

**INVESTIGATION AND DEVELOPMENT OF A DATA  
ACQUISITION SYSTEM FOR BLOOD BANK**

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**INVESTIGATION AND DEVELOPMENT OF A DATA  
ACQUISITION SYSTEM FOR BLOOD BANK**

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## **DEDICATION**

I dedicate this thesis to my beloved parents and the Almighty God.

## ABSTRACT

Blood is a vital fluid where required for saving human's life. Blood is stored in a blood bank which is a bank of blood components, gathered as a result of blood donations that are responsible for collecting, storing and preserved for the use of medical purpose. Investigation of the existing blood collection and tracking system is essential to efficiently manage, control and monitor on all aspect of a blood bank. A comprehensive data acquisition system from collection location to a cloud-based system enables a paperless system with minimum human intervention to oversee the entire collection to dispatch process in a blood bank. A research has been made that most blood banks practicing stand-alone which may contribute to wastage of donated blood. For that matter, this collected data system allows connectivity between the blood banks to effectively conduct and systematically manage their daily activities within one integrated system. This application helps blood donation center receives the registered donated blood from any hospitals easily as it records the donated blood information in cloud immediately.

## ABSTRAK

Darah adalah cecair penting yang diperlukan untuk menyelamatkan nyawa manusia. Darah disimpan dalam tabung darah yang merupakan tabung komponen darah, dikumpulkan sebagai hasil sumbangan darah yang bertanggungjawab untuk mengumpul dan menyimpan untuk kegunaan tujuan utama dalam perubatan. Siasatan pengumpulan dan sistem pengesanan darah yang sedia ada adalah penting untuk menguruskan, mengawal dan memantau secara cekap semua aspek dalam tabung darah. Sistem pengambilalihan data yang komprehensif dari lokasi pengumpulan kepada sistem berasaskan awan mewujudkan sistem tanpa penggunaan kertas dengan meminimumkan campur tangan manusia untuk mengawasi keseluruhan koleksi dan menghantar proses tersebut ke dalam tabung darah. Satu penyelidikan telah dibuat bahawa kebanyakan tabung darah mengamalkan praktis 'stand-alone' yang boleh menyumbang kepada pembaziran ke atas darah yang disumbangkan. Oleh itu, sistem data ini mewujudkan perhubungan di antara tabung darah untuk melaksanakan dan menguruskan aktiviti harian mereka dengan lebih sistematik dalam satu sistem bersepadu. Aplikasi ini membantu pusat pendermaan darah menerima maklumat darah yang disumbangkan dari tabung darah dengan mudah kerana ia merekodkan maklumat darah yang disumbangkan di awan serta-merta.



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## LIST OF SYMBOLS AND ABBREVIATIONS

AC	:	Alternating current
ACD	:	Anticoagulant citrate dextrose
ADC	:	Analog-to-digital conversion
ATP	:	Adenosine triphosphate
CPD	:	Citrate phosphate dextrose
CPDA	:	Citrate-phosphate-dextrose with adenine
DC	:	Direct current
DPG	:	Diphosphoglycerate
FIFO	:	First-in, first-out
GSM	:	Global system for mobile
HIV	:	Human immunodeficiency virus
HLTV	:	Human T lymphotropic virus
HTML	:	Hypertext markup language
I/O	:	Input/Output
ID	:	Identity document
IoT	:	Internet of Things
MFRC522	:	Mifare RC522
PCB	:	Printed circuit board

PLX- DAQ	:	Parallax data acquisition
PWM	:	Pulse width modulation
RF	:	Radio frequency
RFID	:	Radio frequency identification
Rh	:	Rhesus
SIM	:	Subscriber identity module
SMS	:	Short message service
SOP	:	Standard operating procedure
SQL	:	Structured query language
USB	:	Universal serial bus
UV	:	Ultraviolet

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# CHAPTER 1

## INTRODUCTION

### 1.1 Project Background

Blood is an essential fluid that existed in humans' body and the animals' body. Blood is considered very important because it is needed to deliver the nutrients and oxygen to the whole part of the body. There are three important functions of the blood which are transportation, regulation, and protection for the body [1]. The oxygen gas that flows into the lungs will be transported to the body cells. The existence of blood in the body also enables the body to maintain the temperature of one's body. If any parts of the body are wounded or damage of blood vessels occur, the blood clotting process will take place in order to stop the bleeding to protect the body from losing blood any further [2]. The body cannot fight the infections and cannot excrete the waste products without the existence of the blood [3].

There are four main types of blood which known as in categorization of ABO group which are A, B, AB, and O. Some of the blood contains additional marker which known as Rh factor. The blood can be classified as negative or positive such as A- or A+. The negative blood is the blood which does not contain Rh factor whereas the positive blood is the blood which contains Rh factor [4]. The least percentage of the population with negative blood according to the blood connection community blood center comes from AB- blood group which is 0.6%. The highest percentage of the population with negative blood comes from O- which is 6.6%. Apart from the population with negative blood, the least percentage of the population with positive blood comes from AB+ which is 3.4% only and the highest percentage of the population with positive blood comes from O+ which is 37.4% [5].

O+	<b>1 in 3</b>	37.4%
A+	<b>1 in 3</b>	35.7%
B+	<b>1 in 12</b>	8.5%
AB+	<b>1 in 29</b>	3.4%
O-	<b>1 in 15</b>	6.6%
A-	<b>1 in 16</b>	6.3%
B-	<b>1 in 67</b>	1.5%
AB-	<b>1 in 167</b>	.6%

**Figure 1.1: Percentage of population with blood group**

**(Source: America's Blood Centre)**

According to Recruitment and Publicity division head, Dr. Norris Naim, the rarest type of blood come from AB group and Rhesus negative. People with these types of blood are encouraged from not donating their blood when they feel like to donate. Instead, their names and informations will be kept so that hospitals will contact

them once their blood is needed. This is because blood has specific amount of lifespan which means if the blood is not used it will be thrown away. This will lead to wastage of blood which is not a good thing to do. As there is small number of population with rare blood, the donations will be carried out when it is needed. This is due to it will be a problem if there is any emergency cases occur in the hospital as there is a three months recovery period after a person has donated his blood before they able to start donate their blood again [6]. Through the naked eyes, blood looks quite similar but after blood inspection done, the blood can be seen differently as not every human has the same antigens in their red blood cells. Blood carries the same basic constituent which are red cells, white cells, platelets, and plasma [7]. On the other hand, white blood cells or leukocytes are important in the body to go against infection. Meanwhile, platelets or thrombocytes are formed in the bone marrow. This blood constituent help clotting process in case the blood vessels happen to damage by some accidents.

There is one engrossing thing about blood. Our own blood is not merely giving benefits to our own selves but also able to save other people's life who has a problem with their own state of blood in their body, for instance, those who have anaemia, leukemia, sickle cell disease, haemophilia and etc. Anaemia is known as a disease which occurs due to a reduction in red blood cells production. Leukemia is a disease that occurs due to the abnormal production of the white blood cells in the bone marrow or known as the cancer of the white blood cells. Haemophilia is a disease where one has a higher probability to bleed longer after an injury. This causes one to lose their blood in the high amount [8]. Sickle cell disease is a disease which occurs due to the abnormal production of the haemoglobin. This is due to the sickle cell shaped of the red blood cells are not able to carry enough haemoglobin needed and chances are the

cells may abnormally stick together which causes blood vessel damage in one's body. [9].

This shows how blood donation is essential in this life as this good deed able to help people who are suffering from diseases out from their misery. According to Community Blood Bank of Northwest Pennsylvania and Western New York, about 43,000 pints amount of blood donated blood is needed every day in U.S and Canada based on the blood facts and statistics [10]. As stated by Health Minister Dr. S. Subramaniam, in Malaysia, there is about 2,000 bags of blood are needed each day by 925 patients who need transfusion due to diseases. He also said that this amount is not included in the emergency cases and those with rare blood types [11]. Furthermore, red blood cell is very important to be available for every minute as the road accidents, major surgery, and diseases which resulted in the loss of the massive amount of blood cases occur every day. This will bring to the thoughts that donation of blood is a very critical action to be taken in this world. The donation of blood is usually carried out in a hospital or it can be anywhere such as in universities, school or during the health campaign being held.

According to American Red Cross, after the donation which considered as the first step, there are another four steps to go to the distribution of donated blood which considered as the last step. The first step is the donation of blood. The donors will register themselves as the donor and the nurses will check the donors' health history and do some mini physical check-up such as body temperature, pulse, and blood pressure check-ups. Each blood donor will donate at least 1 pint of blood and the blood will be kept in the blood transfusion bag. The blood transfusion bag will be labeled with an identical barcode in order to facilitate the workers to keep track of the donated

blood. The second step will be named as a processing. The blood will be separated into three components which are plasma, platelets and red blood cells. The third step is testing the donated blood. It needs to be further tested in the laboratories to acknowledge the condition of the blood [12]. Testing the donated blood is necessary to group the blood to its own kinds. According to Australian Red Cross Blood Service, the safest blood supplies in the world, seven different tests are conducted on the blood collected to identify whether the blood has been infected with the infectious diseases or safe for transfusion matter. The donated blood need to be checked to make sure there is no presence of five most common diseases in the blood. The most infectious diseases are HIV, hepatitis B, hepatitis C, human T-lymphotropic virus (HTLV), and syphilis. The manufacturers will receive the test results electronically within 24 hours. The donor will be notified if their donated blood test shows positive and the unit will be discarded. After the blood testing process has been done, the blood will be stored in blood storage or as known as a blood bank and this is considered as fourth step. The blood units which are fitting for transfusion will be labeled and stored. The blood bank is an area which the collected blood gained from the donors is stored, separated into components and a place where the preparation for the blood's transfusion to recipients is carried out [13]. Red blood cells will be stored at 6°C in the refrigerator within 42 days. The platelets will be kept at room temperature up to five days. Meanwhile, plasma will be stored in the freezer up to one year. The last step is the distribution which is the donated blood will be shipped to the hospitals [14].