

Blood Transfusion Information System Design for Blood Transfusion Services Unit

Yulius Harjoseputro¹

Abstract—Information Systems Development as an information provider, both for the users and outsiders, becomes very important at this time. Through a good data management, it can minimize the need for human labor that is currently being replaced by computers. This paper will discuss a design for a blood transfusion information system because there are several issues found in the Blood Transfusion Service Unit (UPTD), some of which are donor data recording at the Blood Transfusion Service Unit which still use manual recording with a book, donors data stored in the book is not well organized, and there are blood donors who do not obey the blood donor regulation, reminder for blood donor level is 70 days and the screening result. This design can do managements which are needed when people want to donor their blood. The database in this system was designed using S-Designer, while the model design was designed using Rational Rose.

Keywords— Blood Transfusion Information System, Desktop, UPTD.

I. INTRODUCTION

The most important thing for blood transfusion patients and recipients is how to get blood in the safest way. Information about donated blood must be in accordance with the implemented procedures in order to guarantee blood sources quality [1]. In addition, an issue emerges related to blood transfusion, particularly between the patients and the donor. Efficiency in utilizing reduced resources is a significant issue for hospitals to maximize patients care [2].

In addition, barcode technology allows blood processing and blood transfusions control [3]. The new implemented standard in Blood Center information system of University Hospital in Patras can improve its ability to automatically detect prescriptions or medical protocols violations, misidentification for both patients and blood products. New standards for blood labeling are included in hospital information systems providing an effective tool for detecting medical errors, blood products and medicines administration, observing their compatibility, complications identification, and differences between protocol procedures and requirements. This system can improve patient safety and ensure quality control enhancement [4].

Technology and globalization era as it is today have encouraged the emergence of human needs for information. The needs of a rapid and accurate information are very vital for today's community, either for business world, education, or research in making decisions or taking data. The existence

of an appropriate, good, safe, and precise as well as accurate information system is very helpful in data processing and decision making for user. In order to be able to master and control information, it takes qualified workers and supporting devices.

Several issues found in in Blood Transfusion Service Unit (BTSU) are as follows.

1. Donor data recordings are still done manually by writing them in a book.
2. Donor data stored in a book are not well organized so that it confuses officers in finding the donor data.
3. There are still donors who do not obey the blood donor rules, i.e. warnings for blood donor levels, that is 70 days from screening results.
4. There are more than one recorded donors data because the donors forget the card number
5. Visitors are often having trouble to find information on blood transfusions at the UPTD.
6. Visitors need conditions and methods for blood transfusions.

By creating this new information system design it is expected that a blood transfusions information system for UPTD can be created containing good, organized and efficient data recording and management. The created information system design limits access to processed and stored data so as to maintain security and confidentiality of the stored data. These data will later be accessed by UPTD laboratory so that it can help blood transfusion services at UPTD.

Several related studies have been carried out by several researchers including computerized technology for product control and blood transfusion will be the National Standard of the Russian Federation to prevent human error in blood transfusions. Barcode technology allows control for blood processing and blood transfusions [3]. The new standard applied in the University Hospital Blood Center information system in Patras increases its ability to automatically detect prescriptions and clinical protocols violations, misidentification, for both patients and blood products. New standards for blood labeling are included in hospital information systems providing an effective tool for detecting medical errors, blood products and medicines administration, observing their compatibility, complications identification, and differences between protocol procedures and requirements. This system raises the level of patient safety and ensures increased quality control [4]. In addition, the existing information system supports blood transfusion services with a telemedical system. The proposed telemedical system provides users with the ability to exchange patients' medical data referring to medical cases. Using the proposed system, doctors can consult ambiguous medical cases, regardless of

¹ Lecturer, Informatics Engineering Study Program, Atmajaya University Yogyakarta, JL. Babarsari 43 Yogyakarta 55281 (phone: 0274-487711 psw 3148; fax: 0274-485223; e-mail: yulius.harjoseputro@uajy.ac.id)

physical location. The teleconsulting session is very user friendly and enhanced with multimedia technology [5]. Even with this multimedia technology, the results of diagnostic data can also be raised for data exchange so that it can be easily implemented [6].

Then, for blood transfusions patients and recipients, receiving the safest blood is important. Information about donated blood must be on track to ensure the the blood source quality [1]. In addition, blood products transfusion is a financial problem for hospitals and patients. Efficiency in utilizing reduced resources is a significant issue for hospitals to maximize patients care [2]. Barcode technology has been widely used in the medical and health industries. In a paper, it was first introduced the barcode technology application in an automated information system oriented to blood transfusion banks and other facilities. A supersedure example from Codabar by ISBT 128 through a barcode label system application in CTS-Macau then was tried to be given. This paper is intended as a reference for barcode technology implementation in blood bank automation systems [7].

Being compared to manual system, particularly for blood bank management, computer-based systems have more advantages because they are easier and not time-and-cost consuming [8]. This research shows a various systems comparison that exist and provides some ideas for the existing system improvement and introducing several new ideas to improve the techniques used in web-based blood bank systems. From these comparisons, conclusions were taken. First conclusion, the existing applications did not provide a better inventory solution to end users, so that the seeker could get information about their own blood group at the location. Second conclusion, there should be a proper management from expired blood groups because each blood unit will expire in 21 days, there must be a stemic record for the expired blood groups. The last conclusion, there must be a function utilized to make reports at anytime given by end user, so that the client will be able to find out which blood groups are in demand and difficult to collect. The function also displays blood donor camp notification to fulfill demand for certain blood groups.

From the explanation abovem a blood transfusion information system design for the blood transfusion service unit was made based on some disadvantages and advantages of the previous system using C# and SQL Server 2005 recording as the database.

II. MVC ARCHITECTURE BASIC CONCEPTS IN INFORMATION SYSTEM

Information Systems are very important for a management in decision making and also strongly related to organizational goals [8]. However, information systems understanding cannot be separated from systems and information understanding. The role of information system is nothing but to make a decision which has an impact on top management [9]. Business organizations emphasising the information systems try to gather the desired information for decision making [10].

The word system is defined as an elements collection that interact to achieve certain goals, while the word information

itself is defined as data processed into a form that is more useful and more meaningful for those who receive it [9].

In this case, information systems can be implemented based on desktop applications, which are applications available on client computers and controlled by users. Desktop applications run on local drives and they do not require network to function properly, even if using a network connection this application will also function properly.

One architecture that can be used is Model View Controller (MVC) architecture, a software architecture concept considered as an architectural pattern in software engineering [11]. MVC is used to separate request and relay data as well as business logic from the logic user interface. This MVC separation solution is expected to increase an application flexibility and reusability.

The MVC architecture separates the application into three parts, i.e. model, view and controller, as shown in Fig. 1.

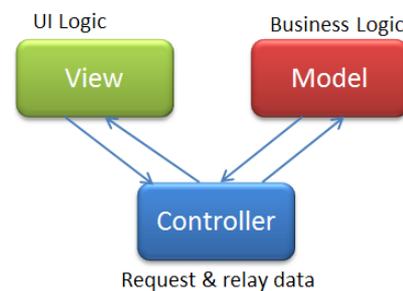


Fig. 1 View Controller Model Architecture [11].

1) *Model*: Model is a component used to retrieve data from a database. This model's main function is related to the database. The function contained in the model will be called by the controller [12].

2) *View*: View is a component that has a role to make presentations to users [12]. View responds to the data sent by the model via the controller.

3) *Controller*: Controller is very closely related to View [13], because every interaction performed by the user is displayed by the View and then responded by the Controller [11].

III. RESULTS AND DISCUSSION

A. Software Analysis

SITranDa is software developed to help manage blood transfusions administered at the UPTD. This system handles staff management, registration management, aftap management, screening management, donor status checking, donor screening result checking, reporting on the donors number for a month, and reporting on the bags number issued for a month. The developed software has the following scope.

1. Manage data from blood donors who are going to donate blood.
2. Record all activities occurring in blood donors, starting from registration, blood drawing, to checking the screening results.

3. Handle users to see donor data that has disease in their blood.
4. Handle users to see whether the donors have sufficient time to donate or not.
5. Give a warning if the donor's time span has not reached 70 days.
6. Give a warning to donors infected with a predetermined disease.
7. Deal with user requests to make reports about the patients' number in a month and the blood bags amount used in a month.

B. Software Architecture

From Fig. 2, it can be explained that in this software architecture there are four interconnected user computers, each of which has its own role and function. Computers in registration officers have a role only to serve registration; Aftap officer computer is used to serve the HB and blood drawing process; computer screening officers are used to manage the donor screening results; and UPTD Head computer can see reports about the entire process, starting from the registration process to the screening results process.

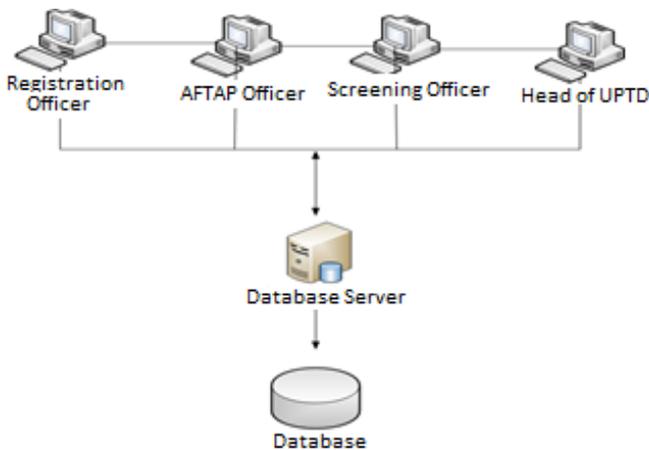


Fig. 2 Software architecture.

C. Product Function

SITranDa software product function is divided into several things as follows.

1) *Officer Data Management Function*: This function is used to manage officer data. This function includes the following.

- a. Officer Data Addition Function, i.e. a function used to add new officer data.
- b. Officers Data Edit Function, i.e. a function used to edit Officers data.
- c. Officers Data Deletion Function, i.e. a function used by officers to delete Officers data.
- d. Officers Data Search Function, i.e. a function used to search for Officer data.
- e. Officers Data Display Function, i.e. a function used to display officers data and show officers data or profile.

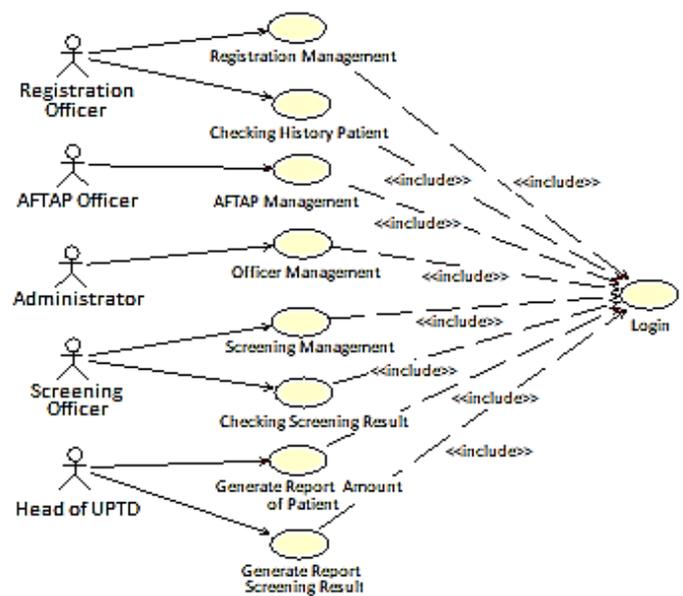


Fig. 3 Use case diagram.

2) *Registration Management Function*: This function is a function that used to manage registering donor data, which includes the following.

- a. Registration Data Add Function, i.e. a function used to add data to registering donors.
- b. Registration Data Edit Function, i.e. a function used to edit donors data.
- c. Registration Data Search Function, i.e. a function used to search for donors data.
- d. Last Registration Data View Function, i.e. a function used to display the most recent donor data in the list.
- e. Data Registration Per Day View Function, i.e. a function used to display donors data every day.
- f. Data Clean Function, i.e. a function used to clean data in the registration form.

3) *Aftap Data Management Function*: This function is utilized to manage data in the Aftap, i.e. in blood drawing room. Aftap Data Management Function includes the following.

- a. Aftap Data Save Function is a function used to add Aftap data to the database.
- b. Aftap Data Edit Function is a function used to edit aftap data on the database.
- c. Aftap Data Search Function is a function used to search for aftap data in the database.
- d. Processed Data Function, i.e. a function used to display all aftap data that have been processed in aftap.
- e. Unprocessed Data Function is a function used to display all aftap data that have not been processed in the aftap.

4) *Screening Data Management Function*: This function is a function to manage donator screening data. Screening Data Management Function includes the following.

- a. Screening Data Save Function, used to add new donor screening data to the database.

- b. Screening Data Edit Function, i.e. a function used to edit donor screening data to the database.
- c. Screening Data Search Function, i.e. a function used to search for donor screening data in the database.
- d. Unchecked Data Function, i.e. a function used to display all donor data that have not been checked in screening.
- e. Checked Data Function, i.e. a function used to display all donor data that have been checked in screening.

- b. Bag Amount Report Function, i.e. a function used to create a report about the number of bags issued every month.

D. Use Case Diagram

Use Case Diagram in software system design is shown in Fig. 3.

E. Entity Relationship Diagram

Entity Relationship Diagram in this software system is shown in Fig. 4.

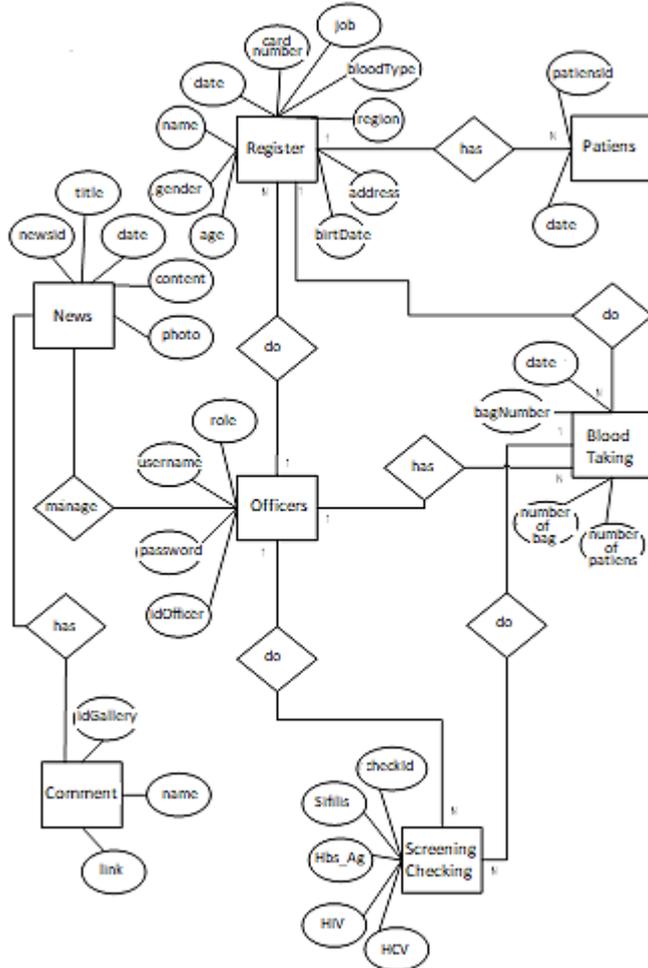


Fig. 4 Entity relationship diagram.

5) **Data Check Function**: This function is used to check donor data and their information. Data Check Function includes the following.

- a. Patient History Function is a function used to see the patient's history, so that the donor recipients and the donors number from a blood donor can be seen.
- b. Screening Results Check Function, i.e. a function used to check screening results from blood donors with a card number as the checking identity.

6) **Monthly Report Generate Function**: This function is used to make monthly reports. Monthly Report Generate Function includes the following.

- a. Patients Screening Reports Function, a function to create a report about patients screening result every month.

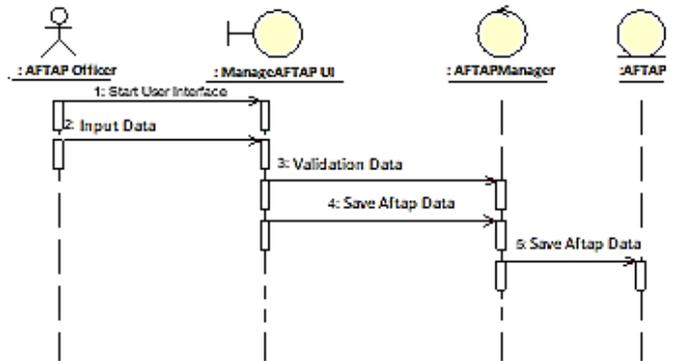


Fig. 5 Aftap add model design.

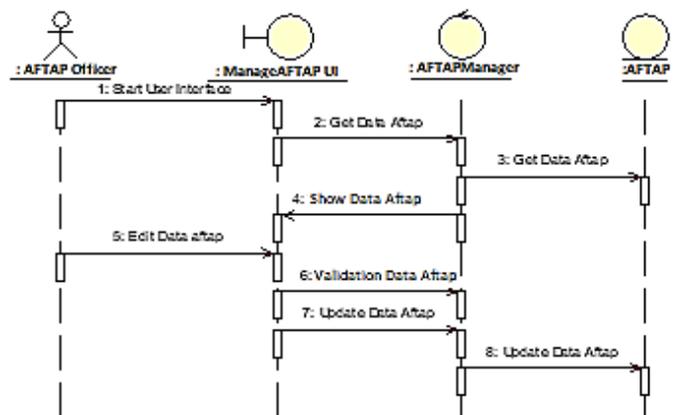


Fig. 6 Aftap edit model design.

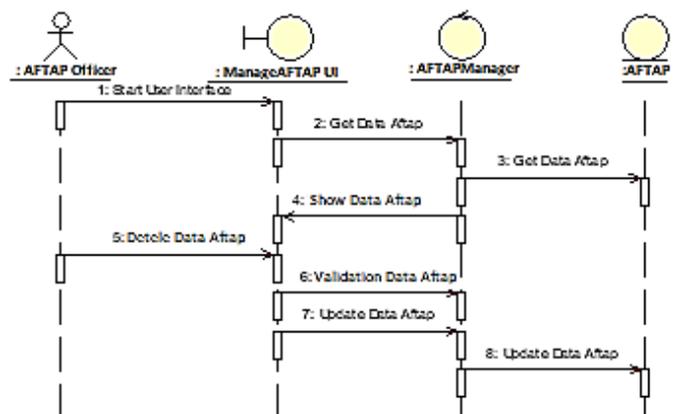


Fig. 7 Aftap delete model design.

F. Model Design

1) *Aftap Management*: The model design in a form of sequence diagram for aftap addition, editing, deletion, display, and search processes are shown in Fig. 5 until Fig. 9.

2) *Screening management*: Model design in a form of sequence diagram for screening edit and delete are shown in Fig. 10 and Fig. 11.

3) *Donor Number History Check*: Model design in a form of sequence diagram for donor number history check process is shown in Fig. 12.

4) *Screening Result Check*: Model design in a form of sequence diagram for screening result checking process can be seen in Fig. 13.

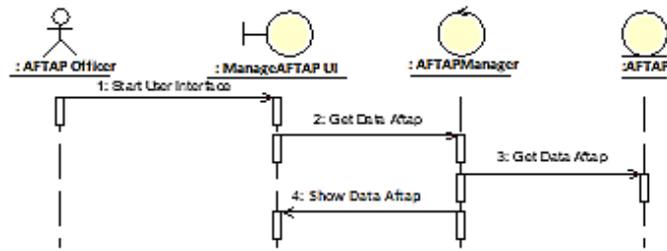


Fig. 8 Aftap display model design.

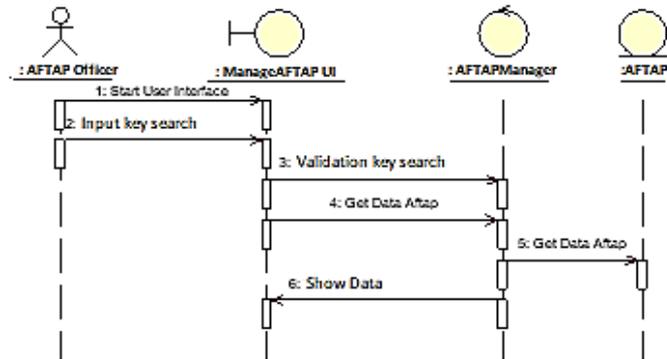


Fig. 9 Aftap search model design.

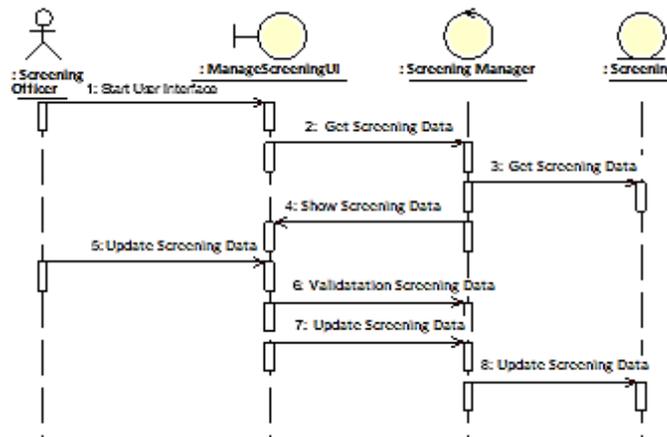


Fig. 10 Screening edit model design.

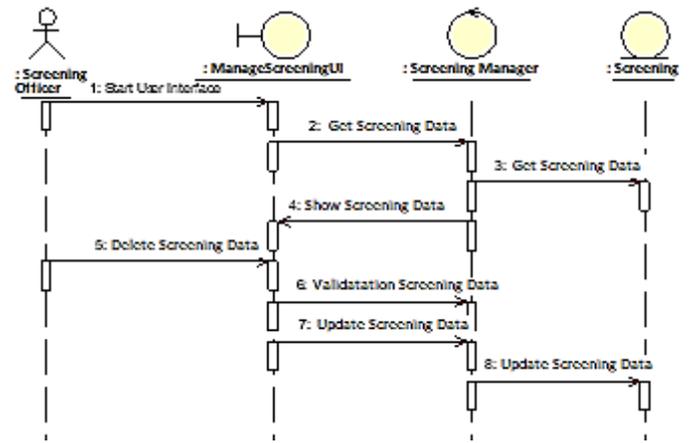


Fig. 11 Screening delete model design.

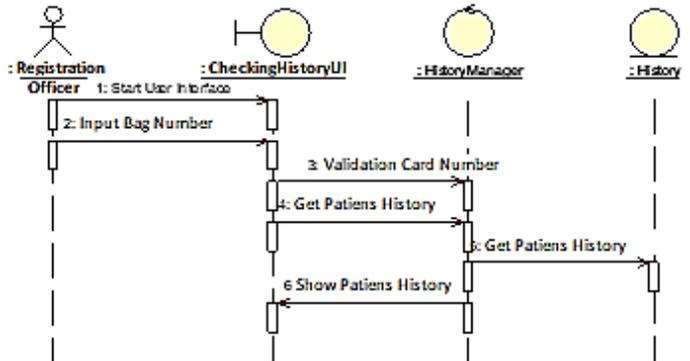


Fig. 12 Donor number history check.

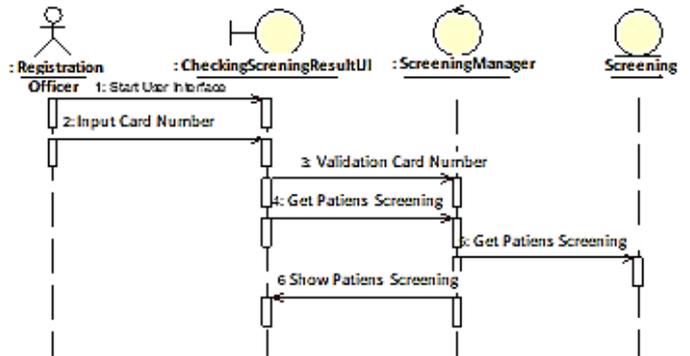


Fig. 13 Screening result check.

G. Interface Design

1) *Login Page*: The interface shown in Fig. 14 is used by officers to log in. Access right to operations that can be done depends on the officer login. The clerk only writes the username and password depending on the role. After that the officer presses the enter button to proceed to the next access. There are two buttons, i.e. Login button, used to enter the system, and Exit button to exit the system.

2) *Aftap Management*: Interface in Fig. 15 is interface used by Aftap officers. This interface contents are input, delete, and aftap data search entered by the officers.

Silahkan Login Disini...

USERNAME

PASSWORD

Fig. 14 Login interface design.

Halaman Aftap

Pelugas: 2/10/2011

No Kartu: Tgl Daftar: 2/10/2011

Data Pendonor:

Nama:

Jenis Kelamin:

Umr:

Alamat:

Tgl Lahir:

Status HB: MEMENUHI TIDAK

Keterangan Donor:

Jenis Donor: DONOR LANGSUNG DONOR SUKAREJA

Jenis Kartag: SINGLE DOUBLE TRIPLE

Can No Kartag: Tgl Daftar: 2/10/2011 Tgl Donor: 2/10/2011

Fig. 15 Aftap management interface design.

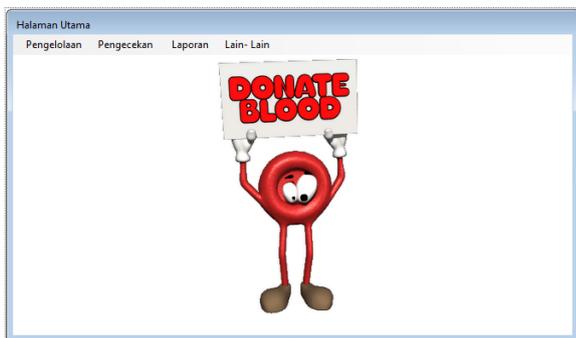


Fig. 16 Main page interface design.

3) *Main Page*: This interface is shown in Fig. 16, which is the main page interface that appears when the login process is successful. This interface contents include officer management, aftap, registration, screening, donor number check, screening results, and generating reports.

4) *Screening Result Check*: Interface in Fig. 17 is interface used by screening officers to check the donor screening results. This interface contents are screening results search based on bag or card number, or name identity and birth date.

5) *Registration Management*: The interface shown in Fig. 18 is registration management interface that can only be managed by registration officers. This interface contents include new donor list addition, patients' data edit, and patients data search.

Hasil Screening

HASIL SKRINING PENDONOR

Berdasarkan Nomor Kartag: Nomor Kartag:

Berdasarkan Nama Dan Tgl Lahir: Nama: Tgl Lahir: 2/10/2011

Berdasarkan Nomor Kartu: Nomor Kartu:

Fig. 17 Screening result check interface design.

Halaman Pendaftaran

Pendaftaran Baru: Pendaftaran Baru

No Kartu:

Tgl Daftar: 2/10/2011

Nama:

Jenis Kelamin:

Umr:

Tgl Lahir: 2/10/2011

Alamat:

Pelugas:

Group Darah:

Can Nama Dan Tanggal Lahir: 2/10/2011 Tanggal: 2/10/2011

Fig. 18 Registration management interface design.

Halaman Screening

Pelugas: 2/10/2011

No Kartag:

Data Pendonor:

Nama:

Jenis Kelamin:

Umr:

Alamat:

Tgl Lahir:

Hasil Screening:

HCV: REAKTIF TIDAK REAKTIF

HEBAG: REAKTIF TIDAK REAKTIF

HIV: REAKTIF TIDAK REAKTIF

SIFES: REAKTIF TIDAK REAKTIF

Can No Kartag: Tgl Donor: 2/10/2011 Tgl Cek: 2/10/2011

Fig. 19 Screening management interface design.

6) *Screening Management*: The screening management interface is shown in Fig. 19. This interface can only be accessed by screening officers who can add as well as edit the screening data from donator. In addition, this interface can also search for the screening results from donors.

IV. CONCLUSIONS AND SUGGESTION

Based on the design results that have been described, it can be concluded that a blood transfusions information system design used for UPTD has been successfully created. It is expected that this design can be implemented in the information system development stage so that it can help the existing blood transfusions process in UPTD.

REFERENCES

- [1] M. Jiang, P. Fu, H. Chen, and M. Chen, "A Dynamic Blood Information Management System Based on RFID," *Proc. of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference*, 2005, pp. 546-549.
- [2] S. Walczak, "Artificial Neural Network Medical Decision Support Tool: Predicting Transfusion Requirements of ER Patients," *Information Technology in Biomedicine*, Vol. 9, No. 3, pp. 468 - 474, 2005.

- [3] N.S. Kordi, B. Zingerman, and M. Krol, "Incorporation of Computerized Blood Product Labeling in Hospital Information System," *Proceedings of 17th IEEE Symposium on Computer-Based Medical Systems*, 2004, pp. 497-499.
- [4] G. Panagopoulou, P. Sirmakessis, A. Tsakalidis, and G. Tzimas, "A Computer Based Solution for Blood Transfusion Centres; The Case Study of Greece," *Proceedings of Computer Based Medical Systems*, 1997, pp. 92-97.
- [5] N. Abdollah, W. Ahmad, and E. Akhir, "Multimedia Design and Development in 'Komputer Saya' Courseware for Slow Learners," *2010 Second International Conference on Computer Research and Development*, 2010, pp. 354-358.
- [6] M. Meza and J. Tasic, "Support of the Blood Transfusion Diagnostic Process with Telemedicine," *EUROCON 2005 - The International Conference on "Computer as a Tool"*, 2005, pp. 195-198.
- [7] B.-N. Li, M.-C. Dong, and V.M. I, "From Codabar to ISBT 128: Implementing Barcode Technology in Blood BankAutomation System," *2005 IEEE Engineering in Medicine and Biology 27th Annual Conference*, 2005, pp. 542-545.
- [8] V. Kulshreshtha and S. Maheshwari, "Blood Bank Management Information System in India," *International Journal of Engineering Research and Applications*, Vol. 1, No. 2, pp. 260-263.
- [9] D.K. Peterson and C.S. Kim, "Information System Objectives: Effects of Experience, Position Level, and Education on Developers," *Journal of Information Technology Management*, Vol. 11, No. 3-4, pp. 29-42, 2000.
- [10] S. Nowduri, "Management Information Systems and Business Decision Making:Review, Analysis, and Recommendations," *Journal of Management and Marketing Research*, Vol. 7, No. 1, pp. 1-8, 2011.
- [11] M. Hemmatfar, M. Salehi, and M. Bayat, "Competitive Advantages and Strategic Information Systems," *International Journal of Business and Management*, Vol. 5, No. 7, pp. 158-169, 2010.
- [12] I.H. Sarker and K. Apu, "MVC Architecture Driven Design and Implementation of Java Framework for Developing Desktop Application," *International Journal of Hybrid Information Technology*, Vol. 7, No. 5, pp. 317-322, 2014.
- [13] N.L.P. Utpatadevi, A.A.K.O. Sudana, and A.A.K.A. Cahyawan, "Implementation of MVC (Model-View-Controller) Architectural to Academic Management Information System with Android Platform Base," *International Journal of Computer Applications*, Vol. 57, No. 8, pp. 1-6, 2012.