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Secure Health Care Systems Using Blockchain Technology

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ABSTRACT

With the technological innovation that is spreading around the globe, smart healthcare and biomedical advancements have always been a big issue to be improved in every way: The Internet of Things (IoT) has made incredible strides in the sharing of healthcare data and triggering the related necessary actions in the modern world, with ever-evolving internet models automating and digitalizing numerous industrial and household implementations. With the technological innovation that is sweeping the globe, smart healthcare and biomedical advancement have always been a vital issue to be improved in every way. The Internet of Things (IoT) has made incredible strides in sharing healthcare data and triggering the essential activities connected with it in the modern world, with ever-evolving internet models automating and digitalizing numerous industrial and household applications. With the technological innovation that is sweeping the globe, smart healthcare and biomedical advancement have always been a vital issue to be improved in every way.The Blockchain Technology has experienced numerous changes since its debut. There has been research that has shown a variety of ways to organize the conventional system's access control mechanism. In recent years, blockchain technology has also demonstrated exceptional dependability in a variety of industries, including smart homes, healthcare, banking, information storage management, security, and others.

Keywords :- Blockchain, Healthcare, IOT, Smart Healthcare, Wearables, Security. Privacy

I. INTRODUCTION

The scope of communication between remote devices connected to the internet for data and access transfer has multiplied due to continuous developments in the Internet of Things (IoT). As a result, practically every business on the planet has been changed and disrupted by IoT, from the education sector to supply

chain management. IoT has also performed admirably in the healthcare industry, making diagnostic procedures easier and effectively observing patient activity. The main benefit of IoT, which is what we are focusing on, is that it facilitates patient monitoring even during inactive patient hours, which is sometimes very difficult to achieve with a conventional system. The full access, transaction, and storage management was recently supplanted by blockchain technology modern technologies. Several industries, including retail, supply chain management, finance, healthcare, and others have demonstrated tremendous interest in and promise for blockchain technology. The privacy and security of the data, which is frequently used by several stakeholders for pursuing various actions, is the main problem that always arises in healthcare. Healthcare system demands the sharing of confidential medical data among the communicating nodes [13]. For instance, insurance companies are one of the parties involved in providing a certain service to the patient, and frequently, they must obtain the patient's data in order to correctly analyze it and design the services. Yet, it is frequently observed that this does not happen. Insuring the security of data shared through the IoT architecture with blockchain technology is proving to be effective. In light of this, the patient monitoring models and the Blockchain technology, which may run over a distributed network with broader security qualities over advanced cryptographic primitives, is the driving force behind healthcare management frameworks that rely on the IoT architecture for monitoring. The blockchain technology, which protects data privacy by keeping track of the nodes in the architecture's transaction history, is what powers healthcare management models like Remote Patient Monitoring Frames Works [15,16]. The foundation of the blockchain is the proof-of-work principle. A transaction is only considered valid if the network confirms that authorized nodes have put forth enough computing effort. Healthcare and medical information systems that deal with data, like electronic healthcare, have a considerable improvement in security thanks to blockchain technology. Clinical Consents, Patient Records, Personal Health Records, Individual Diagnosis Reports, Wearable Device Data, Post-Operative Assessment Records, Hospital Management System Records, Records of the Hospital Management System, Blockchain-based Supply Chain Data for insurance companies, genomic data, telemonitoring, and other private information related to clinical trials. use of blockchain technology, which can enhance efficiency in transmitting healthcare data records and transparency, privacy, confidentiality, and traceability.

II. RELATED WORK

For a better organized management of transactions made by medical sensors and devices, Dey et al. [1] presented an Internet of Things Model based on Blockchain. The MQTT protocol, which can be used as the main agent for connecting the biosensors to the IoT platform, was suggested as an usage for the design. Moreover, the architecture included IPFS (Interplanetary File System), which can isolate state entries or changes in blocks when specific transactions are appended to them, minimizing deduplication of the stored transactions.

An interactive environment with relation to an IOT-controlled healthcare system was proposed by Budida et al. [2]. The cornerstone of the suggested architecture is essentially the ingestion of generating data from smart wearables and biosensors, followed by providing patients with clear feedback and simple solutions.

In order to provide patients with quicker and more appropriate recommendations, Sivagami et al. [3] created a Smart Hospital system that combines the effectiveness of the Sensors and also suggests human reaction. The plan promotes the use of RFID, WSN, and Smart Wearables, which work together over a

single platform to execute a variety of functions, including smart sensing of the patient's environment and allocation to a certain ward based on the placement of the doctor.

The odouli et al[4] .'s facilitation of a Healthcare Data Sharing system that surpasses the current system the pseudonymity of privatizing the identification of the users whose data are shared and used by the Medical Research Centers. The work also developed the idea of a consensus algorithm known as "Proof of Interoperability," which would enable organizations on the system to conduct transactions that were smoother and more effective because they were entirely dependent on the network's various nodes' interoperability. Additionally, the author proposed a three-level architecture on various stages, consisting of a Web Platform that patients will use to upload their health records and maintain an Access Management Suite, a Cloud Middleware that will be used to maintain data fetch from the Web Platform using REST, and a Data Warehouse.

A parallel healthcare system built on a foundation of the ACP Method is advanced by Wang et al.cryptocurrency network. The system outlines the use of a Parallel Healthcare System based on the real-world therapeutic expertise and experience of doctors and patients, as well as the use of an Artificial Intelligence system that determines the implementation of Virtual Doctors and Virtual Patients to go through and defines a Parallel approach in defining the treatment that are required to be administered by doctors to the patients. The second segment of the ACP approach refers to the very segment of computational experiments, where it combines the clinical significance and the four participants' collective experience to determine the general clinical and experimental procedure to be used.

Raj et al. [6] designed and created a novel method for tracking health and also support the fundamental use of Telemedicine technology is used in remote locations where connectivity is a major issue. The research produced a portable method for detecting patients in far-off places. The system included a pulse oximeter, an ECG, an EMG, and other sensors. In addition, the system was capable of operating in both online and offline modes, allowing for the storage of small data packets from the sensors in a local database before being transmitted to the medical professionals while they were on the go or online, depending on what was most practical at the time.

III. BLOCK CHAIN IN HEALTH CARE

The characteristics of the blockchain, which are its decentralized nature, openness and permissionless, may offer a unique solution for healthcare. Wider applicability of the technology paves its way into different aspects of healthcare, including wearables and progress of medical research. Healthcare sector has growing demands for blockchain developments and a recent survey by Deloitte shows that the traditional industry is actively explores new avenues for the use of the blockchain to address its critical needs. (Deloitte, 2018). Immutability of the blockchain is the vital option for healthcare data. It can secure health records, the results of clinical trials and ensure regulatory compliances. Employment of smart contracts demonstrate how blockchain can be used to support real-time patient monitoring and medical interventions (Griggs et al., 2018). Such systems ensure security of records while providing access for patients and medical professionals in a Health Insurance Portability and Accountability Act (HIPAA) compliant manner. Further application of blockchain relates to supply chain in pharma and developing measures against counterfeit drugs. While the development of new drugs incur substantial costs related to trials to evaluate safety and efficacy of the drug, the use of smart contracts allow to facilitate the procedure of the informed consent as well as improve identify management and data quality (Razak, 2018). Providing access to patients for managing their own

identify also allow integration of the informed consent procedure while ensuring privacy of individual heath data.

Table 1. Blockchain benefits and uses cases to improve medical record management

Blockchain: Key Benefit	Biomedical/Health Care Use Case: Improved Medical Record Management
Decentralized Management	Patient-managed health care records: "*[Patient] becomes the platform, owning and controlling access to their healthcare data. This removes all obstacles to patients acquiring copies of their healthcare records or transferring them to another healthcare provider.*"[85]
Immutable Audit Trail	Unalterable patient records: "*The data are stored in the private blockchain cloud. Blockchain may guarantee medical data cannot be changed by anybody including physicians and patients himself/herself internally and natively.*"[77]
Data Provenance	Source-verifiable medical records: "*Records are signed by source, allows legitimacy of records to be verified (and false records to be plausibly denied).*"[78]
Robustness/Availability	Reduced risk of patient recordkeeping: "*Because data is stored on a decentralized network, there is no single institution that can be robbed or hacked to obtain a large number of patient records.*"[85]
Security/Privacy	Increased safety of medical records: "*Data is encrypted in the blockchain and can only be decrypted with the patient's private key. Even if the network is infiltrated by a malicious party, there is no practical way to read patient data.*"[85]

IV. BLOCKCHAIN AND TRADITIONAL DISTRIBUTED APPLICATIONS HEALTH CARE DATABASES

By contrasting blockchain with the conventional distributed database management system (DDBMS), such as Structured Query Language (SQL)-based systems like Oracle68 and NoSQL-based systems like Apache Cassandra, we describe the key benefits or comparative advantages of blockchain45,46,63-65. This will help you understand why blockchain distributed ledger technology may be practical for biomedical and health care applications. Decentralized management is the first major advantage of blockchain. While blockchain is a peer-to-peer, decentralized database management system (i.e., each node runs independently while adhering to the protocols), DDBMSs are logically centralized-managed, giving users the impression that they are managing a centralized database even though the underlying machines may be physically distributed.45,63,64 Because of this, blockchain is appropriate for applications where independently managed biomedical/health care parties (such as hospitals, providers, patients, and payers) want to cooperate with one another without giving power to a central management middleman.

V. PROPOSED SOLUTION

The above challenges can be mitigated by careful design and implementation of the biomedical/health care application systems. We take ModelChain13 as an example. Model Chain adopts blockchain to securely and robustly disseminate privacy-preserving predictive models (ie, a set of machine learning parameters or aggregated values) between health care institutions. Because it only disseminates predictive models but not PHI, transparency is not a critical issue. Also, it contains a machine learning process that can take a long time to run (minutes, or even hours), thus the transaction speed of blockchain becomes relatively negligible. Finally, since it adopts permissioned blockchain networks, malicious nodes could not arbitrarily participate in the network, and therefore the risk of a 51% attack is minimal. Other implementation techniques to mitigate the transparency/ confidentiality issue include encrypting sensitive data (eg, PHI or personal identifiable information) on the blockchain network,87,97,118 storing sensitive data off-blockchain and only disseminating "pointers" (eg, encrypted links) or permission information on-blockchain,88,96,97,117 and automating data management protocols using smart contracts.96–98 To deal with the speed/scalability issue, plausible solutions include exploiting blockchain as an index of health data instead of the repository of all records,86 and storing only ongoing verified transactions rather than the complete history on blockchain.92 Also, several new blockchain implementations, such as BigchainDB,45,50 provide significantly higher transaction speed than the Bitcoin blockchain, which could also solve the speed and scalability problem.18,119 The threat of a 51% attack on the biomedical/health care blockchain network can be drastically reduced by using a virtual private network to disseminate the data and deploying some components of the system on private Health Insurance Portability and Accountability Act–compliant cloud computing environments such as

iDASH (integrating Data for Analysis, Anonymization, and Sharing).

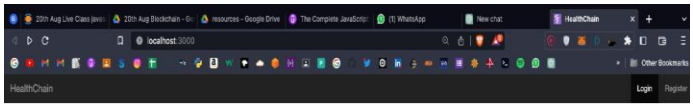
VI. IMPLEMENTATION

Registration page

The first step is registration page where a user will register as either patient or doctor.

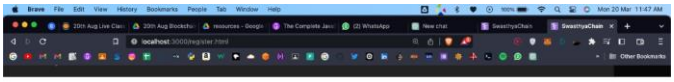
Login Page

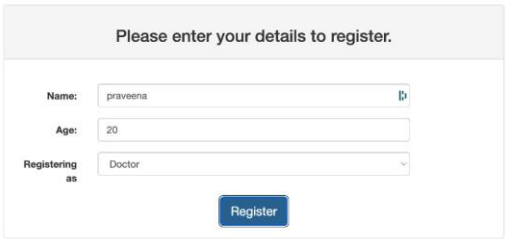
User initially signup with personal details either doctor or patient like name .



Doctor registration page

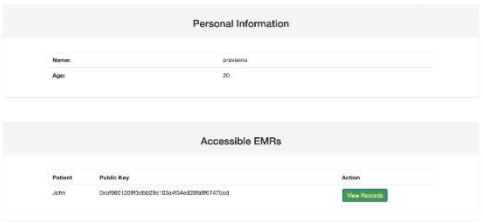
In the doctor registration page the doctor will enter their name and age .





Doctor Home page

The doctor home page contains the details of the doctor as well as the details of his patient like their medical records.



Patient registration page

In the patient registration page the patient will enter their name and age

VII. DISCUSSION

In terms of efficiency, as well as the security and privacy of the data being generated in the traditional Healthcare system, the proposed technique outlined in the paper totally resolves the problem. The suggested structure effectively establishes full oversight of a cure, continuous therapy, or general healthcare from the start to the ultimate conclusion. The main principle that is consistently noted in the study of healthcare data is the reliability or veracity of the data. The question of whether to believe the data is authentic always comes up in relation to using the data produced by the conventional system. We can always trust the data, nevertheless, in the event of using Blockchain for access control and storage. Additionally, the suggested framework greatly benefited insurance companies because they could ask the healthcare facility to give them direct access to the ERM Blockchain so they could validate the data instead of having to search through all the paperwork and vet the scenario when a patient submitted a claim for reimbursement.

VIII. CONCLUSION

Today's world has advanced to the point where everyone is looking primarily for global connectivity and synchronization. Also, the current lifestyle of people around the world has changed, and together with their hectic schedules, it has always been noticed that people tend to ignore minor health issues. In order to give patients prompt and appropriate support, the suggested system incorporates the idea of remote data collection from wearable devices and biosensors, if any. There has always been a demand that the data must always be managed in a proper manner, with careful consideration given to the accuracy, security, and authenticity of the data generated by the patients. Concluding the paper, it is necessary to highlight rapid development of blockchain implementations in healthcare, which is slowed down by the issues identified earlier. Our systematic literature review revealed opportunities as well as challenges that blockchain offers to the healthcare industry. Data privacy and security are the primary concern, identified in more than 50% of the paper. Further challenges relate to data structure and coordination. The findings of the paper identify directions for future research that will promote further developments and innovation in health information systems design (eg public healthcare decision support (Miah et al, 2017) or other similar problem domain such as agricultural decision support system (eg knowledge-based decision support platform (Miah, 2008)) in which blockchain can offer authenticated data dissemination methods.

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