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ijircce@gmail.com



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# MediCare- A Decentralized Healthcare Ecosystem

Mrs. Shoma Mitkari<sup>\*1</sup>, Rewa Aslekar<sup>\*2</sup>, Ankita Chipade<sup>\*3</sup>, Harshita Dhage<sup>\*4</sup>, Onkar Giram<sup>\*5</sup>

Professor, Department of Information Technology, Progressive Education Society's Modern College of Engineering, Pune, India. <sup>\*1</sup>

Student, Department of Information Technology, Progressive Education Society's Modern College of Engineering, Pune, India. <sup>\*2,3,4,5</sup>

**ABSTRACT:** MediCare is a smart and decentralized medical ecosystem that uses Blockchain technology to store Patients' data in a secure and reliable way. People often commute or relocate to different cities for educational purposes. Their medical records and case history is with their Doctors in their native place. In such a case, Doctors have to perform the required tests before performing any surgical procedure. This is a very consuming task, in terms of time, money as well as effort and can be avoided if all the medical records of the Patient can be accessed by Doctors. Medical personnel can access their Patients' data and add/view it as per their needs. They can authorize personal medical records in this proposed management framework. Thereby we update the centralized server system into a decentralized system. This framework employs Smart Contracts to establish a medical record management system to ensure the privacy of Patients. The proposed scheme supports confidentiality of EHR, verification of user along with all other entities present in system and the updation of EHR dynamically using the React based framework. Next, we have implemented multi-signature wallets using Ethereum to demonstrate the practical implementation and usage of the proposed solution. Finally, we have compared the performance and security of the proposed scheme against existing solutions. It includes separate logins for Patients, Hospitals, and Doctors who have registered with us. We aim to develop this system with the help of Blockchain which will guarantee the integrity, security and incorruptibility of data.

**KEYWORDS:** Blockchain Technology, Smart Contracts, wallets, Patients, hospitals, Doctors

## I. INTRODUCTION

Users today demand a rapid and smooth flow of data. Because of differing formats and standards, health data held in older systems is isolated and difficult to share with others. In short, the present healthcare data environment is fragmented and inadequate for modern consumers' immediate demands.

Electronic health records (EHR) [1] are currently stored on centralised databases, where medical data is largely non-portable. Centralization expands the security risk footprint and necessarily involves confidence and trust in a centralised authority and cannot ensure security and data integrity. To eliminate the above limitations in the current health care sector. We propose a solution, an entirely new eco-system developed around the health care sector.

MediCare is a decentralised ecosystem for storing, verifying and sharing medical data. It is a Web3 application developed on React, a JavaScript based front end framework. With the help of blockchain technology, it stores all the data securely. The Blockchain technique accelerates the process of medical record and information exchange in such a way that the cost of human resources is significantly reduced. Thus, a person can access his/her data from any device, whether a smartphone, tablet, laptop or desktop. Thus, when an individual visits any doctor, he/she can show the doctor the data from MediCare. It gives the doctor an accurate view of the person's health and conditions.

### 1.1 Literature Survey :

1. Electronic Health Records (EHR) By Tom Seymour, October 2014 American Journal of Health Sciences (AJHS) [https://www.researchgate.net/publication/267226700\\_Electronic\\_Health\\_Records\\_EHR](https://www.researchgate.net/publication/267226700_Electronic_Health_Records_EHR) It replaces all legacy systems with a new information system that shares company wide data and includes financial, billing, human resources, and material management systems as well.
2. Blockchain-Based Electronic Health Records Management: A Comprehensive Review and Future Research Direction ABDULLAH AL MAMUN<sup>1</sup>, SAMI AZAM<sup>2</sup>, (Member, IEEE) [https://www.researchgate.net/publication/357669751\\_Blockchain-Based\\_Electronic\\_Health\\_Records\\_Management\\_A\\_Comprehensive\\_Review\\_and\\_Future\\_Research\\_Direction](https://www.researchgate.net/publication/357669751_Blockchain-Based_Electronic_Health_Records_Management_A_Comprehensive_Review_and_Future_Research_Direction) This paper highlights on the patient-driven model of record maintenance using Blockchain technology where smart contracts can be incorporated in future days. Making it more potential in data exchange. Finding its huge scope, hoping that more researches will be carried out and practically implemented.
3. "Healthcare Data Breaches: Insights and Implications" (2020) BY Amal Krishna Sarkar, Alka Agrawal, Rajeev Kumar <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7349636/> The sole aim of this study was to examine and investigate healthcare data breaches. This investigation was intended to provide insights into the causes and consequences of these occurrences on individuals and organizations
4. Design and implementation of existing system by designing an efficient practical patient management system" (2013) Udofia israel Udoh [https://www.academia.edu/33578958/DESIGN\\_AND\\_IMPLEMENTATION\\_OF\\_PATIENT\\_MANAGEMENT\\_SYSTEM](https://www.academia.edu/33578958/DESIGN_AND_IMPLEMENTATION_OF_PATIENT_MANAGEMENT_SYSTEM) To examine the current procedures employed in our hospitals with regards to patients admission, diagnosis and treatment. 2. To examine the associated problem(s) or flaws in the current system

## II. BLOCKCHAIN

Anyone can join the network in a public blockchain and access the block data. It uses public Distributed Ledger Technology, where anyone with internet connectivity can join. However, the users' identity address is generated using a pseudo-anonymous hash value in the public blockchain network. Anyone can only know that someone with that address exists but does not know their exact identity. After joining the network, a user can check transactions in the network.[2]

## III. SOLIDITY

JavaScript and Solidity are used to create this application. Solidity is used to write and test smart contracts for Ethereum. Solidity is statically typed, supports inheritance, libraries, and complex user-defined types programming language.

We have used Solidity to create smart contracts for multi-signature wallets using Ethereum. Ethereum is a decentralized blockchain platform that runs smart contracts i.e., applications that run exactly as programmed without any possibility of downtime, censorship, fraud, or third-party interference.

## IV. SMART CONTRACTS

Smart Contracts are deployed on the Goerli test network alchemy node which is a cross-client proof-of-authority testing network for Ethereum via Hardhat. Hardhat is used as a development environment for testing/debugging smart contracts.

## V. HARDHAT

Hard Hat is a development environment for Ethereum software. It consists of different components for editing, compiling, debugging, and deploying your smart contracts. It is a flexible and extensible task runner that helps you manage and automate the recurring tasks inherent to developing smart contracts.

The front end is to be built with React.js and is to be coupled to the smart contract via Ether.js.

### 1.2 Motivation

Since the COVID pandemic has made Hospitals more important than ever, we wanted to use computer science to improve and modernise the Hospital's traditional systems and contribute to this important field.

When considering this subject, we discovered a problem that most of us have experienced: Patients frequently don't manage the documents or reports properly, they don't bring them with them when visiting Hospitals, and as a result, they must undergo additional testing. The traditional methods end up taking more time and resources as a result. Additionally, repeating the tests can be challenging if the Patient is in a critical condition. In this case, we must first perform check-ups and gather the necessary data, putting the Patient's life in danger. As a result, this issue makes Hospital management ineffective.

Therefore, we made the decision to deal with the problems in traditional systems and develop a system that will boost productivity in the enormous Hospital industry.

### 1.3 Problem Statement

- To eliminate the drawbacks of conventional Hospital systems and offer eco-friendly systems that enable people (Patients) to receive medical examinations without having to put in additional effort by creating a reliable database of their medical history reports.[4]

### 1.4 Objectives

- To improve the system's dependability, usability, and speed of operation,
- To create a reliable database of people's medical history reports so they won't have to carry the reports around with them at all times.
- To create a platform that will allow Hospitals to securely store and exchange Patient data.
- To create a system that eliminates the need for Patients to manage reports and eliminates issues with lost or damaged reports.
- To give Patients complete, accurate, and current information
- To securely exchange electronic data with Patients and other medical professionals (Li Wang, 2020).
- To assist medical professionals in safer care delivery, medical error reduction, and Patient diagnosis
- To enhance convenience of health care, interaction between Patients and providers, and allowing for safer, more trustworthy prescriptions.[2]
- To support the advancement of clear, comprehensive documentation and precise, efficient coding and billing
- To lower costs through less paperwork, increased safety, less testing repetition, and improved health.

### 1.5 Methodology

The solution has four main roles: Patient, Hospital, Doctor, and Owner, and all these roles require a single MetaMask wallet to use the application.

When a Patient opens the application, he or she will interact with an interactive user interface to access all the functionalities. The Patient uses a wallet as a unique identifier to log into the system. When the wallet is connected and the Patient enters the required information, the react application contacts the smart contract via an Ethers.js library and stores the data filled by the Patient. This transaction is on the blockchain and can be verified using the transaction id on Etherscan. The Patient can then access all his previous medical records. The Owner is the person whose address the smart contract is deployed at.

The Hospital is a role created by the Owner in which they can view the Hospital's details. The Owner (role) has the authority to add Hospitals; the Owner also adds Doctors to the system; Doctors can view Patient Records from the system and then enter the details after the diagnosis.

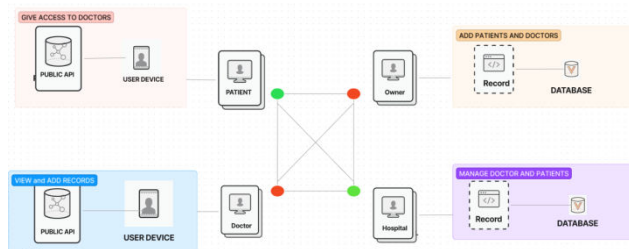
**1.5.1 Algorithm:**

**A) Zero Knowledge Proof:**

A zero knowledge proof is a unique algorithm where a user can prove to another user that he/she knows a particular absolute value, without actually conveying any extra information about it. In this process, the “prover” does not disclose any data about the transaction. Here, the prover could prove that he knows a certain value ‘xyz’ to the verifier without giving him any information other than the fact that he knows the value ‘xyz’.

For example, Doctor has to request access from Patient in order to obtain his/her details.

**1.5.2. System Designs**



**Architecture Diagram:**

The system's primary goals are to help Doctors obtain Patient information more quickly. [8]

The Patient can register in the portal, choose a hospital from the list of hospitals, and schedule an appointment. The doctor will perform the treatment and upload the record when the Patient visits the hospital. The app will allow the Patient to view the description in his history of examinations as well as all his prescriptions there.

The Patient should receive a one-stop for all their healthcare-related needs.

**1.6 Scope**

Immediate access to medical records can help Doctors in diagnosing the cause of the Patient’s illness and thus, saving both time and money. Blockchain technology can be used to store Patients’ data in a secure way and make it available to authorized parties on the go. It can be done by using a single application that can be used on mobile phones, tablets, laptops, or any other mobile devices. This can help Doctors in accessing the records of the Patient anywhere and at any time. The availability of all the data on the Blockchain will help in efficient management of the data. It is evident that

data security is of utmost importance in the modern world. Any data which is stored in the hands of the third party, chances of its loss or theft increase manifold. The data stored on the Blockchain cannot be hacked or stolen.

## VI. FUTURE WORK

We know that Doctors and laboratories require Patients' data for study and research purposes. We can acquire Patient's consent to use their data for research purposes. Thus, we can avoid illegal Patients' data sharing and enable Doctors and researchers to provide enough data to study. In future we can also extend this idea by incorporating a reward-based system where Patients will be rewarded for treatment fees or medication fees depending upon the coins/points earned during visits to the Hospitals and developed platform. Additionally, we can enable Patients to track their lab reports which were sent for testing so he or she has the access and knowledge of the stages the report goes through and can estimate the arrival based on the same. This helps improve trust between both the parties and can attract more traffic towards the Medicare Platform.

## VII. CONCLUSION

This system will boost the Hospital sector's productivity and will be more cost-effective because no one will need to retake any tests simply because he/she does not have the necessary documents. When a Patient is in a critical condition, the system will be more useful because the Hospital will be able to gather the Patient's information from prior records and begin treatment right away rather than having to conduct additional tests to learn more about him/her. We can eliminate the possibility of human error by automating the system. The system will organise the reports for the Patients, so they are not required to do so. Additionally, he/she only needs to login whenever he/she wants to check the prescription or the records. This system will bring positive change to the industry, as the limitations in the current methods will be greatly reduced. The Hospitals will have a common and secure database, allowing for more open communication between the Hospitals.

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2. Blockchain-Based Electronic Health Records Management: A Comprehensive Review and Future Research Direction ABDULLAH AL MAMUN 1 , SAMI AZAM 2 , (Member, IEEE) [https://www.researchgate.net/publication/357669751\\_Blockchain-Based\\_Electronic\\_Health\\_Records\\_Management\\_A\\_Comprehensive\\_Review\\_and\\_Future\\_Research\\_Direction](https://www.researchgate.net/publication/357669751_Blockchain-Based_Electronic_Health_Records_Management_A_Comprehensive_Review_and_Future_Research_Direction)
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