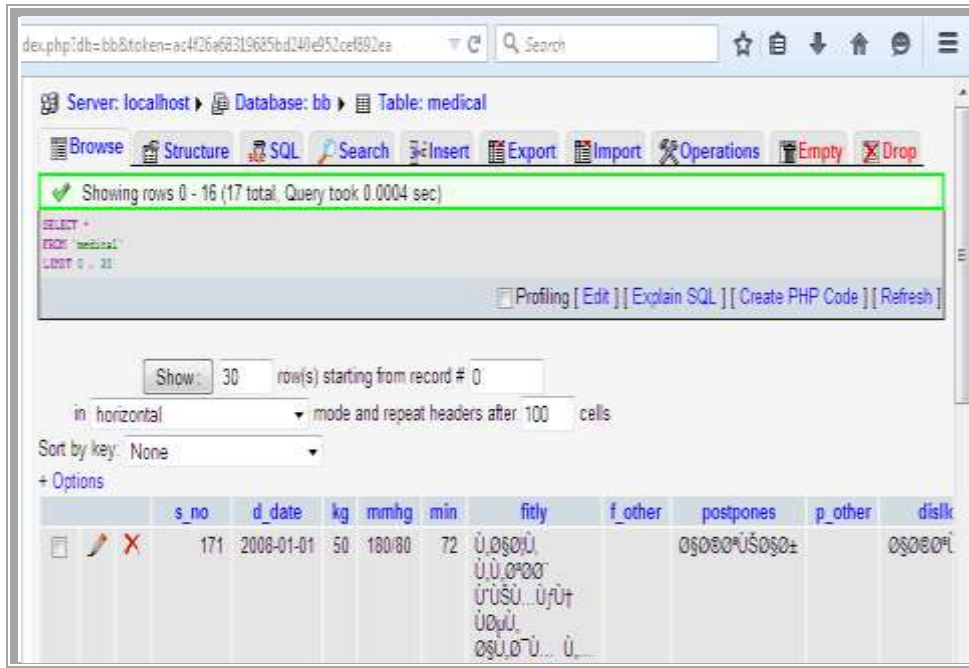
Figure 4.13: database table for doctor
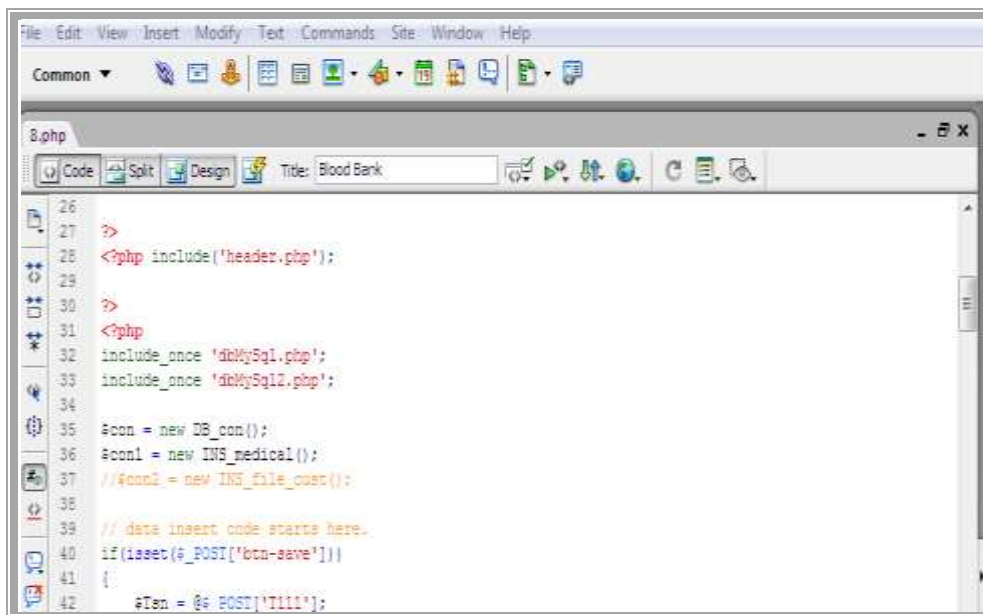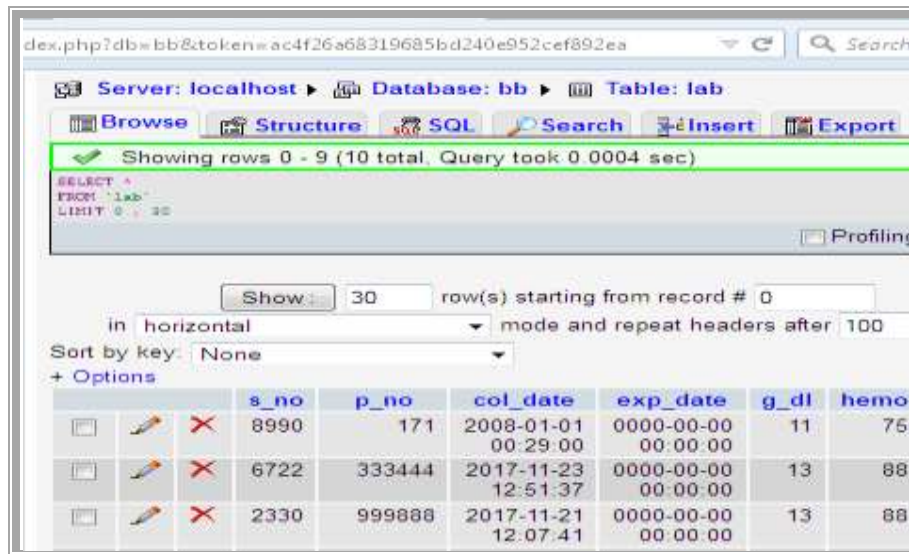
Figure 4.14: PHP code for doctor screen.

4.5.4Fitness:

This module focus on laboratory examinations such as blood group and test 0f hemoglobin, the user is also given his own username and password, he can add examination result which in turn saved in a bar code as sample number and can be send to the next modules, the user can also report daily activities ,and logout.

The database creation table contain the information about blood group, hemoglobin, bag number, and serial number.

Figure 4.15: database table for fitness screen

Figure 4.16: PHP code for fitness screen.

4.5.5 Component (or product):

The most important screen in blood bank, in which the information about blood components, dispatch, is inserted, the component screen mainly has three activities: the first activity is insertion of all details regarding to blood component after separation, the second activity is concerned on dispatching blood components to hospitals by recording the hospital and patient name and also record the component that will be given to patient with the quantity, the third activity is concerned about returning components from hospitals and adds it again to the stock. This module gives an alarm message when components are expired. The user is given his own username and password.

Figure 4.17: database table for component screen

Figure 4.18: PHP code for component screen

4.5.6 Virology:

The critical screen in blood bank system, it concerned about the main four tests of blood which determine the transfusion of the blood, here test information about HIV, HBs, HBc, and Syphilis is inserted, the user is given his own username and password, he can add the results of blood tests and send it to the Quarantine module,and also report the daily reports and logout.
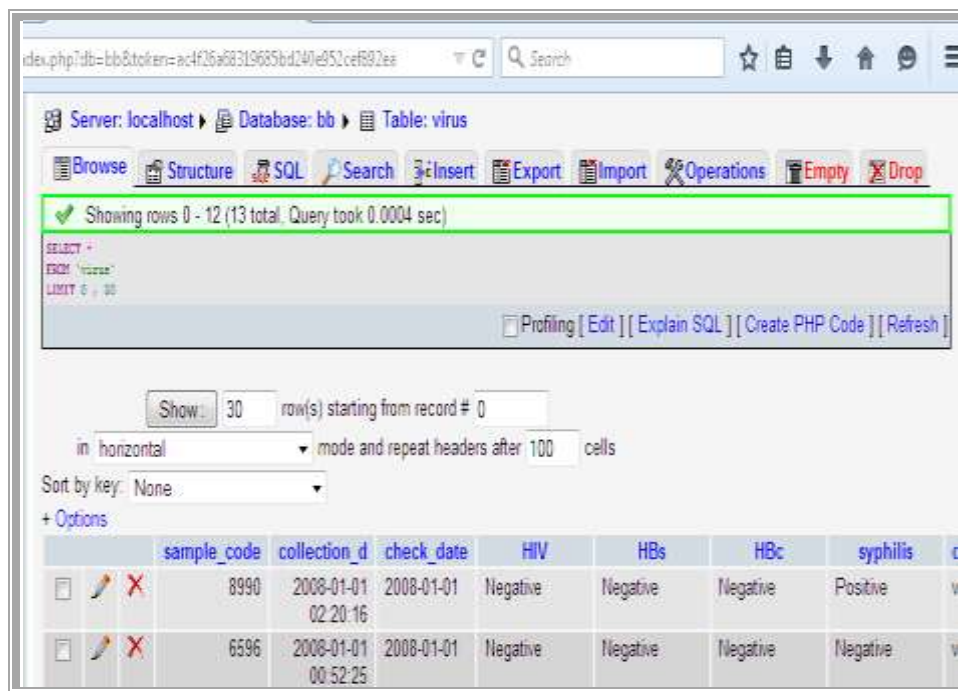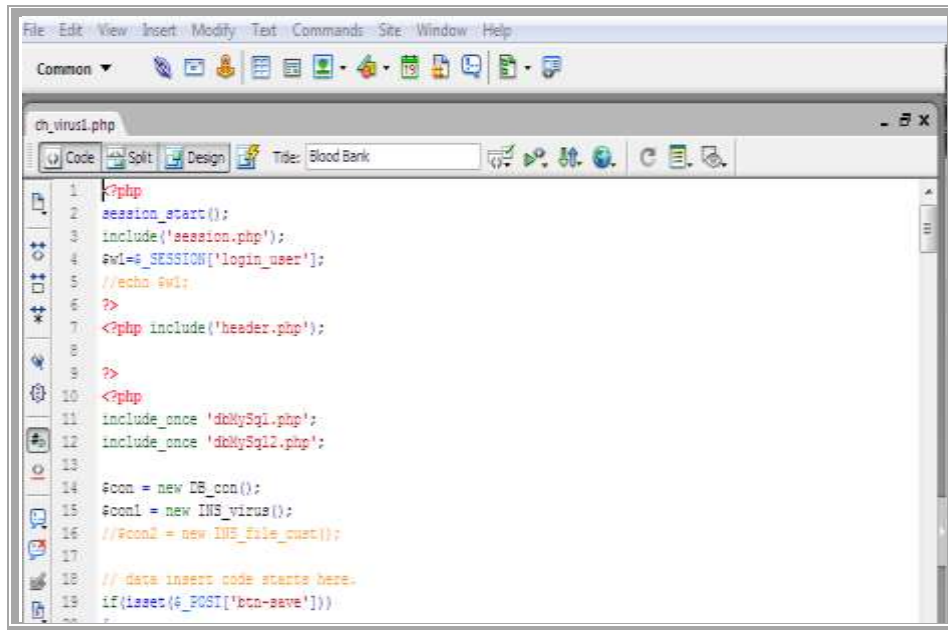
Figure 4.19: database table for virology screen.

Figure 4.20: PHP code for virology screen.

4.5.7 Quarantine:

This module focus on saving blood component before testing, it receive the test's results from virology department and isolate the reactive and non-reactive bags and save reports. User has his own username and password and logout.

Here each blood component is given a number in database, the expired data is saved also, user can delete the expired components.
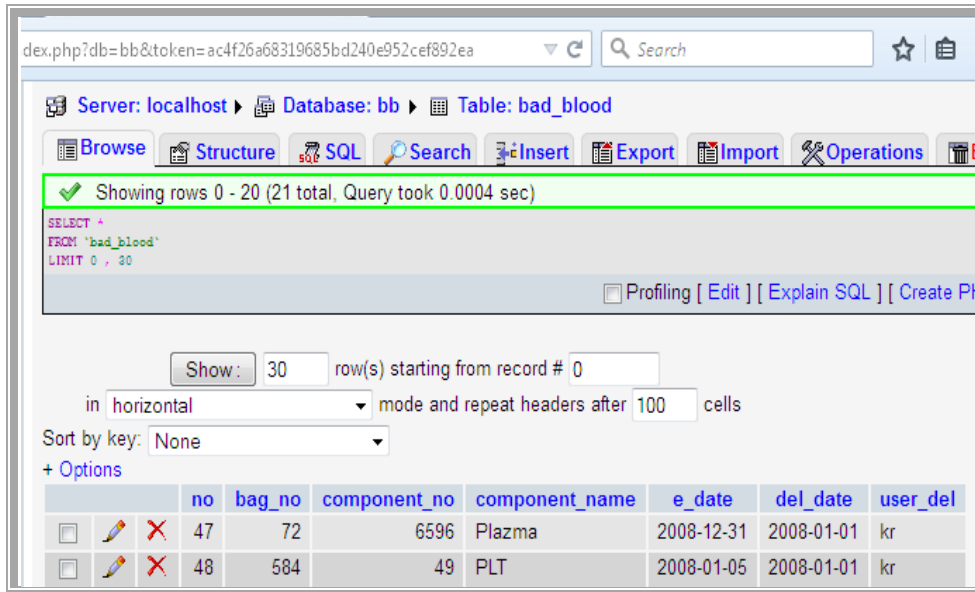
Figure 4.21: database table for quarantine screen
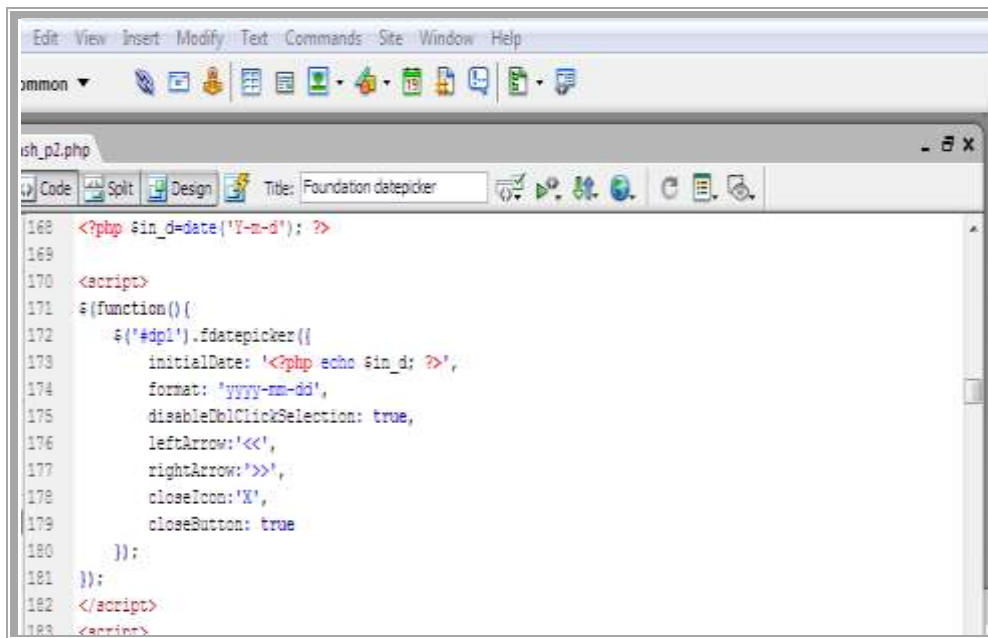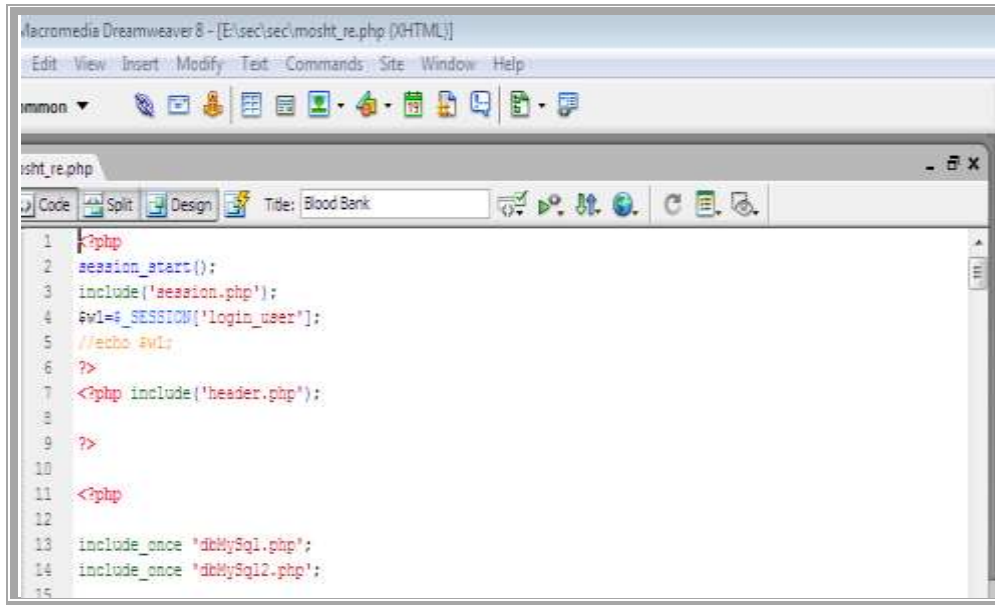
Figure 4.22: PHP code for quarantine screen

4.5.8 Serology:

This module focus on cross matching tests before dispatching units to patient, the user is given his username and password , add cross matching result, repot and log out.

Figure 4.23: PHP code for serology screen.

The computerized central blood bank management system has been obtained after sequence of steps that can be conclude in collecting data from blood bank about donorand blood. The gathering data was evaluated and analyzed , then the needed information was obtained to be an inputs of the system.

The system was created by using programming langue PHP , and My SQL database to save all data.

All results shown in the next chapter was produced by code in php, as it will be described in the next chapter.

Chapter Five

Results and Discussion

Chapter Four

Results and Discussion

5.1 System Layout:

Based on information analysis, modules divisions, database creation tables, php code, that mentioned in the previous chapter, the system results in the following screen's layout:

5.1.1 Login screen layout:

The first result screen of the proposed system is a login screen that enable user to access to his account in a department. User is made to enter the username and password, and then the entered values are verified. If it is a valid username and password, then the user is logged in, else they are asked to reenter the correct values, so the real result of the system is an authentication, keeping of privacy and safety of users.

Figure 5.1: User login screen

5.1.2 Admin screen layout:

As it was mentioned in chapter three admin screen maintain all blood bank screens , that the admin can add or remove or even modify other users, therefore the second result of the system is to make easy of controlling all department in one screen, the layout of screen is shown in the following figure:

Figure 5.2: Admin screen control

5.1.3 Data entry:

The most important result of the system is to make easy of entering donor data, which was very complicated when it compared to manual system, here the system save all essential information about donor, check error of recording and send the result to next step, which mean decreasing of work time. The layout of data entry screen has been divided into five sub-screens as it illustrated in the next figures:

5.1.3.1 Data entry-Essential information screen layout:

The essential information about donor is entered in this screen, the donor is given a serial number that identify him as a first step in order to move to the next sub-screen:

Figure 5.3: Data entry-essential information screen

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5.1.3.2 Type of donation screen layout:

The donation can be voluntary or in favor of patient, donor has the right to choose the type of donation either to be a regular voluntary donor or just for one patient, the result screen layout is as follows:

Figure 5.4: Data entry- type of donation screen

5.1.3.3 Commitment screen layout:

Donor must confirm if he wish to know the test's result or not.

Figure 5.5: Data entry –commitment screen

5.1.3.4 Disease history screen layout:

Donor must answer this questions before seeing the doctor, the answers determine if donor can move to the next step or not, as it illustrated below:

Figure 5.6: Data entry-disease history screen

5.1.3.5 Application formscreen layout:

After completing all required information above the system show the following screen that includes the previous four screens, the data her is saved in system and sent to the doctor screen.

Figure 5.7: Application form screen

5.1.4Doctor screen layout:

The key result of the system is to verify the right information in each step to avoiding error, here the doctor enter the serial number of donor, if its right the system show all donor details that saved in data entry screen, else, the system show no result, and doctor can make sour of the entering number.

Figure 5.8: Doctor Screen

5.1.5 Fitness screen layout:

The desired result of system is the creation of bar code that saves the important information about donor which needed to complete the donation process, and essential to save patient life.

Here the system verify the serial number and suggest a sample number that contain the main information needed to save in a bar code.

Figure 5.9: Fitness screen

5.1.5.1Creation of bar-code:

The creation of the bar code is shown here, it save the following data of donor which can be read by the QR code reader.

Figure 5.10: Fitness report screen

5.1.6Component screen layouts:

Another important result of the system is manifest in the component screen, the system show all available blood groups with quantities and with component separately, and gives alarm if one of the components is expired.

Figure 5.11: component screen-main screen

The separation of blood components is shown here:

Figure 5.12: components screen- separation of blood components

The dispatchingof blood is shown here:

Figure 5.13: component screen-dispatching of blood.

5.1.7Virologyscreen layout:

The critical screen in the system which include the test results of blood which is sent automatically to the quarantine screen.

Figure 5.14: virology screen

5.1.8 Quarantine screen layout:

The most important result of the system is shown in quarantine screen, here the system show the total of all blood bags, and determines which is reactive or non reactive automatically based on virology test result.

Figure 5.15: Quarantine screen

5.1.9Serologyscreen layout:

The final result screen of the system is a serology screen which includes the compatibility test result before sending of blood to the patient.

Figure 5.16: serology screen.

The results of all previous screens enable to achieve many goals that mentioned in the beginning of the development that can be conclude in following points:

1. The system is able to save donor records for future references.

2. The system saves information about blood test results and gives permission to donate.

3. The system shows the stock in screen and updates it.

4. The system retrieves information about a particular donor or blood components by reading a bar-code in blood bag.

5. The system shows the expiratory of components and gives alarm when it gets expired.

6. The system saves time of work.

7. The system helps in minimizing human errors.

5.2   Discussion

A successful transition from paper based to electronic health record requires careful coordination, from selection and implementation to training and maintenance.

A prototype computerized central blood bank management system has been obtained after sequence of coordinated steps which result in turn in several specifications, these specifications was shown as screens.

The privacy screen is the main specification of the system that enable user to save their entered information.

Flexibility of system to add more users is important facility and benefit when using CCBBMS, this allow to share different sub units.

The computerized system creates an integration of information when all donor data, compatibilities of blood, virology blood tests and medical reports are saved in one database.

Allthe world is directed toward new technologies such as bar-code technique, this computerized system use the bar-code technique to ensure and guarantee of every information entered to the system to avoid errors.

From the point of view, the computerized system has a positive share in time wise by minimize time of work, and economic wise byminimize the number of staff and manpower, moreover from the efficiency wise it is easy to use and security of data is enabled, as well as real management of donor and blood.

The goal of this research is met by designing blood bank management information system that maintain all donor records blood details by using a software that provide an easy access to donor record and blood stock and save the data

On the other hand, people have to move from paper based to electronic base to avoid all challenges, minimize errors and to follow technology development.

Chapter Six

Conclusion and Recommendations

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Conclusion and Recommendations

6.1Conclusion:

Computerized central blood bank management system CCBBMS is a system that used to manage and control all activities in blood bank departments. The systems save all donor records, blood information, testing results, distribution of blood to hospitals, discarding of bad blood and create medical reports.

The implementation of the computerized management systemwas done in many steps: firstly the data about donor and blood has been collected by visiting the national blood transfusion center in Khartoum, then the gathered data was analyzing and the needed information was extracted.

The system was designed by creating a database using My SQL and connects with PHP programming language code which results in system screens layout.

The barcode technique was used in the system and the system was able ti create a barcode that save the essential information. Another technique QR code reader was used to read the barcode.

The system results in meeting the user requirements, it was evaluated by member of blood bank staff and gives a reasonable acceptance.

In general, this project designs only a prototype of central blood bank management system focus on the main departments of blood bank.

CCBBMS has flexibility to modify to meet all needs and extend to cover other departments that not cover here.

6.2 Recommendations:

After designing of the prototype computerized central blood bank management system and implement of essential procedures of blood donation, fulfilling of some objectives that shown in the system results, there are many points that recommends to do in future works in order to go ahead to extend the idea and achieve real solutions in blood transfusion that save human life.

It is recommended to extend this system in the future to include other blood bank departments that are not covered here.

It also recommended to connecting various hospitals with central blood bank in a one central database.

It is recommended to train all staff of blood bankhow touse the computerized system and other technologies.

It is recommended to conduct many projects and researching in blood bank in several scopes to reach real goal in medical services delivery.

It is recommended to add a statistical analysis of data in the system.

It is recommended to use an expert system.

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