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INTEGRATING BLOCKCHAIN AND MACHINE LEARNING FOR ADVANCEMENTS IN THE HEALTHCARE INDUSTRY

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ABSTRACT: Examining the potential applications of blockchain technology in the medical field is the focus of this study. The healthcare business may use blockchain technology to keep an immutable record of the truth and protect patient privacy. Hyperledger, a decentralized platform that facilitates secure, transparent, and speedy transactions and provides users with access to healthcare data, was the first thing on which blockchain technology was created. This study proposes that blockchain technology be utilized to build a trustworthy and simple system for healthcare providers, pharmaceutical firms, health insurers, and patients to share and access medical records. With blockchain, no one, not even the healthcare provider, may see a patient's medical records without their express consent. The data is safeguarded in this way. Using the Hyperledger Fabric design, individuals can grant varied degrees of access to their data while still ensuring its security and privacy. Healthcare data trends can be identified, evaluated, and conclusions drawn using both blockchain technology and machine learning. Machine learning can be used to evaluate existing medical data and establish new bounds in real time by applying several algorithms to the data. This is analogous to the way in which blockchain technology can provide authenticated and protected information.
Keyword*: healthcare industry, Hyperledger, decentralized platform, doctors, medical practitioners, pharma and insurance companies.*

1. INTRODUCTION

The distributed public ledgers used by blockchain technology maintain encrypted data that is immutable, making it an ideal solution for archiving reliable records. Distributed ledger technology has several potential uses, including data storage, banking transactions, real estate, and asset management. Blockchain technology has been studied for some time, but its application in digital currencies like Bitcoin has recently attracted a lot of attention. Many players in the market have created blockchain-based business applications. In this investigation, researchers focused on one use case for blockchain technology: EHR.

Depending on their needs, patients may end up leaving clues and pieces of their medical history at multiple hospitals and clinics. In such a scenario, regaining access to the patient's historical medical records is extremely challenging. There is a lot of confusion concerning the patient's health because their records are all over the place at different clinics and hospitals. It is challenging for these groups to maintain up-to-date and accurate records. The information is shattered as a result of the sloppy data handling. The Electronic Health Record (EHR) is a useful digital tool for dealing with these problems since it provides easy access to patient and medical records.

A person's medical history can be found in the cloud, thanks to the Electronic Health Records System. The medical staff sees to it. Information such as the patient's diagnosis, medical background, and laboratory results are all included in these files. The benefits of mandating the use of electronic health records (EHR) include accurate and up-to-date patient records, decreased likelihood of medical mistakes, simplified access to patient information, and enhanced patient participation in care.

2. BLOCKCHAIN IN HEALTHCARE

Because EHR records information from so many processes, it is impossible to guarantee data privacy. The trust amongst medical professionals is harmed as a result of this. Opportunities for blockchain development in this economic sector have arisen in response to the sensitive nature of

the data, which arises alongside the challenges of interoperability and providing health information. The healthcare sector has been one of the most successful early adopters of blockchain technology, where it has been used to protect and streamline data sharing. Blockchain eliminates the need for firms to keep numerous databases for managing patient records. Blockchain data is accessible to everyone who has verified their identity. Because of the way blockchain is built, patients have full choice over who can access their EHR and share data.

3. MACHINE LEARNING IN HEALTHCARE

Machine learning can benefit from the high quality, secure data generated by blockchain technology, which can then be used to educate medical professionals. When it comes to making informed judgments and doing thorough analyses, healthcare offers a glimpse into the future where innovation and data analytics will work together to help a vast number of people. Machine learning is being used more and more in many different fields, including the medical field. Disease diagnosis and treatment are at the forefront of machine learning's uses. Machine learning (ML) techniques and methods are used to the patient's symptoms, test results, and health condition in order to diagnose the ailment.

Using data from previous instances, historical symptoms, and known genetic information, it can also be used to make accurate diagnosis predictions. To help patients live healthier lives, machine learning may examine their current medical records and past medical history.

Machine learning models can be used for more than only medical record reviews; they can also be used to monitor and forecast the spread of epidemics. Large epidemics are common in developing countries due to a lack of basic medical and educational services, making outbreak prediction all the more important in these places.

Machine learning can be applied to both textual records and visual images in the healthcare industry. Many machine learning and deep learning methods were utilized to make computer vision technology practical. Computer vision is used in this field of medical image detection to do things like spot cancers, monitor the development of tumors, analyze and show blood flow, and spot diabetic retinopathy.

Savings in time, money, and effort make machine learning an absolute necessity in the healthcare industry. Computer vision technologies, such as the Google Cloud Vision API and the handwriting recognition engine in MATLAB, are utilized by machine learning strategies for document classification using vector machines and ML-based optical character recognition.

4. BLOCKCHAIN BACKGROUND

Blockchain uses public key cryptography to keep stored information safe. The blockchain is accessible to all nodes in the network thanks to public key cryptography. Time and the certainty that the data in a blockchain cannot be altered are imprinted on each link in the chain. Mechanisms based on proof-of-work guarantee the integrity of the data stored in the node.

Electronic health records allow a wide variety of healthcare professionals access to patient information upon request. Everyone from doctors to hospitals to labs to pharmacists to scientists falls under this category. When a health record in the decentralized registry is modified, an event is recorded in the blockchain. All financial dealings are recorded and safe. Hyperledger, the foundation of the EHR paradigm, is permission-

based and allows for granular access control.

The privacy and content of a patient's medical record is entirely under their discretion. Medical records can be exchanged throughout providers with the patient's permission, and new data can be connected to an existing patient record.

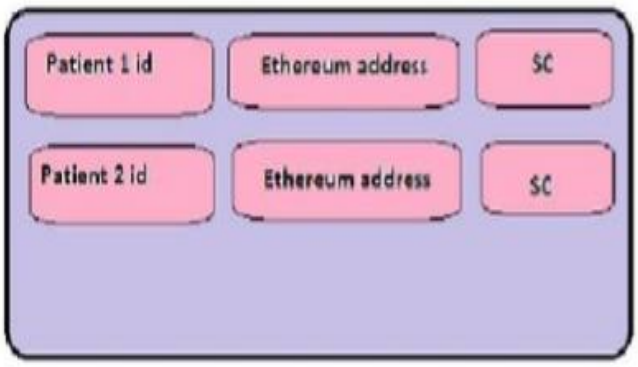
The model maintains a blockchain contract that details all patient-provider interactions and acts as a hub for maintaining each user's up-to-date medical records.

5. SYSTEM IMPLEMENTATION

Smart Contract Structure:

Registrar Contract:

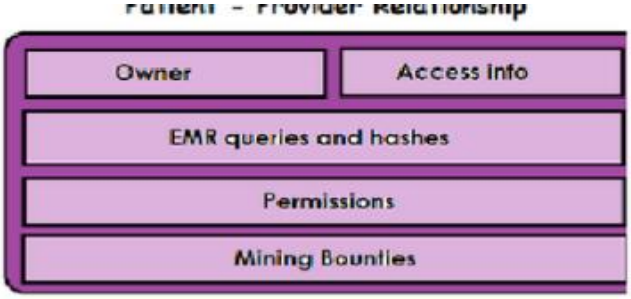
This global contract associates a user's or participant's personal details with their own Ethereum address. It can either add new participants or modify the mapping of current ones. The location of a summary contract, which is linked to this exchange, is indicated.



Patient-Provider Relationship (PPR):

In order for the patient node and the service node to maintain their connection, this agreement is necessary. The health records of all other nodes are protected and stored by each individual node. It consists of numerous types of information and authorizations that are connected to various resources. When the data link query is completed, just the record data that the provider has access to is returned. The data is secured by linking the hash of the data to the query string. The provider might make new or updated data inquiries.

A dictionary implementation is saved, connecting watcher addresses to query strings, allowing patients to share their data with others.

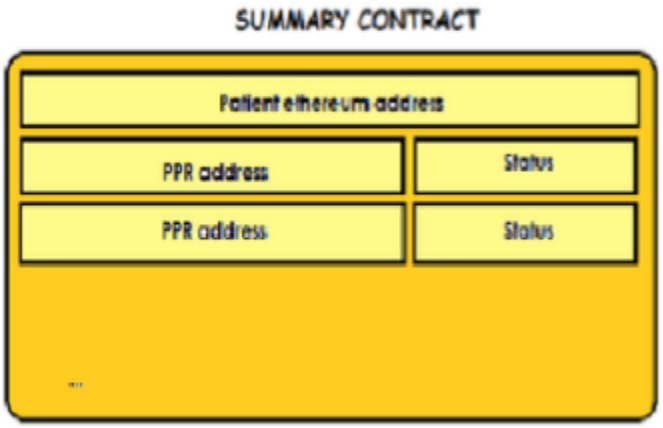


Summary Contract (SC):

Participants can look back on their experience in their medical records thanks to the brevity of the agreement. All interactions between the Client and the Provider are governed by this Agreement. This link between patient and provider illustrates the participant's historical and ongoing engagement with the transaction. The SC will include a roster of all participating medical professionals. The same holds true for service providers; conversations with clients and others will be recorded in their SC.

The backup and restore procedures cannot proceed without this agreement. This action creates a permanent record in the blockchain. Therefore, users don't have to worry about losing their work if they sign in and out of the system multiple times.

Whether the connection is brand new, needs to be updated, or the patient hasn't accepted it yet is all indicated by a status variable. This notifies the user that the feature is active. Due to safety concerns, providers are the only ones who can make changes to status factors. A patient's response to a request can be affirmative or negative.



6. SYSTEM DESCRIPTION

Smart contracts on the blockchain direct the EHR system in how to handle patients and doctors. Provider nodes store patient data in databases even if patient and provider nodes have identical components. It is believed that these databases provide a safe haven for patients' medical records. As a result, the summary agreement can be utilized to safely fill in any gaps in knowledge.

The architecture model consists of the following four pieces of code:

BACK-END LIBRARY:

The Ethereum client interacts with the server software to format data at a basic level. It answers questions and clears any concerns that may emerge throughout a transaction. It streamlines administrative tasks, blockchain transactions, and direct blockchain interactions through its user-friendly interface.

ETHEREUM CLIENT:

To access the Ethereum blockchain network, users must first download and run the Ethereum client. It links users together in a P2P network and transmits financial transactions in an encrypted fashion. Names and addresses of customers are shared with them. This service has been launched and is being continuously evaluated for enhancement. When an update is needed, it means that the data on the local machine needs to be brought up to date.

Database gatekeeper:

To access the Ethereum blockchain network, users must first download and run the Ethereum client. It links users together in a P2P network and transmits financial transactions in an encrypted fashion. Names and addresses of customers are shared with them. This service has been launched and is being continuously evaluated for enhancement. When an update is needed, it means that the data on the local machine needs to be brought up to date.

EHR Manager:

The model is based on EHR Manager, a middleware that facilitates communication between the user interface, database administrator, back-end library, and Ethereum client.

IMPLEMENTATION

The following examples show how the EHR paradigm is currently being implemented: A new patient file is started by the doctor. The patient's name may be determined by comparing Ethereum addresses, and the relevant summary contract can be determined by examining the registrar contract.

To keep track of the patient's medical history, the doctor makes a fresh PPR and associated inquiry. The PPR is updated after that point.

The patient's SC is linked to the updated PPR so that the exchange can be obtained and used later.

The individual's Ethereum client is constantly checking for updates to the relevant summary contracts. Individuals are informed of the formation of new PPR relationships. If the user grants the request, the SC will change in accordance with their decision.

After receiving confirmation of the message's receipt, the practitioner can then send a query requesting access to the patient's medical history. The new PPR is employed to track down the provider and link it to the gateway server for the database. Patients can choose what information they want to share with third-party organizations when they create a PPR and submit it along with a query string and the appropriate third-party address. When the database administrator approves these requests, they can be processed.

PROTOTYPE EVALUATION

The patient's entire medical history is presented in the study design specified in this publication. The information is kept on a blockchain network and in a separate database just for providers, where it is kept alongside patient data. Recent years have seen an increase in the number of hackers and data breaches. Blockchain's many benefits can be attributed to its decentralized nature.

The discovery of many patterns can be aided by cooperation between service providers and businesses to make data more easily accessible. In some cases, patients may choose to take part in an outside researcher's study.

Patients and medical staff are free to talk to one another. Users have the option of authorizing select service providers with write access to their blockchain and assigning privileges. The level of privacy and security afforded to users has increased.

7. CONCLUSION

Machine learning can be used to gather information and examine it. By simplifying both disease diagnosis and study design, ML algorithm models have a profound impact on healthcare. Machine learning models perform best when they are fed high-quality, validated data. Blockchain technology allows businesses to safely store, share, and disseminate sensitive data, which has implications for everyone involved. According to this theory, patients should have complete control over who can see and use their medical records. The blockchain infrastructure desperately requires this. Applications of Blockchain Technology in Medicine In the healthcare industry, Global is a trade group working to remove governance and regulatory barriers to blockchain implementation. There were significant privacy worries despite the fact that numerous technologies were used to bolster security. By combining the patient's consented-to electronic medical records from several healthcare providers, blockchain technology guarantees that patients can lead healthy lives.

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