Proceedings of the International Conference on Sustainable Computing and Smart Systems (ICSCSS 2023)
DVD Part Number: CFP23DJ3-DVD; ISBN: 979-8-3503-3359-6

Blockchain Based Smart Healthcare System

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***Abstract*—The term "electronic health record" (EHR) refers to a patient's electronic data collection that contains medical history, which can be accessed by authorized personnel from any location at any time. The use of e-healthcare has led to improved social and health outcomes, as well as a reduction in medical errors. However, the security challenges associated with patient data storage in IT frameworks pose a significant challenge to the advancement of e-healthcare. Blockchain technology has emerged as a potential solution to this issue and may revolutionize the healthcare industry. This study lays the foundation for secure patient data management using a blockchain-based approach, which incorporates a public ledger, private ledger, smart contracts, and context-based access control. The suggested architecture ensures reliable access to patient data, safe storage, and interoperability. Additionally, the proposed blockchain-based framework provides an efficient and trustworthy means of managing complex medical procedures. The study also outlines potential uses for blockchain technology in the healthcare industry, such as facilitating secure and anonymous sharing of health data for research purposes. The authors propose a novel, accessible, interoperable, and audible approach for maintaining medical records using smart contracts.**

Index Terms-Blockchain, Electronic Health Records (EHR), Security, Healthcare.

I. INTRODUCTION

As blockchain technology continues to gain traction, research in various sectors of science relevant to society is advanced thanks to the variety of applications it may be used for. Blockchain is seen as a revolutionary arrangement that resolves a few squeezing issues in the area of innovation, like the personality of the board, decentralization, information proprietorship, and trust-and information-driven decision-making, despite its relative infancy and the fact that it is still in its experimental stages[9]. Each node in a blockchain-based distributed network is furnished with an indistinguishable duplicate of the information and is expected to comply with similar standards. Blockchain is a circulated record that grows as more information is contributed in the form of blocks. The users' safety and the ledger's integrity are both taken care of using cryptographic operations and distributed consensus procedures. [15]The expression "enormous information" alludes to different informational indexes that are excessively huge and complex to be handled by traditional database or software methods[10]. Seven "V" traits define big data: volume, variety, velocity, variability, veracity, visualization, and value. The magnitude of the data may be described by its "volume." Data access speed is measured in velocity. Diverse sources and the unstructured character of the data are what we mean by variety. According to variability, the same data might have several interpretations. Data quality is a factor in veracity. Graphics, charts, and other plots are used in visualization to assist people to grasp the meaning of data and find out additional information. Finally, value considers how processing the data could provide an important outcome. [12]Blockchain technology has the potential to improve a wide range of huge information use cases, from the administration of private/individual information and the goal of licensed innovation debates to production network the board and the correspondence of IoT devices and in healthcare[11].

II. LITERATURE SURVEY

A. Blockchain and Health IT: Algorithms, Privacy, and Data

Authors: Anne Chang, Nadia Diakun-thibault, Luca Forni, Fernando Landa, Jerry Mayo, Raul van Riezen, and Allison Ackerman Shrier

The Precision Medicine Initiative (PMI) is "enabling a new era of clinical care" by funding research, developing new technologies, and modifying existing legislation in ways that bring together patients, researchers, and providers to provide customized medicine. [1] An interagency working social event, including the Work environment of the Public Facilitator for Wellbeing Data Innovation, as a team with various partners, fostered the "Protection and Trust Standards" and the "Information Security Strategy Standards and System" to communicate the gathering's obligation to protection and security with regards to dependable information sharing and

straightforwardness. In this study, we investigate potential threats to PMI data's safety, privacy, integrity, and use. MIT's OPAL/Enigma is a revolutionary system architecture for confidential shared data storage and analysis. It is built on a highly streamlined form of multi-party computing with secret-sharing and may aid PMI companies in overcoming these challenges[6]. An immutable distributed ledger (permissioned blockchain) monitors and controls access by predetermined conditions, as shown by smart contracts and digital identities. We end with a preliminary OPAL/Enigma use case that might support clinical trials and research in precision medicine. Traditional data security paradigms are questioned by MIT's OPAL/Enigma. Regardless of limited access and de-identification criteria, centralized databases cannot guarantee security and data integrity[2]. Safe, validated queries submitted to private, encrypted databases provide forward energy for another time in clinical exploration and practice by permitting associations and members to impart medical care information with cryptographic securities of protection with varied parties.

B.Blockchain-Based Data Preservation System for Medical Data

Authors: Li, H., et al.,

[3]The availability of medical information has skyrocketed, making health care a necessity in many people's life. (e.g., diagnosis certificates and medical records). Notwithstanding, it is not difficult to take, change, or erase clinical records. On the off chance that the above occurs, patients' lives might be in jeopardy since doctors wouldn't be able to rely on the security of their medical records. This study proposes a novel blockchain-based DPS for the drawn-out stockpiling of delicate clinical records[4]. To guarantee the power and unquestionable status of putting away information while safeguarding client security, we influence the blockchain design to give a solid stockpiling arrangement. With the proposed DPS, users may permanently save vital data, and verify its validity in the event of any suspicion of data tampering. Cautious information stockpiling components and different cryptographic measures are also used to protect user confidentiality; for instance, even if the data are stolen, an adversary would be unable to read the plain text[4]. We deployed a working prototype of a decentralized payment system built on top of the Ethereum blockchain. Performance assessment findings show that the suggested system is effective and efficient.

C.Blockchain for secure ehrs sharing of mobile cloud-based e-healthsystems

Authors: Seneviratne, A., D.C. Nguyen, P.N. Pathirana, M. Ding.

In order to facilitate a more rapid trade of clinical information among patients and medical care suppliers, EHRs are progressively being kept in portable cloud settings, where cell phones are connected with distributed computing.By adopting this forward-thinking paradigm, healthcare services may be provided with little overhead, high adaptability, and easy access to electronic health records (EHRs)[5]. Concerns concerning data privacy and network security are also raised by this new paradigm shift in e-health. It may be challenging to consistently share EHRs across mobile users in the mobile cloud while maintaining high levels of security. In this exploration, we construct a clever EHRs sharing design for utilization on a versatile cloud stage utilizing the decentralized interplanetary record framework (IPFS) and blockchain. We plan a solid access control framework in light of brilliant agreements to guarantee the protected exchange of electronic well-being records (EHRs) between various patients and medical care suppliers. We show a model arrangement utilizing the Ethereum blockchain in a genuine information-sharing situation on an Amazon-fueled versatile application. The consequences of our experimental review show that our idea gives a feasible method for safeguarding delicate patient information while transmitting it across portable cloud stages[6]. Lightweight access control plans, least organization idleness with high security, and information protection levels are undeniably featured as areas of progress in the framework assessment and security examination in comparison to existing data-sharing models.

D.MedRec: Using Blockchain for Medical Data Access and PermissionManagement

Authors: A. Azaria, A. Ekblaw, T. Vieira and A. Lippman

[7]Electronic medical record innovation has been hindered by years of cumbersome legislation and ineffective bureaucracy. (EMRs). There is an urgent need for such innovation today that personalization and data science are empowering people to take charge of their own healthcare and regain ownership of their own medical records. We recommend MedRec, a blockchain-based, decentralized system for managing electronic medical records (EMRs), in this piece. With our system, patients can easily share their medical history with any doctor or hospital in the world and always have access to the most up-to-date version of their records. MedRec uses the unique properties of the blockchain to enable identification, privacy, accountability, and data sharing, all of which are crucial while dealing with delicate data[16]. Our measured plan is viable with the suppliers' current neighborhood information capacity arrangements, making our innovation valuable and versatile. We give motivators to clinical partners like colleges and general well-being organizations to become blockchain "miners" and participate in the network. In return for helping to keep the network up and running through Proof of Work, miners are rewarded with access to aggregated, anonymized data. By giving researchers with access to huge datasets and including both patients and healthcare providers in the choice to share data, MedRec contributes to the growth of the data economics field[8]. The goal of this brief paper is to provide a functioning prototype before field testing so that the strategy can be evaluated and debated.

III. ARCHITECTURE

The architecture of a blockchain-based smart healthcare system is designed to provide a secure, decentralized, and interoperable environment for managing patient data. By leveraging the benefits of blockchain technology and integrating it with other healthcare systems, such as electronic health records

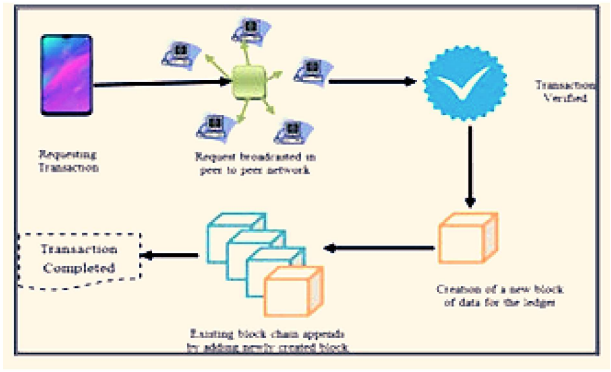

Fig. 1. Architecture

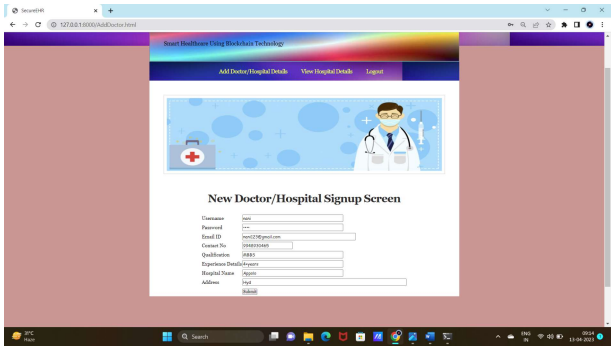

Fig. 2. Admin Functionalities

(EHRs), these systems can improve the quality and efficiency of healthcare delivery.

IV. PROBLEM STATEMENT

The usual strategy involves each institution storing this data on their own, making data interchange exceedingly time-consuming. Due to the possibility of sensitive information being disclosed, access to health data is also extremely restricted.

V. PROPOSED SYSTEM

To address these issues, this paper explores how blockchain technology may be integrated with healthcare records and data to facilitate secure and trustworthy data sharing.

VI. IMPLEMENTATION

A. Tensorflow

TensorFlow is a library for dataflow and differentiable programming that is free and open-source and is used in many unique situations. It is a symbolic mathematics library that is also used by applications of machine learning, such as neural networks[14]. It fulfills a dual purpose for Google in terms of manufacturing and research. For internal usage, Google's Mind team developed TensorFlow. Its release began on November 9, 2015, under the Apache 2.0 open-source license.

B. Pandas

An open-source Python library called Pandas provides solid information architectures and excellent execution tools for managing and analyzing data. Python was mostly used for preprocessing and data munging. It did not have a major effect on statistical evaluation. The problem was solved with pandas. Regardless of where the information comes from, we might utilize Pandas to do the five normal strides of information handling and examination: plan, adjust, model, and investigate. The fields of money, financial matters, measurements, investigation, and so forth all utilize Python and the Pandas library.

C. Numpy

Numpy is a program for manipulating arrays that may be used in a variety of contexts. It provides a fast and flexible object for working with arrays of data in several dimensions. It's the must-have module in Python for any serious research project. The following are some of its most salient features: a robust entity suitable for an N-dimensional set. sophisticated (TV) add-ons.Software that can merge C/C++ and Fortran code. useful Knowledge of the Fourier transforms probability and linear algebra. Beyond its apparent scientific applications, Numpy is a powerful multidimensional data container. Because of its adaptability in defining data types, Numpy can easily interact with a broad range of databases.

D.Matplotlib

Matplotlib is a Python 2D plotting program that can make conveyance-quality figures in a combination of printed duplicate plans and natural settings across stages. The Jupyter Notebook, online application servers, Python scripts, the Python and IPython shells, and Matplotlib are just some of the graphical user interface toolkits that may be used. [13]Matplotlib has the ability to make even the simplest of jobs look insurmountable. A wide variety of charts and plots may be generated with only a few lines of code, including histograms, power spectra, bar charts, error charts, scatter plots, and others. Some examples may be seen in the thumbnail galleries and sample charts. When combined with IPython, the pyplot module gives a MATLAB-like point of interaction to straightforward plotting. Power clients might take utilization of an item-situated interface or a bunch of MATLAB-accommodating techniques to completely control things like line styles, font settings, axis characteristics, and more.

E. Scikit – learn

Scikit-learn provides a common Python interface to a number of learning methods, both supervised and unsupervised. The simplified BSD license under which it is distributed allows for its use in both academic and commercial settings, and it is included in a number of Linux versions.

To launch the project, double-click the "run.bat" file to launch the Python Django server and display the screen.

Python server will be running on the screen. Open a browser and type the address http://127.0.0.1:8000/index.html into the address bar to access the home page. It will direct us to the main window and displays the screen.

To see the admin login page below, click the "Admin" option on the top screen. After logging in, the administrator will see the screen in the screen.

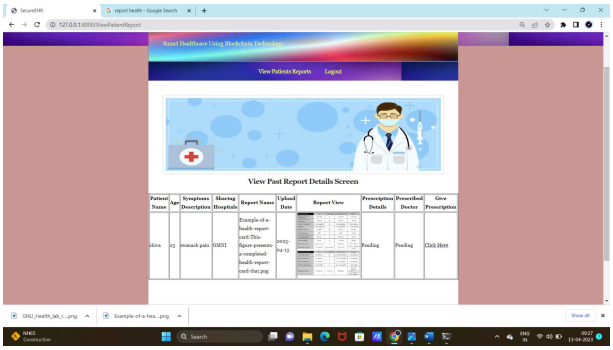

Fig. 3. Doctor Screen

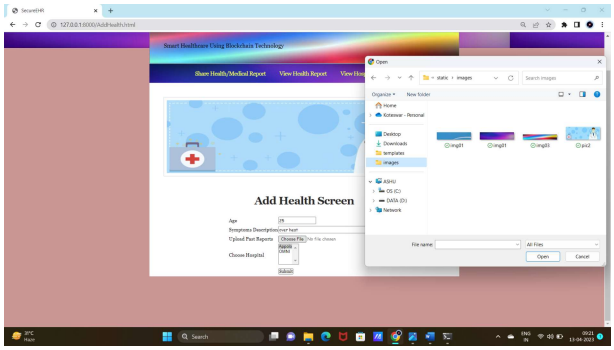

Fig. 4. Patient Sharing Data

The ”Add Doctor/Hospital Details” link in the screen above will take the administrator to the page below.

On the page,the administrator will enter the names of a doctor and a hospital, and then click the Submit button to record those data in the blockchain.

By holding down the ”CTRL” key and pressing the ”Submit” button, the patient may share information with the hospitals they have chosen by entering their symptoms, uploading any medical reports, and selecting multiple hospitals from the LIST. To read this patient report, log out and back in as a doctor. The patient may examine all the specifics of his condition on the screen. On the screen you can see we are displaying “Prescription Details and PrescribedDoctor” and the doctor has not given any prescription so it’s displaying ‘Pending’ now the doctor can click on the ‘Click Here’ link to give a prescription.

VII. RESULTS

Overall, a blockchain-based smart healthcare system has the potential to transform the healthcare industry by providing a secure, decentralized, and interoperable environment for managing patient data. By improving data security, promoting data interoperability, enhancing patient control, streamlining clinical trials, and improving healthcare outcomes, these systems can significantly improve the quality and efficiency of healthcare delivery.

VIII. CONCLUSION

In this piece, an architecture and a mechanism for building a blockchain-based EMR system are suggested. In addition, the blockchain variety that might serve this function and its justification are shown. It is recommended that Hyperledger Fabric and Hyperledger composer be utilized to implement the proposed method. Patients may actively manage their medical records here. Security and privacy concerns have also been addressed. The patient may manage who has access to their medical information using doctored and can remove that authorization at any moment. If the patient’s medical records are maintained current and available via the blockchain network, the doctor will be able to perform a more complete study and evaluation of the patient’s health. The doctor may update the current visit on the blockchain if any prescriptions are made and medical procedures are carried out.. The paper’s shortcomings may primarily be broken down into three categories. The system is not scalable, to start. Second, only patients and physicians are allowed to participate. Finally, the database’s ability to hold information is severely constrained. Only a few fundamental diagnostic details—all of which are text-based—are taken into account. There are two components to the upcoming work. The suggested solution is essentially a prototype to obtain a sense of how blockchain works when it is connected with EHR. The first step is to include additional participants, such as a hospital or an insurance provider. The system must then be scaled up and an off-chain database must be maintained in order to keep the actual prescription in the form of an image or another format. Additionally, efforts to find a better blockchain, such as one that is layered or hybrid, will continue.

IX. ACKNOWLEDGEMENT

We would like to convey our heartfelt gratitude towards the Department of Information Technology at Vignan Institute of Technology and Science, Hyderabad, for providing us with every tool and resource possible, assistance, and guidance necessary to complete this research.

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