

Enabling the efficiency of Blockchain Technology in Tele-Healthcare with Enhanced EMR

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Abstract - A blockchain is a growing list of records, called blocks, that are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp and a transaction data. A blockchain consists of a structure of data that represents a financial ledger entry, or a record of transactions. Each transaction is digitally signed to ensure its authenticity, therefore no one tampers with it. So the ledger itself along with an existing transactions within it are assumed to be with great integrity. The basic advantages of blockchain technology includes the features of decentralization, Peer to peer network, immutability, security and transparency. If once the data has been re-entered into the record, it will not get deleted instead, it gets updated. Every block in the blockchain has a permanent timestamp that indicates authentication and verification. Here, we promote the facility of having a smart contract between the patient and a healthcare sector. It highly concentrates in the field of diabetes as it is a rapidly growing disease in today's world. It requires regular checkups to keep the disease in control. This paper consolidates the features of blockchain technology to produce an enhanced EMR in the field of diabetes.

Keywords : *Blockchain, Electronic Medical Record (EMR), Smart contracts, Tele-Healthcare, Diabetes, Electronic Health Record (EHR), Machine Learning, Decentralization*

I. INTRODUCTION

Blockchain technology is most frequently referred as a decentralized, distributed ledger that records the provenance of a digital asset. The research community has started to realize the capacity of blockchain beyond the financial applications. It is possible to utilize this technology in immense useful applications like healthcare, logistics, supply chain management and Internet of Things (IoTs) among others [1]. Blockchains can manage to create a distributed system which keeps an immutable chain of data transactions among trustless parties without the intervention of a trusted third party [2]. Many sort of problems can be caused due to

the ignorance of diabetes. In certain papers, socially available EMR's have been acquisitioned to provide betterment in the field of treating drugs, monitoring people along with their outcomes among patients with diabetes over paper records. But it is known through studies that specific EMR components differs in their association with diabetes care processes while examining them [5]. Also, EMR-integrated dataset has been designed to monitor routine health condition for the cases like neuro-inflammatory demyelinating diseases, retinopathy (caused due to Diabetes), Cerebrovascular diseases etc., [6]. For example, in the case of Diabetic Retinopathy (DR), its symptoms can help the ophthalmologists to easily suggest an optimal

treatment plans to prevent and manage Diabetic Retinopathy (DR) progression [3]. Healthcare is moving away from the traditional care model to a more cost-effective home-based care and Tele-health method [7]. The usage of Blockchain technology in the field of healthcare includes giving the patient complete access to his/her medical records while maintaining its privacy and security in order to refer it at any time [9].

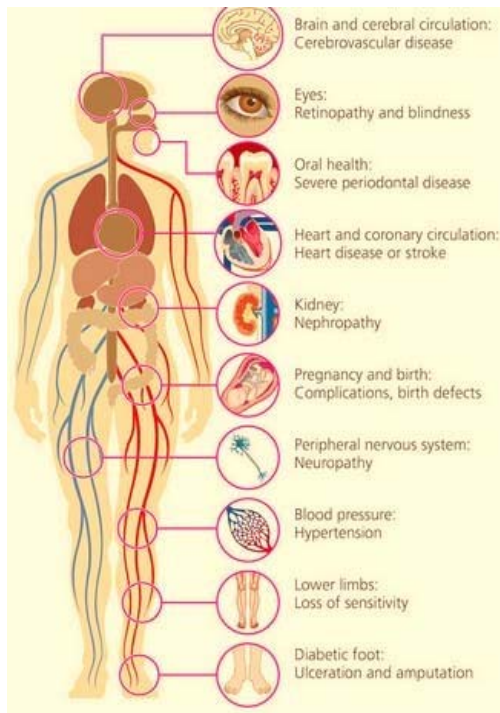


Fig (a). Health Issues caused by lethargic attitude on Diabetes

The contemporary utilization of technologies with the convergence of widespread well-being and environs, particularly with an amalgamation of AI along with Blockchain technology and IOTs makes a huge difference in our traditional healthcare system by providing major advancements in our society, also stepping forward towards the digital environment [4]. Ensuring the privacy and secureness of Electronic Medical Record is a crucial issue which must be followed to enhance our healthcare sector [8]. In [14],

introduction to Electronic Medical Record for data which are obtainable within the Clinical Data Management System (CDMS) in Electronic Data Capture (EDC) has been designed and developed. Certain authors proposed a paper on challenges that has been faced by blockchain technology in e-health [21]. With the unique features of this technology, there is no need for the patient to waste their time on repeated checkups if they have changed their consultant. Instead they can make use of their EMR to enrich tele-healthcare system. Tele-healthcare system is a personalized communication occurs over a distance, here data are transferred from patient to the professional to provide feedback accordingly. In this paper, we are going to include the features of this technology to the field of medicine in order to enrich the Healthcare system of our country.

II. MATERIALS & METHODS

With the Data collected from the patients while consulting the Doctor, an Electronic Medical Record (EMR) will be generated. Blockchain technology includes methodologies like Smart contracts, Proof of Work, Proof of Stake, Byzantine Fault Tolerance algorithm [8].

A. Proof of Work

It is a Consensus mechanism. The purpose of it, is to bring all the nodes in agreement, i.e., trust one another, in an environment where the nodes does not trust each other. This PoW procedure is known as mining in Bitcoin and the nodes that finds out the hash values are termed as miners.

B. Proof of Stake

In PoS-based crypto-currencies, the creator of an upcoming block will be chosen through different combinations of random selection and wealth or age, etc., In contrast, the algorithm of proof-of-work will be done with the help of crypto-currencies such as bitcoin uses mining; that is, the process of solving computationally rigorous puzzles to validate transactions and to create new blocks.

C. Smart Contracts

Smart contracts can be defined as the lines of code that are stored on a blockchain. Then they will be automatically executed when pre-established terms and conditions have been satisfied. A smart contract is just a digital contract with the security coding of the blockchain [10]. A smart contract has details and permissions written in code that require an exact sequence along with timestamp of events to take place to trigger the agreement of the terms mentioned in the smart contract. It is a replacement for the traditional contract which occurs in the presence of third parties.

D. Byzantine Fault Tolerance

The concept of Byzantine Fault Tolerance in cryptocurrency is the feature of reaching an agreement or consensus about particular blocks based on the proof of work, even when some nodes are failing to respond or giving out malicious values to misguide the network. At least (2/3) two thirds of nodes has to agree for a particular action to get carried out or else the process gets terminated. This technique reduces the influence of faulty nodes.

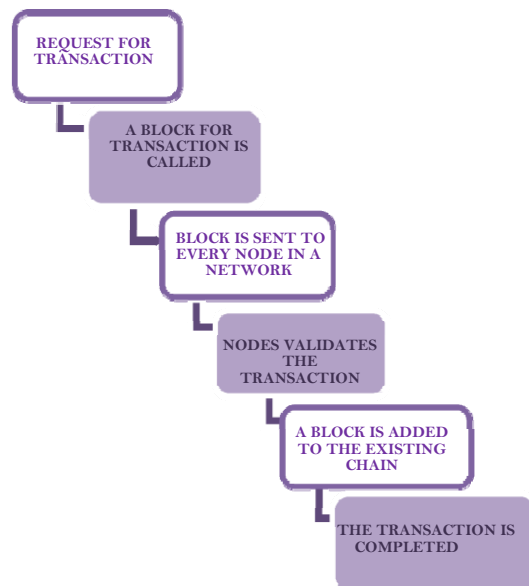


Fig (b). Working procedure of Blockchain

The above diagram clearly depicts the work flow of the blockchain. Initially, it requests for a transactions. Then the transaction will be called. Once the transaction has got started, its block will be sent to every node in a network, in order to share information regarding the transaction. Then every node validates the transaction. The transaction gets completed once the block is added to an existing one. A multi authority ABS scheme has been proposed to enrich the secureness of EHRs [25] which can also be implemented for EMRs. For EHR, it is formulated that its sharing system has four branches of participants like admin, patients, clinicians and laboratory staff. Also, the algorithms for each participants has been mentioned separately [20].

III. RESULT

Exchange of anything between distinct parties can be managed with help of Blockchain technology. It might involve variety of features like digital money, proof of identity, insurance payment, medical history of patient, etc., but the logic will be the same. That is, the process calls for an exchange and its history of transactions and it has to be referable, well organized, explicit and also capable of being audited. EMR holds an entire medical history of the patient. These EMRs are mostly developed by blockchain frameworks like Ethereum and Hyperledger Fabric [18]. Recognition of activity with an ensemble classifier using the data which are collected from two specific sources provides an increase in the accuracy level from 90% to 93% while considering condition based classifier along with classification accuracy [15] to furnish a detailed activity recognition using sensors. Electronic clinical remainder has decreased the probability of the severeness of Diabetes [5]. This process has provided a quick alert to the patients as well as to their caretakers. So that, there is chance for the solemnity of a disease to get reduced. It can be noted that the comparison with ABE and KAC, intimates us the fact that this kind of updated medical system is meddle-resistant by featuring the privacy shelter along with storage security [12].

Cases involved in EMR	Case Summary
System Functionality	Service, service inputs, financing and functioning are the functionalities included by Healthcare sectors.
Connectivity	The term ‘circulation’ connects the healthcare information systems. Also simplifies the process to provide efficient patient care.
Data Integrity	Enables honest and trustworthy actions.
Access to Personal Medical History	Personal Medical History improves the quality of the Healthcare sector and it is easy to update patient’s medical records in electronic form.
Secureness of data	Data security in healthcare is a concern because it includes patient’s information and health records.
Privacy	It is essential to protect our personal information and medical records in healthcare sector.

Table 1. Cases involved in Electronic Medical Record [11]

Certain problems like double spending and byzantine problems can also be solved with the help of this blockchain technology. Inclusion of blockchain to healthcare sector paves way for the digitalized environment. Also, we cannot alter the order of the blocks as every blocks are linked with each other. The hash value of previous node will be mentioned in the current block or node fig.(c). So that, the duplication cannot be done. The time taken for each transaction has been noted and compared for better performance in PACEX: PATient Centric EMR eXchange proposed by certain authors[22]. Certain problems like

acceptance, regulation and ethics are not resolved efficiently which has to be considered for the better usage of this technology [21].

IV. DISCUSSION

In this paper, we have discussed about the collaboration of EMR and Blockchain in order to improve the efficiency of the healthcare sector. All the medical data about the patients will be maintained under the single roof called Blockchain. Hence these data can be accessed from anywhere without bothering about the physical reports. There is no need for the patients to repeat the tests in case of lost medical records. Every data can be accessed through the secure ID of the patients. As we are concentrating on Diabetes, these patients have to undergo regular checkups to maintain their diabetic level. With the help of Machine Learning [13], it is possible to intimate the care takers regarding the abrupt change in the glucose level of the patient’s body. Electronic clinical reminder can be done to remind the diabetic patients regarding their timely medication and regular check-ups to avoid the seriousness of the disease.

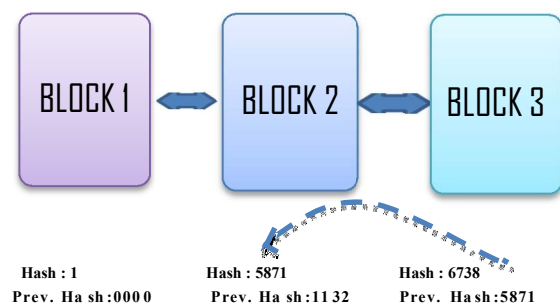


Fig (c). Blocks with their Hash

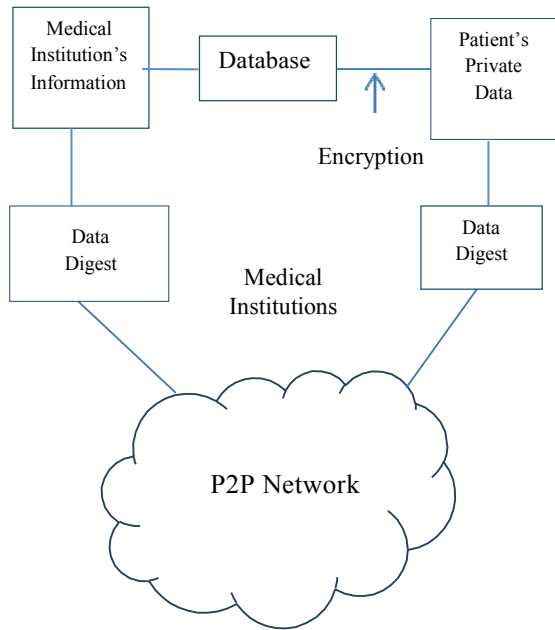


Fig (d). Storage method of medical data

Due to the ignorance of the regular diabetic treatment, people are liable to get affected by various sorts of health issues like retinopathy, neuropathy, nephropathy, hypertension, etc., Tele-healthcare can be performed by getting the medication through the blockchain platform without directly consulting the Specialists regularly. With this feature, there is no need for the patients to wait for hours on a regular basis to consult his specialist. Here, the identity of a consultant will be kept transparent hence the treatment will be authenticated. In this platform, Doctor and patient maintains a Smart contract between them. It was initially implemented in the field of dermatology to develop an e- health system along with Dermo-net comparison [9]. The features of dermatology can also be inculcated to the diabetic care. Usage of blockchain oriented authorization scheme with granularity restrictions has been done along with encryption and decryption without relying on public key encryption or public key infrastructure to lower the computation time [23]. The clinicians can scan IOT device in case of exigency to acquire access to critical healthcare information like blood group, allergies, etc., This helps doctor to provide the finest feasible concern to the victim during exigent situations [17]. Clustering of patients also refines the

federated machine learning by combining the diagnosis and drug features [19] in order to yield a better performance with proof of concept. The Food and Drug Administration [FDA] has also inaugurated its novel Software Pre-certification Pilot Program for medical software applications to develop its features [16]. In [24], the medical data has been divided into two divisions as shown in fig (d). One is the Medical institution's data and the other is Patient's private data. The collected data will be stored under blockchain platform to provide its response when requested by its authorities.

V. CONCLUSION

With an enlightenment of digital health technologies, we have proposed a blockchain based platform to overcome the major problems created by the negligence of diabetes through the alert system for patients and their care takers in case of emergency. Also, we have paved way for the medical records of a patients to be placed under one roof with high authentication, privacy, security along with all the features of blockchain technology in order to provide technological enlightenment for our healthcare sector. In future, we can make this EMR, a globalized one. So that, there will be no patients to depend on the traditional method of physically documented medical records.

VI. REFERENCES

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