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Blockchain based Medical Record Storage and History Tracking and Machine Learning Based Treatment Comparision

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Abstract
This paper presents the implementation of the storage of the treatment history and the records using the blockchain and a comparative analysis of the treatment using the various machine learning algorithms. As traditional systems which store records face some issues with respect to the security of those records, the system we have implemented using the blockchain by making use of IPFS storage removes threats and gives secure storage platforms where healthcare providers and patients can store records safely and securely. In addition to this, there is somewhere an unhealthy relationship between the doctor and patients, so we have tried to overcome it by using various machine learning algorithms to provide them with insight related to it. The blockchains decentralized storage ensure that no one central authority have the control on the records and hence due to its immutable and the distributed nature it has become more popular and secure.

Keywords: *Healthcare, distributed, decentralized, treatment, machine learning, ipfs, record storage, safety, security.*

1. Introduction
Electronic Health Records (EHR) play a crucial role in modern healthcare by enabling the efficient storage and management of patient data. However, traditional EHR systems face several challenges, including data fragmentation, security vulnerabilities, and limited interoperability [4]. These issues primarily arise due to the centralized storage approach, which makes data susceptible to cyber threats, unauthorized access, and inefficiencies in healthcare decision-making [5]ti. Patients often have limited control over their medical records, leading to concerns regarding privacy, data integrity, and restricted accessibility. Blockchain technology offers a decentralized and secure solution for healthcare data management. By eliminating a single point of failure, blockchain enhances data security and transparency. It operates as a distributed ledger where each transaction is recorded in an immutable manner, ensuring that patient records cannot be altered or deleted without authorization. Smart contracts further automate data access permissions, allowing only authorized users such as doctors, diagnostic centers, and patients themselves to access relevant medical information. This enhances trust and security in medical record management. [7] In addition to blockchain, the use of machine learning in healthcare has proven to be effective in predictive analysis and automated decision-making. The proposed system integrates machine learning to provide accurate disease predictions and drug recommendations based on patient symptoms and medical history. The model is trained on a dataset containing medical conditions, prescribed drugs, side effects, and treatment outcomes to improve diagnosis and prescription accuracy. The machine learning component helps in identifying patterns in patient data, allowing for early detection of diseases and personalized treatment suggestions. [11] The system is implemented using modern technologies such as the ReactJs , Nodejs , css, expressJS stack for web-based access, Web3.js for blockchain interactions, and Ganache for local blockchain deployment. Metamask is used for secure

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authentication, while IPFS provides decentralized storage for medical records, ensuring that patient data remains both accessible and tamper-proof. The machine learning model used in this research achieves high accuracy in disease and drug prediction, demonstrating its effectiveness in assisting healthcare professionals in making informed decisions. [13] This paper presents a detailed evaluation of the proposed system, including its performance analysis, security measures, and real-world applicability. The results validate that integrating blockchain and machine learning in healthcare provides a scalable, secure, and efficient approach to managing medical records and improving patient outcomes. [5]

2. System Overview

2.1.Doctor Registration and the Doctors Role

Adding the treatment The doctor can add the treatment to the patient by making the use of his id for the transaction. 2. Able to see records: The doctor is able to see the records of the patients and able to see the previous history too and based on this he can make the assumptions. [4]

Patient Role

- **Create Profile**: Patients can create their profile through the patient registration page. Here, the patient can add their health information such as weight , height , blood group , previous records etc. [4]
- **Give access to Doctor Using his id Number:** Which doctors can see the patients data is only dependent in the patient as if patient allows doctor to see his data by entering give access to doctor and the doctors id then only that particular doctor can see the data. [9]
- **Check the Treatment Analysis:** Patients can see the correctness of their treatment by using the portal created by us where there is standard set of medicines is taken and mapping is created by which which medicine is beneficial for which is given and once the patient enters the details then he can able to see the analysis. [9]
- Health Condition Detection on the Drugs give: Patient can also use the portal to cross check , in this he can just enter the drug name , brand name and he can also enter classes of that particular drug , current condition and by entering this things , patient can able to see the drug based medical condition prediction. [4]

2.2.Diagnostic Role

Insert the records into the patient account: This model is similar to the doctor model where when a patient tries to do some tests then at that time, the diagnostic centers, with the permission of the patients, add the records to the patient module. [7] Drug based medical condition prediction model This model is created using the random forest algorithm where the data set of the drug side effect is used. In this model, various data are trained and tested, but due to insufficiency of data, this model lacks accuracy, but most of the time this model predicts the correct output. [12] This model is trained on the recurrent neural networks algorithm, and this model is specifically built for the end patient. This model takes drug class, rx / OTC, pregnancy category, CSA, Alcohol interaction, brand names, and side effects as input, and on this basis predicts the medical condition. A way of reverse engineering is used to make the correct outputs [19] (Figure 1,2)

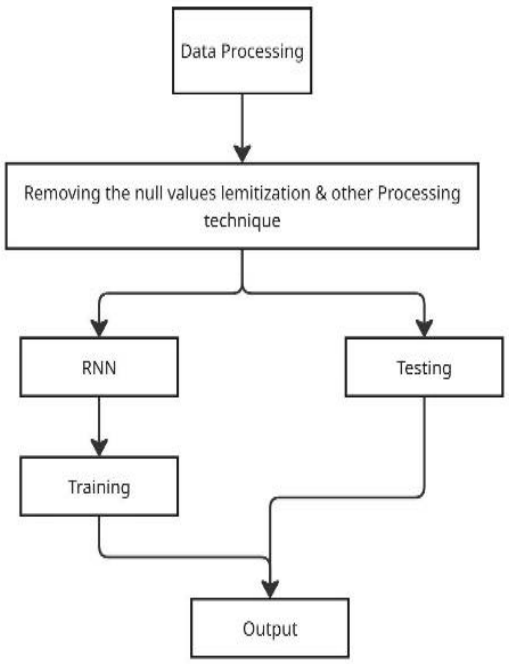

Figure 1 ML-Model Diagram

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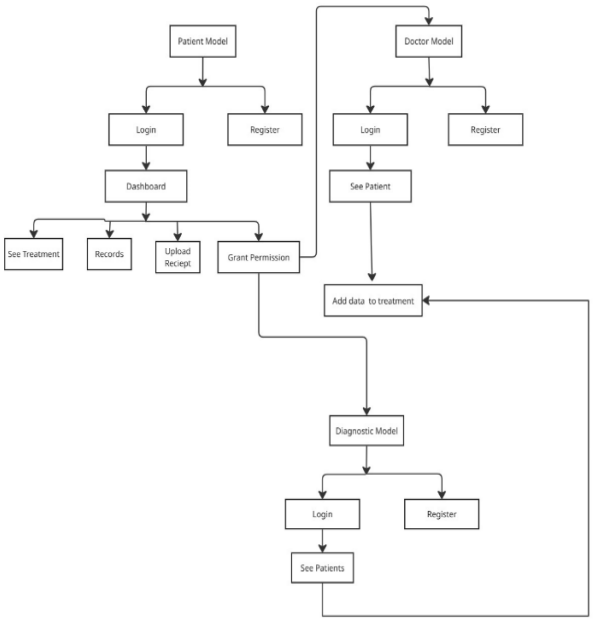

Figure 2 Architecture Diagram

3. Architecture and Methodology

Blockchain The blockchain is implemented is hybrid due to the condition that some of the parties have complete access over their data but some of the parties have the restricted access over their data. [8] For the Blockchain, metamask is used as a wallet and for that blockchains ethereum cryptocurrency is used. [4] Machine Learning For improving the accuracy and overall outcome , we tried to implement the ml algorithms but due to lack of datasets , result was not so strong so we tried the implementation of reverse training of model. [12] In this instead of treating or predicting the treatment , we tried to predict the disease or overall health condition by inserting the drugs , and other related information such as dosage , pregnancy category , ROC and other terms and based on this the user can see the desired health condition for such type of treatments so he can compare his current health condition with the predicted health condition so in this way he can analyze the correctness of the treatment. [13] Data is trained through the multiple layers. Recurrent neural network model is used for this purpose where the model is continuously tries to find out the more hidden patterns through it. [19] Previous systems which were storing the records were not that much secure that they contains the problems such as centralized access and hence we choose Blockchain for this where no single authority have the right to access or delete the data and it can be securely stored. [12] As stated in paper [13] , IPFS is a platform for uploading and storing files and efficiently retrieving them, the problem statement of our project and requirements were matching, so we have taken reference from [19] to store and upload files using this IPFS. Metamask For the transactions purpose , the metamask wallet which supports both the mobile and also the Web browser is used . [19] Ganache This is a platform which provides us the free ethereums for the testing purpose and we have used this platform. mined blocks are visible on this platform. [12] Frontend For the frontend , we have used the ReactJs and css. User can access it through the both , mobile and the laptop and with the media queries , we have made it responsive. [12] Route Management For managing the routes , we have used the nodejs. Smart contracts for writing the smart contracts, we have used the solidity as a programming language. [19]

4. Results and Discussion

The proposed blockchain-based healthcare system integrates machine learning for drug and disease prediction. The performance of the model is analyzed using various metrics, including a confusion matrix, training and validation loss, and accuracy trends.

4.1.Confusion Matrix

Figure 3 represents the confusion matrix of the classification model. It provides insight into the model's prediction performance across different classes. The diagonal elements indicate correctly classified instances, whereas off-diagonal elements represent misclassifications. The model achieves a high accuracy for most classes, demonstrating its effectiveness in disease and drug prescription prediction. [12] (Figure 3)

4.2.Training and Validation Loss

Figure 4 illustrates the loss curves for both training and validation datasets. The loss decreases progressively over epochs, indicating effective learning and convergence of the model. The gap between training and validation loss remains minimal, signifying reduced overfitting and better generalization. [14] (Figure 4)

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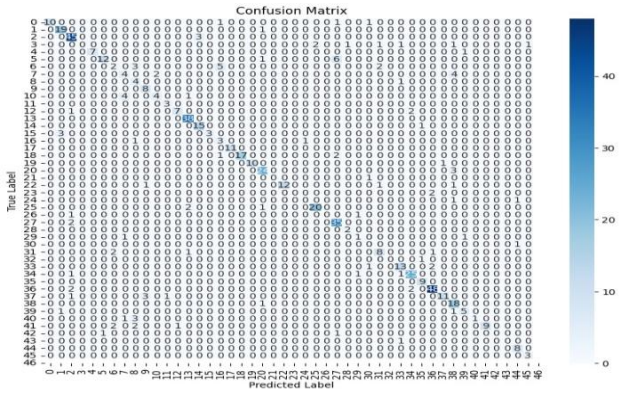

Figure 3 Confusion Matrix of the Classification Model

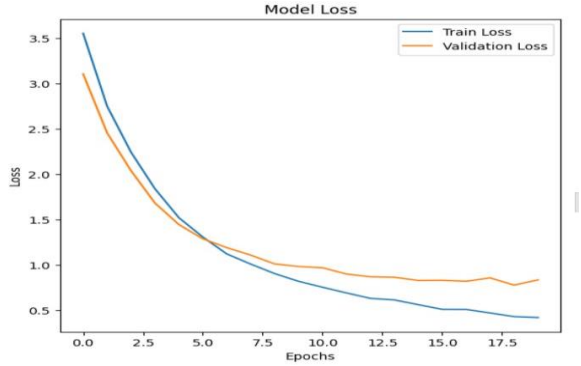

Figure 4 Training and Validation Loss Curve

4.3.Training and Validation Accuracy

The accuracy trends for training and validation datasets are depicted in Figure 5. The steady increase in accuracy suggests that the model effectively captures patterns in the data. The final validation accuracy is close to the training accuracy, confirming the model's robustness in prediction tasks. [19] (Figure 5)

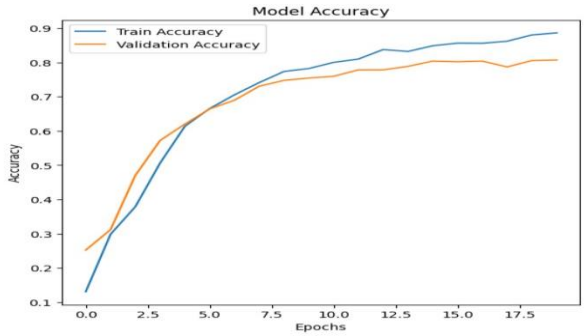

Figure 5 Training and Validation Accuracy Curve

4.4.Discussion

The experimental results demonstrate that the proposed model achieves high classification performance. The confusion matrix indicates minimal mis-classification, and the loss curves suggest a well-trained model with strong generalization capabilities. The accuracy trends further validate the efficiency of the approach, making it a promising solution for healthcare data analysis and drug recommendation. [19] Overall, the integration of blockchain ensures secure and immutable data management, while machine learning enhances predictive accuracy in medical decision-making. [16] (Table 1)

4.5.Accuracy Based on Different Factors

Table 1 Accuracy Results for Different Models

Model	Accuracy (%)
Symptom-Based Drug Prediction	81
Disease Prediction	80
Treatment Prescription Analysis	76

4.6.Blockchain Integration for Secure Healthcare Data Management

The implementation of blockchain technology in our healthcare system ensures secure, decentralized, and immutable storage of medical data. The system effectively manages patient records, doctor access, diagnostic data, and history tracking through a hybrid blockchain model. [17] Key Outcomes:

- **Data Security:** The use of blockchain and IPFS ensures that patient records are tamper-proof and securely stored.
- **Access Control:** Doctors can only access patient records with explicit permission, reducing unauthorized data access.
- **Transparency and Auditability:** Every modification to healthcare records is logged on the blockchain, ensuring full traceability.
- **Efficiency:** Decentralized storage and smart contracts automate processes, reducing administrative overhead.

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Conclusion and Future Scope

This research introduces a blockchain-based healthcare system combined with machine learning to improve the security, accessibility, and accuracy of medical records and treatment recommendations. Traditional healthcare systems often struggle with centralized storage, making them vulnerable to security breaches, data loss, and restricted patient control. The proposed system overcomes these limitations by using blockchain to store medical data in a decentralized and tamperproof manner, ensuring that only authorized users can access patient records through smart contract-based permissions. [18] Machine learning enhances the system by providing predictive analysis for diseases and drug recommendations based on patient symptoms and historical medical data. The results demonstrate that the model achieves high accuracy in classification tasks, improving diagnostic support for healthcare professionals. The combination of blockchain and machine learning ensures that healthcare data remains secure, transparent, and useful for both doctors and patients. [19] The system lays a strong foundation for secure and intelligent healthcare management, but further improvements can be made in the future:

- Increasing the dataset size and diversity to improve the accuracy of predictions and treatment recommendations. [17]
- Expanding the blockchain-based medical record system to enable seamless data sharing between healthcare providers. [18]
- Implementing advanced machine learning models to compare and analyze different treatment outcomes for better decision-making. [18]
- With ongoing advancements in blockchain and artificial intelligence, this system has the potential to revolutionize healthcare data management, offering improved security, efficiency, and personalized patient care.

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