

# Blockchain based blood donation management system

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**Abstract-** *The current blood donation management system has some limitations which needs to be resolved for improving the quality of healthcare facilities. The existing system lacks the detailed blood information and it also involves a lot of discrepancies such as hoarding, stealing and selling of contaminated blood which might even lead to the death of a patients. Also there is a delayed supply of blood to hospitals due to poor communication facilities. Therefore, in order to overcome such shortcomings, we propose a blood donation management system using blockchain technology. By using blockchain, we build a decentralized database which is can be managed and accessed only by authorised users. This database can be used to store donor and blood informations including blood consumption and disposals. Hence, this system aims to increase the efficiency and security of the blood donation management system.*

**Key words:** *blockchain, ethereum, nodejs, html5*

## INTRODUCTION

Healthcare systems around the world face challenges that often lead to poorer health outcomes. Health sector is complex and include various professionals ranging from physicians, practitioners, researchers and patients who face several problems everyday. Information security is one such challenge which arises primarily due to data sharing regulations. In order to overcome such limitations we can incorporate various technologies into the healthcare system.

With the application of technology, healthcare has become more efficient and responsive. It has allowed physicians and doctors to diagnose better and treat their patients. With continuous development of

technology in healthcare, mankind has been able to save numerous and increase the life expectancy.

Today in the developed world more and more volunteers are coming forward to donate blood. It is a procedure which can help save the life of others. Millions of people need blood transfusions each year. Some may need blood during surgery or because they have a disease that requires blood components or due to accidents. The amount of blood available for transfusion depends on the amount obtained through blood donation. It is the responsibility of the visionaries to ensure that healthy blood is supplied to the needy at the required time. But there are several issues faced by the existing blood donation management systems such as hoarding, commercial sale of the blood bags at exorbitant rates and the supply of contaminated blood. All such discrepancies occur due to the lack of proper management and tracking which can be improved by incorporating advanced technologies such as blockchain. Blockchain is a form of distributed-ledger-technology which is a shared-ledger with a growing ordered list of records stored and persisted in a giant computer database. It has replaced much of the existing centralised systems in various sectors such as finance, power markets and supply chains.

We present an approach which would reduce the discrepancies in blood donation management system. The idea involves streamlining the blood donation, monitoring and usage process. With help of blockchain, a decentralised would be built to store the information such donor information, blood type, blood bank name, blood packet location etc. The database would be accessed by only authorised person of the hospitals and the blood donation centres.

When someone makes a request for a blood packet, the concerned authority would check the blockchain database and accordingly, act on the request.

Whenever the packet is used, it would be updated in the blockchain database.

Each donor would have their own account in the database through which they could login to see the details regarding their blood. As soon as the blood packet is used, the donor would be notified about the use of his/her blood. In this way we can also ensure the donors about the proper use of their blood, thereby achieving their trust and promoting blood donation.

## RELATED WORKS

The increasing rate of discrepancies at the blood donation system has lead many researchers develop various platforms which would provide a safe blood donation system.

Ming Jiang, Bo Xing, Zhonghua Sun, Ping Fu, Hexin Chen, Mianshu Chen, Yu Wang proposed a RFID based blood information management system that adopts fingerprint sensor to identify donor and RFID is used to increase the convenience of management. Moreover, GPRS is used with along with this system to transmit real time data between bloodmobile and blood centers.

Anish Hamlin M R, Albert Mayan J has developed a mobile application to assist in donation of blood from a donor in emergency case. In the need of the hour, nearest potential blood donor will be tracked by gps which as the same blood group as required. If potential blood donor accepts the request and OTP will be sent to donor for verification. If request is not accepted, the app will automatically search the next potential blood donor.

Basit Shahzad, Jon Crowcroft proposes a system in which adjustable blockchain would be used in the process of electronic voting from polling, quantifying data to declaration of result. Effective hashing techniques would be used to secure the data.

Adsul, A. C., Bhosale, V. K., & Autee aims to fulfill the requirement of blood bags using android application and raspberry pi. The participant's data will be collected using android application and raspberry Pi via installing it at different locations.

Mittal, N., & Snotra, K. aims to present a relation between existing framework of blood banks and enhanced framework to improve efficiency. An android application will be created to manage the

blood bank system of receiving and retrieving information about donor and recipient.

Boonyanusith, W., Jittamai, aims to develop a web based system to organise blood donation within the supply chain. The main objective of the work is increase the efficiency of data communications among different stakeholders in the supply chain so as to improve response time to delivery of blood bags to patients.

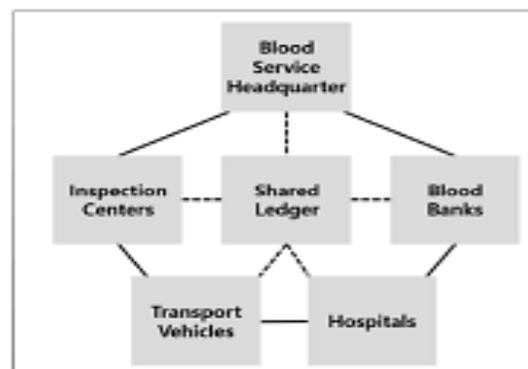
## PROPOSED SYSTEM

The proposed system works using blockchain to create a secure blood donation database. A person who is interested in donating blood can register himself by approaching a registered hospital. An account would be created for each user through which they can view the process of blood supply take place. In this way they can also ensure that their blood is utilized properly.

The process of supplying blood packet can be divided into four steps:-

- Donor registration
- Blood collection
- Packet storage
- Utilization of packets.

The system works as depicted in the figure.



At the beginning of process that is blood collection stage donors arrive at blood donation centres or hospitals to donate blood. After donation of blood, the blood collected is screened to check purity of blood and to know that the blood is disease free. Then, the blood bags are stored in hospitals or blood banks. Afterwards, the blood packets are distributed among

hospital, clinics as per requirements. Lastly, blood bags are transfused to its final user.

### 1. Donor registration

This phase includes the donor registration. In this phase, the registration process takes place. The registration process consists of steps like collecting donor's personal information followed by blood test. After registration donor will be provided with a unique batch number. Each blood packet would be identified using this batch id with respect to the blood group required at that moment. The registration would be completed by authorised personnel who would have login access to the web interface.

### 2. Blood collection

This phase involves drawing blood from the user and screening. Screening is done to ensure that the blood donated is fit for transfusion. It is ensured that the blood is free of any kind of blood borne diseases. Finally the screened blood would be stored in a desirable temperature. Each blood packet will be inscribed with a unique batch id before its transportation.

During this phase the management also has to make sure that the blood is stored at specified temperature so the blood doesn't get spoiled during transportation. Special vehicles need to be used in order to transport these blood packets. While transporting a blood packet to a particular hospital, the donor needs to be notified about the hospital details. The donors account will consist of these details. So when the donor logs into his account he will be able to see the hospital name where his blood was donated.

At delivery point of blood packet that is hospital or blood bank, management will receive the information from where the blood packets were dispatched and management will check the temperature of blood packets. If temperature is not in the range of minimum and maximum threshold, the packet will be considered as damaged and cannot be used by recipient. If the packet temperature is between the required ranges, the management updates the distributed ledger.

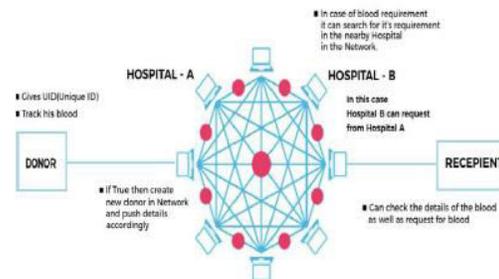
### 3. Packets storage

When packets are being stored at a hospital or a blood bank, the temperature of storage should be monitored.

The blood packets are used up in a FIFO order based upon the blood group needed. That is, the older packets will be used up first. It will ensure the proper utilization of blood packet because packets should be used within 42 days of donation.

### 4. Utilisation of blood Packets

It is the last phase, when the blood is given to the recipient. The packet id will be scanned from the packet and corresponding changes will be updated in the database such as the information about the recipient. The smart contract will check for recipient details and ensure that the person is taking same blood group packet. After donation; these informations would



also be available to the donor via his account.

The figure shows the architecture of the entire blood donation system. In order for a donor to register himself with this system, he/she should approach the hospital authorities. These hospitals would complete their registration process as soon as their blood is checked. Once the donor registration is completed, the donor can access his account on his own. In order for someone to receive the blood, they also have to approach the concerned hospitals. Then the authorities would update the patient details into their database.

## RESULT AND ANALYSIS

The entire project is built on Ethereum and it uses nodejs, web3, Express, Nodejs, Html5 and Javascript. Ethereum is a decentralized open source blockchain featuring smart contract functionality.

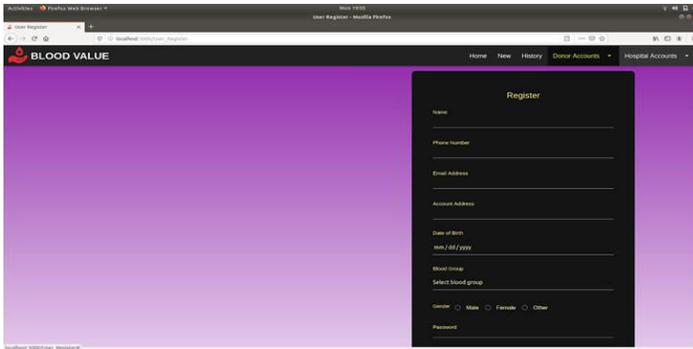
Basically, 4 contracts are created each for the user, donor, migration and the base contract.

### Donation of blood

```

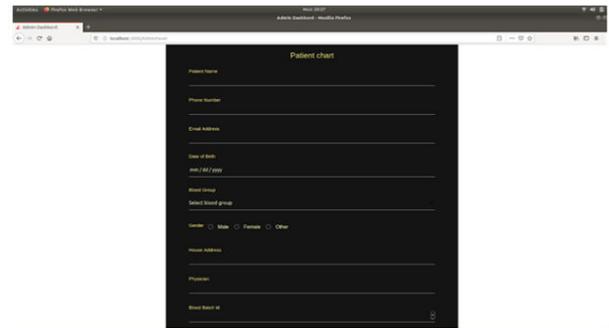
DonationContracts {
    function getCurrentTime();
    function add_donation_details();
    function get_donation_details();
}
    
```

This donation contract creates a structure for donor informations which can be used for registering new



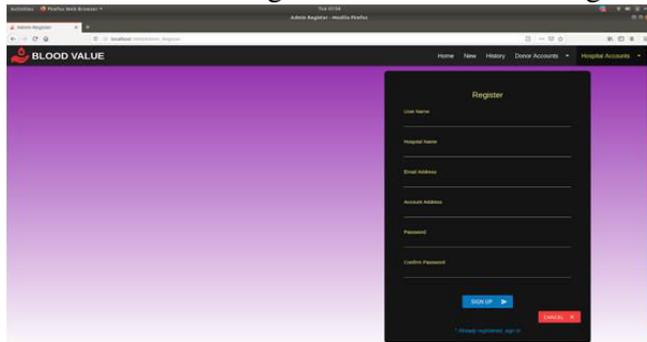
The above figure shows the hospital or admin registration web page. It takes inputs such as the hospital name, email address, account address, and password. Once this account is created, the hospitals can log in to their account and view the entire blood donation details such as the patient and donor charts. Using these informations they can perform the blood donation transactions based upon the availability of blood packets.

users and it consists the above mentioned functions. The `getCurrentTime()` function is used to update the time at which the donation was made which can be used later to check the usability of the blood packet. `Add_Donation_details` functions are used to register a new donation detail into structure `donation_Details`. It increments the donation count. The `get_donation_details` function is used to retrieve donation details from structure `donation_Details`.



Once a match of blood group is found between the donor and the patient, the admin updates the database.

The above figure shows the donor registration



web page. It asks for the donor name, phone number, email address, account address which is the virtual address, dob, blood group, gender and password. Once these details are given, an account for the donor is created.

### Hospital Registration

The user contract consists of the hospital registration structure.

```
HospitalReg{
    function addAdmin();
    function getAdmin();}
```

The `addAdmin()` is used to register admin or the hospital to structure `adminProfile`. The `getAdmin()` function is used to retrieve admin details from structure `adminProfile`.

### Patient registration

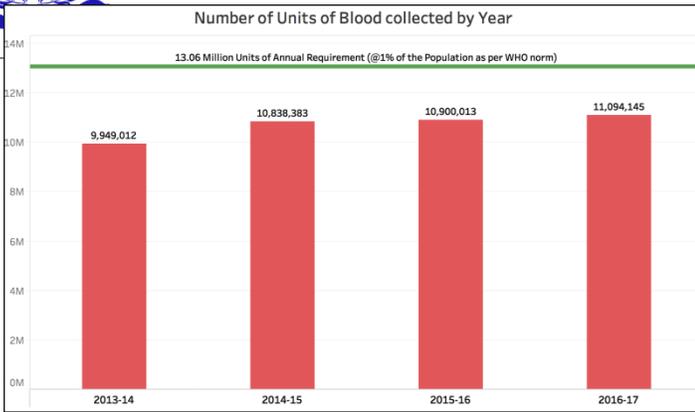
The user contract creates a structure for representing the patients.

```
PatientReg{
    function addPatient();
    patient_chart_array.push();}
```

The function `addPatient` is used to register patient to structure `patientProfile`. The function `patient_chart_array.push()` is used to push each patient's details using the registration number to the patient chart.

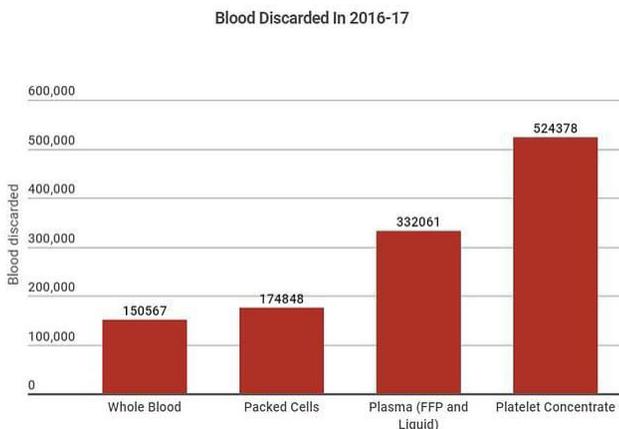
The figure shows the patient registration chart. It asks for patient name, phone number, email address, dob, blood group, gender, house address and the batch id. The batch id is a unique number generated for each donor. Hence, the patient and donor details are linked by this batch id.

The admin which is the hospital can view the various details and update the database accordingly. While creating each account the admin assigns the virtual address generated by the etherium framework to each of these accounts. The admin can view the list of donors and patients. When a blood packet is requested, the admin checks for an available matching blood group in the donor list. If a match is found, the



admin the admin fills in a blood donation detail chart which takes in the donor and the hospital address along with the quantity of blood donated in blood packet units. It is in this step that a unique batch id is created for each donor. After this procedure, the admin has to update the status in the donation list from available to donated.

Today, many countries including India face



challenges in maintaining an adequate supply of safe blood and blood products and ensuring their appropriate use. In the past few years, India has seen an improvement in the blood collection. Despite this, India stares at a high rate of blood shortage.

The figure shows the number of units of blood collected has increased from 9.94 million in 2013-14 to 11.09 million in 2016-17, an increase of about 12%. Even with this increase, annual collection is less than the projected requirement of 13 odd million units. The blood collection is almost 15% less than the required number of units.

As many as 1.18 million units of blood—nearly 38 tankers full—was discarded in 2016-17 as shown in the figure. The reasons attributed included reactivity for infections like malaria, syphilis, HIV, Hepatitis B, Hepatitis C: expiry due to outdating, especially for platelets which have a short shelf life of only 5 days; deterioration during storage in the form of discoloration, haemolysis, bacterial contamination; not

meeting quality parameters after collection and production; and non-completion of blood collection in requisite quantities due to donor reactions.

The blockchain technology used in this proposed system will increase the efficiency of the existing blood donation system by eliminating the manual efforts and paper processing. It will also improve the security of the entire process thereby reducing the discrepancies.

## CONCLUSION

This system presents an alternative way to manage and track the blood packets in a healthcare ecosystem. This blood donation management system primarily achieves two goals that is it increases the security of the entire system and it also reduces the blood supply time which is directly related to saving the lives of emergency patients. It also prohibits the usage of contaminated blood thereby preventing the spread of blood borne diseases.

Existing centralized blood management system does not provide detailed information on blood usage or disposal as well as security. The blockchain technologies enables to maintain a transparent blood management system, as the data cannot be tampered with and it can also reduce human errors. By building such a safe and secure system, more and more people would be motivated to participate in blood donation activities.

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