KIGALI INDEPENDENT UNIVERSITY ULK

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

P. o Box: 2280 KIGALI

TOPIC: ONLINE BLOOD TRANSFER MANAGEMENT SYSTEM

Case study: PRINCE REGENT CHARLES HOSPITAL IN BURUNDI

Done by:

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DECLARATION

I, NIYONSABA Violette, hereby declare that this work entitled "Online Blood Transfer Management System "Submitted in partial fulfilment of the requirement for the award of Bachelor's degree in computer science, is our original work and has not been presented for other University

Student Name.....

Date.....

Signature.....

APPROVAL

This dissertation entitled “Online Blood Transfer Management System’’ has been done under my supervision and submitted for examination with my approval.

Supervisor Name: ……

Date: ……/……/……

Signature: …….. .

DEDICATION

With Genuine Gratitude,

We dedicate this Research Project

To Our parents and Siblings,

To the family of BARIGORA Alphonse,

To all our friends and relatives

To All Lecturers and our colleagues at ULK

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Table of Contents

LIST OF TABLE

LIST OF ILLUSTRATION OR FIGURE

ABBREVIATIONS AND ACRONYMS

CSS: Cascading Style Sheet

DBMS : Database Management System

DFD: Data-flow diagrams

DP: dynamic programming

EHRs: Electronic Health Records

EMD: External Hard

ERD: Entity Relationship Diagram

HTML: Hyper Text Markup Language

IT: Information Technology

JS : JavaScript

LIMS: Laboratory Information Management Systems

OBTMS: Online Blood Transfer Management System

PDF : Portable Document Format

PHP**:** Hypertext Preprocessor

PRCH: Prince Regent Charles Hospital

RAM: Random Access Memory

SDLC: Software Development Life Cycle

SQL : Structured Query Language

SRS : Software requirements specifications

SSADM: Structured System Analysis and Design Method

ULK: Kigali Independent University

UML : Unified Modeling Language

UP : Unified Process

ABSTRACT

Effective blood transfer management is critical to preserving lives and guaranteeing prompt access to vital resources in the field of medicine. A computerized platform called the Online Blood Transfer Management System (OBTMS) was created to improve and expedite blood transfer procedures between blood banks, hospitals, and patients.

OBTMS makes it easier to track and manage blood inventory in real-time, allowing blood banks to keep enough supplies on hand and handle requests quickly. Hospitals can use an intuitive interface to submit blood requests, including the kind and quantity needed. The requests are subsequently forwarded to the closest blood transfer facility that has the appropriate inventory. The system's automated alerts make sure that all parties involved in the blood transfer process are informed on time.

It also provides a safe, centralized database for the storage of transfusion records, blood test results, and donor information, improving accountability and transparency in blood management procedures. By streamlining blood transfusion services and maximizing resource use, OBTMS uses technology to improve patient outcomes and healthcare efficiency.

Key Words: **Online, Blood, Transfer, Management, System**

CHAPTER ONE: GENERAL INTRODUCTION

1.1 Background of the Project

The Prince Regent Charles Hospital (PRCH)is a gift from Prince Regent Charles of Belgium, a colonizing country of Burundi. It was offered in 1949 after two years of construction to help the indigenous people gain access to care. It was a public hospital until 1992 when it became a Custom Administration of the State (APE) with management autonomy entrusted to a team of directors acting under the supervision of the Board of Directors (Smith, J. , 2023).

From 1949 to 1990s, Prince Regent Charles Hospital utilized manual record-keeping methods for blood management, including paper records, handwritten logs, and inventory checks, requiring significant time and effort. And from 1990s to 2000s: Basic digital systems are introduced, marking the initial transition from manual to digital record-keeping (HealthIT.gov, 2022).
Hospital Prince Regent Charles begins using early computer databases to store information related to blood inventory and transfusions.

Online Blood Transfer Management System (OBTMS) is a sophisticated web-based platform designed to streamline and enhance the process of transferring blood from blood banks to hospitals or other medical facilities. OBTMS utilizes advanced technology to automate various aspects of the blood transfer process, ensuring efficient and timely access to blood supplies for patients in need. OBTMS, a blood bank management system, includes User Authentication and Access Control, enabling authorized users like administrators, staff, and donors to securely access the system (Dabrowski, 2020).

Request Management of Hospitals or medical facilities can place requests for specific blood types through the system. These requests are processed and matched with available blood units in nearby blood banks. Automated Matching Algorithm of OBTMS employs an automated matching algorithm to identify suitable blood units based on the requested blood type, quantity, and other relevant factors. This ensures quick and accurate matching of blood supply with demand. Reporting and Analytics of the OBTMS generates reports and provides analytical insights into blood inventory levels, donation trends, transfer efficiency, and other performance metrics. This data can be used to optimize operations and resource allocation (Kaur, 2019).

The OBTMS prioritizes data security and regulatory compliance, ensuring patient confidentiality and blood safety protocols. Robust encryption methods and access controls are implemented to safeguard sensitive information.

The Online Blood Transfer Management System (OBTMS) significantly enhances the efficiency, transparency, and reliability of blood transfusion processes, leading to improved healthcare outcomes and patient care (Hospital Prince Regent Charles, 2022).

1.2 Problem statement

The problem statement for implementing an Online Blood Transfer Management System (OBTMS) could be articulated as follows: "In healthcare facilities of the Hospital Prince Regent Charles, including hospitals, clinics, and blood banks, the process of managing blood transfusions faces significant challenges. Manual and paper-based systems for tracking blood inventory, managing donor information, and coordinating blood requests often lead to inefficiencies, delays, and errors in the transfusion process. These inefficiencies can compromise patient safety, result in wastage of valuable blood resources, and contribute to suboptimal healthcare delivery. There is a critical need for a modern, automated solution that can streamline blood transfusion management, and allocation, enhance communication between healthcare facilities and blood banks, and ultimately ensure timely and safe blood transfusions for patients in need.

This problem statement captures the broader challenges faced by healthcare facilities in managing blood transfusions and underscores the necessity for an Online Blood Transfer Management System (OBTMS) to address these challenges comprehensively and effectively (Mushtaq, 2020).

1.3 Objective of project

The objective of the online blood transfer management system is to efficiently connect blood donors with recipients, streamline the process of blood donation, and ensure timely and secure transfer of blood units to those in need, ultimately saving lives through effective coordination and communication**.**

1.3.1 General Objective

The general objective of the online blood transfer management system is to facilitate the seamless exchange of blood donations between donors and recipients, enhancing accessibility and efficiency in blood transfusion services.

1.3.2 Specific objectives

i. To develop a user-friendly platform for donors to register.

ii. To implement a robust research and matching algorithm to swiftly connect donors with recipients.

iii. To establish secure channels for communication and coordination.

iv. To incorporate tracking features to monitor the status of blood donations from collection to delivery, ensuring transparency and accountability throughout the process.

V. To provide comprehensive reporting tools to analyze donation trends, optimize resource allocation, and enhance the overall efficiency and effectiveness of online blood transfer management.

1.4 Research Questions

Research questions related to an Online Blood Transfer Management System (OBTMS) may vary depending on the specific context and goals of the research. However, here are some example research questions that could be explored:

i.How can we develop a user-friendly platform that allows donors to easily register and manage their information?

ii.How can we implement a robust research and matching algorithm to efficiently connect donors with recipients?

iii. How can we establish secure communication and coordination channels to ensure confidential?

iv. How can we incorporate tracking features to monitor the entire process of blood donations, from collection to delivery, ensuring transparency and accountability at every stage?

v. How can we provide comprehensive reporting tools to analyze donation trends, optimize resource allocation, and improve the overall efficiency and effectiveness of online blood transfer management?

1.5 Scope of the project

The "Hospital Prince Regent Charles" online blood transfer management system will be tailored to the hospital's needs, facilitating donor registration, blood inventory tracking, appointment scheduling, and real-time notifications. It aims to enhance efficiency and reliability in blood transfusion services, ensuring seamless coordination between donors, recipients, and the hospital's blood bank, ultimately improving patient care.

1.5.1 Content scope

The Online Blood Transfer Management System (OBTMS) is an innovative solution designed specifically for Hospital Prince Regent Charles to streamline and optimize the blood donation, collection, and distribution process. With a user-friendly digital platform, the OBTMS aims to enhance efficiency, improve patient care, and ensure timely access to blood units for those in need.

Donor Registration: The system will allow individuals to register as blood donors, providing necessary personal information and medical history. Donors can update their profiles, ensuring accurate and up-to-date records.

Blood Inventory Management: Hospital staff can efficiently manage blood inventory, including storage, categorization, and expiry date tracking. Real-time updates on blood availability will be provided to ensure adequate supply.

Appointment Scheduling: Recipients can schedule appointments for blood transfusions through the online platform, reducing waiting times and enhancing patient convenience. The system will prioritize appointments based on urgency and blood availability.

Real-time notification: Automated notifications will be sent to donors, recipients, and hospital staff regarding appointment confirmations, blood availability, and other relevant updates. This feature ensures timely communication and improves coordination.

Secure Data Handling: The OBTMS will prioritize data security and confidentiality, implementing robust encryption protocols and access controls to protect sensitive information. Compliance with healthcare data regulations will be ensured.

1.5.2 Geographical scope

The geographical scope of the Online Blood Transfer Management System (OBTMS) at Hospital Prince Regent Charles encompasses the local area surrounding the hospital, including nearby neighborhoods and communities within a radius of approximately 50 kilometers in Burundi. This area typically constitutes the primary catchment area for the hospital's patient population and blood donation pool. However, the system's reach may extend further based on transportation infrastructure and regional healthcare networks, facilitating blood transfusion services for a broader population as needed. It aims to address blood transfusion needs in urban centers as well as remote rural areas of Burundi. The OBTMS will primarily focus on coordinating blood donation, collection, and distribution within this defined geographical scope, ensuring efficient and timely access to blood units for patients in need while adhering to local regulatory requirements and healthcare standards.

1.5.3 Time scope

The study aims to use data from 2017-2023 to develop an online blood transfer management system for Prince Regent Charles Hospital in Burundi. The hospital has seen a significant rise in blood transfers, underscoring the need for an efficient, user-friendly system. This project will focus on improving real-time tracking and management of blood transfers. Data generated between 2017-2023 will play a key role in designing the system. The time scope of the project includes integrating this information into the hospital's processes. The system is designed to streamline operations and enhance service deliver.

1.6 Project Methodology

The project will utilize an agile methodology, emphasizing iterative development, collaboration, and adaptability to meet evolving requirements efficiently. It will involve sprints, daily stand-up meetings, and regular feedback cycles to ensure continuous improvement and timely delivery of the Online Blood Transfer Management System.

1.6.1 Software Development Methodology

Agile methodology prioritizes iterative development, collaboration, and adaptability, enabling quick responses to changing requirements and delivering incremental value to stakeholders. It emphasizes close customer involvement, frequent iterations, and continuous feedback loops, fostering transparency and flexibility throughout the development process.

1.6.2 Tools and Technology

1.6.2.1 Documentation

The documentation for the Online Blood Transfer Management System encompasses user manuals, technical specifications, and installation guides to aid users and administrators in understanding, operating, and deploying the system effectively. It also includes training materials, support documentation, and compliance guidelines to ensure smooth implementation, user training, and adherence to regulatory requirements, fostering efficient blood transfer processes and enhancing patient care (Gusev, 2020).

1.6.2 .2 Telephone interview

Telephone interviews are chosen for online blood transfer management due to their reliability, accessibility, cost-effectiveness, technical issues, privacy, and comfort, ensuring clear and efficient communication for managing critical details.

1.6.3 System Analysis and Design Method

Structured System Analysis and Design Method (SSADM) is a systematic and disciplined approach to analyzing and designing information systems. It begins with a thorough analysis of the current system and user requirements through techniques such as data flow diagrams (DFDs), which map out the flow of information within the system. The analysis phase also involves creating an entity-relationship diagram (ERD) to model the system's data structures and relationships. In the design phase, these models are transformed into detailed specifications for the new system, including logical data models and process descriptions. SSADM emphasizes a top-down approach, breaking down complex processes into simpler, more manageable components. This method ensures a clear, comprehensive understanding of the system's functionality and data requirements, promoting consistency, accuracy, and a well-defined pathway from analysis to implementation. By focusing on rigorous documentation and phased

development, SSADM helps in creating reliable, maintainable, and well-structured information systems.

1.7 Interest of the project

The online Blood Transfer management system holds significant importance and generates interest due to several reasons for example:

I.7.1 Personal interest

Our profits us a Person who develop an Online Blood Transfer Management System (OBTMS) various valuable gains of technical skills are significantly enriched. They are deep into designing and coding a complex system, enhancing their expertise in web development, databases, security protocols, and system integration. That the project is developing a technology-driven platform to enhance the blood supply chain, thereby significantly improving healthcare.

It's a testament to our commitment to leveraging innovation for the greater good. Community Impact: The OBTMS has the potential to touch the lives of every member of our community. Whether as a patient in need, a donor eager to give back, or a healthcare professional striving to deliver the best care possible, this project unites us in a common purpose – to support and uplift one another. the interest of the Online Blood Transfer Management System lies in its ability to bring hope, healing, and humanity to healthcare. It embodies our collective commitment to making a positive impact in the world, one blood transfusion at a time. As we embark on this journey, let us remember the lives we'll touch and the difference we'll make – that's what truly makes this project invaluable.

1.7.2 Institutional interest

The implementation of the Online Blood Transfer Management System (OBTMS) resonates deeply with our institution's core values and commitments. Enhanced patient care: At the heart of our institution lies a dedication to providing exceptional patient care. The OBTMS aligns seamlessly with this commitment by ensuring timely access to critical blood transfusions for our patients. By streamlining the transfusion process and optimizing blood inventory management,

we can elevate the standard of care we provide, ultimately improving patient outcomes and satisfaction. Efficiency and resource optimization: Operational efficiency is paramount in delivering high-quality healthcare services. The OBTMS offers a robust solution for optimizing resource utilization within our facility. By implementing real-time inventory tracking and appointment scheduling functionalities, we can minimize wastage, reduce administrative burdens, and allocate resources more effectively, thereby enhancing operational efficiency and cost-effectiveness. Community engagement and partnership: Our institution is deeply rooted in the community we serve, and the OBTMS presents an opportunity to strengthen these bonds further. By providing a user-friendly platform for blood donation and engagement, we can foster a sense of community responsibility and partnerships. Commitment to technology Innovation: As a forward-thinking institution, we are committed to embracing technological innovation to improve healthcare delivery. The OBTMS represents a significant stride in this direction, harnessing the power of digital technology to revolutionize blood transfusion services. By investing in cutting-edge solutions like the OBTMS, we demonstrate our dedication to staying at the forefront of healthcare innovation and providing our patients with the best possible care.

Alignment with Regulatory Compliance: Ensuring compliance with healthcare regulations and standards is a top priority for our institution. The OBTMS is designed to meet and exceed regulatory requirements, safeguarding patient data, maintaining confidentiality, and adhering to industry best practices. By implementing a robust system like the OBTMS, we can ensure compliance while delivering seamless and secure blood transfusion services to our patients

1.7.3 Public interest

The Online Blood Transfer Management System (OBTMS) piques public interest by offering a seamless platform for individuals to contribute to lifesaving efforts through blood donation. By providing easy access to donation opportunities and promoting awareness, the OBTMS encourages community involvement in healthcare. Its transparent and efficient process for blood transfer fosters trust among donors, recipients, and the public, inspiring confidence in healthcare systems. Additionally, the system's ability to improve patient care and save lives resonates with individuals on a personal and emotional level, driving further interest and support. Overall, the OBTMS serves as a unifying force, rallying communities to come together for a common cause and make a meaningful impact on public health.

1.8 Limitations of the project

This research study focuses on the development and implementation of the Online Blood Transfer Management System (OBTMS) but does not include the actual blood collection or transfusion processes. Blood donors and recipients are not direct users of the system, as their information will be entered by blood bank receptionists. While the OBTMS offers various benefits, such as streamlining blood transfer management, it is important to recognize its limitations to manage expectations and mitigate risks effectively. The challenges include the system's dependence on technology infrastructure, which could disrupt services during technical failures, and user adoption, as some may resist the transition due to concerns about privacy or lack of technological proficiency. Additionally, the OBTMS faces risks related to data privacy and security, resource constraints for implementation and maintenance, integration issues with existing healthcare systems, and regulatory compliance. Geographical factors, such as infrastructure limitations in remote areas, could also affect the system's effectiveness in providing equitable blood transfusion services across diverse regions.

1.9 Organization of the project

There are four chapters in the online tourism system recording and analysis research project:

- the first chapter contains a general introduction to the study, the study's background, The problem statement, the project's motivation objective, the methodology used and Requirements collection techniques, the scope of the project, and the expected results.
- The second chapter is the study's requirements analysis, which highlights in detail the Analysis of the existing information system's current position, the descriptions of the models, and the weaknesses of the existing system, as well as define the requirements of the new system, functional and non-functional requirements, use-case specifications, logical data model, system overview, and benefits of the proposed system.
- the third chapter describes the study's system design, high-level architecture, module Description, and solution design. Describing the new system's process model, physical data

Model, class diagram, use-case diagram, and user interface diagram.

● the fourth chapter discusses the study's system implementation, the technologies used To develop the system, coding, and testing of the new system.

● The last contains the project's conclusion and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.0. Introduction

The literature review for the Online Blood Transfer Management System (OBTMS) explores existing research, studies, and publications related to blood transfusion management, healthcare technology, and system implementations. By examining peer-reviewed journals, conference proceedings, and relevant academic sources, the review aims to identify best practices, emerging trends, and potential challenges associated with similar projects. Additionally, it analyzes case studies and success stories of comparable systems to glean insights into effective implementation strategies and lessons learned. The literature review serves as a foundation for understanding the current state of knowledge, gaps in research, and opportunities for innovation in the field of blood transfusion management systems. It provides a comprehensive overview of the theoretical framework and practical considerations that inform the development and implementation of the OBTMS, guiding future research and decision-making processes (Tchoukou, 2021).

2.1 Definition of concepts

In the context of this project, the following key concepts related to online Blood Transfer management are defined.

2.1.1 Transfer Management

Donor Registration: Process whereby individuals provide personal and medical information to become eligible blood donors via the online platform. Inventory Management of the Systematic control and tracking of blood units, including storage, categorization, and expiry date monitoring, facilitated through the online system (Vaidya, 2020).

Blood bags are designed for the collection, processing and storage of whole blood and blood components They help in providing aseptic conditions for the separation of blood components. It acts as a closed system reducing the chances of contamination (Mohan, 2019).

Blood bank is a place where blood bag that is collected from blood donation events is stored in one place. Which refers to a division of a hospital laboratory where the storage of blood product occurs and where proper testing is performed to reduce the risk of transfusion related events (Singh S. &., 2018).

Donor is someone who gives a part of their body or some of their blood to be used by doctors to help a person who is ill.

Transfusion: transfusion is done as a lifesaving maneuver to replace blood cells or blood products lost through severe bleeding. Transfusion of one's own blood (autologous transfusion) is the safest method, but it requires advanced planning, and not all patients are eligible (BSSSB Hospital, 2020).

2.1.2 Blood Transfer

Blood Transfer: The process of safely transporting donated blood from the donor to the recipient through established protocols and logistical arrangements. Transfusion of the medical procedure involving the transfer of blood or blood components from a donor to a recipient for therapeutic purposes (Das, 2020).

2.1.3 Management System

Management system: A structured approach or framework designed to organize, coordinate, and oversee activities, resources, and processes within a specific domain.

Efficiency: Aiming to optimize resource utilization, streamline operations, and achieve predetermined objectives or goals effectively (Kumar, 2017).

Control: Providing mechanisms for monitoring, evaluation, and adjustment to ensure alignment with desired outcomes and continuous improvement (Nguyen, 2018).

2.1.4 Application Submission

Application Submission: The process of submitting completed forms or documents through an online platform for consideration or processing (Wu, 2019).

2.1.5 Review and Approval

Review and Approval: it Utilizing automated systems to expedite the review and approval process for blood donation applications, ensuring timely responses and enhancing donor satisfaction (Singh A. e., 2018).

2.1.6 Tracking and Monitoring

Tracking and Monitoring: Implementing a system for real-time tracking and monitoring of blood units from donation to transfusion, ensuring transparency, efficiency, and safety throughout the blood supply chain (Dias, 2020).

2.1.7 Communication and Collaboration

Communication and collaboration: it Utilizing digital platforms to facilitate seamless communication and collaboration among blood banks, hospitals, and donors, ensuring timely coordination and resource optimization (Zhang, 2021).

2.1.8 Compliance and Reporting

Compliance and Reporting: Employing digital solutions to ensure adherence to regulatory standards in blood transfer processes, while generating comprehensive reports for auditing and monitoring purposes, enhancing regulatory compliance and transparency (Rafique, 2020).

2.1.9 other terms definition:

- ✓ **Visual Studio Code**: a redesigned and enhanced code editor for creating and debugging contemporary online and cloud apps.
- ✓ SQLite: a SQL database engine that is compact, quick, self-contained, highly reliable, and feature-rich is implemented in a C language library
- ✓ HTML: Hypertext Markup Language, the basic function is creating web pages. The goal of the web browser is to read the documents as web pages; and it is also possible to include scripts written in several languages, such as JavaScript, which an impact on the behavior of web pages (Freeman, 2018) .
- ✓ PHP: A scripting language that is integral part of HTML to add functionality that native HTML is unable to do. Originally designed for web development to produce dynamic web pages, “PHP allows you to collect processes and utilize data to create a desired output (Gottfried, 2020).

- ✓ MySQL: A database system, queries, and features easily paired with PHP because it works side by side with ease. Uses MSQL to store many kinds of data, information and graphics. Also it is easily accessible from anywhere in the world (Williams, 2019).
- ✓ JavaScript: A programming language developed for the design of interactive sites and creating web applications. JavaScript can interact effectively with HTML source code, enabling web authors access to their sites with dynamic content (Resig, 2021) .
- ✓ CSS (Cascading Style Sheets) is a style sheet language used for describing the presentation of a document written in a markup language such as HTML (including XML dialects such as SVG, MathML or XHTML) (Kramer, 2022).

2.2. Other points relate to Literature

2.2.1 Introduction

The constituents of blood, referred to as blood products in this context, comprise whole blood, frozen blood, blood plasma, blood cells, and blood platelets. These parts can all be consumed. The blood products listed above are examined in this research. In this review, white blood cells or other elements are no longer protected. Red blood cells make up the majority of the frozen blood. Few studies consider using fresh-frozen plasma, and none address the use of frozen blood (Ericson et al. Since frozen pink blood cells are the most vital blood product, we are sensitive to the problems with them. Even still, it is reasonable to assume that this is a utilitarian approach to categorizing the research because the majority of publications are explicit about the blood merchandise they are examining (Powers, 2020).

2.2.2 Whole blood

All the components of blood necessary for maintaining homeostasis and transporting oxygen are present in whole blood, albeit in almost physiological concentrations and ratios. It is possible to keep whole blood refrigerated for up to 35 days. It combats or stops illness infections. WBCs, or white blood cells, produce antibodies to build immunity against pathogens. Although it needs to be supplemented with certain blood products, coagulation factors, etc., it has a sufficient hemostatic capacity. When fully tried, whole blood or blood segments are unreachable and the need for transfusion is dreadful. However, whole blood can be collected from blood donors in a mobile blood donation center to provide viable stimulation. Accessible clinical data suggests that, when it comes to the restoration of dangerous discharge, whole blood is at least as good as segment treatment (Schmidt, 2021).

2.2.3 Red blood cells

The bone marrow, which produces red blood cells, has a 120-day half-life. In addition to transporting carbon dioxide and other waste products, it provides oxygen to various bodily regions. Their ability to carry carbon dioxide and oxygen is made possible by the hemoglobin found in it. Besides being a transport molecule, hemoglobin is a pigment as well (Choi, 2020).

2.2.4 Plasma

The fluid portion of blood is known as plasma, or blood plasma. Plasma serves as a medium via which nutrients are delivered to the cells of the various organs in the body and waste products that are absorbed by the cells are transported to the kidneys, liver, and lungs for expulsion. About 92% of blood's composition is water, 7% is made up of essential proteins like albumin, gamma globulin, antihemophilic factor, and other clotting factors, and 1% is made up of minerals, carbohydrates, fats, hormones, and vitamins. Additionally, it serves as a carrier for platelets and performs a fundamental function in maintaining a regular pulse. Heat is distributed throughout the body via plasma, which also maintains homeostasis (Ericson, 2019).

2.2.5 Frozen blood

Two crucial steps in the fractionation of plasma are freezing and thawing. Water makes up to 95% of the fluid component of blood plasma, but it also includes dissolved proteins, hormones, carbohydrates, electrolytes, clotting factors, and breathing gases. Plasma can be frozen and thawed to create concentrated solutions of specific plasma constituents, including clotting factors, for patient transfusion. This biological fluid is supplied to the red blood cells to shield them from the detrimental effects of freezing, which damage the cellular membranes. The effectiveness of freezing red blood cell stock preservation appears to be very low, and a biological fluid also suggests that the cells ought to be cleaned following thawing. These illustrations highlight the exorbitant costs. To fulfill this, nevertheless, a list of donors with unusual phenomena is maintained (Smith, 2021).

2.2.6 Blood platelets

The bone marrow produces platelets. Platelets have the job of stopping bleeding. Triple bag system is used for the manufacture of platelets concentrate. Compared to red blood cells and total blood, a relatively small number of publications are protected about blood platelets. Comparing platelets to other blood products, platelets have a fairly quick projected survival rate This outcome has likely changed both geographically and in terms of complexity. Owing to the problem's complexity, it fills a long-standing gap in the literature by introducing a novel technique to solving it. Write the problem of perishable inventory using the dynamic programming (DP) approach. The issue is that solving a realistic-sized DP model is incredibly challenging. In order to address this, they proposed a multi-step process that combined dynamic programming with simulation (Johnson, 2022).

CHAPTER THREE: SYSTEM ANALYSIS AND DESIGN

3.1 **Introduction**

The online blood transfer management system leverages analysis and design principles to optimize the blood donation process. It identifies user requirements, system functionalities, and designs an interface for donors, recipients, and medical staff. The system's architecture supports scalability and security, accommodating future needs and protecting an information. it enhances efficiency and reliability in blood transfusion services through structured and well-designed system solutions.

3.2 Analysis of the current system

The current system for blood transfer management at Prince Regent Charles Hospital in Burundi is largely manual, involving paper-based records and phone communication, which leads to inefficiencies and errors. making it challenging to maintain accurate records of blood stock levels, donor details, and transfusion history.

Donor recruitment and management are inefficient due to the lack of an integrated platform to streamline registration, eligibility verification, and communication. This results in delays in matching donors with recipients and managing urgent blood transfusion needs.

The manual system also poses significant challenges in terms of data security and privacy, as sensitive health information is stored in physical records that are vulnerable to loss or unauthorized access. Additionally, the absence of automated data analysis tools hampers the ability to forecast blood demand accurately and plan accordingly (Transfusion, 2020).

Overall, the current system is outdated, inefficient, and prone to errors, highlighting the need for a comprehensive, automated online blood transfer management system to enhance operational efficiency, accuracy, and security.

3.2.1 Problem of the current system

The hospital administrator mentioned that the blood transfer management system was facing significant challenges due to their reliance on manual, paper-based processes. They pointed out that the hospital lacked a centralized database for donor information, had difficulty tracking donor eligibility and donation history, and struggled with communication regarding donor schedules and requirements. It was also noted that modern technology was not being used effectively for data management and reporting.

3.3 Analysis of the new system

The proposed Online Blood Transfer Management System aims to streamline the communication and operations between the two key stakeholders: the donor and the patient (hospitals/clinics). This system will address the inefficiencies of the current manual processes and enhance the overall effectiveness of blood transfusion management at Prince Regent Charles Hospital. It introduces several features to enhance the efficiency and effectiveness of blood donation management. Here are four key aspects of the new system:

1. **User Registration and Login System**

The system provides a secure user registration and login mechanism. Users, including donors and recipients, can create accounts and log in to access their personalized dashboards. This ensures secure access to the system and helps in maintaining individual user profiles and data integrity.

2. **Donor and Recipient Management**

The system allows for efficient management of both donors and recipients. Donors can update their profiles, view their donation history, and schedule future donations. Recipients can register their need for blood, and the system can match them with suitable donors. This streamlined management improves the accuracy and reliability of the donor-recipient matching process.

3. **Donation and Blood Request Management**

The system automates the management of blood donations and requests. Donors can easily schedule donations, and hospitals or recipients can submit blood requests online. The system

tracks these activities in real-time, ensuring timely responses to blood needs and maintaining an accurate inventory of available blood types.

4. **Admin Dashboard for Management**

An admin dashboard provides comprehensive tools for managing users, donors, recipients, donations, and blood requests. Administrators can monitor the overall activity, approve or reject requests, manage inventory, and generate detailed reports. This central control point enhances oversight and decision-making capabilities, ensuring smooth operation and efficient management of the blood bank.

3.3.1 System requirements

The features of the Online blood Transfer Management request approval and analysis system include functional and non-functional requirements. Functional requirements are those requirements that are easier to be found at the beginning while Non-functional requirements are those that define the system properties and constraints.

3.3.2 Functional requirements

3.3.2.1 Hardware requirements

Computer desktop or a laptop with the following specifications:

i. RAM (Giga Byte Random Access Memory) of at least 2GB
ii. A CPU running at 2.0 GHZ (Giga Hertz)
iii. A minimum of 20GB of hard drive space
iv. An external hard drive (EMD) with about 20GB of memory for data backups

3.3.2.2 Software requirements

The software requirements are as follows:

i. The database's information is maintained using MySQL.
ii. PHP, HTML, and Cascading Style Sheet (CSS) are the primary front-end programming languages and tools.
iii. Windows XP or higher as the operating system
IV. An antivirus program for computers is software that guards produced files against corruption brought on by viruses and malware.

3.3.3 Non-functional requirements

Security: All passwords that are generated or accepted must be stored in a database in an encrypted form.

User friendly: The system must be user friendly, understandable and easy to use

Privacy: The system shall be able to protect the user's privacy.

Availability: The system should be available to all user 24 hours a day, 365 days a year. The system must be available 24 hours a day, seven days a week.

Performance: The system must have a quick performance and should be able to respond requests in a reasonable amount of time.

Accessibility: Users can access their results from any location (as long as they are within a network service reception area).

Recoverability: The system should be able to recover from any disturbance.

Environmental: The system should be able to run on an android operating system.

3.3.4 Functional Diagram

A functional diagram, also known as a system architecture diagram or a system flow diagram, provides an overview of the key components and how they interact in an online patient management system.

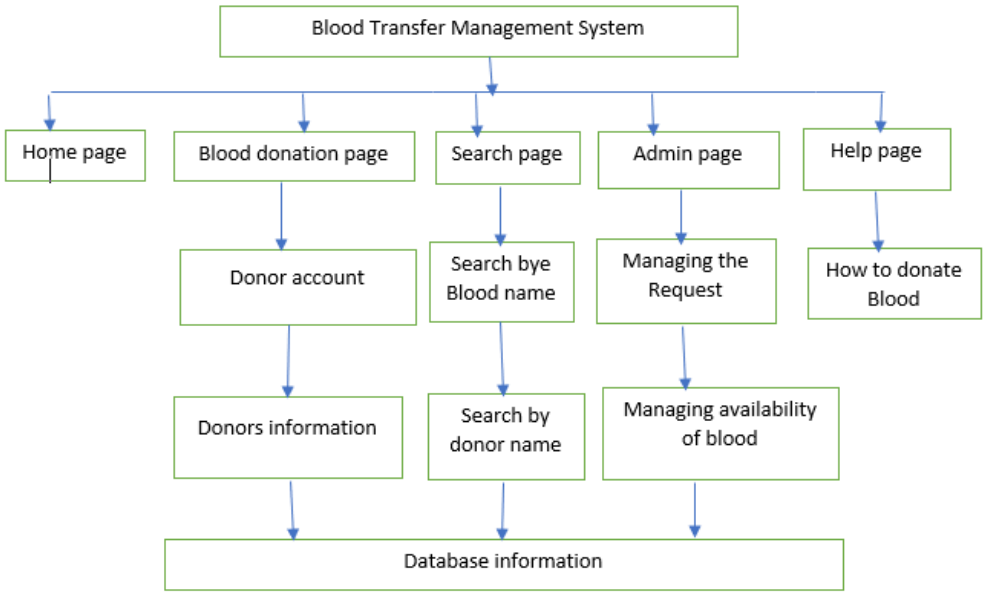


Figure 1:Function Diagram

3.4 METHODOLOGY APPROACH

3.4.1 Data Collection Technics

The project's success, accomplishment, and accuracy will depend on how authentic the data is and how many different ways and methods are used to collect it. The following methods of data collection will be employed for this research of the prince regent Charles hospitals in Burundi.

Observation

Careful observation of phenomena without attempting to modify them necessitates pertinent research and thorough examination. It has been discovered that observation is a helpful technique that enables researchers to witness occurrences directly and helps them determine the true status of the system they are studying.

Interview

Interview-based data gathering methods involve interactions between two or more people via a series of questions and responses. The researcher formulates the interview questions with the intention of eliciting information from interview subjects on a particular topic or range of topics.

3.4.2 **Software Development Methodology**

The formal, sequential phases involved in developing a software product are included in the Software Development Life Cycle (SDLC). Coding and programming address the issue that the current or planned application seeks to resolve, and it is an essential step in the process. Different approaches to the tasks and activities that take place during this phase are outlined by various models. Our software development process for the radio frequency identification attendance management system was based on the waterfall paradigm. Requirements, analysis, design, implementation, verification, and maintenance are the five phases of this sequential software development process. This model satisfied all of my particular needs, which is why I chose it (Pressman, Software Engineering: A Practitioner's Approach, 2020).

Waterfall model

The waterfall model is a sequential software development process that, like a waterfall, progresses continuously downward through the phases of requirement, analysis, design, implementation, verification, and maintenance. Each step begins only after the previous one is finished, tackles a distinct issue, and lacks a feedback loop. The waterfall model is a popular adaptation of the system development life cycle model used in software engineering.

The waterfall model's phase

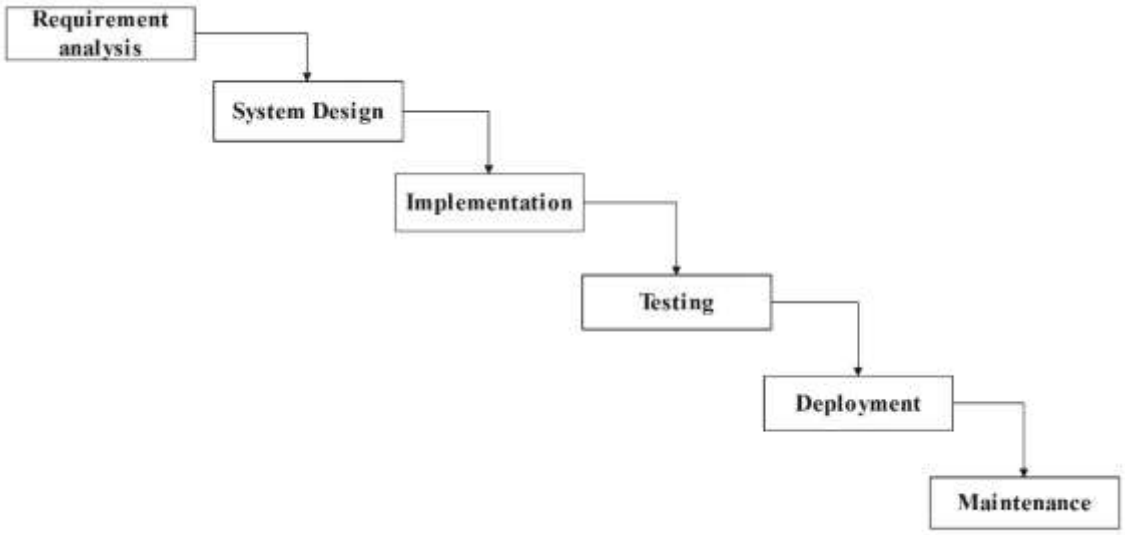


Figure 2: Waterfall model

The waterfall model is the most widely utilized, as was already said. Software design is greatly simplified by variants of this approach that permit some phases to overlap or incorporate feedback after each phase.

The waterfall model's phase description

- **Requirement analysis**

In this stage, all potential system needs are gathered and recorded in a requirement specification document (Sommerville, 2019).

- **System Design**

In this phase, the system design is created while the required specifications from the first phase are examined. System design aids in determining the overall system architecture as well as hardware and system requirements.

- **Implementation**

The system is initially built as small programs known as units with input from the system design and is then combined in the following phase. The process of developing and testing each unit for functioning is known as unit testing.

- **Testing**

Following the testing of each unit created during the implementation phase, the entire system is merged. The entire system is tested for flaws and failures after integration.

- **Deployment of the system**

Once the product has undergone functional and non-functional testing, it is either released onto the market or deployed in the customer's environment.

- **Maintenance**

The client environment can present certain challenges. Patches are published to address certain problems. Additionally, improved versions of the product are issued. Maintenance is carried out to implement these modifications in the surroundings of the customer.

3.4.1 SYSTEM DESIGN METHODOLOGY

A Structured Systems Analysis and Design Method (SSADM) can be defined as performing the stages of analysis and design of information systems with the help of a methodology. It includes requirements gathering, data flow diagram development, logical data modeling, and piloting as well as physical data modeling in order to reflect processes of the system accurately. With respect to an online blood transfer management system, SSM allows to determine the core functionality of the system as well to develop its workflows and implementation regulations.

- **Logical Data Modeling:** The system's data requirements have been defined, modeled, and documented. Relationships between the various entities in this data have been identified (Elmasri, 2019) .
- **Data Flow Modeling:** apprehensive about the information system's data flow. Examines internal and external entities, processes, data repositories, and data flows (Dennis, 2018)**.**
- **Entity Behavior Modeling:** The process of detecting, modeling, and documenting events about the system's entities and the sequence in which they occur (Ambler, 2019).

Therefore, SSADM consists of three important features:

Define the frameworks of steps and stages and their inputs and outputs

- **Techniques** define how the steps and tasks are performed.

- **Documentation** defines how the products of the steps are presented.

SSADM (Structured Systems Analysis and Design Method) is a structured approach to software development. In SSADM, application development projects are divided into five modules or stages, which are further broken down into a hierarchy of stages, steps, and tasks. Here is a brief overview of the five modules in SSADM:

- **Feasibility Study**: To examine whether the system can be implemented and whether it is cost-effective to do so.
- **Requirements Analysis**: determining the system's needs and requirements and modeling those demands in terms of the procedures being used.
- **Requirements Specification**: The functional and non-functional criteria are specifically listed in the requirements specification.
- **Logical System Specification**: The logical design of the system is created along with technical system possibilities. This covers update and query processing design.
- **Physical Design**: A physical database and a set of program specifications are designed using the logical system specification and technical system specification.

SSDAM's objectives are to:

- Ensure that projects may continue successfully in the event of a staff loss without hurting the project.
- Create systems with improved overall quality.
- Streamline the management and control of projects.
- Allow for the development and better use of both experienced and unskilled staff
- enabling the use of computer-based technologies, such as computer-aided software engineering systems, to support projects
- Ensure better communication among project participants to establish an effective framework.

3.4.2 DATA Flow Diagram

Data-flow diagrams (DFD) provide a clear picture of a system, which facilitates understanding of the movement and processing of information by both specialized and non-specialized users. These graphic representations ensure clear and basic concepts while facilitating productive collaboration between users, clients, and software developers. Data-flow modeling is required in order to specify needs and carry out efficient analysis (Yeates, 2019).

They consist of four major components: entities, processes, data stores, and data flow.

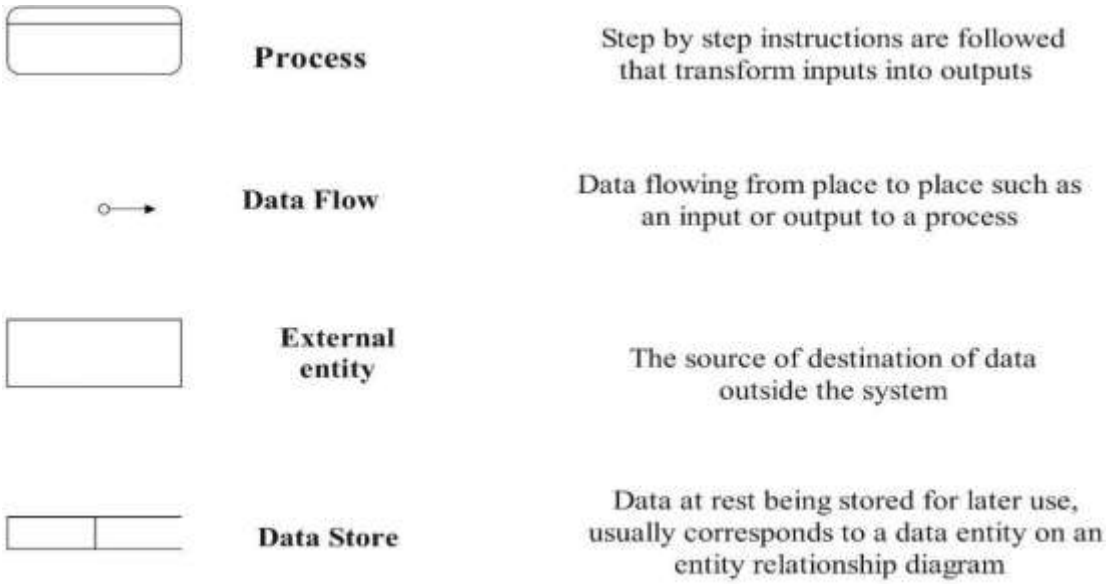


Figure 3: **Data Flow Diagram Components**

Data Flow Diagram Levels

Level 0

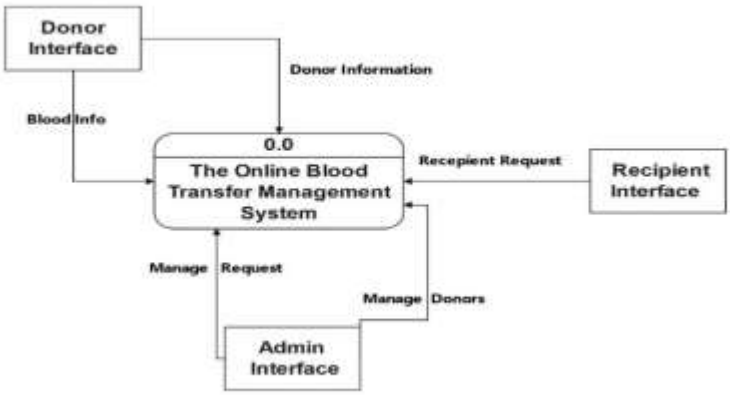


Figure 4:System DFD level 0

Level 1s

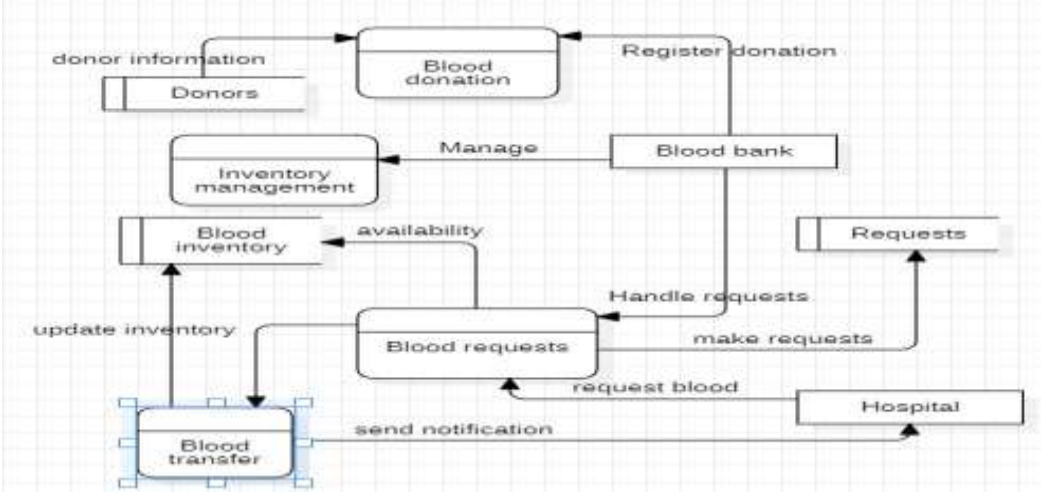


Figure 5: System DFD level 1

Level 2

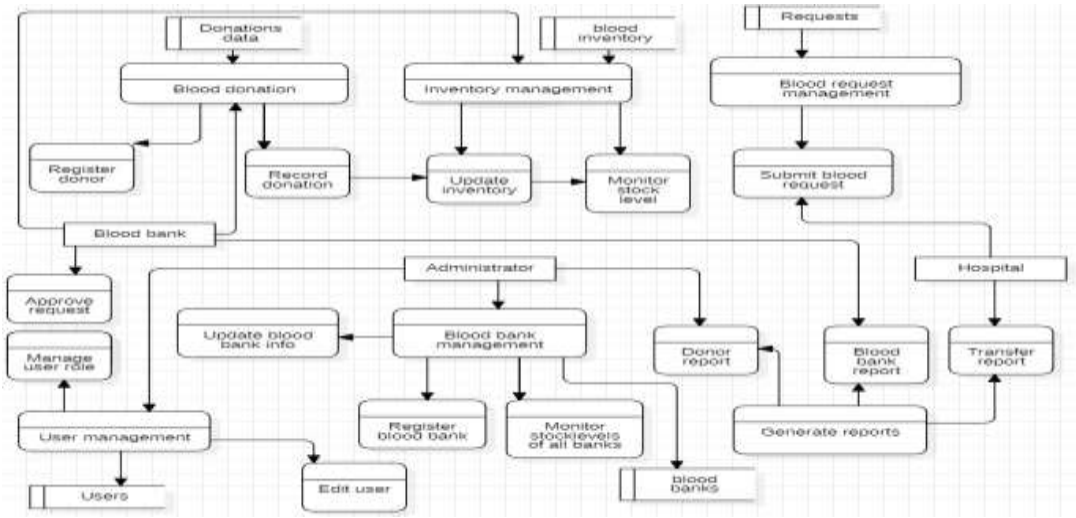


Figure 6 : System DFD level 2

Entity Relationship Diagram

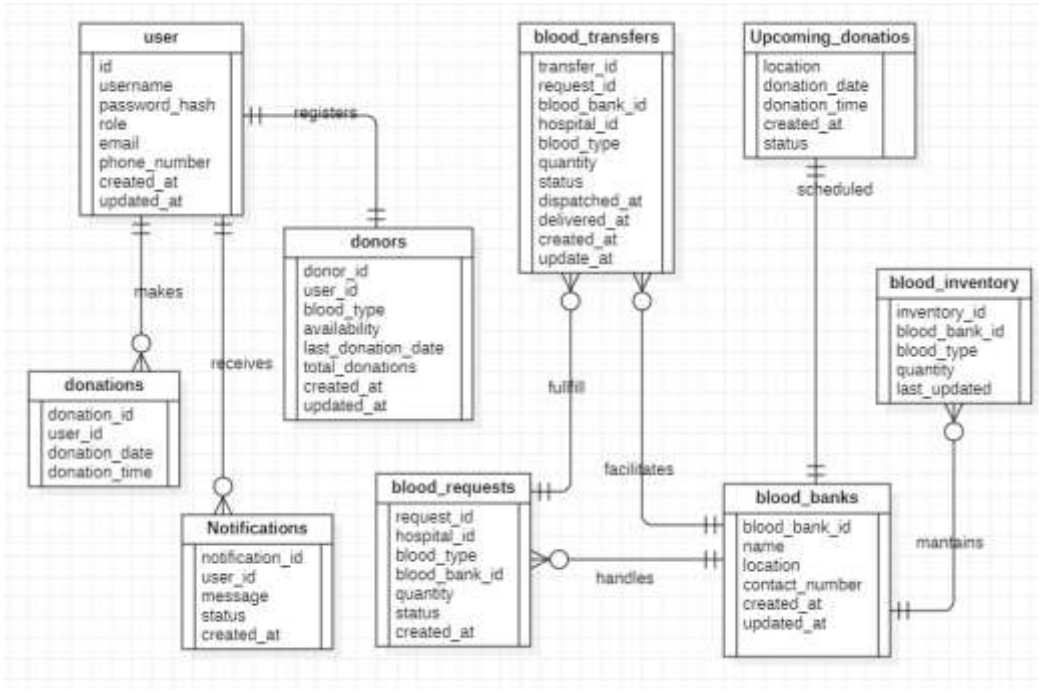
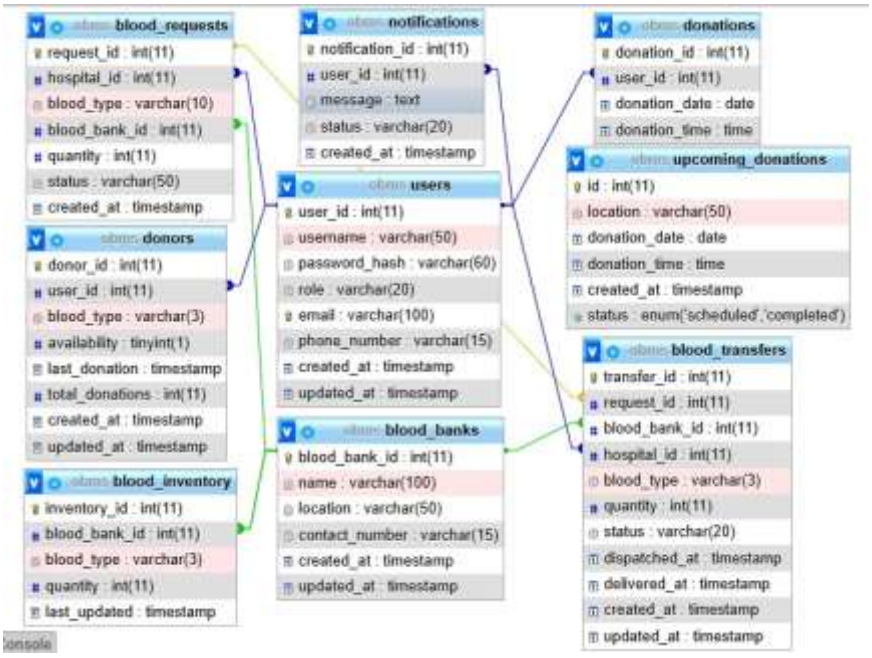


Figure 7: ERD Diagram



3.4.3 Data Dictionary

Table 1. Users

Column Name	Data Type	Size	Description
user_id	int	11	Unique identifier for each user. Autoincremented primary key.
Username	Varchar	50	User's login name. Must be unique and used for authentication.
Password	VARCHAR	30	Encrypted password for user authentication.
Email	VARCHAR	100	User's email address, used for communication and notifications.
Role	ENUM	20	User's role within the system (e.g., Lecturer, HoD, VP, Logistics). Determines permissions and access levels.

Created at	DATETIME		Timestamp indicating when the user account was created.
Updated at	DATETIME		Timestamp indicating the last update to the user's information.

Table 2. Blood banks

Column Name	Data Type	Size	Description
blood_bank_id	INT	11	Primary key, Unique identifier for each blood bank
Name	VARCHAR	100	Name of the blood bank
Location	VARCHAR	50	Location of the blood bank
contact_number	VARCHAR	15	Contact number of the blood bank
created_at	TIMESTAMP		Timestamp when the record was created
updated_at	TIMESTAMP		Timestamp when the record was last updated

Table 3. Blood inventory

Column Name	Data Type	Size	Description
inventory_id	INT	11	Primary key, Unique identifier for each inventory
blood_bank_id	INT	11	Foreign key referencing blood_bank_id in blood_banks
blood_type	VARCHAR	3	Type of blood
quantity	INT	11	Quantity of blood units available
last_updated	TIMESTAMP		Timestamp when the inventory was last updated

Table 4. Blood_requests

Column Name	Data Type	Size	Description
request_id	INT	11	Primary key, Unique identifier for each request
hospital_id	INT	11	Foreign key referencing hospital_id in users
blood_type	VARCHAR	10	Type of blood requested
blood_bank_id	INT	11	Foreign key referencing blood_bank_id in blood_banks
Quantity	INT	11	Quantity of blood units requested
Status	VARCHAR	50	Status of the request (e.g. Pending, transferred)
created_at	TIMESTAMP		Timestamp when the request was created

Table 5. Blood transfers

Column Name	Data Type	Size	Description
transfer_id	INT	11	Primary key, Unique identifier for each transfer
request_id	INT	11	Foreign key referencing request_id in blood_requests
blood_bank_id	INT	11	Foreign key referencing blood_bank_id in blood_banks
hospital_id	INT	11	Foreign key referencing hospital_id in users
blood_type	VARCHAR	3	Type of blood being transferred
Quantity	INT	11	Quantity of blood units being transferred
status	VARCHAR	20	Status of the transfer (e.g., in transit,

			completed)
dispatched_at	TIMESTAMP		Timestamp when the blood was dispatched
delivered_at	TIMESTAMP		Timestamp when the blood was delivered
created_at	TIMESTAMP		Timestamp when the record was created
updated_at	TIMESTAMP		Timestamp when the record was last updated

Table 6. Donations

Column Name	Data Type	Size	Description
donation_id	INT	11	Primary key, Unique identifier for each donation
user_id	INT	11	Foreign key referencing user_id in users
donation_date	DATE		Date of the donation
donation_time	TIME		Time of the donation

Table 7. Donors

Column Name	Data Type	Size	Description
donor_id	INT	11	Primary key, Unique identifier for each donor
user_id	INT	11	Foreign key referencing user_id in users
blood_type	VARCHAR	3	Blood type of the donor

Availability	TINYINT	1	Availability status of the donor (1 = available, 0 = not available)
last_donation	DATE		Date of the last donation
total_donations	INT	11	Total number of donations made by the donor
created_at	TIMESTAMP		Timestamp when the donor record was created
Updated_at	TIMESTAMP		Timestamp when the donor record was last updated

Table 8. Notifications

Column Name	Data Type	Size	Description
notification_id	INT	11	Primary key, Unique identifier for each notification
user_id	INT	11	Foreign key referencing user_id in users
Message	TEXT		Content of the notification message
Status	VARCHAR	20	Status of the notification (e.g., unread, read)
created_at	TIMESTAMP		Timestamp when the notification was created

Table 9. upcoming_donations

Column Name	Data Type	Size	Description
Id	INT	11	Primary key, Unique identifier for each upcoming donation
Location	VARCHAR	50	Location of the

			upcoming donation event
donation_date	DATE		Date of the upcoming donation event
donation_time	TIME		Time of the upcoming donation event
created_at	TIMESTAMP		Timestamp when the upcoming donation record was created
Status	ENUM		Status of the donation (e.g., scheduled, completed) Status of the donation (e.g., scheduled, completed)

CHAPTER 4: SYSTEM IMPLEMENTATION

4.1 Implementation and Coding

4.1.1 Introduction

The implementation phase is a critical stage in the software development lifecycle, where the conceptual design and architectural plans are translated into a functional system through coding. In this chapter, we focus on the actualization of the Online Blood Transfer Management System (OBTMS), detailing the process of transforming design specifications into a working application. The primary goal of this phase is to develop a robust, efficient, and secure system that meets the functional requirements outlined during the analysis and design stages. This chapter will cover the key aspects of system implementation, including the choice of programming languages, development tools, frameworks, and coding practices employed to bring the OBTMS to life.

The implementation of the OBTMS is divided into several modules, each corresponding to the core functionalities of the system, such as user authentication, donor management, blood inventory management, request handling, automated matching, and notification services. The

modular approach ensures that each component can be developed, tested, and maintained independently, contributing to the overall scalability and maintainability of the system.

In the following sections, we will delve into the specific technologies used, the structure of the system's codebase, and the integration of various components to achieve a cohesive and functional system. Additionally, we will highlight the security measures integrated during coding to protect sensitive data and ensure compliance with relevant regulations.

This chapter sets the stage for understanding how theoretical design principles have been practically applied to develop a system capable of streamlining blood transfer processes, enhancing the efficiency of healthcare services, and ultimately saving lives.

4.1.2 Description of Implementation Tools and Technology

The successful implementation of the Online Blood Transfer Management System (OBTMS) required the careful selection and integration of various tools and technologies. This section outlines the key software, programming languages, frameworks, and development environments used in the development process, as well as their specific roles in building a robust and efficient system.

1. Programming Languages

- **PHP**: PHP was chosen as the primary server-side scripting language for OBTMS due to its wide adoption, ease of integration with web servers, and ability to handle complex database interactions. PHP's flexibility allows for dynamic content generation and seamless communication with the database, making it ideal for creating responsive web applications.
- **JavaScript**: JavaScript was utilized for client-side scripting to enhance user interaction and provide a dynamic user experience. Through libraries like jQuery, JavaScript enabled real-time updates, form validations, and interactive features that improve the overall usability of the system.
- **SQL**: SQL (Structured Query Language) was employed for managing and manipulating the database. SQL queries facilitated efficient data retrieval, insertion, updating, and deletion operations, ensuring that the database remained consistent and accurate throughout the system's operation.

2. Development Frameworks

- **Bootstrap**: The Bootstrap framework was used to create a responsive and visually appealing user interface. By leveraging Bootstrap's pre-built components, the development process was accelerated, allowing for consistent design across different pages and devices. The framework also ensured that the system was mobile-friendly, catering to users on various platforms.
- **Ajax**: Ajax (Asynchronous JavaScript and XML) was implemented to enable asynchronous data exchange between the client and server. This technology allowed for real-time updates of specific sections of the web pages without the need to reload the entire page, enhancing the user experience and reducing server load.

3. Database Management System

- **MySQL**: MySQL was selected as the database management system (DBMS) for OBTMS due to its reliability, scalability, and robust support for large-scale data operations. MySQL provided a structured environment for storing and managing donor information, blood inventory, and request data, ensuring data integrity and security.

4. Development Environment

- **XAMPP**: XAMPP served as the local development environment, providing a full-fledged Apache server, MySQL database, and PHP interpreter. This all-in-one solution allowed for the easy setup and testing of the OBTMS on a local machine before deployment to a production server. XAMPP's ease of use and configurability made it an ideal choice for the development phase.

4.1.3. Screen shorts and source codes

Figure 8: The index page of the system

The figure 8 above is the index page that is single but contain multiple fuctionalities in form of modals.

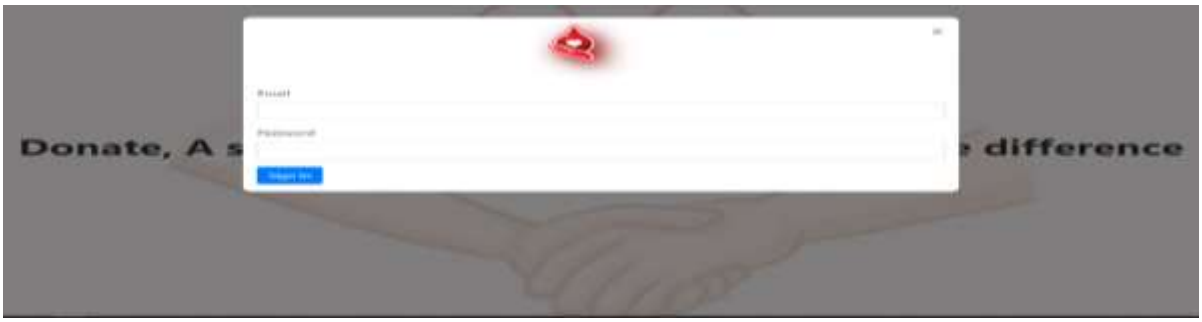


Figure 9: **Login page for all users**

Figure 9 is login modal for all users of the system where via the authentication the system knows the role of the user.

Figure 10: **Register the account**

This figure 10 is page dedicated to user who is accessing system at first time for creating account and wait for admin confirmation.

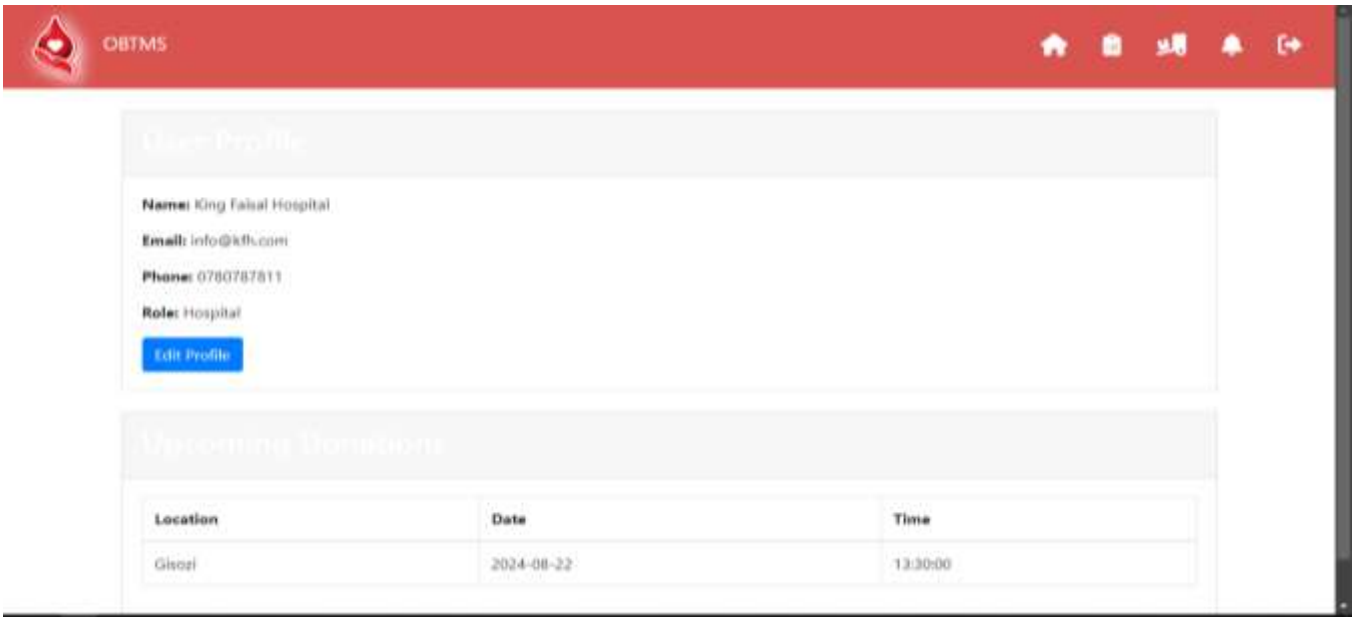


Figure 11: Home of all users (depends on role)

This image above figure 11 is homepage for user who is logging in success

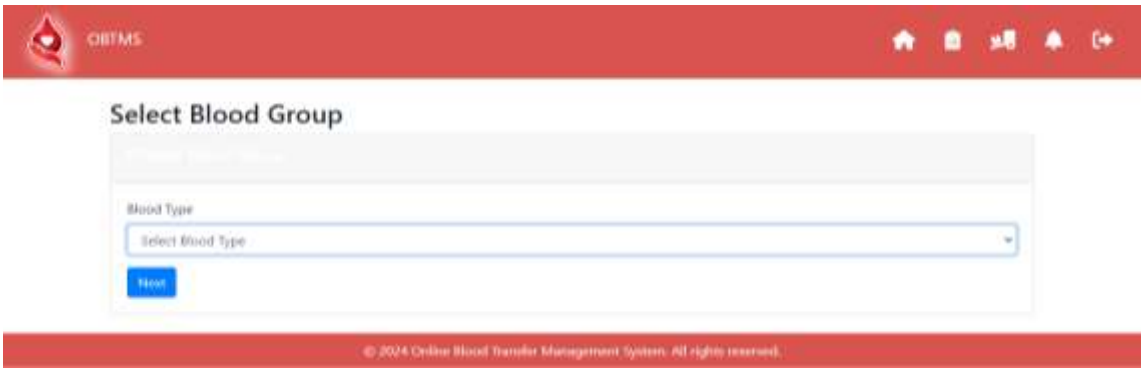


Figure 12: Blood requesting form (first choose blood group)

This figure 12 above is page reserved by hospital to request blood where they specify which blood type is needed and then press to next button.

Figure 13: Request blood form

After we proceed to blood banks with that blood group in their stock and you specify quantity which must be less or equal to available stock for that type

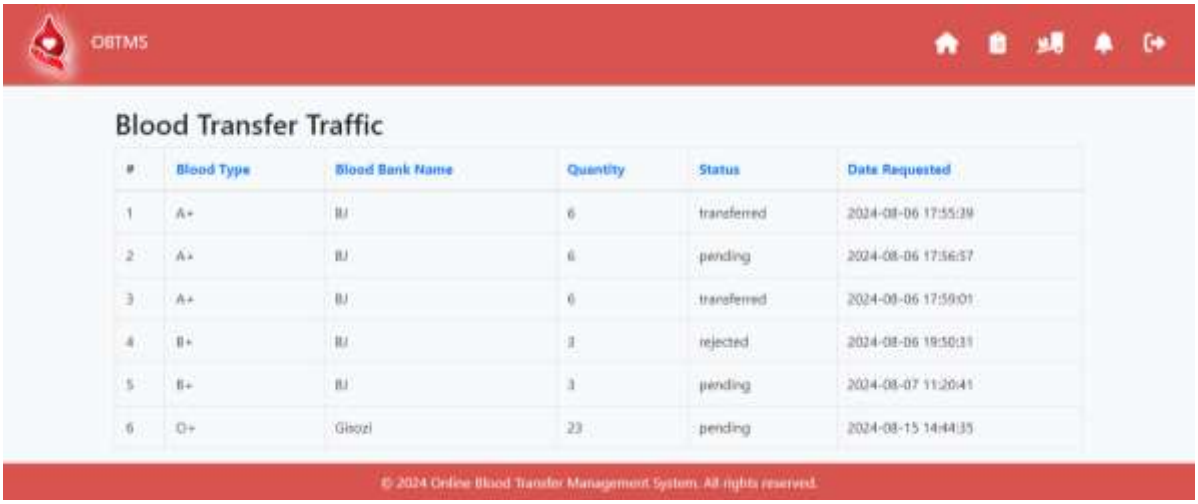


Figure 14: **Hospital blood traffic**

Figure 14 is for hospital to track their traffic history of their blood requests.

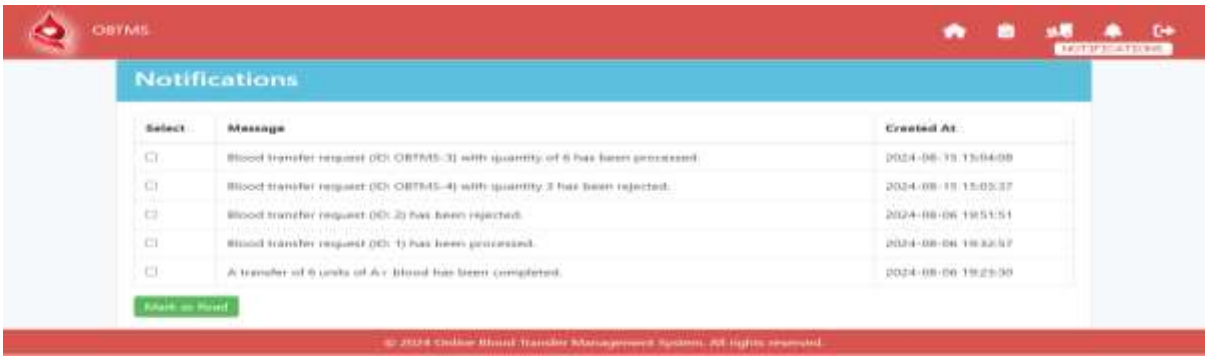


Figure 15: Notifications page

Figure 15 is for hospital to get the notifications specially for their requests.

Figure 16: Register donor page

Figure 16 is for staff to register donor if is his/her first time of donation.

Figure 17: List of donors

Figure 17 is for blood bank staff where have list of all registered donors and all their information and then with option of donate. The donation are made once in 6 months. And this page have lived search functionality.

Figure 18: request management page

Figure 18 is reserved for blood bank staff to manage request either to confirm or reject.

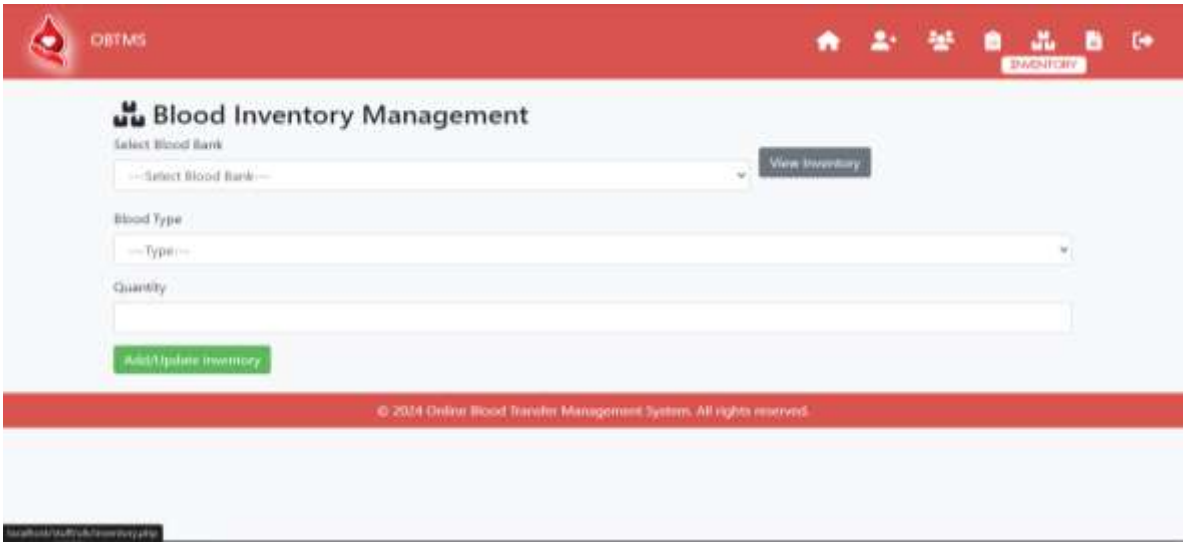


Figure 19: Blood bank staff Stock inventory management

Figure 19 is the inventory management where blood bank staff can view stock, or add in stock.

Figure 20: Blood bank staff view remaining stock

Figure 20 is where blood bank can manage their stock inventory.

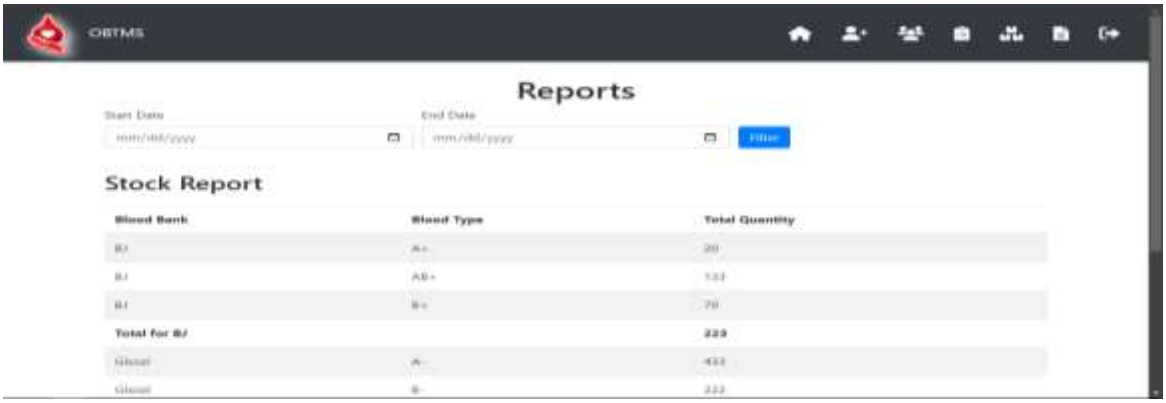


Figure 21: Blood bank activities report

Figure 21 is page where user can view report of the blood bank at specific range of date.

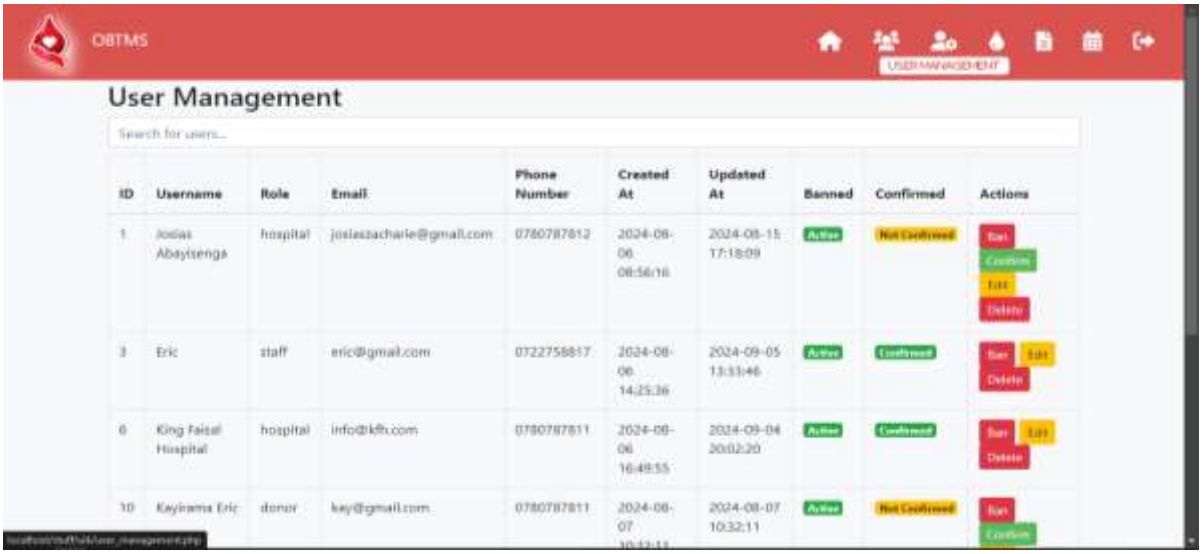


Figure 22: Admin Users management page

Figure 22 is where admin manages all system users where is able to ban and unban banned account, modify user, confirm registered user and is able to delete user.

Figure 23: Admin Blood management page

The figure 23 is where admin manages the all blood banks where is able to add, or remove blood bank and also is able to view available stock on each of them.

Figure 24: **Admin global report form page**

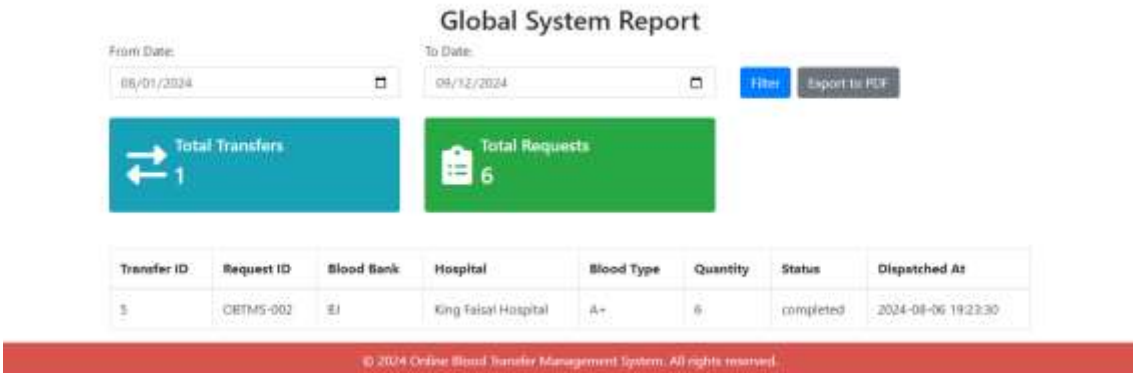


Figure 25: Admin report for specific date range

The figure 25 above is ranging report where you pick from(date) and to(date) and then filter or export it as pdf.

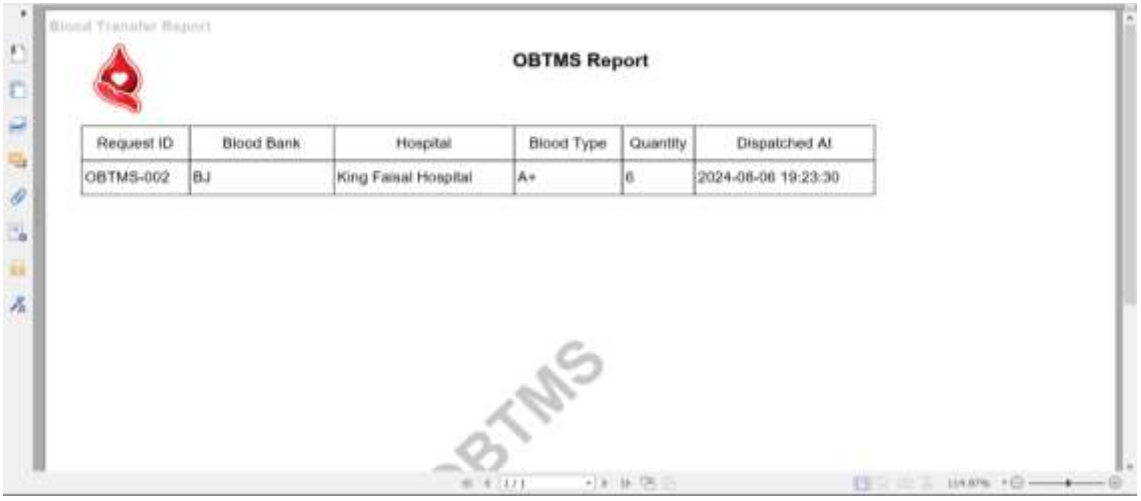


Figure 26: Exported pdf report

This figure 26 is pdf document exported by blood bank as report of all transfers made.

4.2 Testing

4.2.1 Introduction

Testing is a critical phase in the software development lifecycle, aimed at ensuring the functionality, reliability, and performance of the system. In the context of the Online Blood Transfer Management System (OBTMS), thorough testing was conducted to identify and rectify any issues that could compromise the system's integrity or user experience. This chapter details the testing strategies employed, the types of tests conducted, and the results of these tests.

The primary objectives of testing the OBTMS were to:

1. **Verify Functionality**: Ensure that all features, such as user authentication, donor registration, blood inventory management, and request handling, operate as intended.
2. **Ensure Security**: Test for vulnerabilities in user authentication, data storage, and access control to protect sensitive information, such as donor details and blood inventory data.
3. **Validate Performance**: Assess the system's performance under various loads to ensure it can handle real-time operations without degradation in response times.
4. **Confirm Usability**: Evaluate the user interface and experience to ensure that the system is intuitive and accessible for all user roles, including administrators, staff, donors, and hospitals.
5. **Check Compatibility**: Test the system across different devices, browsers, and platforms to ensure consistent behavior and appearance.

The testing process was methodically planned and executed, covering unit testing, integration testing, system testing, and user acceptance testing (UAT). Each testing phase aimed to address specific aspects of the system, progressively building confidence in its overall functionality and readiness for deployment.

4.2.2 Unit Testing Outputs

Unit testing focuses on validating individual components or units of the system to ensure they perform correctly in isolation. Each function, method, or module within the OBTMS was tested independently to verify its functionality, correctness, and reliability.

Key Outputs:

- **User Authentication Module:** Verified that the login, registration, and role-based access controls operate correctly. Tests included checking invalid login attempts, role-based redirections, and session management.
    - *Test Result:* All test cases passed. The module correctly differentiated user roles and handled authentication errors gracefully.
- **Donor Registration Module:** Ensured that the system correctly captures, stores, and updates donor information, including personal details and blood type.
    - *Test Result:* All test cases passed. The module stored data accurately and allowed updates without data corruption.
- **Blood Inventory Management Module:** Tested the functions responsible for updating, querying, and alerting inventory levels.
    - *Test Result:* All test cases passed. Inventory updates were reflected in real-time, and alerts triggered correctly when thresholds were breached.

4.2.3 Validation Testing Outputs

Validation testing ensures that the system meets the needs and expectations of the end users. It involves checking that the software does what it is supposed to do.

Key Outputs:

- **User Interfaces:** Validated that all forms, buttons, and navigation elements are user-friendly, intuitive, and accessible.
    - *Test Result:* User interface elements were responsive and displayed correctly across different devices and screen sizes.
- **Data Validation:** Checked that data input fields correctly enforce validation rules (e.g., mandatory fields, format checks).
    - *Test Result:* All validation rules were correctly enforced, preventing the submission of invalid data.
- **Notification System:** Validated that notifications are sent to the appropriate stakeholders at the correct times.
    - *Test Result:* Notifications were delivered as expected, with no delays or mis deliveries.

4.2.4 Integration Testing Outputs

Integration testing was performed to verify that different modules and components of the OBTMS work together seamlessly. This phase focused on interactions between modules such as user authentication, donor management, and blood inventory.

Key Outputs:

- **Authentication and Donor Management Integration:** Ensured that authenticated users can access and manage donor profiles according to their roles.
  - *Test Result:* All test cases passed. Donor profiles were accessible and manageable only by authorized users.
- **Blood Inventory and Request Management Integration:** Verified that inventory updates reflect accurately when a new request is fulfilled and that requests match the available blood units.
  - *Test Result:* Inventory updates occurred correctly, and matching algorithms accurately matched requests to available blood.
- **Notification and Inventory Management Integration:** Tested that notifications are correctly triggered by inventory changes (e.g., low stock alerts).
  - *Test Result:* Notifications were triggered as expected during inventory changes.

4.2.5 Functional and System Testing

Functional testing assessed the complete system's adherence to the specified requirements, ensuring each function operates according to expectations. System testing evaluated the system as a whole, ensuring it meets the defined performance, security, and usability standards.

Key Outputs:

- **Functional Testing:** Each system function, such as donor registration, blood request handling, and user authentication, was tested to ensure it meets the functional requirements.
  - *Test Result:* All functionalities operated as expected, with no critical defects identified.
- **System Testing:** The entire OBTMS was tested in an environment that closely mimics the production setting. Tests included stress testing, security testing, and load testing.

- *Test Result:* The system performed reliably under expected load conditions, remained secure against common vulnerabilities, and maintained usability standards.

4.2.6 Acceptance Testing Report

Acceptance testing was conducted with the involvement of end users, including hospital staff, blood bank managers, and system administrators, to ensure the system meets their needs and expectations.

Key Outputs:

- **End-User Feedback:** Users found the system intuitive, with functionalities meeting their operational requirements. Minor adjustments were suggested and implemented.
  - *Test Result:* The system was accepted by all user groups, with a high level of satisfaction regarding its usability, performance, and reliability.
- **Acceptance Criteria Met:** All predefined acceptance criteria were satisfied, confirming that the OBTMS is ready for deployment.
  - *Test Result:* The system was formally accepted by the stakeholders and approved for production rollout.

CONCLUSION AND RECOMMENDATION

1.Conclusion

The Online Blood Transfer Management System (OBTMS) was developed to address critical challenges in the efficient and timely management of blood resources. By leveraging technology, the system enhances the coordination between blood banks, hospitals, and donors, ensuring that blood donations and requests are handled with greater precision and speed.

Throughout the development and testing phases, the OBTMS has proven to be a robust solution, effectively streamlining the processes involved in blood donation, inventory management, and blood requests. The system's ability to track real-time blood inventory levels, automate donor management, and facilitate seamless communication among stakeholders marks a significant improvement over traditional method. This results in reduced delays, minimized errors, and optimized utilization of blood resources, ultimately contributing to better patient outcomes.

The OBTMS not only ensures that blood is available where and when it is needed but also upholds data security and privacy standards, maintaining the confidentiality of donor and patient information. The successful implementation and rigorous testing of the system have demonstrated its capability to meet the needs of the healthcare sector, making it a valuable tool in the ongoing effort to save lives through improved blood transfusion services.

In conclusion, the OBTMS represents a significant step forward in modernizing blood transfer management. It stands as a testament to the positive impact that well-designed digital solutions can have on healthcare efficiency and patient care. The system is now ready for full deployment, and it is expected to play a crucial role in enhancing the effectiveness of blood transfusion services in the regions where it is implemented.

2.Recommendations

I would like to recommend the Kigali independent university office to think of this system and try to implement it in real life, for it is easy for all the process involves in issuing and requesting of online blood transfer management system. it will make life much easier for people and organizations with projects of request blood and transfer blood in any hospital with as the student and within anyone want them to continue the building according that project. This system is scalable and can be updated by including other features and functionalities.

In concluding this work, I would like to explicitly say that the Online Blood Transfer Management System approval and analysis system works. I would also like to suggest any other person wishing to improve this research by adding functionalities to go for it and improve our services.

3. Future work

As technology and construction industry practices evolve, an online construction permit management system should evolve accordingly to remain efficient, user-friendly, and compliant with regulations. Regular updates and a focus on innovation will be key to the system's long-term success.

Summary

The Online Blood Transfer Management System (OBTMS) is a digital platform designed to enhance the efficiency of blood transfer processes between blood banks, hospitals, and patients. This system streamlines the management of blood donations, inventory, and requests, providing a centralized and secure database for storing donor information, blood test results, and transfusion records.

OBTMS features user authentication and access control to ensure secure login for various user roles, including administrators, staff, and donors. It offers real-time tracking of blood inventory levels, automated matching of blood requests with available units, and a notification system to keep stakeholders informed throughout the blood transfer process.

The system was implemented using PHP, MySQL, and Bootstrap, and thoroughly tested through unit, integration, functional, system, and acceptance testing to ensure reliability and effectiveness. The testing results confirmed that the system meets its design specifications and functional requirements.

To further improve OBTMS, recommendations include expanding system integration with other healthcare systems, enhancing user training and support, introducing advanced analytics, regular system updates, expanding geographical coverage, and developing a mobile application. Additionally, strengthening data security, promoting awareness, and monitoring system performance are key to ensuring the system's continued success and impact.

In conclusion, OBTMS is a vital tool in modern healthcare, contributing to the timely and efficient management of blood resources, ultimately improving patient outcomes and healthcare efficiency.

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Appendix
Source Code A

```
<div class="modal-body">
    <form action="" method="post">
        <div class="form-group">
            <label for="signin-email">Email</label>
            <input type="email" class="form-control" id="signin-email" name="email" required>
        </div>
        <div class="form-group">
            <label for="signin-password">Password</label>
            <input type="password" class="form-control" id="signin-password" name="password" required>
        </div>
        <button type="submit" name="signin" class="btn btn-primary">Sign In</button>
    </form>
</div>
```

This code above is used Login page for all users'

```
form action="" method="post">
    <div class="form-group">
        <label for="username">Username</label>
        <input type="text" class="form-control" id="username" name="username" required>
    </div>
    <div class="form-group">
        <label for="email">Email</label>
        <input type="email" class="form-control" id="email" name="email" required>
    </div>
    <div class="form-group">
        <label for="password">Password</label>
        <input type="password" class="form-control" id="password" name="password" requir
    </div>
    <div class="form-group">
        <label for="phone_number">Phone Number</label>
        <input type="text" class="form-control" id="phone_number" name="phone_number">
    </div>
    <div class="form-group">
        <label for="role">Role</label>
        <select class="form-control" id="role" name="role" required>
            <option value="">---Role---</option>
            <option value="hospital">Hospital</option>
            <option value="staff">Staff(Blood bank Personeel)</option>
        </select>
    </div>
    <button type="submit" name="register" class="btn btn-primary">Register</button>
```

This code that indicate for that to register if you want to create the account

```
<div class="container mt-4">
    <h2>Select Blood Bank for Blood Type: <?php echo htmlspecialchars($blood_type); ?></h2>
    <form action="create_request.php" method="POST">
        <input type="hidden" name="blood_type" value="<?php echo htmlspecialchars($blood_type); ?>">
        <div class="form-group">
            <label for="blood_bank_id">Blood Bank</label>
            <select id="blood_bank_id" name="blood_bank_id" class="form-control" required>
                <option value="">Select Blood Bank</option>
                <?php foreach ($banks as $bank) { ?>
                    <option value="<?php echo htmlspecialchars($bank['blood_bank_id']); ?>" data-quantity="<?php echo htmlspecialchars($bank['qu
                        <?php echo htmlspecialchars($bank['name']); ?> (Available: <?php echo htmlspecialchars($bank['quantity']); ?> units)
                    </option>
                <?php } ?>
            </select>
        </div>
        <div class="form-group">
            <label for="quantity">Quantity Required</label>
            <input type="number" class="form-control" id="quantity" name="quantity" required>
        </div>
        <button type="submit" class="btn btn-primary">Submit Request</button>
    </form>
</div>
```

This code is indicating the Request blood form

```php
<div class="container mt-4">
    <h2>Blood Transfer Traffic</h2>
    <table class="table table-bordered">
        <thead>
            <tr>
                <th>#</th>
                <th><a href="?sort=blood_type" class="sort-link">Blood Type</a></th>
                <th><a href="?sort=blood_bank_name" class="sort-link">Blood Bank Name</a></th>
                <th><a href="?sort=quantity" class="sort-link">Quantity</a></th>
                <th><a href="?sort=status" class="sort-link">Status</a></th>
                <th><a href="?sort=created_at" class="sort-link">Date Requested</a></th>
            </tr>
        </thead>
        <tbody>
            <?php
            $counter = 1;
            foreach ($requests as $request) { ?>
            <tr>
                <td><?php echo $counter++; ?></td>
                <td><?php echo htmlspecialchars($request['blood_type']); ?></td>
                <td><?php echo htmlspecialchars($request['blood_bank_name']); ?></td>
                <td><?php echo htmlspecialchars($request['quantity']); ?></td>
                <td><?php echo htmlspecialchars($request['status']); ?></td>
                <td><?php echo htmlspecialchars($request['created_at']); ?></td>
            </tr>
            <?php } ?>
        </tbody>
```

The code above here indicates the Hospital blood traffic

```php
<div class="container">
    <h2>Pending Requests</h2>
    <table class="table table-bordered">
        <thead>
            <tr>
                <th>Request ID</th>
                <th>Blood Type</th>
                <th>Quantity</th>
                <th>Status</th>
                <th>Hospital</th>
                <th>Blood Bank</th>
                <th>Action</th>
            </tr>
        </thead>
        <tbody>
            <?php foreach ($requests as $request) { ?>
            <tr>
                <td><?php echo htmlspecialchars($request['request_id']); ?></td>
                <td><?php echo htmlspecialchars($request['blood_type']); ?></td>
                <td><?php echo htmlspecialchars($request['quantity']); ?></td>
                <td><?php echo htmlspecialchars($request['status']); ?></td>
                <td><?php echo htmlspecialchars($request['hospital_name']); ?></td>
                <td><?php echo htmlspecialchars($request['blood_bank_name']); ?></td>
                <td>
                    <form method="post" action="requests.php">
                        <input type="hidden" name="request_id" value="<?php echo htmlspecialchars($request['request_id']); ?>">
                        <button type="submit" name="action" value="Transfer" class="btn btn-success">Transfer</button>
                        <button type="submit" name="action" value="Reject" class="btn btn-danger">Reject</button>
                    </form>
```

Here the code above is pending request management page

Appendix B

Research questions:

Telephone Intervier and Questionoire:

1. Do you have interacted system or website that connects donor and recipient?

   Yes ☐ No ☐

2. If No, how do you manage blood at the hospital?
3. If yes, what is the name of the system or website?
4. How can someone donate blood online?
5. How can the recipient receive blood online?
6. How does the website started working?
7. How does the website is currently working?
8. What are the main features of the system or website?

Appendix C

RESEARCH ANSWERS

1. No
2. They manage blood in registers or some kind of books
3. They don’t have interacted system
4. Not Applicable
5. Not Applicable
6. Not Applicable
7. Not Applicable
8. Not Applicable