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Safe and Efficient Blood Donation

Hybrid Application connecting Hospitals, Blood Banks, and Donors

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Abstract: Blood donation, apart from being an act of kindness is also a vital process to help save lives. Blood collected is stored in blood banks and is directed to hospitals to save patients in need. There are eight different blood groups which are classified by the presence or absence of antigens (A, B, AB, O) and by the RH factor. Transfusion of blood can be difficult at times as it may provoke allergic reactions and anaphylactic shocks. We live in an era where technology manages to pervade into our lives to ensure availability and accessibility of services without compromising our security. By applying the very same technology in blood donation, an efficient system to monitor and map blood donations to patients to minimize such risks can be developed. The proposed project is a web based application which allows volunteers to register to donate blood and stores their validated details in a database along with details of all blood banks and hospitals. The real-time location of volunteers, patients, and hospitals help locate eligible candidates or the best possible blood samples for transfusion. These various data sets are validated, stored and mined to acquire useful analytic results. Cross referencing patient details with donor sample details help prevent transfusion risks and including location details helps map a faster way to acquire blood samples. This can in turn save many lives and make blood donation a hassle-free process for people willing to help.

Keywords:*blood donation, big data, proximity sorting, analytics*

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I. INTRODUCTION

[1] Blood is a fluid substance found in all living vertebrates, which circulates in blood vessels providing nourishment and oxygen to various organ systems while simultaneously filtering toxic substances to expel from the living organism [1]. Apart from which it provides circulation of white blood cells and antibodies, invokes coagulation when required, regulates body temperature and enables hydraulic functions in the cardio-muscular system. [2] Blood is a complex fluid consisting of free flowing blood cells in a pale yellow liquid comprising of water, albumins, fibrinogens, and globulins [2]. This goes on to validate the fact that blood is an integral, life sustaining fluid. [3] So integral that if a human being fails to maintain the prescribed quantity (4.5-5.7 litres) of blood, the human being could face severe complications that could lead to even death [3]. To prevent such cases, blood is intravenously transferred to the circulatory system.

The process of transferring blood from one individual to another is called blood transfusion. The individual providing the blood is called a donor whereas the individual receiving the blood is called the recipient. [4] The World Health Organisation (WHO) classifies the blood donors into three categories - voluntary unpaid, family/replacement, and paid. Donated blood is valued for four major components of the many present, which includes cryoprecipitates, plasma, platelets, and red blood cells. One unit of blood can contain either two or three of these components [4]. Thus, one donor can save up to three people. Donors have the option of donating either whole blood or specific blood components. The latter is known as apheresis. [5] The availability of unpaid, voluntary blood donors at all times will help tackle the issue of blood shortage during emergencies. In fact, it has been stated that there is a need for five crore units of blood in India, of which only half is met causing a shortage of over two crore units of blood annually [5].

The demand for blood surged during the Second World War, when wounded soldiers died due to heavy blood loss. [6] To prevent this the International Society of Blood Transfusion was established by the International Red Cross in 1935. To ensure that the right type of blood was transfused the representatives began profiling blood on the basis of the blood group. Initially, blood was classified on the basis of the group it belonged to – A, B, O and this was called ABO classification. Later another method of classification was introduced based on the presence and absence of the Rhesus factor. If the Rhesus antigen was present the blood type was marked as Rh positive, while the absence of the same is marked as Rh negative. This was further classified based on the type of Rhesus antigen which are D, C, c, e, E. [6] Since a majority of the population is Rhesus-positive, finding a match for Rhesus-negative patients can be very difficult. [7] Combining the two commonly used systems for classification, the ISBT has listed thirty-five different blood groups [7]. This has made transfusion a hassle free task.

It was observed early on during transfusion processes that certain complication and allergic reactions to the transfused blood occurred. [8] Such immunological reactions could be due to mismatch of blood groups in the ABO classification (acute haemolytic reactions), lack of antigens per unit of blood (delayed haemolytic reactions), increased white blood cells in donor blood (febrile nonhemolytic reactions), IgE anti-allergen presence (allergic reaction), and anaphylactic reactions caused due to the presence of IgA antibodies [8].

To prevent all such reactions and improve the mean standard time of donor to recipient, the authors of section II have developed systems which have failed to take into account inter-cellular compatibility and mean time of donation. The basic concept is to create a web application that enables medical personnel to request blood from proximate blood banks or volunteers. In order to ensure the lowest possible rates of refusal, the web application will run the patient's details through the database to select a blood bank or a volunteer who meets the requirements as closely as possible. The proposed system in section III aims to rectify these challenges and section IV and V provide insight about the working and developing of a prototype.

II. EXISTING SYSTEM

A.BIMA

An existing system for blood donation and management would be BIMA (Blood Information Management Application), a web application developed to improve access to safe blood for transfusion during emergencies. The BIMA system is a web application that provides access to different blood information databases. It gets information such as the name and location of proximate, licensed blood centers, stock of each type of blood available and a donor list. It also has a booking information system to reserve specific quantities of blood.

Whenever blood is needed, the concerned medical personnel can operate BIMA through a smart device. The application allows the concerned personnel to access the blood information databases connected with the system.

B.Donor2donor

The Ardhaay Foundation, an NGO came up with a mobile application to connect donors and recipients all across Punjab, India to tackle the issue of insufficient blood supply to those in need. They have been successful in connecting and supplying blood in various regions of Punjab and Haryana, and are trying to expand their services to the rest of India in an efficient manner.

The above-mentioned applications have not been successful in reducing the mean acquiring rate of blood or the average transport time. Moreover, they have not considered the factors that may cause risks and have not considered the mean refusal rate of recipients. To overcome the above-mentioned challenges a new application flexible to accommodate these factors linking hospitals, blood banks and donors is required.

III. PROPOSED ARCHITECTURE

In the proposed system, to improve the mean duration between the identified need for blood by incorporating location services and implementing a sorting algorithm to list out available blood samples based on compatibility and distance between the donor or sample and the patient.

Moreover, it will also provide a platform to enable volunteers to register themselves and attend to requests through a hybrid application that can be hosted on a smart device. The efficiency and stability can also be guaranteed through an architecture to process big data, using the Hadoop ecosystem and can support larger data sets of volunteer details, hospital databases, and blood bank details.

The Hospitals are required to fill out a blood requisition form by some authorized medical personnel which is forwarded via the application to the server. The server administrator forwards the request to blood banks. The nearest blood banks are sent the request. Provided that the blood bank has the required match, the request is accepted. In cases, where the blood banks cannot accept the request, the server administrator forwards the request to the registered donors. The donors are listed based on proximity. The donor who accepts the request is sent details of the hospital and the request is marked by a time stamp. On the other hand, the hospital receives the latest blood report uploaded by the registered donor. The doctor or authorized medical personnel in-charge can review the report to ensure that there are no risks involved in the transfusion process.

IV. IMPLEMENTATION

A.DATA SETS

The data sets required in the proposed project include existing data sets about hospital and blood bank details through registered medical personnel. New data sets to store information about registered volunteers and location data will be created and integrated into a central database.

B.BACK END

The Back end of the proposed system will involve request management and form processing. Upon receiving the request from the hospital, the server identifies registered blood banks in the hospital's immediate vicinity and forwards the request, along with a medical report of the patient. If a blood banks has the needed type and amount, an affirmation is sent to the server, which in turn forwards the blood bank's details to the hospital, along with the required blood type based on their current/recent location and distance from the hospital. The system then contacts the volunteers via their mobile devices. If a willing donor is found, the system informs the hospital. Every message sent or received by the server is recorded for future reference and the life time of a request is 24 hours.

C.FRONT END

The front end of the proposed system will include two sub-modules. One that allows medical personnel to post requests and the other that allows volunteers to register themselves through a form. Registered volunteers can access the application to get notified about requests whereas the medical personnel can keep track of the requests and incoming blood samples. Hospitals and blood banks can update their blood stocks to provide a statistically updated data set. The real time implementation of the application will help hospitals all over the country in procuring blood

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promptly and from reliable sources, thereby helping save countless lives.

The user interface request processing will be such that every time a request for blood is made the server is alerted and the notification enters a queue. The time stamp on every request made ensure that requests are on the first come first serve basis. The requests are then forwarded to blood banks in the defined proximity by calculating the displacement. Provided the request is not accepted then the displacement is calculated for the available volunteers in the defined radius search. If the requests are not attended in the given time period, then the request will expire.

V. SYSTEM DIAGRAMS

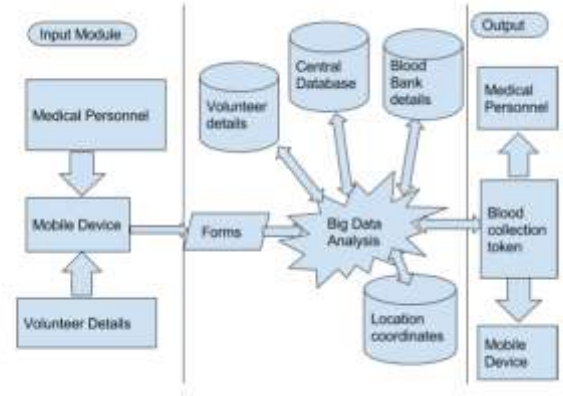

Fig.1

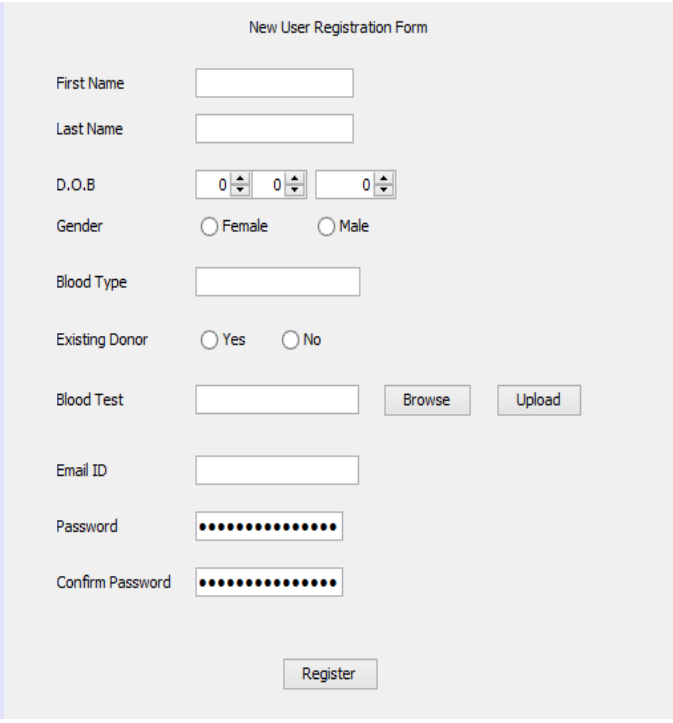

Fig.2

Fig. (1) Architecture Diagram of Proposed System and Fig. (2) Donor Registration Form.

VI. CONCLUSION

The web application for safe and efficient blood donation using data analytics on implementation aims to obtain experimental results that will result in the mean waiting time reduced by half. Hospitals will be able to acquire the required amount of blood easily and efficiently. In cases where the blood is usually not available in blood banks, the volunteers in the proximate area, who have registered with the application, will be contacted and the transfusion will take place successfully. The refusal rate will also reduce to an incredibly significant low.

The application will also help hospitals all over the country in procuring blood promptly and from reliable sources, thereby helping to save countless lives using real time data.

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