DEVELOPMENT OF A BLOOD DONOR AND SEEKER MANAGEMENT SYSTEM FOR HOSPITAL USE

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Abstract

Malaysia's population is growing, and the demand for blood supply from hospitals is increasing. Presently, computer-based blood bank management is not widely used in most of the countries and relies on manually searching individual records, which consumes time. Hospital employees face difficulties identifying blood supply needs because of mistaken, lost, and imprecise blood donation records, especially during the pandemic. Consequently, hospitals have difficulty identifying the urgent need for blood. Staffs or donors need to search for blood donation information one by one, which considerable time. Therefore, this study designed a Blood Donor and Seeker Management System using Microsoft Visual Studio 2019 integrated with Microsoft SQL Server Management Studio 18 to automate the blood bank management, making it faster, easier, and more reliable. This system was developed using the Waterfall model, which is continuous even with errors, saving time. This system enables simplified access to information regarding blood donation, such as supply according to blood group, donation date, and the validity of blood. Additionally, it is a stand-alone system to maintain and generate organised blood transaction reports that enable users to obtain information quickly. This system makes the maintenance of hundreds of thousands of blood donor or seeker records manageable. Consequently, this system provides accurate information on the availability of a blood group, prompting donors to donate blood and replenish the limited stock.

Keywords: *Microsoft Visual Studio 2019, Microsoft SQL Server Management Studio 18, Blood Bank Management System*

I. INTRODUCTION

In this 21st century, various countries are adopting the latest technologies to access and their economies various sectors [1], [2]. In addition, there has been an increase in demand for blood due to the recent COVID-19 pandemic, accidents, and crimes occurring, which requires a patient to obtain regular blood transfusions. Consequently, information on blood supply, donor information and validity of blood donated must be current, organised, and easy to access.

The medical sector has been utilising various technology to improve and facilitate hospital management. For example, current manual blood donation records can be replaced with an automated system that streamlines the search for blood. Moreover, this system must be primarily based on the swift, efficient, and accurate collecting, storing, and distribution of blood in times of need.

II. PROBLEM STATEMENT

Presently, hospitals computer-based blood bank management system is restricted to one-by-one searches, which are time-consuming[3]. Additionally, hard copies of system information and blood donors' certificates can be misplaced or limited information. Due to the COVID-19 pandemic, the total amount of blood used per month is inaccurately reported by hospital employees due to missing or redundant data. Consequently, hospitals have difficulty identifying the urgent need for blood.

III. OBJECTIVES

- To develop a stand-alone blood bank management system using Microsoft Visual Studio 2019
- To help hospital staff monitor inventory of blood donated
- To upkeep information on the blood donors and seekers efficiently

Received: 01 October 2021
Revised: 16 November 2021
Accepted: 26 November 2021

Publisher: ICBE Publication

IV. SCOPE OF PROJECT

a. System

- Streamline and automate the blood searching process in hospitals
- Upkeep archives on blood donation history, donor and recipient information, blood donation programs, and blood availability in the blood bank

b. User

Admin

- Store blood and maintains documentation and records
- Give other staff access to the system by appointing super admins

Staff

- View information of donors and seekers
- Edit the particulars of donors and seekers in the system

V. LITERATURE REVIEW

a. Blood Types and Definition

Blood is a fluid that carries plasma and cells throughout the body to provide necessary chemicals such as carbohydrates, oxygen, and hormones to cells and organs and eliminates waste products from cells[4] . An individuals' blood type is defined by the type of antigen present in their blood. Antigens consist of plasma protein molecules on the surface of the cells that notify the immune system of pathogens. Consequently, the immune system will then defend our body against the infection [6]. The human blood can be divided into four types (A, B, O, and AB) where each of these groups comprises eight categories containing the presence of antigen rhesus D (RhD-positive) or absence of antigen rhesus D (RhD-negative) [5]. Patients with the presence of RhD-positive are known to have a positive blood group. Therefore, it is essential to know the blood type of patients who need a blood transfusion or an organ donation to ensure that the antibodies present in the transfused blood do not attack the antigens in their bodies and threaten their lives[3], [6]. For example, antibodies may attack cells containing antigen A if the wrong blood type is transfused to the recipient.

Both antigen A and antigen B are found on the surfaces of blood cells, whether positive or negative. Anti-B and Anti-A antibodies can be found in the blood. Conversely, antibodies are absent in the plasma [3], [6], [7]. Antigens are not present on the surfaces of blood cells in Group O. People with the O blood group can generally donate blood to any other group. In contrast, those who have an AB+ blood group can usually receive blood from any group.

b. Blood Donor and Seeker Management System for Hospital Use

This Blood Donor and Seeker Management System will help authorised staff upkeep donors and patients' records using a secure login password. In addition, this system aims to computerise the blood management records to ensure the records in the system can be efficiently and swiftly accessed. This system comprises several features such as a password-secured login, donor registration and data, blood receiver data, and blood availability.

The advantages of the system are listed below:

- Secure access to the system only accessible through authorised users
- The search facility for finding blood donors is based on various search criteria
- Search facility for finding blood transfusion patients is based on various search criteria

Received: 01 October 2021
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VI. MODEL DEVELOPMENT

The Waterfall process or the linear-sequential life cycle model was utilised to develop the Blood Donor and Seeker Management System to ensure that system operates using cyclic phases. This process model applies the simplest Software Development Life Cycles (SDLC) method, which is popularly utilised in software engineering due to its ease of use. In addition, this model portrays the system development in progressive stages. One stage must be finished before the next begins after the other has ended to ensure no overlay [9].

The overall Waterfall development cycle is divided into six stages (requirement analysis, system design, implementation, testing, deployment, and maintenance). The output of one stage will act as the input for the consecutive stages. The outline of the development of the Blood Donor and Seeker Management System is described in **Figure 1.**

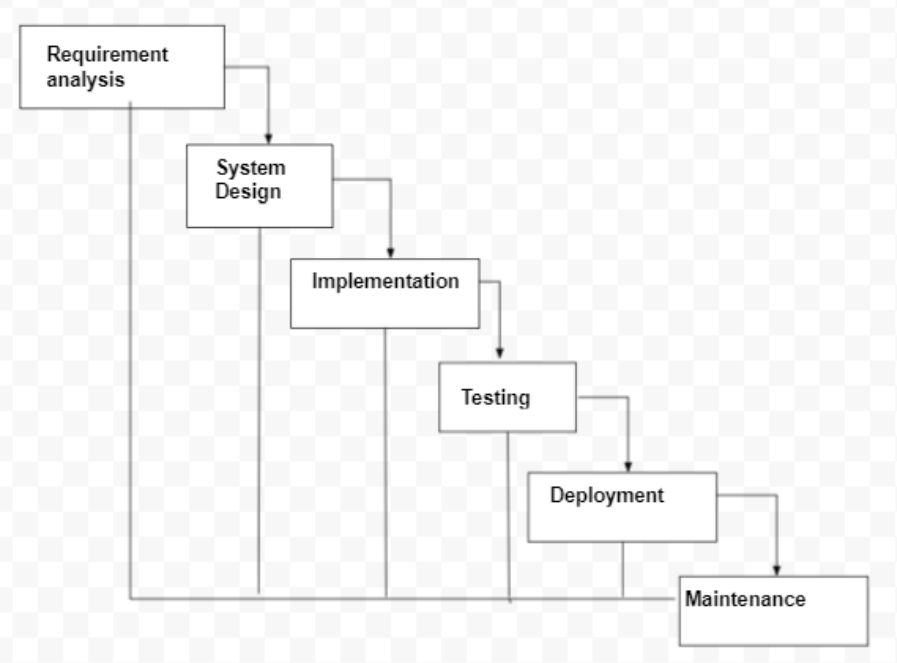

Figure 1 The System Development Cycle Using the Waterfall Model [8]

VII. MODEL JUSTIFICATION

The Waterfall model was used to develop the Blood Donor and Seeker Management System. Several factors were considered when choosing this model, such as ease of use, flexibility, and time consumption.

- **Ease of use**

The overall flow of the model is easy to understand as it is systematic.

- **Flexibility**

This model enables the system to be implemented and accomplish desired goals even when deviation occur mid-process.

- **Saves Time**

This system was developed to reduce time consumption as it uses a cyclic model which is uninterruptedly even in the presence of errors, saving time.

VIII. REQUIREMENT ANALYSIS

The initial phase in this project requires procuring specific hardware and software for the system to be developed. The various specifications of the requirements are listed below.

a. Hardware Specifications:

- Hard disk space: A minimum of 800 MB to 210 GB of available space
- Processor: 1.8 GHz or faster
- RAM: 2 GB or more (A 8 GB RAM is recommended)
- Video card: Supports a minimum resolution display of 720p (1280 by 720)

Received: 01 October 2021
Revised: 16 November 2021
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Publisher: ICBE Publication

b. Software Specifications:

For the developer

- Front End: Microsoft Visual Studio 2019
- Back End: Microsoft SQL Server Management Studio 18

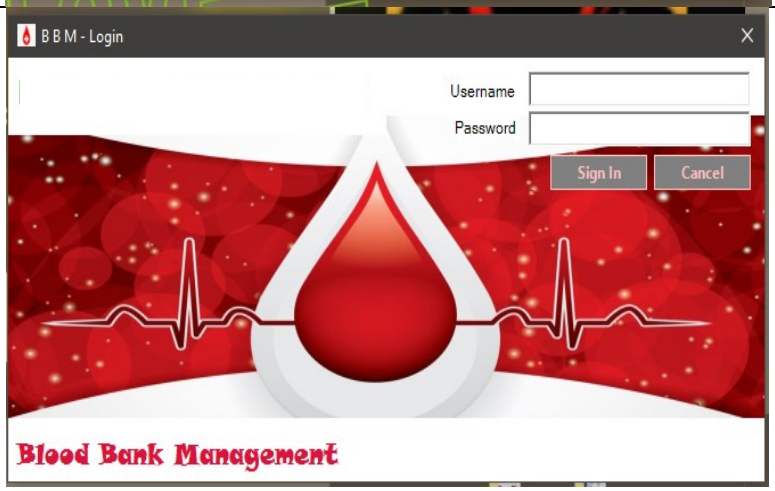
For the admin

- Operating system: 64-bit Windows 7 or later.

IX. SYSTEM CONFIGURATION

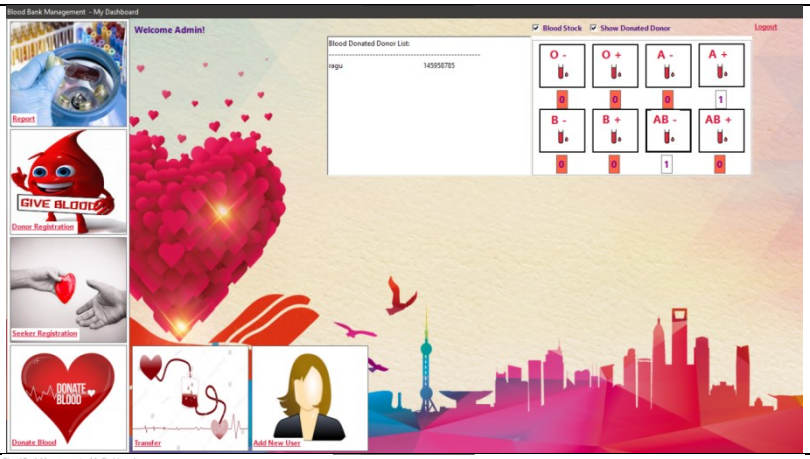
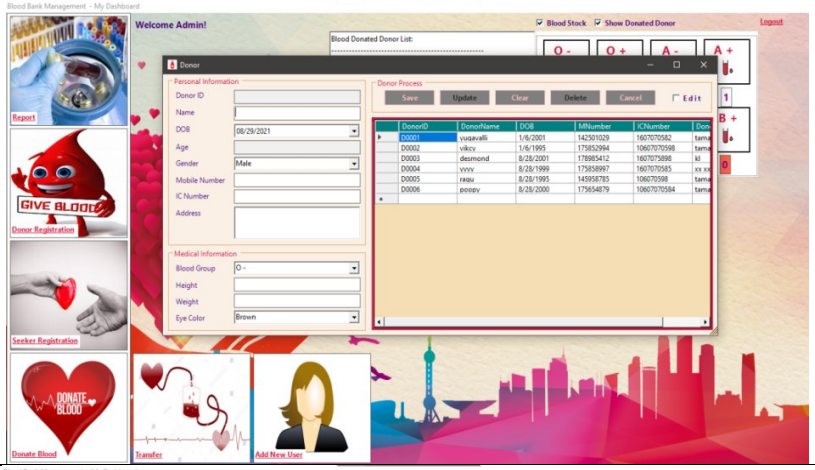
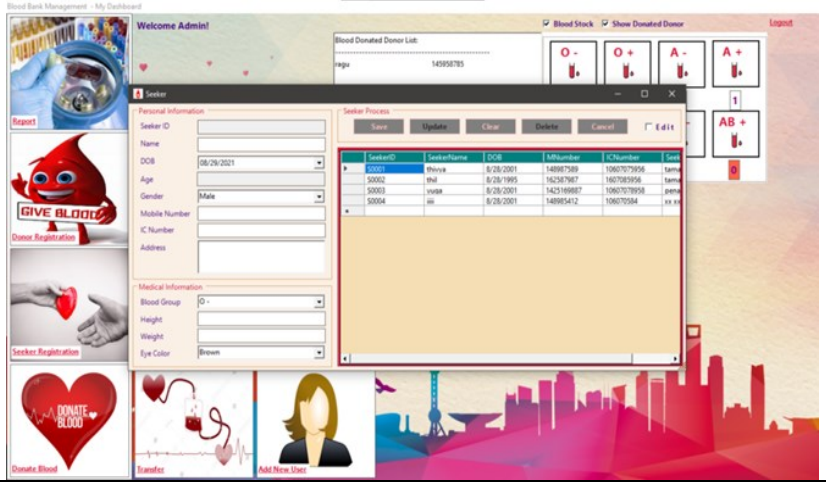
The explanation on how to access the system for staff and the administrator is shown below in Table 1.

Table 1 Description of How to Use the Blood Donor and Seeker Management System

Explanation	Screenshots
Once the system is run, the splash screen will be displayed.	
Then, the login page will be displayed, and the username and password must be inserted to gain access to the system.	

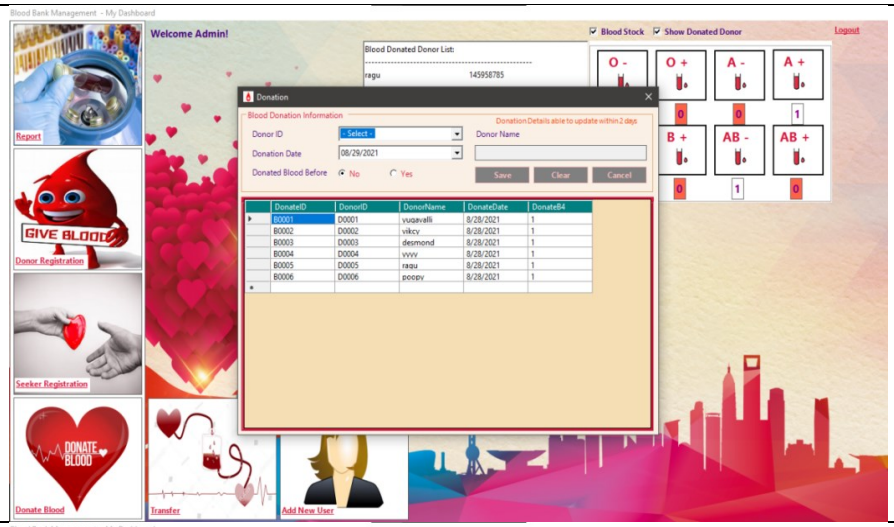
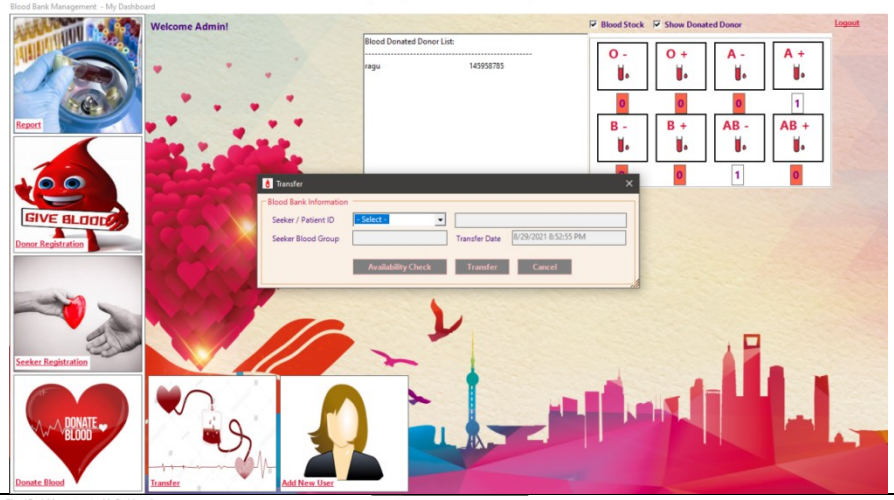
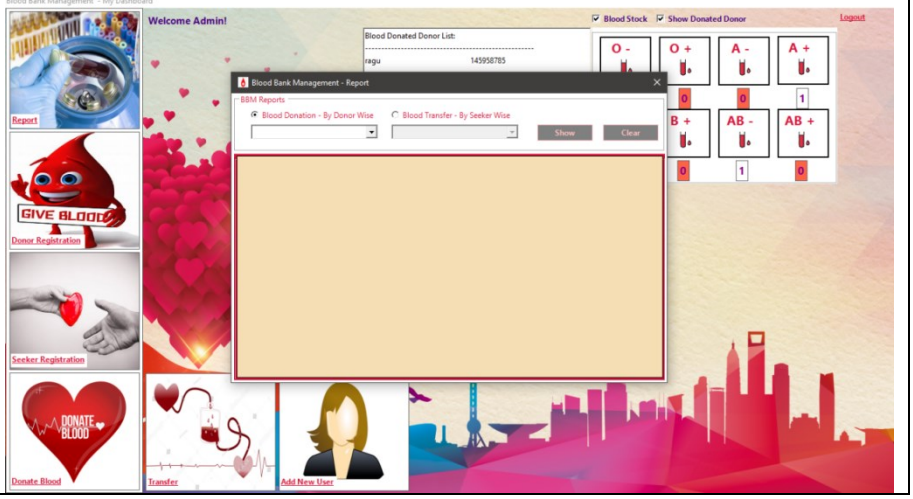
Received: 01 October 2021
Revised: 16 November 2021
Accepted: 26 November 2021

Publisher: ICBE Publication

The user will then be directed to the dashboard of the system after logging in.	
The information of the donor must be filled into the information form and then saved. The edit button enables users to edit the information on this system.	
Similarly, all the information must be filled in and saved. This system allows for the editing of information.	

Received: 01 October 2021
Revised: 16 November 2021
Accepted: 26 November 2021

Publisher: ICBE Publication

Once the donor registration is done, the blood stock number can be updated by clicking the donate blood button and filling the donation form. The blood stock number will increase if the information inserted is saved. Conversely, the blood stock number will decrease if not saved.	
Once the seeker registration is done, the user must click on the transfer button to transfer the blood. The transfer form must be filled before clicking on the transfer button. Moreover, the available blood stock must be checked to ensure sufficient blood before transferring.	
By clicking the report, the user will be able to access both donor and blood seeker information. The user should click on the radio button to obtain reports on specific fields.	

Received: 01 October 2021
Revised: 16 November 2021
Accepted: 26 November 2021

Publisher: ICBE Publication

The admin can add users who can access the system whenever the admin is unavailable. Super admins can also add new users.	

X. Security Requirement / Exceptional Handling

This system is well secured as it is only accessible by the system admin and technicians. A third party will only be allowed access to the system by the admin as this system contains sensitive donor information that can be misused. Furthermore, this system has a limitation for key information such as height, weight, phone number, and Identification Card (IC) number of donors.

a. Logical Design

The flowcharts shown in Figure 2 and Figure 3 explain how the Blood Donor and Seeker Management System for Hospital Use are utilised on a computer.

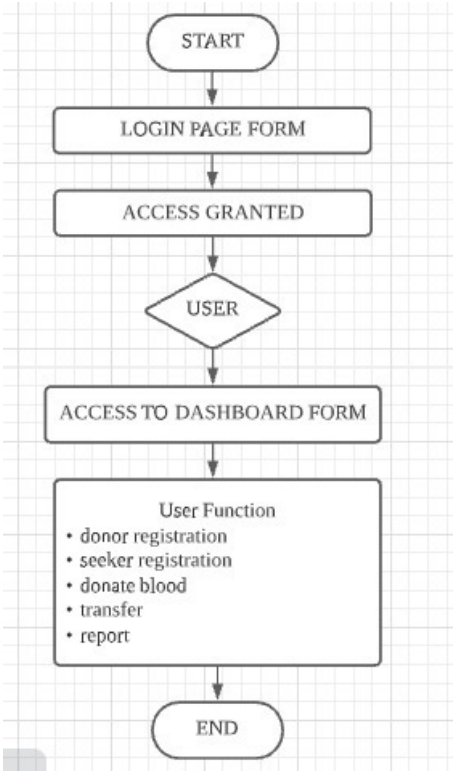


Figure 2 Flowchart of User Access

Received: 01 October 2021
Revised: 16 November 2021
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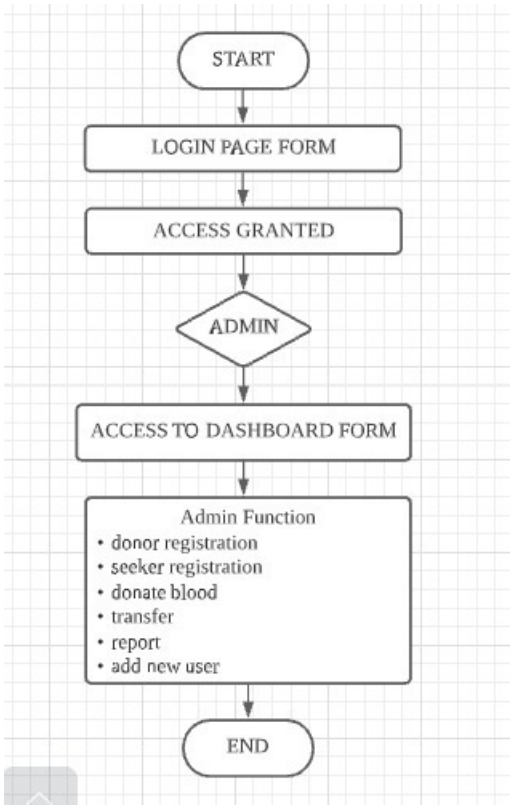

Figure 3 Flowchart of Admin Access

XI. DISCUSSION

The proposed system aids users who need information on blood group availability and donor information. This system enables the management to organise an up-to-date inventory of available blood in the blood bank. Furthermore, this system enables the management to be more flexible. It minimises the time taken to obtain the required information, such as the frequency of blood donation and whether the donor has donated previously. Moreover, this system enables donors to obtain current stock updates on their blood group to replenish stock by donating blood on time. Additionally, blood seekers can obtain information of the desired blood group availability from the system.

XII. LIMITATIONS OF THE PROJECT

This system faces several limitations and caveats. Firstly, there was limited time to develop this system as this system was created to help resolve issues faced during the COVID-19 pandemic. Furthermore, this system does not provide online services for users and has limited resource availability.

XIII. CONCLUSION

This system was designed to be implemented in hospitals to ensure the blood donation process works effectively and efficiently, particularly during emergencies. The blood drive system minimises errors that occur from redundancy or missing data from hard copy reports while reducing paper dependency. Consequently, this automated management system provides accurate information on the availability of a blood group, prompting donors to donate blood and replenish the limited stock. In addition, staff and management will be able to upkeep and manage donor and recipient information and ensure patients looking for a donor match can search for information in a rapid, easy to use, and safe manner.

Received: 01 October 2021
Revised: 16 November 2021
Accepted: 26 November 2021
Publisher: ICBE Publication

REFERENCES

[1] NMC, *The report of the 21st century literacy summit*. Adobe Systems, Incorporated, 2015.

[2] L. Shanmugam and G. Nadesan, "An Innovative Module for Learning Computational Thinking Skills among Undergraduate Students," *International Journal of Academic Research in Progressive Education & Development*, vol. 8, no. 4, pp. 116–129, 2019, doi: 10.6007/IJARPED/v8-i4/6440.

[3] R. Mitra, N. Mishra, and G. P. Rath, "Blood groups systems," *Indian Journal of Anaesthesia*, vol. 58, no. 5. Indian Society of Anaesthetists, pp. 524–528, Sep. 01, 2014. doi: 10.4103/0019-5049.144645.

[4] S. Sulaiman, A. A. K. Abdul Hamid, and N. A. Najihah Yusri, "Development of a Blood Bank Management System," *Procedia - Social and Behavioral Sciences*, vol. 195, pp. 2008–2013, Jul. 2015, doi: 10.1016/j.sbspro.2015.06.215.

[5] Y. Colin, B. Cherif-Zahar, C. le Van Kim, V. Raynal, V. van Huffel, and J. Cartron, "Genetic basis of the RhD-positive and RhD-negative blood group polymorphism as determined by Southern analysis," *Blood*, vol. 78, no. 10, pp. 2747–2752, Nov. 1991, doi: 10.1182/blood.v78.10.2747.bloodjournal78102747.

[6] N. D. Avent and M. E. Reid, "The Rh blood group system: A review," *Blood*, vol. 95, no. 2. W.B. Saunders, pp. 375–387, Jan. 15, 2000. doi: 10.1182/blood.v95.2.375.

[7] S. Sulaiman, A. A. K. Abdul Hamid, and N. A. Najihah Yusri, "Development of a Blood Bank Management System," *Procedia - Social and Behavioral Sciences*, vol. 195, pp. 2008–2013, Jul. 2015, doi: 10.1016/j.sbspro.2015.06.215.

[8] I. Massitela, J. Assunção, A. Santos, and P. Fernandes, "A structured stochastic model for software project estimation in Waterfall models," no. July, 2018, doi: 10.18293/SEKE2018-033.

Received: 01 October 2021
Revised: 16 November 2021
Accepted: 26 November 2021
Publisher: ICBE Publication

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Received: 01 October 2021
Revised: 16 November 2021
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Publisher: ICBE Publication