Blockchain in Blood Bank Supply Management

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Abstract: Blood Donation is an act of donating healthy blood to needy people. Due to excessive loss of blood, a person may die. Nobody should die from absence of blood. To date there is no pseudo substitution for blood. In this way, blood donation is essential. Blood donation, handling, testing, appropriation and transfusion is a complex, profoundly controlled cycle. Also the supply of blood to the patient isn't secure. The blood doesn't reach to the patient in time. We need to secure amount of blood units, time and supply. To solve these problem, this paper presents a proposed system to secure information visibility and reducing blood supply time by tracking the whole blood donation process using blockchain and improving healthcare transparency and outcomes, driving efficiencies to better match donors with recipients and improve patient outcomes. In this paper, the blockchain technologies offer the possibility to maintain a transparent blood management system, especially since data cannot be counterfeited and tampered with.

Keywords: Blockchain Technology, Blood bank, Blood units, Healthcare

1. Introduction

The blood supply chain begins with the donor and an end with the patient, at the end of the day it is the prerequisite for blood by the patient that drives the chain and subsequently the quantity of blood required. Different elements influence the blood supply chain like the quantity of contributors who are happy to donate routinely, the blood administrations capacity to satisfactorily predict the quantity of units of blood required consistently and to guarantee that they don't overload and along these lines increment wastage, the clinicians awareness of appropriate blood ordering and transfusion and the hospital laboratories ability to ensure sufficient stock yet have minimal wastage. Hence tracking and information assortment are significant components of the blood supply chain. We will aim on understanding focused blood supply chain management including capacity, transportation and stock administration.

Tokenizing blood may help with donation process efficiencies, making an approach to track blood from the donor to the medical clinic. A framework where healthcare authorities would have the option to track blood from veintovein continuously, given the complexities of the blood supply chain, may sound incomprehensible. In any case, utilizing blockchain innovation to track and trace blood donation process may turn this thought nearer to the real world. Blockchain is well suited for tracking this process, as it creates digital, standardized tokens that can be treated the same across different organizations. Blockchain not only standardizes a way of keeping track of things across network boundaries, but it also applies discipline and trust within a decentralized system. So taking all these in consideration we are proposing a framework to track and trace the blood donation process for securing the amount of blood units, time and supply and also to avoid the tampering of information during the whole process.

2. Literature Review

Centre of Excellence in Blockchain Technology (2020) proposed a framework of Blood Bank which stated that using blockchain they will have the option to accomplish the details like quality of blood can be learned by any hub of the chain, donor history can be known to every node, details of blood remembering expiry of blood for each stage can be confirmed, sample to beneficiary detail is kept up, ease of access of blood as for blood donation centres. As a donor or patient, each of them will have the option to know the accessibility of blood in various blood donation centres.

TITH Dara from Institute of Technology of Cambodia (2019) proposed Blockchain-Based Blood Bank Ecosystem for Improving Public Health and Encouraging Voluntary Blood Donors which focus on giving track ability and

straightforwardness of data in appropriating blood packs, urging wilful blood contributors to give blood as often as possible. Information Systems Science and Department of Management and Entrepreneurship (2015) looks at how circulated ledger advances could be utilized inside the plasma subsidiaries gracefully chain. The plasma subordinates are utilized progressively in the pharmaceutical market and the flexibly chain is worldwide. Be that as it may, there are huge dangers identifying with the administration of the supply. Blodon.com (2018) is a first open social blood bank based on blockchain missions to guarantee blood accessibility for all the poor, to decide the financially low blood donation advancement framework and to fundamentally decrease cost of blood repository and the executives.

Rachel Wolfson (2020) in her article stated that tokenizing blood may help with gracefully chain efficiencies, making an approach to follow blood from the donor to the emergency clinic. Seungeun Kim and Joohyung Kim (2020) through their paper presented an inventive blood cold chain framework dependent on blockchain innovation. The proposed framework expects to build data visibility by recording the general data on the blood supply and giving definite blood data, for example, blood utilization and removal to the conveyed ledger.

3. Need of Blockchain Technology in Blood Bank Management System

There are two main problems with the existing blood donation process systems that have not been addressed in previous studies.

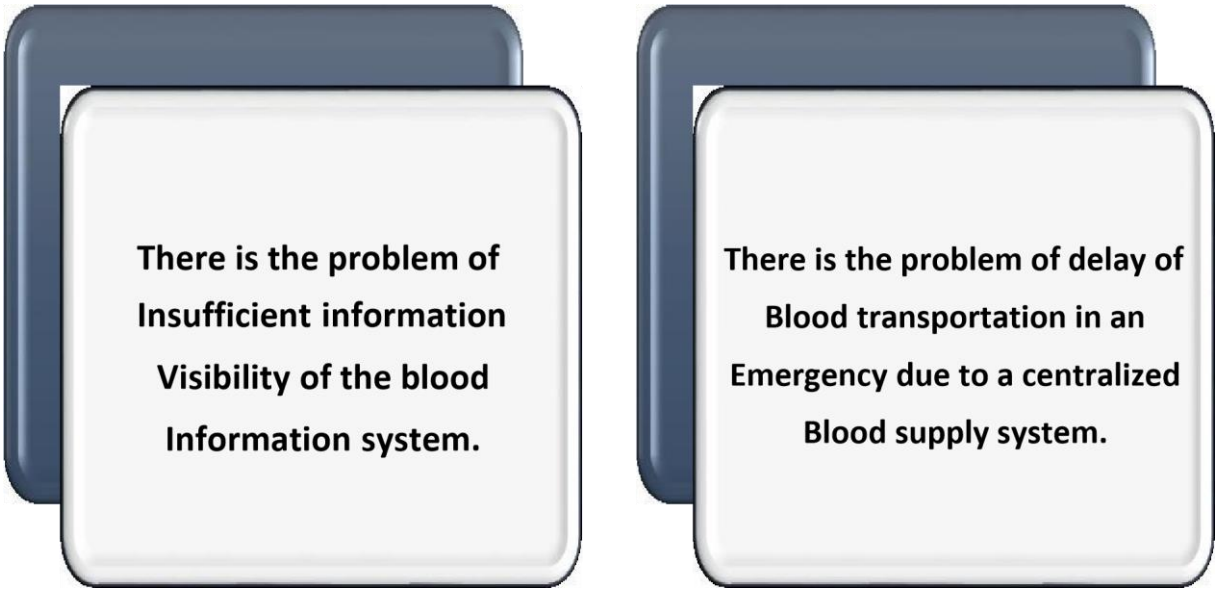

Fig.1. Why Blockchain in Blood Bank Management System

The blood supply chain is more than just about storing and processing blood; it's also a vital topic in medicine that impacts a patient's life. As a result, it is important to address the issue of knowledge sharing in the blood supply chain and to develop a solution to deal with high demand using blockchain technology, as demonstrated in this study. The aim of this research is to develop and introduce a new blood bank management system based on blockchain technology. Blockchain technology allows forgery and falsification of information impossible, enabling the system to be operated transparently in real time. Furthermore, smart contracts built on the blockchain can save time and effort when it comes to document processing, and they have the added benefit of scalability. Blood transactions between hospitals are planned and conducted as smart contracts in emergency situations to solve the supply time problem by leveraging these advantages. As a result, by taking into account both the current blood information system and the supply time, the proposed system overcomes the shortcomings of the existing system and prior study.

4. Methodology

4.1. Use Cases of Blockchain

a. Blockchain and Monetization: Information adaptation with blockchain can restrict this misrepresentation – and decrease client exhaustion with being informed consistently – by endorsing and separating every client's trip through checked advancement conveyance, avowing that a certified individual considered the to be as per the

focal points of a media contract. Utility is the absolute fulfilment got from burning-through products or administrations. The utility symbolic model includes driving the usefulness in business using tokens. Best instances of this model are Ripple and Stellar. The banks which are a piece of their organization will have the option to encourage store move utilizing XRP (Ripple) or XLM (Stellar) tokens.

b. Blockchain and funds: Blockchain interfaces client needs with asset the board systems basic to imparted resources for nonstop customer data, taken care of at a single, secure region. It helps shared hold chairmen with the hypothesis dynamic cycle, basic for abundance age, and shields portfolios from hazards. These administrations are given to new companies and different organizations by driving master improvement organizations to kick them off with blockchain. For instance, if an organization expects somebody to fabricate their custom business venture, they can employ organizations like IBM, Deloitte, or others to complete the undertaking for them.

c. Blockchain and Automobile: The 21st-century vehicles are moving worker trots with locally accessible sensors and PCs that get information about the vehicle. More secure, perceptible trades and better admittance to and lucidity of information, blockchain can strengthen trust and participation among associations, purchasers and even vehicles. These administrations are given to new companies and different organizations by driving master advancement organizations to kick them off with blockchain. Different types of blockchain proficient administrations are inspecting a business, creating legitimate papers, and counselling.

d. Blockchain and supply chain: Blockchain can enable all the more clear and accurate beginning to end following in the gracefully chain. Associations can digitize actual assets and make a decentralized immutable record things being what they are, making it conceivable to follow assets from creation to conveyance or use by end customer. Blockchain can go about as a "solitary wellspring of truth" for all the elements (auxiliaries, accomplices, and so on) doing buys for your sake and arranging various terms with providers. A blockchain-based information base can store pertinent information from every one of your accomplices, giving your organization a 360perspective on the complete volume of buys, paying little heed to who dealt with the buy movement.

e. Blockchain and IOT: IoT grants devices to send data to private blockchain records for thought in conferred trades to alter safe records. IBM Blockchain enables your partners to get to and deftly IoT data without the prerequisite for central control and the heads. Blockchain is an appropriated record innovation that consolidates with IoT to make machine-to-machine exchanges conceivable. It utilizes a bunch of exchanges that are recorded in an information base, confirmed by numerous sources and entered in a typical record appropriated over each hub. The blend of IoT and blockchain offers different possible advantages and permits a brilliant gadget to work self-governing without the requirement for an incorporated position.

f. Blockchain and Healthcare: Blockchain is a reasonably new development, anyway alongside various progressions, for instance, huge data assessment, IoMT, and 5G, it can help medical care with improving its standard method to manage prosperity data dealing with and flexibly chain straightforwardness. Numerous parts of blockchain innovation, for example, the permanence of the information put away in a blockchain, are drawing the consideration of the medical services area, and ruddy possibilities for some, accessible cases are being examined.

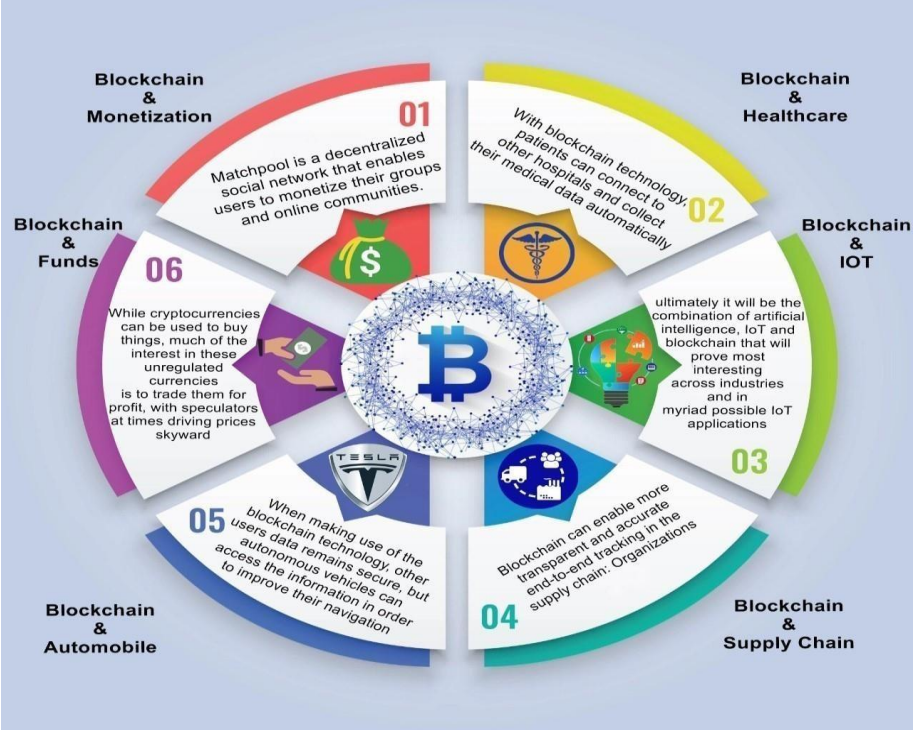

Fig.2. Use Cases of Blockchain

4.2. Blockchain in Healthcare

The insights on blockchain in medicinal services predict a brilliant future for this innovation. As indicated by Research and Markets, the worldwide blockchain innovation market in the human services industry is required to cross $500 million by 2022, developing at a CAGR of 61.4% somewhere in the range of 2018 and 2022. Simultaneously, IDC proposes that 55% of all medicinal services applications will have utilized blockchain for business purposes by 2025.

Following are some use cases of Blockchain in Healthcare:

a. Digital Identity Management: Character is basic to basically any blockchain use case in wellbeing the board - extensive of character the chiefs of individuals (e.g., persistent, part, provider), one of a kind gadget identifiers (UDIs) for clinical contraptions in the prosperity flexibly chain, or various levelled individuals or validators in a framework.

b. Financials, Insurance and Records: With early DLT triumphs found in the cash related development (FinTech) field, the rising cost of human administrations, and the procedure with challenges around extortion (particularly from an administration perspective), medical care store has a lot of changed prerequisites for the properties of blockchain. Moreover, the client's computerized personality scene experience is uncommonly divided. Clients shuffle different characters related with their usernames across various sites.

c. Clinical Research and Data Access/Monetization: Choosing and upkeep remain two of the best troubles in clinical primers, and notwithstanding countless undertakings all through the long haul, improvement remains commonly covered up. Clinical primer data sharing and the limit with regards to investigate individuals to experience regard disclosure (tallying singular wellbeing data transformation) are a segment of the certifications of blockchain for these uses cases. Information

d. Health Supply Chain Management: Item supplies, from starting inception to end-of-life, is the most overwhelming use case for DLT across adventures. In human administrations, drug, clinical supplies, blood things, and clinical devices are models where blockchain is being used for exercises, consistence, and deciding among drug creators, blood gift focuses, providers, drug stores and payers.

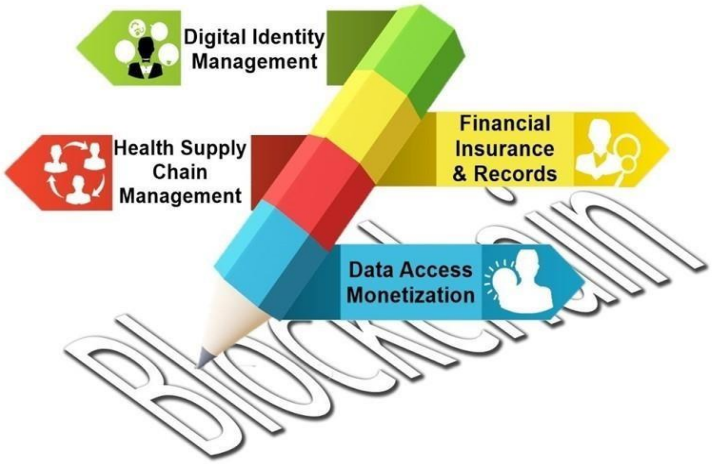

Fig.3. Blockchain in Healthcare Industry

5. Proposed Framework

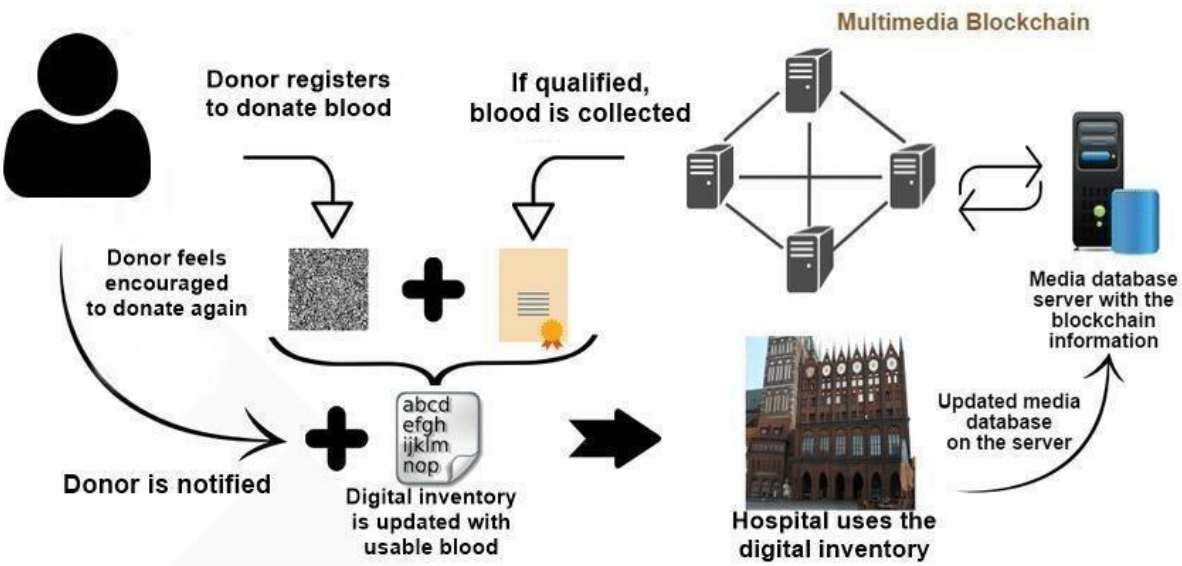

Fig.4. Proposed Framework

- The process of registering to donate begins with the user interacting with the Authentication Server via a website. The AS contains information about donors in a blockchain node. The user enters his/her Personally Identifiable information (PII) and scans supporting documentation to upload into the system along with an email address. The users' picture is also taken for verification. If the information is verified and is correct, the user is allowed to create an account. The user enters a username of their choice and a password to log in. This information is stored separately and not linked to the users' PII. This ensures privacy and anonymity while donating. Also an entry is made next to the users' node entry storing whether he/she has registered to donate. If the users' information cannot be verified, he/she is not allowed to create an account.

- All the information between the user and the AS is sent using TLS v1.2 protocol to ensure it is all secure. The process of storing blood units and data in the blockchain for synchronization is a multi-step process. It involves verifying your identity with the AS and then storing using the AR. Each candidate is given an account on the blockchain system so they can get robustness and security. There is also "Abstain account" for abstained donations to be sent to.

- Using the username and password generated in the previous stage, the user logs in to the authentication server. To ensure that the user is the account owner, an image of the user is taken. This image is compared to the one that was taken during the registration process. Before the user logs in, a short video of them is taken and sent to the Authentication Server. Using the Affective API the AS can identify user emotions based on machine learning technology. If the system detects fear, the users' session is stopped and told to retry after 5 minutes. This system would reduce the impact of the issue related to donating under duress.

- After a user signs in, their system generates a public key that they send to the Authentication Server. The AS would then connect the key to the user name. The user's account on the blockchain system will be created using the key. A certain amount of ether (the currency in which the user can vote) is added to the user's account, allowing them to complete the mission.

- The AS will then give the user a session token. The user will be led to the augmented reality. The user would hand over the session token to AR, who would then check it with AS. The Modified Needham-Schroeder protocol is used to verify and generate tokens between the AR, user, and AS. This guards against impersonation and man-in-the-middle assaults. The AR would send a verification message to the user along with the public key of the blockchain node to which his/her vote would be sent.

- After registration and verification of the donor. The time and unit of donated blood sample is stored in the blockchain. As the donated blood is stored in blood bank and the digital inventory is updated. Hospital uses the digital inventory to keep themselves updated regarding the units of blood available. According to the smart contracts, each node will verify the transaction. These contracts will verify whether a transaction was duplicated or not, as well as its validity.

- A database will be created on the blockchain which will contain the patient's information as per the registered record for the need of blood in the inventory of hospitals. The blood bank will supply unit of blood as per the demand from hospital for the patients and the unit and time of the supplied blood will be stored in the blockchain. After this process the node would pass this transaction to other nodes in the blockchain system.

- The process will continue from donor to patient without any tampering in data stored in blockchain between the processes.

6. Challenges Associated with Blockchain Technology

Block chain's key attributes present difficulties to the current lawful and administrative system. It is contained carefully recorded information in "blocks" that are connected together in sequential request in a way that makes the information hard to change once recorded, without the adjustment of every ensuing square and plot of a dominant part of the organization. Every hub on the organization by and large contains a total duplicate of the whole record, from the principal block made—the beginning square—to the latest one. Each square contains a hash (a fixed length alphanumeric string created from a line of text) pointer as connect to a past square, a timestamp, and exchange information. By its inclination, dispersed record innovation takes into consideration exchanges and information to be recorded and shared over a conveyed organization of members without the requirement for a confided in middle person. The first occasion of blockchain (bitcoin) was to empower shared exchanges without the necessity for, or cost of, a focal gathering.

Despite the fact that this study proposes a creative strategy for blood donation management and usage of a model framework, there is lacking check of the proposed framework. In this way, later on, we will perform a careful assessment concentrate so as to demonstrate the effectiveness of the proposed framework by coordinating the proposed framework with the real blood data framework. Moreover, we will consider the proposed plan's cost and implementation of the complete framework.

7. Conclusion

We proposed a blood bank management system based on the private blockchain technology for securing information visibility and reducing blood supply time. Initially, the constant chronicle and sharing of data as blood is moved, tracked, and disposed of in distributed records empowers productive administration of blood. Also, this

framework, which avoid tampering and data altering, will make the blood the board activity more transparent by taking care of issues that may happen in clinical organizations and with clinical staff, for example, missing contributions of entry, exit, and errors. Second, the framework, which supports blood exchanges between clinical institutions after agreement is reached on earnest interest, has the importance to avoid the delaying of the blood supply time, which is legitimately identified with saving the lives of crisis patients. This additionally implies medical clinics can utilize their overflow blood effectively, because they can keep their blood stock intact while maintaining excess blood inventory.

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