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MEDBLOCK

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Abstract - *Due to inefficient management of health records we face a critical issue with accountability, confidentiality and authenticity of medical data. Medical records are difficult to maintain and it takes time to search for a particular record in the current system which still uses a file based storage system.*

In this paper, we propose MedBlock, a record management system to handle EMRs, using blockchain technology. Our system gives patients a comprehensive, immutable log and easy access to their medical information across providers and treatment sites. Leveraging unique blockchain properties like authentication, confidentiality, accountability and data sharing we aim to create a platform for the users where they can store their records securely and it is authentic. Using this technology we invite Insurance agencies to make their insurance settlement process easy and hassle free by making use of the platform to verify the records of a patient and their invoices. The user will not have access to add the data they can only view the data and grant access to hospitals to add the records and authorize the concerned insurance agency to validate the information and process the claim. Companies can use the platform to reduce the response time for insurance claiming processes and be secured from fraudulent claims.

Keywords—Secure, Encrypted, Blockchain, Verification

I. INTRODUCTION

Medical records need innovation. Patients leave data scattered across various jurisdictions and they lose easy access to past data, because the provider, not the patient, generally holds the primary responsibility. We need a system where healthcare facilities are more friendly towards users and they have the right to give access to various hospitals and doctors. Creating a platform where we leverage characteristics of blockchain to make things more user centric and providing interfaces to insurance companies to get the authentic data through a trustworthy solution.

Claiming medical insurance in the current system is a tedious process and vulnerable to many frauds, hence our aim is to create a trustworthy medium where patients can store their data and distribute it efficiently and it is authentic.

Owing to its security features, we'll use blockchain technology for building this system. The system should be secure and give full access control to data owners. It should provide an interface wherein all the EHRs can be accessed containing lab reports, medical prescriptions, medical history, etc. Accountability for each data item is maintained as the address and the public key of all the concerned parties are recorded at every step. Insurance Companies can also verify invoices and medical bills and calculate the transactions thereby reducing the response time for the insurance claim process

The main objective of this project is to build a system for storing the health records securely with access control. To provide an easy interface for medical insurance agencies for verification of records and their visualization. To minimize spoofing of data for false claiming of insurance and improve authenticity of records. We aim to create a private peer to peer blockchain with each concerned entity as a node and it will be a role based access control i.e all nodes will not be able to access the data unless authorized by a user.

The block content represents data ownership and viewership permissions shared by members of a private, peer-to-peer network. Blockchain technology supports the use of "smart contracts", which allow us to automate and track certain state transition (eg, changing viewer rights or the birth of a new record in the system). We record patient-provider relationships through Ethereum blockchain smart contracts that associate a medical record with viewing permissions and data retrieval instructions (essentially data pointers).

We include on the blockchain a cryptographic hash of the record to ensure against tampering, thus guaranteeing data integrity. Providers can create records for a particular patient, and patients can authorize sharing of records between providers. This keeps participants informed and engaged in the evolution of their records.

In Medblock we provide an interface to Insurance Administrators to retrieve the information of concerned patients and they can view all the invoices related to the patient as well. The authorization is given by patients and other than the authorized entity no other node will be able to view the information.

Potential Benefits of the System:

- Safe Place to Store data.
- Based on the paradigm of Blockchain.
- Improved Response rate for Claiming Insurance.
- Secure Access control mechanism.
- Tamper-resistant system to prevent forged data

II. Related Work

The existing systems provide the basic functionalities and can be easily handled in a hospital environment. There is no intelligence software which supports secure patient access to healthcare records. Most of the works done in these systems are not secure and some of them are not accurate. There are also fear of data breaches and missing information or records. Another huge problem in these existing systems is that the information is not fully secured enough. Any unauthorized users can access all the sensitive information of a patient and exploit it for very wrong purpose. The technological advancements are applied to data securities which can reduce the risks.

[1] Medical project management

In the medical field, for a single patient, data originates from various sources and each of these sources may have a separate format to represent this data like general info of a patient, or in case of hospitals data may be split across multiple departments. This restricts the data exchange between different stakeholders.

This paper proposes a new mediator semantic based on XML format which would help users to interact with large medical data and research similar projects. It takes the input data stream to provide a unified representation. Any input must first pass through the data module which converts all data into metadata which in turn is stored in a relational database. Then comes the 2nd module which runs the user queries performing simple queries like adding or deleting data or searching for particular dataset. The 3rd module consists of user data interaction and visualization. In this paper, storing of data is mostly confined to relational databases, here propose an alternative of using blockchain ledger for storing data.

[2] Secured health records

This paper talks about securing the medical data and making it easily accessible for later use. This paper proposes a SHA3 based system for secure access of data. It clearly defines the access for writing and reading of data between different users. It also addresses the issue of unifying a way to record the details of patient encounter. As the current system is quite subjective to each health care institution. This paper majorly focuses on data security from unauthenticated sources, but even here data is editable from the proposed system. The need of our project is the data should not be edited once it is uploaded in block.

[3] Medrec

This paper proposes a decentralized storage of electronic medical records based on blockchain. The data stored is confidential and we have accountability of each data block. It leverages the blockchain properties for sensitive data handling.

They have incentivized the stakeholders like researchers and public health authorities to become data miners and be a part of this network, in return they will get anonymized and aggregated data as mining rewards for storing the network securely. Thus, it encourages big data for researchers and also engaging patients and providers in choice to release metadata. It defines data ownership and viewership permissions in a network and the data is then logged into a network using hashing algorithms. They also use smart contracts to store the representation of medical records and relationships between different users.

[4] A Blockchain-Based System for Anti-Fraud of Healthcare Insurance

The incidence of healthcare insurance fraud and the number of people involved in the frauds have increased year by year, causing tremendous concern in society. Typical frauds include falsifying information, concealing third-party liability, falsified electronic bills.

Therefore, this paper proposes a healthcare insurance anti-fraud system based on blockchain. Sharing the data such as inspection reports, prescriptions, and treatment records related to the medical procedures of the relevant medical institutions with the healthcare insurance agencies is an essential element for identifying violations of healthcare insurance policies.

[5] Research of Medical Insurance Based on the Combination of Blockchain and Credit Technology.

Blockchain technology can effectively solve many problems in credit investigation technology. The combination of blockchain technology and credit investigation technology is more popular to apply in many fields. In the field of medical insurance, a medical insurance monitoring system can be established under the mode of blockchain and credit investigation, which can effectively solve the problems of medical insurance dishonesty.

[6] MI Store: a Blockchain-Based Medical Insurance Storage System

In this paper, they proposed a blockchain-based threshold medical insurance storage system, called MI Store. When combined with the blockchain, it brings some special benefits to the system., e.g. decentralisation, tamper resistance and registration nodes allow users to check publicly verifiable data. Firstly, the blockchain's property of tamper-resistance gives users high-credibility. Moreover, due to decentralization, users can communicate with each other without the third-parties.

III. PROPOSED METHODOLOGY

We implement a system wherein a patient would have the control to grant and revoke the access rights of his medical records but he won't have the rights to create a new record. This functionality is desirable as a doctor is more accountable and this would ensure that the data generated into the system is authentic and credible. This data will be recorded in a smart contracts. Since for a patient, the records can originate from different sources we need to keep a track of all such contracts related to a patient. This will be our summary contract which map a patient to all it's related records.

Insurer will get access to the patients enrolled for a policy after the patients claim any policy. Once the claims are processed the insurer will reimburse the patient accordingly.

The records are true account as in Blockchain, stored data is immutable and permanent, it cannot be modified or deleted, which makes the technology meet the main data integrity requirements. Since storing the images of bills or medical records, on blockchain will result in high gas amount, the images are stored in ipfs which uses content-addressing to uniquely identify each file in a global namespace connecting all computing devices. This content-address is stored in smart contracts. These files can be easily retrieved from the address.

The software requirements of our system are

- Ethereum network: wherein the smart contracts are written in solidity language.
- Ganache : for mining blocks and testing our system. It provides 10 accounts and 100 ethers with each account.
- Metamask : A browser extension which is used to connect our app to the blockchain. It is used to make the transactions through UI.
- IPFS : Since our system demands storing of large files and data which can be in image and other format, We use Interplanetary File System(IPFS) which stores large files in a decentralized network and generates the hash of the stored address which is used for retrieving of the files and storing of the address in blockchain network.

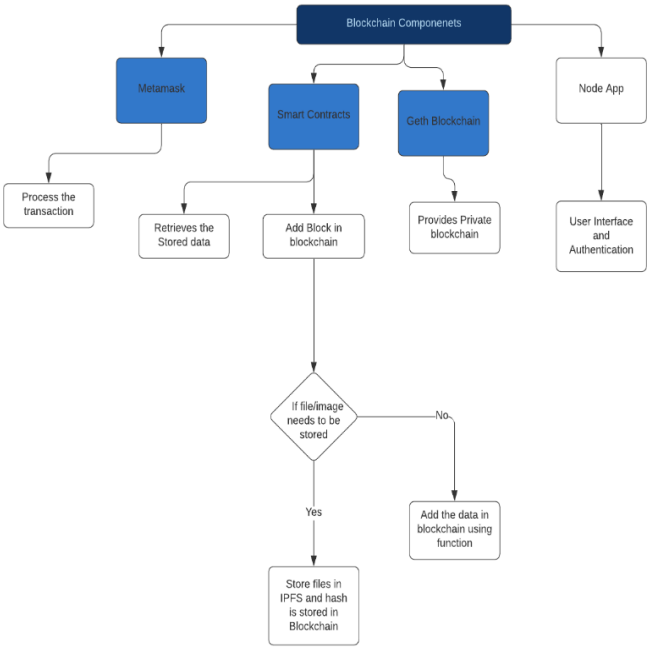

Fig. 1. Blockchain Components

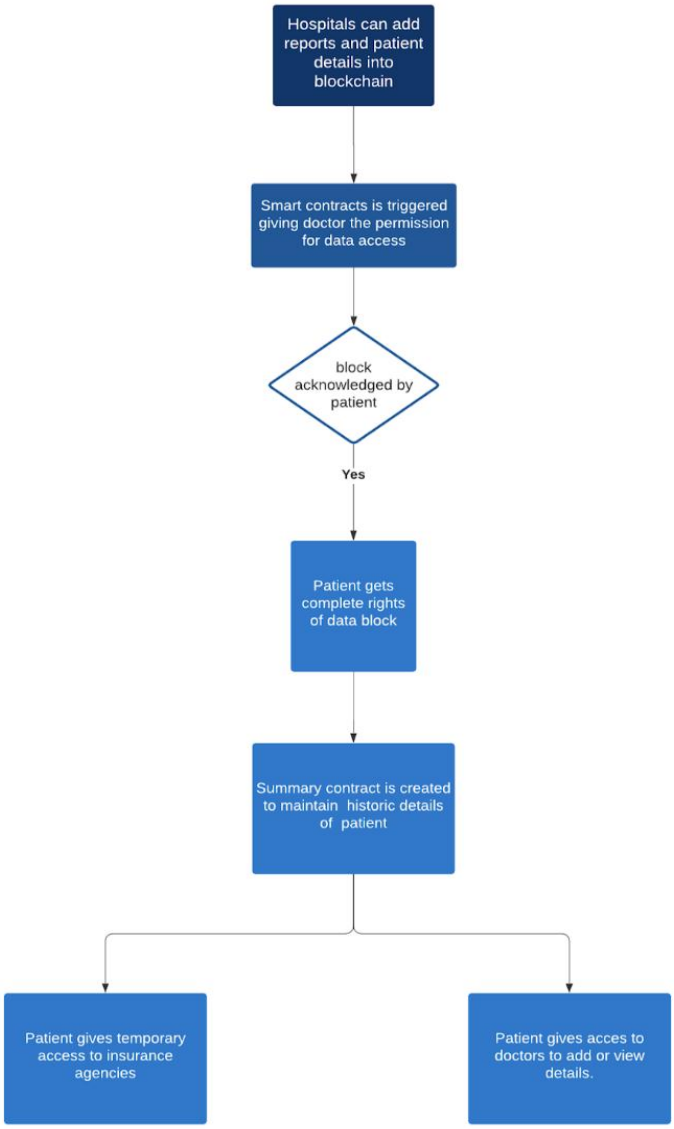

Fig. 2. Project Flow

A. Registeration of new user to blockchain:

The user first needs to register himself into the network. The system stores the public key of the user through metamask. When a patient registers himself, an ipfs hash key is generated for that user. This is used to store all the medical records and bills related to that user.

B. Patient:

1. After registering a patient needs to give access to selected doctors for adding new records to his account. A patient cannot himself add any new records, this is to ensure that only trusted parties add data into the chain and any illicit data can be traced back to the responsible user. After the data is uploaded by the doctor the patient can revoke the access from that doctor. Granting/revoking access requires ethers.

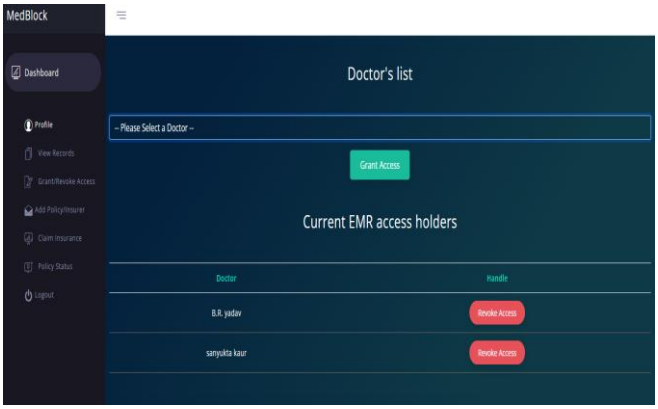

Fig. 3. Grant access to doctor

2. A patient can enroll into any medical insurance policy and then also claim for any policy if applicable.

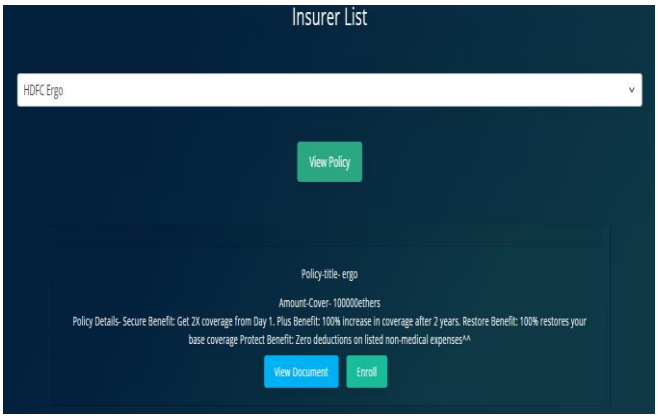

Fig. 4. Enroll to policy

C. Doctor:

After registration, a doctor can see list of patients that he has access to and then proceed on to upload any documents related to that patient. These documents are stored in Ipfs, which is a peer-to-peer network, and the hash address generated is stored into blockchain to reduce the amount of gas used for the transaction

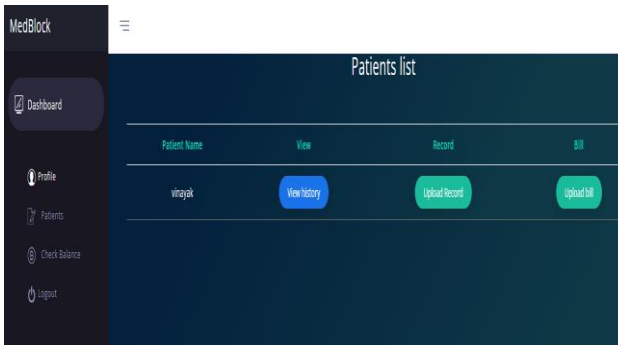

Fig. 5. Upload files

D. Insurer:

Insurer can add policies to his account, patients can enroll for these policies and claim them.

Insurer can be given access to patients medical records when a patient claims any policy, this is to check which all expenses are covered under the policy.

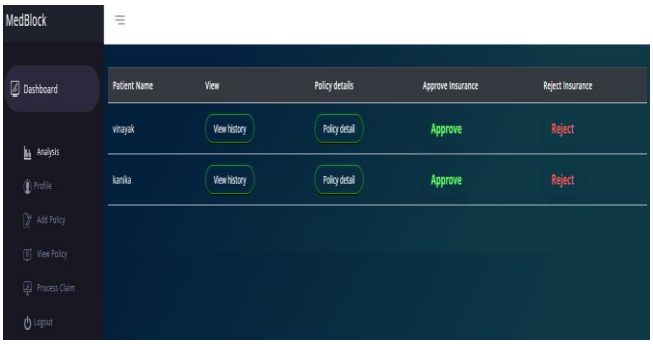

Fig. 6. Approve Claim

IV. RESULT AND ANALYSIS

We observed that comparing to the current system in the market, our proposed system is more convenient and reduces the response time in insurance claiming process by more than 60% and the Customer satisfaction is thereby received. The traditional method is also not secure and does not guarantee untampered and unforged reports, which may lead to loss of company's revenue. Also due to public and private key system our method enables accountability in the system each peer acts as trustworthy node , even if some ill people enter the system they won't be able to access the system and view or edit other people's records unless he is given access by other user.

The proof of work concept in our system which is consensus algorithm requires each node in the blockchain network to solve a problem. The first node that solves the problem gets permission to add new a block. Nodes are the governing body of the blockchain and verify the legitimacy of transactions in each block. Once a block of transactions has been verified, the data is written into the blockchain.

V. ACKNOWLEDGEMENT

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