

# MedEx: Secured Medical Report Management System using Blockchain Technology

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## ABSTRACT

In daily life, every person holds onto some medical reports, which is not an easy task to handle. So, this arises a problem that can be solved by making the reports available digitally. But, only making this thing online doesn't solve the whole problem. So, to solve the whole problem we made a decentralized system using Blockchain Technology, which will help in the exchange of medical reports in times of any medical procedure. Since the system is built on Blockchain Technology, it will provide immutability, security, and transparency between users.

**Keywords** - Medical reports, Blockchain, transparency, immutability, accessibility, Smart Contract.

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## I. INTRODUCTION

Blockchain technology is one of the most important inventions and innovations that play an important role in today's professional world. Blockchain technology is constantly changing with change and change. It is a Blockchain that encapsulates information and maintains trust between them, no matter how far apart they are. Critical maintenance. In addition to traditional medical examinations, a variety of medical equipment can be used to monitor the physical condition of patients, including vital signs in the medical field such as heart rate, blood pressure, and EEG for medical diagnosis or health promotion. Providing more information about these assets can help improve diagnostics, biomedical research, and decision-making. For example, a doctor may need a patient's medical history from several hospitals when deciding on the best treatment. The rapid spread of digitalization in healthcare has led to the emergence of a large amount of electronic information about patients. This development has created an unprecedented need to protect medical information during use and exchange. The rise of Blockchain technology for accountability and transparency in data storage and distribution is paving the way for new capabilities that address key data, security, and health concerns. In addition, the healthcare system is changing in a patient-centered way, focusing on two important things: consistent delivery and appropriate treatment. Blockchain enables medical facilities to

provide adequate patient care and quality medical facilities. Health information exchange, another time-consuming and repetitive process that is costing the healthcare industry, can be quickly resolved using this technology.

Our MedEx plan is based on the use of Blockchain technology. The app will make the exchange of medical information easier and safer. Information sharing in healthcare is dangerous because it can be easily misused; Our system will go a long way in avoiding these risks.

## II. LITERATURE REVIEW

**"Secure Electronic Medical Records Storage and Sharing Using Blockchain Technology"** 2020. [1]

In this article, they discuss how Blockchain technology can help better manage medical records. They proposed a Blockchain data management system to manage and share electronic medical records (EMR). They implemented the electronic medical data management model using the permissioned Blockchain platform "Hyperledger".

**"Health Record Management through Blockchain Technology,"** 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI), 2019. [2]

Our approach also uses smart contracts, which are rules that are automatically executed when both parties agree on a set of rules. Here we see the

hospital administrator as the end user and the patients as the others. Smart contracts is divided into three steps namely Invocation, Registration creation, and Verification.

**"Integrating Blockchain for data sharing and collaboration in mobile healthcare applications"**, Proc. IEEE 28th Annu. Int. Symp. Pers. Indoor Mobile Radio Commun. (PIMRC), pp. 1-5, Oct. 2017 [3]

In this article, the authors discuss the mobile application they use to collect health data from personal devices, referrals, and medical devices and sync data with the cloud to share with doctors and health insurance companies. However, the certificate of integrity and certificate can be permanently removed from the cloud database and migrated to the Blockchain network as needed to store information. In addition to improving efficiency, they used data trees to process data and worked to manage the vast amounts of medical data they collected and transmitted on a mobile platform.

**"MedRec: Using Blockchain for Medical Data Access and Permission Management,"** 2016 2nd International Conference on Open and Big Data (OBD), 2019. [4]

It aims to provide a data management system to manage electronic medical records and provide patients with comprehensive, immutable, and easily accessible information to their medical information using Blockchain technology.

**"Blockchain Technology in Healthcare: A Systematic Review."** Healthcare (Basel, Switzerland) vol. 7,2 56. 4 Apr. 2019. [5]

This article presents an ongoing research review of the use of Blockchain technology in healthcare. The review highlights cutting-edge technology in medical Blockchain application development, its limitations, and future research areas.

**"Blockchain technology applications in healthcare: An overview"**, The International Journal of Intelligent Networks, Volume 2, 2021.

[6]

In this article, they review Blockchain technology and its potential benefits in healthcare. This diagram shows the various projects, actors and collaboration that Blockchain technology supports in global health. Finally, the article identifies and discusses fourteen key applications of Blockchain in healthcare.

**"MedChain: A Design of Blockchain-Based**

**System for Medical Records Access and Permissions Management,"** in IEEE Access, vol. 7, pp. 164595-164613, 2019. [7]

It aims to improve the existing system as it provides interoperability, security, and access to information to patients, doctors, and other third parties. The treatment is effective while maintaining patient privacy.

**"Management of medical records: facts and figures for surgeons."** The Journal of Maxillofacial and oral surgery vol. 10,3 (2020) [8] It explains all the details about the patient's medical history, clinical findings, diagnosis, pre-operative and post-operative care, diagnosis and medications.

**"Blockchain-Based Medical Record Management with Biofeedback Information"**, in Smart Biofeedback - Perspectives and Applications. [9] This article examines Blockchain-based architecture and their applications in medical data management or biofeedback data. The framework uses smart contracts to create a secure medical information management system to ensure patient identity.

**"Application of Blockchain Technology in Healthcare: A Comprehensive Study"**. (2020). [10]

This article provides an overview of the use of Blockchain in healthcare. It also aims to identify the limitations of the study and some open questions in future research.

### III. PROPOSED SYSTEM

#### 1. Patients

The patient is one of the most important parts of our system. The user will register as a Patient where he/she will add details such as name, wallet address, age, etc... Further, the Patient will be directed to the Dashboard where he/she can give access to the selected Doctors and also can revoke access. We used the ML prediction model which will help Patients to see an insurance premium value which is discussed later in detail.

#### 2. Diagnostic Centre

A Diagnostic Centre is a laboratory that patients visit to perform laboratory tests, and test data is exported to the Interplanetary File System (IPFS) for display on the patient's dashboard.

#### 3. Doctors

Doctors have to register as a Doctor entity on our system and then be directed towards the Dashboard where he/she can see which patient has

given access to which reports and further processes will be discussed with the Patient offline.

#### 4. Smart Contract

The Smart Contract holds on to the code which includes doctor, patient, and diagnostic center registration which is connected through the web3.js library to the frontend part.

#### 5. ML Model

The Machine Learning Model in our system is used for predicting an estimated value which shows an idea to the user of how much amount he/she would get as insurance based on their profile.

##### a. Data Visualization

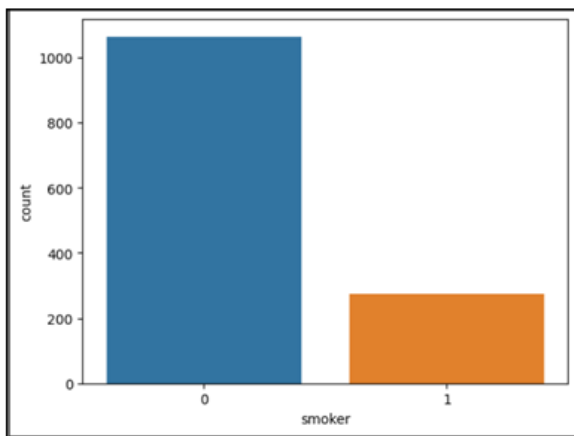


Fig 1. Smokers count in the dataset

The above figure shows the count plot of all the Smokers and Non-Smokers in the dataset.

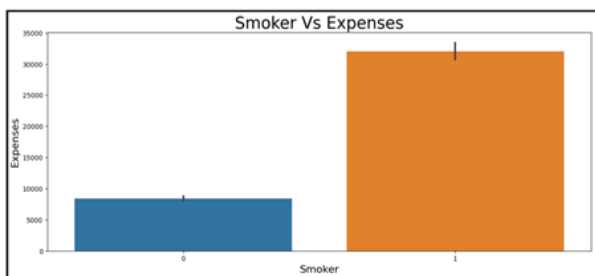


Fig 2. Smokers v/s Expense in the dataset

The above figure shows the bar plot between Smoker/Non-Smoker v/s Expenses.

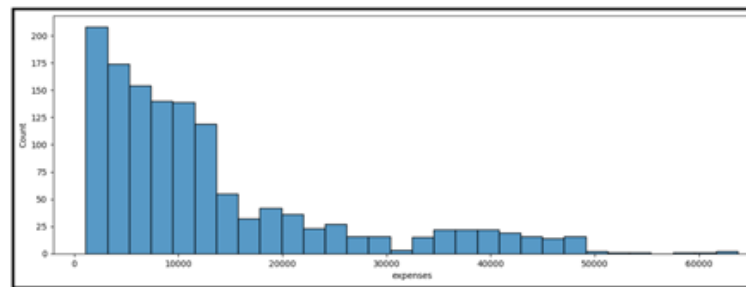


Fig 3. Average Expense count in the dataset

The above figure shows the Histogram of Expenses which gives the count of expenses concerning the dataset.

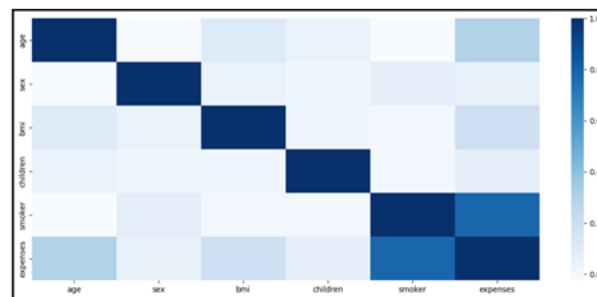


Fig 4. Correlation

The above figure is formed using a heatmap of seaborn library that shows the Correlation in the dataset and explains how one or more variables are related to each other.

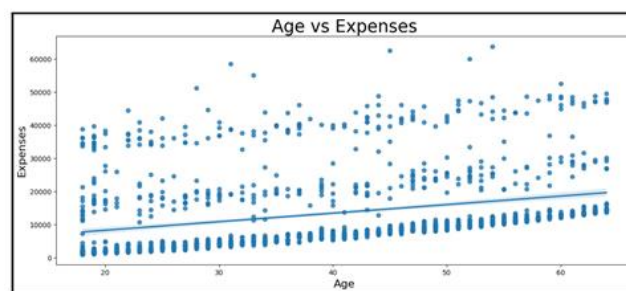


Fig 5. Age v/s Expenses in the dataset

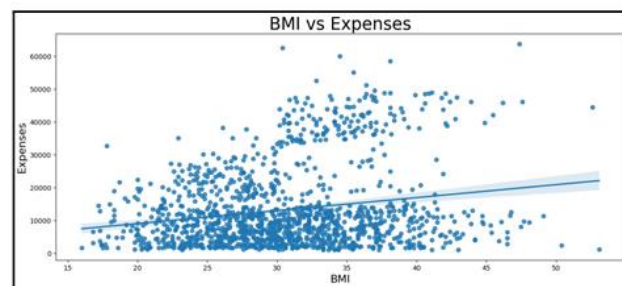


Fig 6. BMI v/s Expenses in the dataset

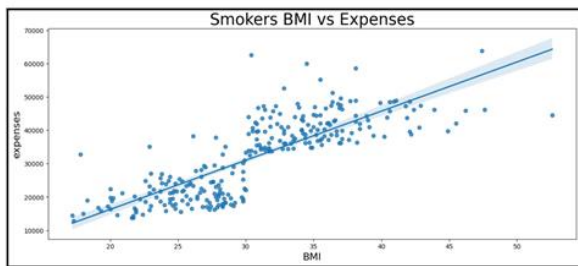


Fig 7. Smoker's BMI v/s Expenses in the dataset

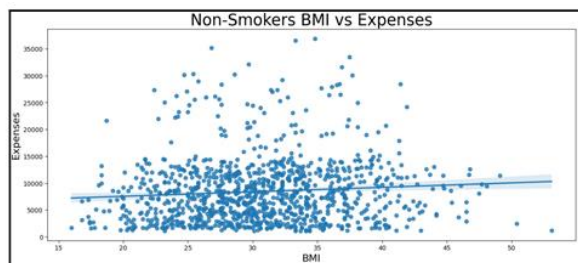


Fig 8. Non-Smokers v/s Expenses in the dataset

Figure 5,6,7, and 8 shows the regression plot method which is used to plot data and draw a linear regression model fit. (with respect to the attributes present in the dataset)

**b. Algorithms Used**

**i. Linear Regression -**

Linear regression analysis is used to estimate the value of one variable relative to the value of another variable. The changes you want to make are different. The variables you use to predict the values of other variables are called independent variables.

Due to low accuracy, we didn't use the Linear Regression Algorithm for our system.

**ii. Random Forest Regression -**

A random forest is a forecasting tool that places multiple decision trees on multiple data samples using the mean to improve accuracy and control performance.

This algorithm has more accuracy and fits best for our ML model.

**c. Performance Measure**

**i. R2 score -**

R2 score is an important metric for evaluating machine learning. It is pronounced as R-square, also known as the coefficient of determination. It works by measuring the variance of the variable described by the dataset. The R2 score for each model :

Linear Regression - -0.7681076791920676

Random Forest Regression - 0.8486587367910166

**ii. RMSE -**

The root of the mean squared error or the root of the mean squared deviation is one of the most commonly used metrics to evaluate forecast quality. It uses the Euclidean distance to show how far the estimate is from the actual measurement.

The RMSE score for each model: Linear Regression - 5831.042042662665

Random Forest Regression - 4710.65899241182

We used Random Forest Regression Model which gives more accuracy for our system compared to Linear Regression.

**FLOWCHART**

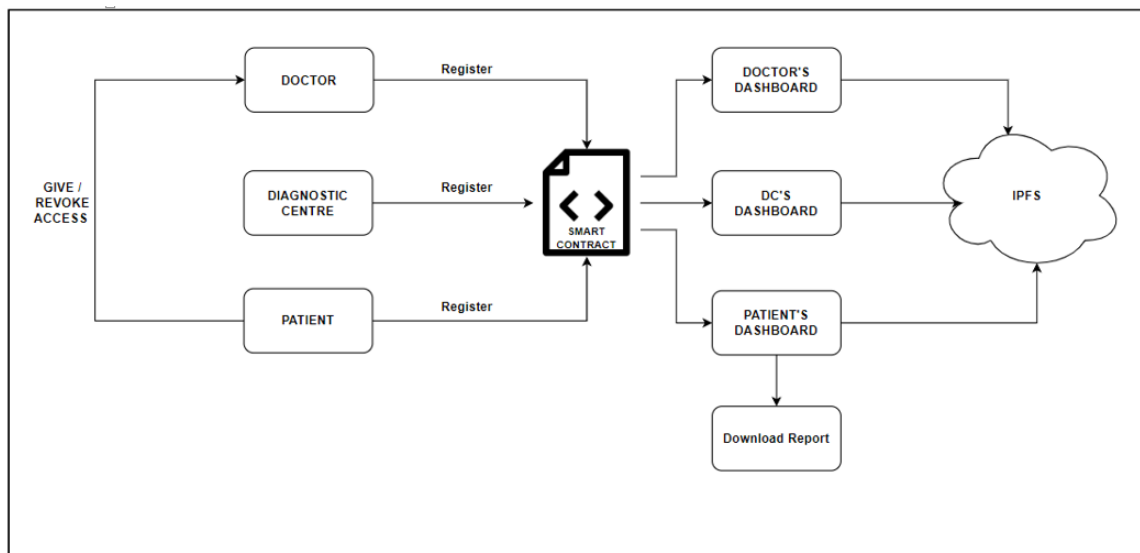


Fig 9. Flowchart of the Proposed System

#### IV. RESULTS AND DISCUSSION

##### UI Images

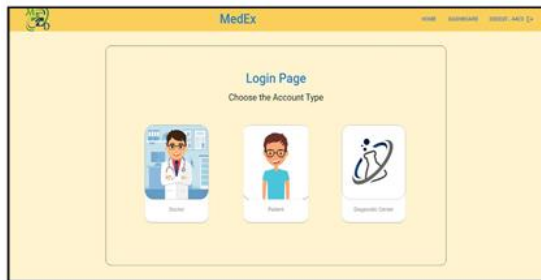


Fig 10. Login Page,

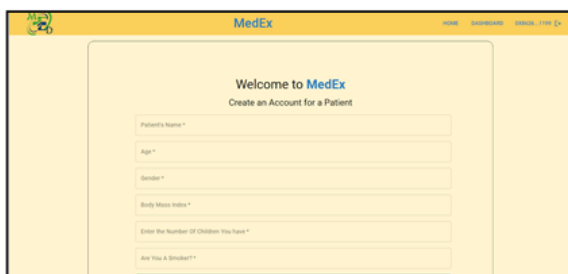


Fig 11. Patient Registration Page

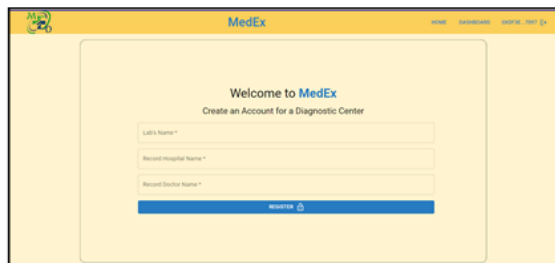


Fig 12. Diagnostic Center Registration Page

The above figure shows three login cards which are Doctor, Patient, and Diagnostic Center. The user will select any one of the profiles which define the user best.

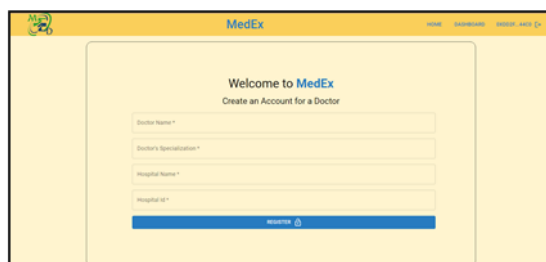


Fig 13. Doctor Registration Page

Figure 11,12,13 shows the registration page for each profile that will be filled by users.

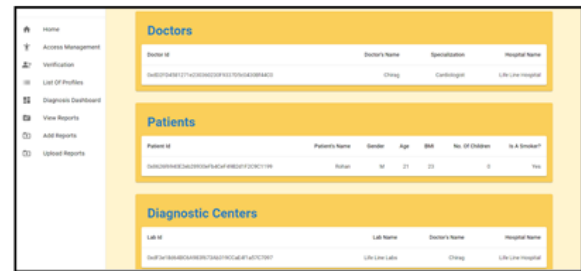


Fig 14. Dashboard

The above figure shows the Dashboard for all three Profiles where all the registered Profiles will be shown with all data provided by the user.



Fig 15. Add Report / Generate Report

The above image shows the Report form which will be filled out by the Diagnostic Center, generated by them, and will be shown on the Patient's Dashboard where he/she can download the report.

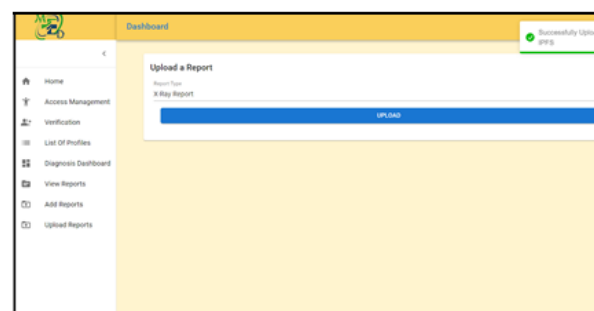


Fig 16. Uploading Reports to IPFS

The above image shows how the Diagnostic Center uploads a report on IPFS.

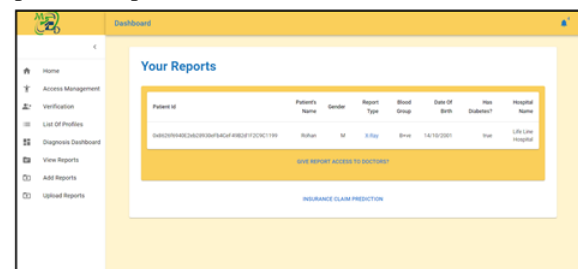


Fig 17. Reports View on the System

This image shows all the Reports that are there in the system.

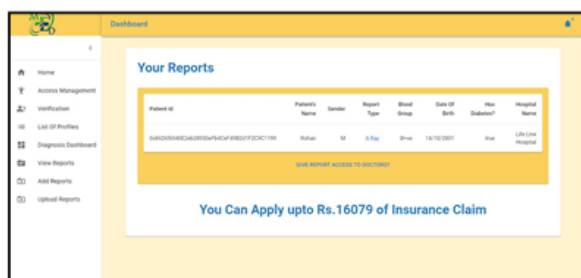


Fig 18. ML model predicted value (Ex - Rs. 16079)

The above image shows how the calculated value by the ML Model will be shown to the user.



Fig 19. Provide Access of Reports by Patients

In this image, we can see how a Patient can provide access to the Doctor which changes the button to Revoke Access.

#### IV. CONCLUSION

The end product will help in the easy management of medical records, which will be helpful for all entities Doctors, Patients, and Diagnostic Centers. Using Blockchain Technology in this, the healthcare system will be more secure compared to the existing centralized systems. And the ML model used in our system will help the insurance companies to take advantage and provide the premiums to the necessary ones.

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