A Decentralized Patient Health Record Storage Using Blockchain And Prediction Of Multiple Disease Using Machine Learning

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Abstract: Through the integration of Blockchain technology and Machine Learning (ML), healthcare is being revolutionized on the basis of improving the data security, interoperability and predictive analytics. The current healthcare systems have the challenge of data breaches, fragmented records, and delays in diseases diagnosis and management. Blockchain provides a decentralized, immutable and semi-transparent platform for sharing information while ML improves the prediction, decision making processes and the workflows in the clinical area. This survey paper aims to demonstrate the relationship between blockchain and ML in the healthcare sector with regard to EHR, disease prediction, secure medical data, and patient care. It also focuses on challenges like scalability, regulatory issues and computational complexity and with that, it presents some potential future directions. The results of the study show that the integration of these technologies may lead to the enhancement of population health management, precision medicine, and medical research and, therefore, better patient care and healthcare delivery.

Index Terms - Blockchain, Machine Learning, Healthcare Data Security, Electronic Health Records (EHR), Disease Prediction, Decentralized Healthcare, Predictive Analytics, Smart Contracts, Data Interoperability, Artificial Intelligence in Healthcare.

I. INTRODUCTION

The application of blockchain technology and machine learning (ML) has recently gained attention as a possible solution to address some of the most challenging issues in the healthcare sector; such as, security of data, interoperability, and predictive analysis. Current healthcare systems have numerous problems, including data breaches, disjointed patient records, and ineffective disease prediction. Thus, the combination of blockchain's distributed ledger technology with the analytical functions of ML can improve the effectiveness of EHRs, the diagnosis of diseases, and other aspects of healthcare decision making.

Blockchain technology guarantees the security and transparency of data sharing through the use of cryptographic techniques, smart contracts and decentralized storage systems. This creates a trust and privacy in the management of medical data and also facilitates real time patient monitoring and cooperative research. However, machine learning algorithms learn from large healthcare data and help in the identification of disease outbreaks, recommending the best treatment, and enhancing patient care management. These technologies are most effective when used in conjunction with each other in processes such as symptom to disease prediction, secure EHR storage and access, and decision making in the clinical process.

Recent shows that the integration of blockchain and ML can potentially change the way population health is managed, drugs are discovered, and healthcare is personalized. However, some issues include; scalability, regulatory issues and the need for a large set of computational resources. This survey paper aims to present an overview of the current developments, the principal applications, and the future of blockchain and ML in healthcare and the effects of their integration in the healthcare sector

II. LITERATURE SURVEY

Machine Learning Techniques for Healthcare Applications [1]
Mohammed et al. (2021) discuss the potential of combining machine learning with blockchain technology to improve data security and privacy in healthcare applications. They highlight the importance of leveraging ML techniques for predictive analytics and decision-making while ensuring data integrity through blockchain (Mohammed et al., 2021).

Blockchain and Machine Learning in EHR Security: A Systematic Review [2]
Umer Zukaib (2023) provides a comprehensive review of existing research on the integration of blockchain and ML in healthcare. They identify key applications such as patient data management, medical supply chain tracking, and disease prediction. The study also outlines technical challenges and future research directions, emphasizing the need for scalable and secure solutions (Umer Zukaib (2023)).

Med Access: A Scalable Architecture for Blockchain-based Health Record Management [3]
Mishbaudgin et al. (2020) propose a decentralized medical structure using blockchain for health record management. Their work underscores the benefits of decentralization in enhancing data accessibility and security, which is crucial for efficient healthcare delivery (Mishbaudgin et al., 2020).

Blockchain-Based Deep Learning as a Service (BinDaaS) [4]
Bhattacharya et al. (2020) address the challenges of confidentiality, security, and data integrity in Electronic Health Records (EHRs). They propose a framework that combines blockchain technology with deep learning algorithms to ensure secure data transfer and accurate predictions, highlighting the synergy between these technologies (Bhattacharya et al., 2020).

Blockchain and Machine Learning Integration for Healthcare: Opportunities and Challenges [5]
KMet al. (2019) explore the potential benefits of integrating blockchain and ML in healthcare, focusing on improving data security, interoperability, and patient privacy. They also address challenges related to data heterogeneity and scalability, suggesting that future research should focus on overcoming these barriers (KMet al., 2019).

Blockchain Technology in Healthcare: A Comprehensive Review [6]
Seyednima Khezr. "Blockchain Technology in Healthcare: A Comprehensive Review," discuss the potential of blockchain technology to address various challenges in healthcare, including medical records management, clinical trials, and supply chain management. They highlight opportunities for integrating blockchain with ML techniques to enhance data analytics and decision-making processes (Seyednima Khezr., 2019).

Blockchain-Based Healthcare Data Management: A Review [7]
Agbo et al. (2019) review the role of blockchain technology in healthcare data management. They discuss potential applications in EHRs, medical imaging, and telemedicine, emphasizing the need for integration with ML algorithms to improve data processing and security (Agbo et al., 2019).

A Secure and Scalable Data Source for Emergency Medical Care using Blockchain Technology [8]
Hasavari and Song (2019) address the poor management and causes of failure in emergency medical care. They propose using blockchain technology to reduce pre-hospital deaths by ensuring access to accurate medical histories, thereby improving emergency response efficiency (Hasavari and Song, 2019).

Med-Block: Blockchain-based Multi-role Healthcare Data Sharing System [9]
Yu et al. (2019) introduce a data management system for multiple users by combining blockchain and the InterPlanetary File System (IPFS). Their system aims to facilitate secure and efficient data sharing among various stakeholders in the healthcare ecosystem (Yu et al., 2019).

Machine Learning in Healthcare: A Review [10]
K. Shailaja (2018) review the applications of machine learning in healthcare and discuss the potential impact of integrating ML with blockchain technology. They emphasize the importance of this integration in enhancing data security and interoperability, which are critical for the advancement of healthcare systems (K. Shailaja 2018)

III. PROBLEM FORMULATION

The current healthcare systems are facing crucial issues in data security, interoperability, and predictive analytics. Current EHRs are prone to data breaches, unauthorized access, and sharing of data. Also, disease prediction models are constrained by incomplete data, data integration, and computational capacity.

Blockchain technology provides a secure and decentralized data storage but the issues of scalability and legal framework are limiting factors. On the other hand, ML improves the predictive healthcare analytics but it needs good and accurate data sources to function effectively. The challenge is how to combine the two so that data privacy, accuracy and efficiency are maintained in healthcare decision making, disease prediction and medical record management.

This paper is aimed at solving the following key problems:

- How can blockchain enhance security and interoperability in healthcare data?
- How can ML improve disease prediction while ensuring data privacy?
- How can blockchain-ML integration be optimized for scalable and efficient healthcare solutions?

IV. SOLUTION DOMAIN

In tackling the issues of safeguarding healthcare data integrity connectivity, among systems and forecasting analytics combining technology with machine learning (ML) provides a remedy. The suggested approach concentrates on three aspects:

1. Secure and Decentralized Healthcare Data Management
   - The EHR systems based on blockchain should be introduced to make the patient records unchangeable, clear and protected.
   - Apply smart contracts for the control of access and consent of the patient for the improvement of privacy of data.
2. Enhanced Disease Prediction and Decision-Making with ML
   - Use ML algorithms (Random Forest, Deep Learning, KNN) to analyze symptom-based data and predict diseases accurately.
   - Integrate privacy-preserving AI techniques such as federated learning to process data without spreading sensitive information.
3. Optimized Blockchain-ML Integration for Scalable Healthcare Solutions
   - Utilize the combination of blockchain and cloud technology to address challenges related to scalability and delay in order to guarantee storage and access of information.
   - Let's create AI blockchain systems that strike a balance, between computing and secure adherence, to regulations.

By merging the security of blockchain with the capabilities of machine learning (ML) this field seeks to boost effectiveness, in healthcare operations by cutting down on fraudulent activities and empowering instant data driven decision making processes.

V. CONCLUSION

This paper aims to explore how the integration of blockchain technology and machine learning (ML) can address the issues of data security, interoperability, and predictive analytics in the healthcare sector. Blockchain enhances the security, decentralization, and immutability of electronic health records (EHRs), thus improving the privacy and trust in managing medical data. On the other hand, ML uses large healthcare datasets to make accurate predictions of diseases, recommend diagnoses, and suggest treatment plans.

Combining the transparency of blockchain with the predictive analytics of ML enhances the management of EHRs, detection of diseases, and delivery of patient care while also addressing problems such as data breaches, access control, and regulatory compliance. However, there are still some issues to solve, including those related to scalability, cost, and interoperability of the solution.

Further research and innovation are therefore necessary in the following areas: Light-weight blockchain architectures, Privacy-preserving AI models, and Interoperability frameworks. The integration of blockchain and ML is likely to redefine the future of healthcare by enhancing security, efficiency, and data-driven decision making.

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