Mendix-based medical record storage using blockchain

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Abstract – In order to enhance security and reliability of medical records storage, this system proposes an innovative approach. This system aims at changing the way medical data is stored by incorporating blockchain for effective and secure data handling and Mendix for speed of application deployments. With current centralized systems the issues that connect them allow inappropriate access to patient information resulting in loss of patient confidentiality Most. Cloud Computing promises a future where we will have a safe, reliable cloud for storage of medical history. The Mendix low-code development platform may be applied in the creation of systems that will integrate well with the current healthcare processes. The blockchain prevents unauthorized accessing or distortions of the data thereby empowering the patients on the claim of ownership of their data. This will improve privacy and less possibility of data breaches increasing the confidence levels in the health care systems and also improving management of patients records in general.

Keywords: Mendix, Blockchain, Solidity, MetaMask, Ethereum, Rest API.

I. INTRODUCTION

The twenty-first century healthcare systems are faced with countering problems in the ways they store and manage medical records which to some extent are explained by the weaknesses of the highlighted systems which are centralized. Even with technological advancement, such systems remain indefensible against data corruption, unwarranted access and lack of common protocols rendering them ineffective in the respect of patient confidentiality and gradually diminishing confidence on the healthcare sector. In just a span of one year, more than ever before, reports of huge amounts of stolen data in the healthcare centres have attracted much attention and help use looking for these cases

This paper offers a different perspective on the recording and the carrying out of the medical records management process through combining the fast application development capabilities of Mendix with the secure multiple-party record keeping provided by the Blockchain technology. The low code nature of Mendix as a development tool enhances the quick creation and enhancement of the user-centric application and this is what is referred to as the appropriate speed for development however the blockchain assures all data management around security from immutability.

The main aim of this project is to create a patient-centric secure, virtual healthcare record storage system which is decentralized and interoperable. Patients will continue to control their private health information. In such a bilocal setting, the option to store and manage patients' medical records at their houses or at distributed clinics allows patients to overcome the challenges associated with the centralization of such critical data and its management. Furthermore, it also helps in promoting the prevention of misuse of transparency because people are held more accountable.

Such an approach helps encompass cancellation performance limitations by means of Mendix and blockchain. In utilizing these approaches, and especially Mendix's rapid application development techniques, we seek to develop interactive and intuitive high level user interfaces that plug in to health care systems to enhance adoption and usability. At the same time, blockchain is critical for data transactions security and transparency. It enables patients to exercise strict control over their medical records and know all about their health information.

II. PROBLEM STATEMENT

Data-centered or centralized systems for repositories of medical records are susceptible to a number of shortcomings like data breaches, unauthorized access, and limited interoperability, which the architecture was designed to eliminate. Last year, a number of healthcare data breaches resulted in loss of millions of records of patients. These systems also complicate the processes of healthcare providers in exchanging information with one another for a more efficient delivery of services thus increasing both the time spent and medical costs. Further, patients trust providers with sensitive medical information but most of them do not have firm guarantees on who can

access their medical information and this raises conflicts concerning privacy which leads to lack of confidence in the healthcare system.

Hence, this system summarizes a change in the philosophy of the storage and management of patient's records where a combination of Mendix and blockchain is proposed to provide an effective, secure, and collaborative record management system. This project is oriented on changing the current state of affairs in the healthcare industry by giving patients control over their data and making healthcare data management more secure and trustworthy.

III. LITERATURE REVIEW

This paper employs group key management, dispersed access control and IPFS proxy algorithms to ensure their system on the file sharing is secure. The architecture also has one of the components referred to as the IPFS proxy. It is responsible for the application of the control principles. We construct an IPFS proxy and a fusion of an IPFS server and a blockchain network to give secure file sharing. Users are free to create new groups or don't have to if there is an existing group. Hence, users are able to view only files pertaining to those groups that they have been granted permission to. [1]

This research presents a system, where the blockchain is combined with file storing and sharing and uses both Named Data Networking (NDN) technology and Interplanetary File System (IPFS). The distinct NDN approach improves the system by enhancing file security through separating the overhead and content of files into two different processes. NDN is used for content signing and encryption whereas IPFS acts as a secure and confidential content storage network. Besides, the content transmission is made more secure through the use of repeated path transmission NDN and routing methods. This strategy further protects the encrypted content during its ingestion and sharing phase. [2]

The current model discussed in this article pertains to one system that makes use of a file storage system that is both decentralized and impervious to cracks. This system was implemented using an internal blockchain. It means more privacy and less secrecy. A proprietary protocol called the Interplanetary File System (IPFS) is designed to solve the large file storage problem with security concerns. Students upload their files using peer-to-peer (P2P) networks, and the files are stored within the IPFS system. [3]
This study covers Solidity, a programming language used for developing smart contracts on the Ethereum blockchain. We create a user-friendly application using blockchain technology. It allows decentralized file processing and distribution. Users can create a smart contract with instructions and file-handling features. MetaMask wallet is used to store Ethereum that is used to pay the network fuel which the system is using. [4]

IV. METHODOLOGY

A computer program or transaction protocol created to automatically carry out the necessary actions in accordance with the terms of the agreement is referred to as a "smart contract." A smart Contract is a self-executing program that runs on blockchain. In this we write the functions to store and retrieve the data on and from the blockchain. These are written in solidity language. Among the various goals of smart contracts are the removal of trusted middlemen, lower costs associated with arbitration and enforcement, lower losses from fraud, and the abolition of both purposeful and unintentional exclusions. Ethereum supports two different types of accounts. Ethereum is used as a digital currency for transactions on the blockchain.

A user is in charge of an account that is owned outside. The Externally Owned Account(EOA) stands for these accounts. The use of EOA is in the hands of a private key. With the help of a private key, only one can initiate a transaction. The computer-running smart contract is in charge of managing a contract account. The letter CA stands for a contract account. CA is implemented by code itself not by an external user. Unlike EOA, CA are not controlled by a private key. It is possible to store the Ethereum cryptocurrency, or ether, in both types of accounts. Without user input, Ethereum does not carry out operations (computations) under a smart contract. Therefore, an EOA must permit a CA before it may carry out its duties. EOA first evokes the smart contract by making a transaction to CA. Then, CA will execute its predefined logic. To run its activities, the EOA has to purchase "gas," and it can only do this with ether money. Gas is basically the amount of fuel network that is being consumed for a transaction. We have to pay Gas using ether currency which is stored in the wallet named Metamask. First and foremost, we need to establish the required ecosystem before we

can integrate a blockchain-based voting mechanism in Ethereum.

1. Mendix: -

Mendix is a low-code platform for developing apps that allows users to quickly construct and launch web and mobile applications. With Mendix, developers can build complex applications with minimal hand-coding, using visual models and pre-built components. Its intuitive interface allows for collaboration between developers, business analysts, and stakeholders, speeding up the development process. Mendix provides features like drag-and-drop functionality, reusable modules, and built-in templates, streamlining app creation. It also allows connection with other data sources and cloud services. Mendix provides us a rapid development environment thus enabling us to focus more on our goal. It allows us to build the application with minimum coding, which results in less error resolution time and debugging. This speeds up the time-to-market compared to other development techniques. Mendix provides a great collaborative environment as we can invite a collaborator on the project and it provides us facility to set the Access Role of the contributor thus maintaining security.

Mendix allows easy integration of various APIs which makes connection with external systems and databases easier. Mendix is cloud-native by default hence meeting scalability demands further. Mendix incorporates features such as role-based access, data encryption and complements with industry standards therefore covering the security aspect in a promising way.
It goes without saying that Mendix allows companies to undergo changes faster in the rapidly changing digital environment.

2. Solidity: -

Solidity, a high-level, contract-oriented programming language is the one we use in the development of the smart contracts in our system. Functioning in a manner similar to Javascript, will Solomon. Smart Contracts based on solidity language contracts are structured in the same format as classes when using Object Oriented languages. Like in any other programming languages, contract codes consist of variables and functions. An EVM compiler converts the Solidity language codes to machine codes which are understood by the programmed EVM.

3. Metamask: -

Metamask, an application built over Ethereum, is a cryptocurrency wallet as well as an interface with DApps which fundamentally changes how people interact with the blockchain. It is also packed with extensive and essential features that allow users to create and manage their Ethereum accounts, make payments in Ethereum and ERC-20 tokens, and use various DApps from browsers. Owing to the ‘Internet’ extension facility to Metamask, it reaches to the people and nurtures the adoption of such advancements in technologies as decentralization. In addition, appropriate measures are fostered, such as the encrypted storage of private keys, and the use of hardware wallets to hot wallets which protect the user’s assets in the digital economy. Offerings to create custom networks and connect to DApps through WalletConnect helped Metamask as well easily integrate to the growing ecosystem of decentralized finance (DeFi) and the creation of smart contracts enhancing the wider picture in the blockchain ecosystem. WalletConnect is one protocol in MetaMask which helps in secure transactions between DApps and wallet. Whenever user want to do a transaction, always a popup box opens, which allows users to either approve or deny the transaction through MetaMask from any device. This feature is being provided by WalletConnect. DeFi activities include staking, lending, and trading.

4. Mocha: -

Mocha is one of the best testing frameworks created for javascript with a primary focus on running on node.js. A significant part of its resolutions is the usability focus on simplifying the task of testing the features of asynchronous JavaScript with more emphasis on browser application testing. For Mocha, it is possible to test the working and performance levels of JavaScript codes before they are presented in the server environments. The framework is therefore filled with a myriad of powerful and additional features thus making it possible for developers who are intent on the quality and stability of javascript applications to whip it out without second thoughts. Mocha supports both enhancement synchronous and asynchronous tests which suit different classes of testing.

V. FLOWCHART

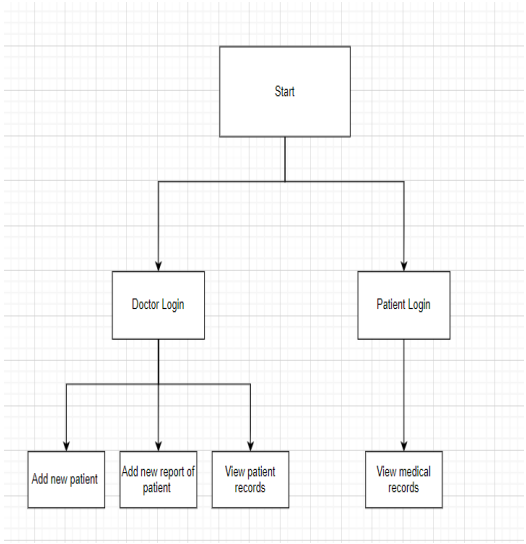

Fig. 1 - Flowchart of the system

VI. RESULTS

The implementation of this system helps store patient's medical records safely. Through our system, doctors can create patient profiles and store their medical records on the blockchain, as well as view all records related to their patients. Patients can easily access their records through our portal. In this system, once medical records are stored, they cannot be changed or deleted, ensuring the integrity of the medical records. This makes our system more secure and reliable. The use of Mendix enhances the user interface and user experience.

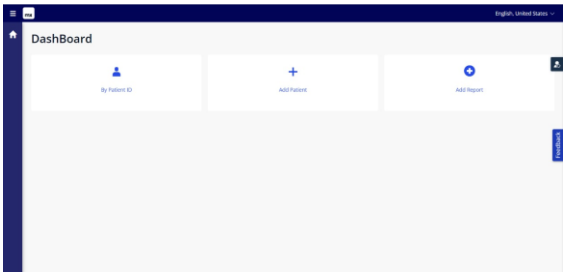

Fig. 2 - Doctor Dashboard

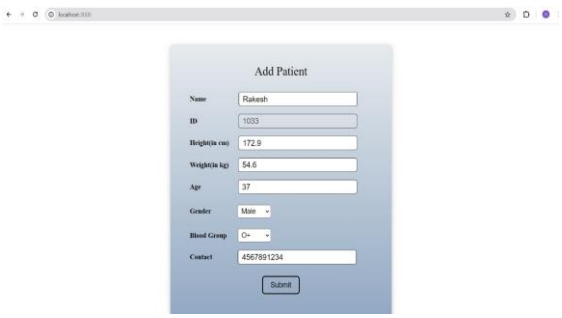

Fig. 3 - Add patient

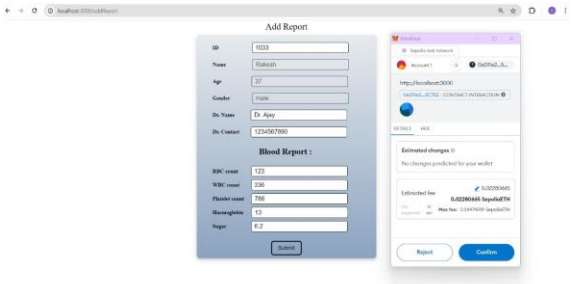

Fig. 4 - Upload report

VII. CONCLUSION

Consider the fact that there is a consistent emphasis on the need for a safer and more versatile and decentralized storage of medical records systems in the monocentric scenario. In using Mendix. In addition to improving patient data security and thereby curtailing the possibilities of unauthorized breach of these data. Judging by their results, patients have regained their control over their medical records, which will lead to enhancement of trust in the healthcare system. It should be noted that inter-system data exchange became much easier. Although the system gave good results, it was obvious that in subsequent work care should be taken about scalability as well as the possibility of embedding the system to the wide range of healthcare systems. In summary, this work demonstrates substantial progress towards a change for the better development process of healthcare data management with a focus on patients.

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