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Blood Management System Using Blockchain

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Abstract

Blood is a crucial constituent within the human body that is irreplaceable for human life, it supplies supplements and oxygen to all the cells, due to this fundamental part, the requirement for a decentralized blood bank has been introduced in this paper. Manual frameworks as compared to computerized frameworks are time-consuming, exorbitant, and may regularly contain human errors. Moreover, they are helpless to the single point of disappointment issue due to centralization and may lack privacy and security features. This research paper explores the usage of a blood management system based on blockchain technology. The current blood management systems confront challenges such as donor-recipient anonymity, traceability, and straightforwardness. These issues can be tended to by utilizing blockchain, which gives a decentralized and secure database for data administration. The suggested system makes use of blockchain to handle and preserve data from blood banks, such as donor details, blood type, and availability. Automating the blood donation procedure using smart contracts ensures accountability and transparency. Additionally, the system has an interface that both donors and receivers may use to obtain data and follow their donation history. While preserving the anonymity of the donors and recipients, the proposed blood management system employing blockchain is projected to boost efficiency, transparency, and trust in the blood donation process.

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1. Introduction

Every year, blood transfusions, a crucial medical procedure, save millions of lives. To ensure that blood and its components are promptly available to patients in need, a successful blood bank management system is necessary. The present management systems for blood banks confront a number of difficulties, including a lack of accountability, transparency, and traceability. These problems can result in medical mistakes, blood loss, and the spread of illnesses. Due to its decentralized and secure nature, blockchain technology has grown in popularity in recent years and is an excellent fit for a variety of applications, including healthcare. In this research paper, we suggest leveraging blockchain technology to construct a blood management system. Blockchain will be used by the system to handle and preserve blood bank data, including donor details, blood type, and availability.

Additionally, the proposed system will automate the blood donation procedure using smart contracts, assuring accountability and transparency. The technology will let donors keep track of their past donations and get alerts when they are eligible to donate blood. The technology will also give recipients a safe interface via which they may access details about their blood transfusion and information on the donors without jeopardizing their privacy. This paper will go address the problems that blood management systems are now facing and how blockchain technology can help. We will outline the proposed blockchain-based blood bank management system's design and implementation specifics. We will compare the proposed system to the current blood bank management systems and talk about its advantages and disadvantages. Overall, the proposed approach is anticipated to improve blood donation's effectiveness, transparency, and confidence while preserving the confidentiality of both donors and recipients.

2. Literature Survey

Most of the literature on blood management systems focused on allowing those in dire need of blood a way to get in touch with blood banks and donors nearby and request blood. According to [1], the paper has put forth the idea of a framework that has the potential to improve the efficiency of the blood donation process by reducing the risk of errors and fraud, improving the traceability of blood donations, and enhancing the security and privacy of donor

information. The authors highlight several key benefits that increased trust and confidence in the blood donation process, improved access to blood for patients in need, and reduced costs and administrative burdens for blood banks and healthcare providers. The work in [2], suggests implementing blockchain technology to create a reliable and secure blood bank administration system. The authors contend that several issues, including inefficiencies in blood delivery and collection, the possibility of data manipulation, and security flaws, confront the blood banks' current administration systems. They assert that by offering a safe and open platform for blood management, blockchain technology can overcome these issues. According to [3], the authors have created a cloud-based program using Amazon EC2 service (a cloud computing platform) for the deployment of the application, which is composed of multiple modules that track hospitals, blood donations, and blood requests. They have developed an online platform that enables individuals to request blood as and when they are needed, and hospitals to supply details about the blood types that are present in their inventory so that the information is updated on the platform. In this paper [4], the authors have proposed a smart platform-oriented approach that will create a robust blood demand and supply chain able, using machine learning and time series forecasting models to develop an AI/ML decision support system. It aims to focus on the blood demand forecasting module which is designed to forecast blood demand, and blood donor classification that helps predict daily unregistered donors thereby enhancing the ability to control the volume of blood collected based on the results of blood demand forecasting and also helps in scheduling blood donation appointments according to the expected number and type of blood donation and thereby reducing blood wastage. Additionally, [5] presents a framework that could be used for the implementation of blockchain technology in the healthcare sector for Electronic Health Records (EHR). Their framework aims to provide secure storage of electronic records by defining granular access rules for the users. [6] presents a robust optimization model for the design model for the supply of blood during and after disasters. The authors have given a practical optimization model developed that can assist in blood facility location and allocation decisions for multiple post-disaster periods.

3. Problem Statement

Many issues, including a lack of transparency, inefficiencies in the donation procedure, and problems tracking blood supply and demand, plague the current blood donation and management system. These difficulties may lead to blood shortages, blood loss, and delays in getting blood to patients in need. Consequently, the goal of a blockchain-based blood bank management system is to develop a donation, storage, and distribution system that is more effective, transparent, and safe. The system should make it simple for donors to donate blood, guarantee that the blood supply is kept at an adequate level, and make it simple for hospitals and other medical facilities to access and order blood when they need it.

Also, the system needs to deal with issues including preserving blood quality throughout distribution and storage, lowering the possibility of fraud, and protecting donor information's privacy and security. Furthermore, the system should provide insights into blood donation trends, storage levels, and distribution patterns to help blood banks and hospitals plan for future blood needs. By offering a decentralized, transparent, and secure platform that protects the correctness and immutability of blood donation and management data, blockchain technology [11] can help the blood management system overcome these difficulties. The availability of blood for patients in need will be helped by this approach, saving lives, and enhancing public health outcomes.

4. Methodology

4.1 Existing Systems

The existing system for blood management system typically relies on manual information management and record-keeping. It can be time-consuming and error-prone for blood banks to keep paper-based records of blood donors, blood types, and availability. It is challenging to follow the flow of blood donations and guarantee accountability using the manual approach since it lacks transparency and traceability. In recent years, some blood banks have implemented computer-based systems to maintain their records, however, these programs frequently lack integration and uniformity. Various blood banks employ various software platforms, which might cause compatibility problems and make information sharing

challenging. Additionally, the current systems for managing blood banks do not take advantage of the potential of cutting-edge technologies like blockchain [7], which could provide a more effective and secure approach to managing blood bank data. Overall, the management system for blood banks now in place is cumbersome, time-consuming, and lacking in openness and traceability. These problems can be solved and the blood donation procedure improved by implementing new technologies like blockchain.

4.2 Proposed System

The issues that the current blood management systems face are addressed by the proposed blood management system (see Fig. 1), which employs blockchain technology. The system is built to protect donor-recipient anonymity while ensuring transparency, traceability, and accountability. The proposed system consists of a decentralized database that organizes and retains data from blood banks, such as information about donors, blood types, and availability. Smart contracts [10] are used to automate the blood donation process, ensuring accountability and transparency throughout.

When a donor donates blood, the details of the blood unit and the donor's information are both recorded on the blockchain [8]. The blood type is automatically verified by the smart contract, which also changes the inventory of blood units that are available. Throughout the procedure, the donor's identity is concealed to protect their privacy and confidentiality. The system looks through the inventory for a blood unit that is compatible when a recipient needs a blood transfusion. The system records the transfusion's specifics and updates the inventory once a suitable blood unit has been found. In order to protect privacy and secrecy, the recipient's identity is likewise always kept secret. The blood donation procedure is anticipated to become more effective, transparent, and trustworthy thanks to the planned blockchain-based blood bank administration system [9]. It can deal with problems like donor-recipient anonymity, traceability, and transparency that the current blood bank administration system has. The suggested system also includes a user interface that enables donors and recipients to access data and view their donation histories.

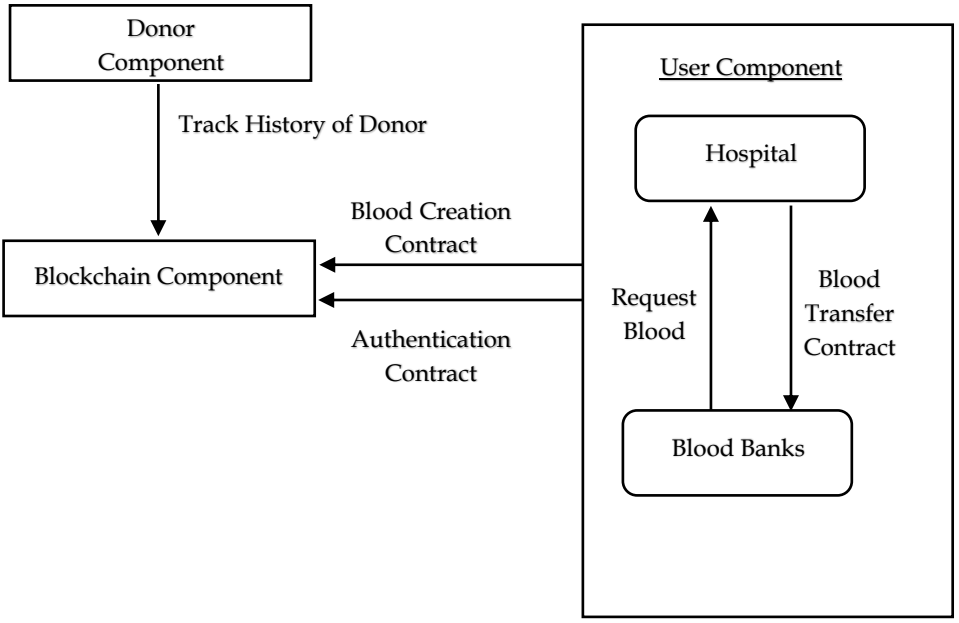

Fig. 1. Proposed System

5. System Architecture

Donors can donate blood, possibly at the campsite or at the blood bank itself. All the information about the donated blood is recorded in the blockchain. A new block of data consisting of Information like Aadhaar numbers, blood groups, blood ID, etc. is appended to the Blood Store. This blood is not yet verified, and hence it cannot be classified as safe or unsafe. Now, the blood is taken to the blood inspection center, where after proper physical examination, the Blood will be declared as "Tested and Safe" or "Tested and Unsafe". As this happens, a QR code will be generated which is the combination of Aadhaar numbers, blood ID, and Batch number's hash. This QR code will be automatically downloaded and is to be attached to the physical blood packets. The Donor will be notified in both cases about the acceptance or discarding of his blood. The blood, which is marked "Tested and Safe" can now be used for patients.

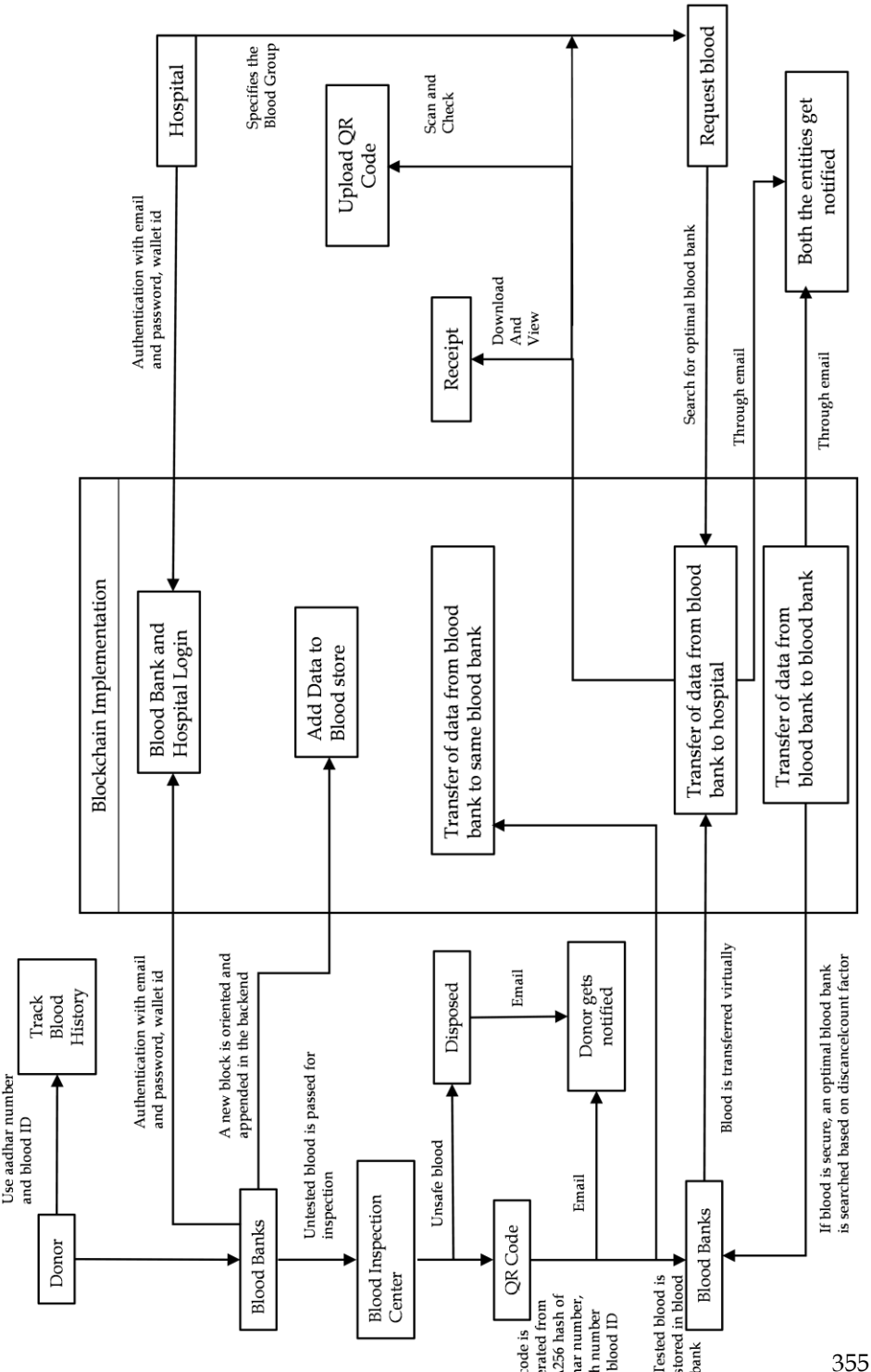

Fig. 2. System Architecture

Now, if the Hospitals require any blood, they must specify the required blood group and the patient's Aadhaar number for whom the blood is required to keep the accountability and dignity of the hospital intact (ensuring that the hospital does not showcase any fraudulent behaviour by selling the blood in black). Then, the algorithm will search for the most optimal blood bank based on the Deciding factor. Deciding Factor Formula is calculated based on the thought that the distance between the two entities must be as minimum as possible. They must have a greater quantity of blood available.

After finding the optimal blood bank, the Blood will be transferred from that blood bank to the current Hospital. The Hospitals can see details of the Blood they have received virtually. They can also view the location of the blood bank with the help of Google Maps, and finally, when the Blood is received physically, they can upload the QR code present on the Blood bags and verify whether the correct Blood bag is received or not.

Hospitals and blood banks also have the functionality to log in where they need to enter their email and the admin would provide a password. Each transaction contains the functionality of transferring or creating an asset, which must be verified and confirmed with a meta-mask wallet. Blood donors can also track the history of their Blood without any login or registration, just by entering their Aadhar number.

6. Results and Discussion

Through this study, we discovered that the application of blockchain technology in blood bank management systems can offer several advantages, including:

1. More transparency: Because of blockchain technology, all stakeholders involved in the blood donation process may now access and verify data on blood donations, processing, and distribution. This can improve the blood donation process' openness and accountability.
2. Increased effectiveness: By providing real-time tracking of blood donations, processing, and distribution, blockchain

technology can simplify the blood donation process. As a result, managing blood banks may need less time and money.

3. Improved security: A secure and impenetrable record of all blood donations, processing, and distribution is made possible by blockchain technology. By doing so, fraud risk can be decreased and the blood supply's security and quality can be guaranteed.
4. Improved trust: By providing a visible and secure record of all blood donations, blockchain technology can increase public confidence in blood banks and the blood donation process.

Fig. 3 illustrates the Login page. Hospitals and Blood banks can login using their Registered Email Id. The Hospitals and Blood banks are added by the Admin. All the requests raised for the blood units and also the pending requests can be viewed on the requests raised page (Fig. 4 and Fig. 5). The Blood Banks have the authority to request and accept the blood unit requests as per the availability of the Blood units at their center is illustrated in Fig 6.

Through this, we generally imply that integrating blockchain technology into blood management systems can have a big impact in terms of greater security, efficiency, and transparency. To fully grasp the potential of blockchain in blood management systems, more study and development is required.

Fig. 3. Login Page

Fig. 4. Request Raised Page

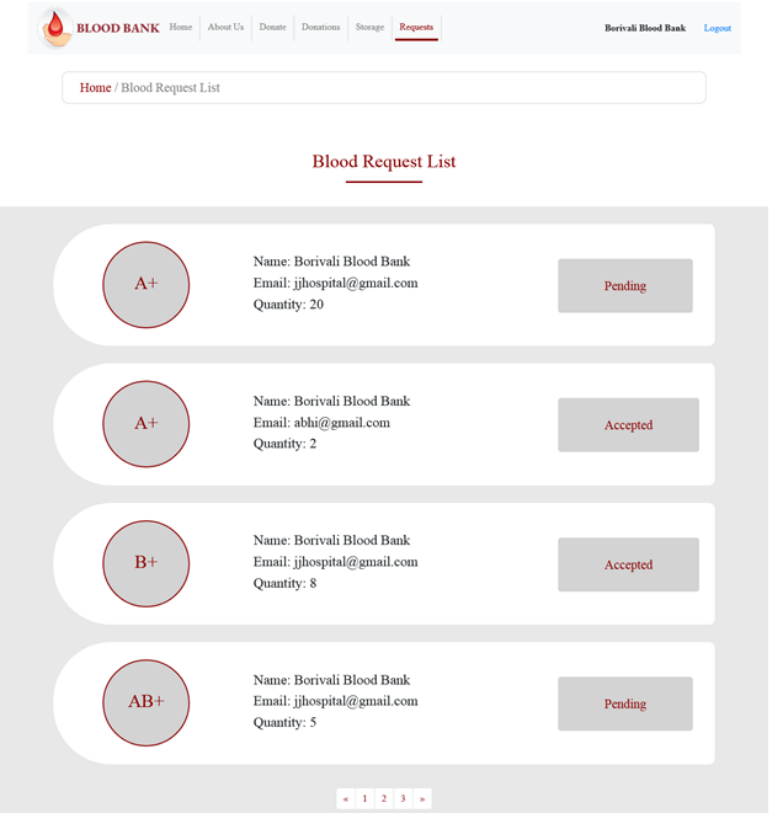

Fig. 5. Blood Request List Page

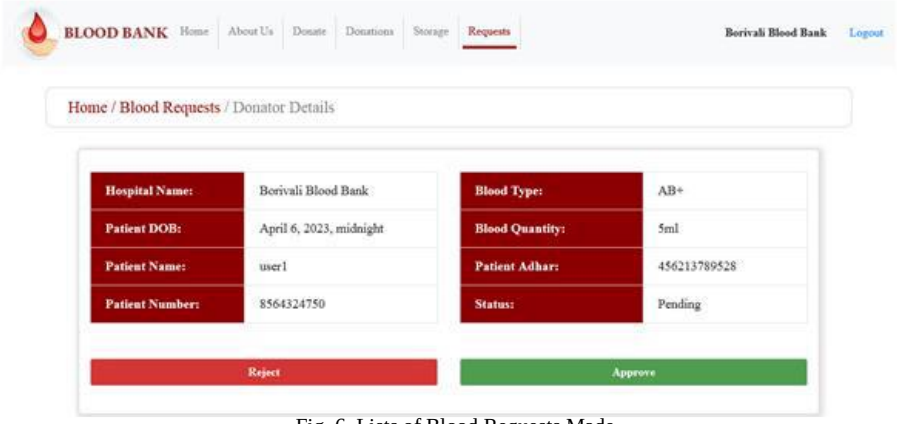

Fig. 6. Lists of Blood Requests Made

7. Conclusion

The proposed system will be one step ahead of the other blood donation systems. The blockchain-based approach guarantees visibility through traceability. This system saves all the donor records, blood information, results, and all the credentials of a user. The QR code authentication and encrypted transactions ensure that the blood reaches the patient in perfect condition. Also, the optimization technique guarantees that blood is always available in hospitals. And the possibility of blood scarcity during an emergency is minimized. Also, traditional systems' lack of transparency is abolished.

References

[1]. Sivakamy Lakshminarayanan, P. N. Kumar, N. M. Dhanya. Implementation of Blockchain-Based Blood Donation Framework. 3rd International Conference on Computational Intelli-gence in Data Science (ICCIDS), Feb 2020.

[2]. Sandaruwan, P.A.J., Dolapihilla, U.D.L., Karunathilaka, D.W.N.R., Wijayaweera, W.A.D.T.L., Rankothge, W.H., Gamage, N.D.U.: Towards an efficient and secure blood bank management system. In: 2020 IEEE 8th R10 Humanitarian Technology Conference (R10-HTC), 23 February 2021

[3]. Aditya S. Iyer, Dr. C Menaka, Adnan Faisal, Ammar Hussain , Chethan S.D.: Cloud Based Online Blood Bank Management System. Journal of Emerging Technologies and Innovative Research (JETIR), 2022.

[4]. Ben Elmir W, Hemmak A, Senouci B.: Smart Platform for Data Blood Bank Management: Forecasting Demand in Blood Supply Chain Using Machine Learning. Information. 2023

[5]. Ayesha Shahnaz, Usman Qamar, Ayesha Khalid.: Using Blockchain for Electronic Health Records, IEEE,2019.

[6]. Jabbarzadeh, A., Fahimnia, B. and Seuring, S.: Dynamic supply chain network design for the supply of blood in disasters: A robust model with real world application, Transportation Research Part E: Logistics and Transportation Review, (2018)

[7]. Shelke S.K., Shitole Poonam B., Bhor Priyanka S., Labade Rutuja K., Yewale Pratiksha S.: Online Blood Bank System Using Blockchain Technology. In: IJSDR (2020)
[8]. Min-jung, K., Hyun-joo, P., Jin-min Jang-ji, L.: Blood donation transfer system based on blockchain. KR102151706B1, Sept 03 2020.
[9]. De Meijer, C.: Smart working with blockchain-based smart contracts', (2020).
[10]. Dajim, L.A., Al-Farras, S.A., Al-Shahrani, B.S., Al-Zuraib, A.A., Mathew, R.M.: Organ donation decentralized application using blockchain technology. 2nd International Conference on Computer Applications and Information Security (ICCAIS), (2019).
[11].Chetan Masram, Arshad Mulani, Rasika Bhitale, Jidnesh Koli.: Online Blood bank Management System, Department of Biotechnology Engineering, MGM College Of Engineering and Technology, Kamoth*e.,* 06 June 2021