Revolutionizing Healthcare With Blockchain And Gpt: Secure Data Storage And Ai-Powered Assistance

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Abstract- *Blockchain technology is transforming the healthcare industry by providing a secure, transparent, and efficient framework for the management of sensitive patient data. In light of the sector's susceptibility to data breaches and cyber threats, blockchain guarantees data integrity, lowers transaction costs, improves regulatory compliance, and promotes universal access to medical records. This study presents a sophisticated method that combines Ethereum blockchain with a GPT-based AI chatbot to enhance security, efficiency, and patient engagement in healthcare management. Although Ethereum's elevated costs pose scalability issues, the AI-driven chatbot optimizes system performance by offering personalized, context-aware healthcare assistance, which includes preliminary diagnoses, medication suggestions, and symptom-based medical advice. This seamless integration not only bolsters data security but also improves patient autonomy, simplifies healthcare processes, and encourages a technologically advanced, patient-centered healthcare ecosystem.*

Keywords- Blockchain, Ethereum, AI in Healthcare, GPT Chatbot

I. INTRODUCTION

The swift progress in technology has transformed numerous sectors, including finance, supply chain management, and healthcare. Among these advancements, blockchain technology has emerged as a formidable tool for improving security, transparency, and efficiency in data management. In the healthcare sector, where sensitive patient information is susceptible to breaches and unauthorized access, blockchain provides a decentralized and immutable framework to protect medical records. Unlike conventional centralized systems, which are prone to cyber threats and data manipulation, blockchain guarantees data integrity through the use of cryptographic methods and a distributed ledger system [1].

Blockchain functions by storing data in blocks, each of which contains a distinct cryptographic hash, a timestamp, and a reference to the preceding block, thereby creating an unalterable chain of records. This decentralized ledger technology (DLT) prevents tampering and unauthorized alterations, rendering it particularly suitable for securing electronic health records (EHRs), managing pharmaceutical supply chains, and facilitating secure data sharing among healthcare providers, researchers, and patients [2]. Additionally, smart contracts permit the automated and transparent execution of agreements, ensuring seamless processes such as patient consent management and access control[3].

Nevertheless, despite its benefits, the implementation of blockchain, especially utilizing the Ethereum blockchain, incurs high computational costs, which present challenges for large-scale healthcare applications. To mitigate these constraints, this research incorporates Generative Pre-Trained Transformer (GPT) technology as an AI-driven chatbot alongside the Ethereum blockchain. The GPT chatbot acts as an intelligent assistant, delivering medication recommendations, preliminary diagnoses, and personalized healthcare guidance based on patient symptoms and medical history [4]. This amalgamation of blockchain and AI not only secures healthcare data but also enhances patient engagement and accessibility to medical insights.

The proposed system capitalizes on blockchain's decentralization, immutability, and cryptographic security to revolutionize healthcare data management. By integrating AI-driven solutions, this approach presents an efficient, secure, and intelligent healthcare ecosystem, benefiting patients, healthcare providers, and researchers [5]. This study aspires to illustrate how blockchain, in conjunction with AI chatbots, can improve healthcare services by ensuring data integrity, accessibility, and smart healthcare assistance while tackling the challenges faced by traditional healthcare data management systems.

1.1 Literature Review

Zohar, E. , et al. (2025) in their paper "Blockchain for Health Data Protection and Integrity," discuss the utilization of blockchain technology for improving the protection and integrity of health data. The authors underscore the importance of employing blockchain in healthcare to protect patient

information from unauthorized access and alteration. The decentralized nature of blockchain guarantees that health data is securely stored, thwarting unauthorized modifications and granting patients increased control over their medical records. They additionally examine how the immutable ledger characteristic of blockchain can be employed to verify and audit medical data, ensuring that patient histories remain unaltered and reliable. Zohar et al. emphasize the potential for blockchain to foster a more transparent, secure, and efficient healthcare data ecosystem while addressing the shortcomings of traditional centralized databases [1].

Jha, R. , and Khosla, A. (2024) present a comprehensive review in their work "Blockchain-Based Healthcare Data Management Systems: A Review," wherein they evaluate the increasing adoption of blockchain technology in the management of healthcare data. Their study investigates the challenges associated with the secure storage, sharing, and access of medical data across various stakeholders. The authors explore how blockchain can resolve issues such as data fragmentation, interoperability, and the lack of transparency within current healthcare systems. By utilizing blockchain's distributed ledger and cryptographic features, healthcare organizations can ensure secure data sharing while maintaining a high standard of data integrity. Jha and Khosla discuss how smart contracts in blockchain systems can automate processes such as patient consent management, thereby streamlining workflows and enhancing the efficiency of healthcare services. Notwithstanding these advantages, they recognize that scalability and regulatory concerns continue to pose significant challenges for the adoption of blockchain in healthcare systems [2].

Sundararajan, V. , and Gupta, S. (2024) in their study "Smart Contracts in Healthcare: A Pathway to Seamless Data Transactions" investigate the potential of smart contracts within healthcare environments. They propose that smart contracts, which are self-executing agreements with the terms of the contract directly embedded in code, could transform the manner in which healthcare transactions are performed. Smart contracts can automatically enforce agreements between parties, diminishing the necessity for intermediaries and ensuring that data is shared and accessed according to pre-defined regulations. The authors highlight various applications in healthcare, such as managing patient consent, automating insurance claims, and ensuring adherence to regulations. By integrating blockchain and smart contracts, the authors contend that healthcare organizations can attain enhanced efficiency, transparency, and security, ultimately resulting in improved patient care and diminished administrative costs [3].
Chowdhury, A. , et al. (2024) investigate the incorporation of AI-driven chatbots in healthcare in their work "AI-Driven Chatbots for Healthcare: Personalized Assistance and Decision Support. " The paper examines how AI-based chatbots, particularly those powered by sophisticated Generative Pre-Trained Transformers (GPT), can furnish personalized healthcare assistance and decision support to both patients and healthcare providers. The authors underscore the capability of AI chatbots to deliver real-time medical advice, facilitate medication recommendations, and support interventions in mental health. They contend that these systems can reduce the workload on healthcare professionals by providing automated, accessible, and scalable solutions for patients. Through integration with existing blockchain infrastructure, these AI chatbots can further guarantee that patient interactions and recommendations are securely stored and linked to the patient's blockchain-based health record, thereby enhancing data privacy, security, and trust [4].

Alvarez, J. , et al. (2025) in their paper "Revolutionizing Healthcare with Blockchain and AI: Challenges and Opportunities" investigate the convergence of blockchain and AI technologies within the healthcare sector. They discuss how the amalgamated application of these two technologies can substantially transform healthcare by enhancing patient outcomes, streamlining administrative procedures, and facilitating personalized treatments. The authors note that while blockchain can offer data security and privacy, AI can provide intelligent insights and decision-making support, which is particularly beneficial in clinical environments. They identify several challenges, including implementation costs, integration complexities, and the necessity for specialized training for healthcare personnel. Despite these obstacles, Alvarez et al. propose that the collaboration between blockchain and AI can yield a more efficient, transparent, and patient-centered healthcare system, providing both immediate and long-term advantages [5].

1.2 Problem Statement

The healthcare sector encounters difficulties in securely managing and sharing patient data due to centralized systems that are susceptible to breaches and manipulation. Although blockchain technology provides improved security and data integrity, its adoption is hindered by challenges related to scalability, cost, and integration with current systems. Furthermore, the management of patient engagement and decision support continues to be inefficient.

This research proposes the integration of Generative Pre-Trained Transformers (GPT) as AI-driven chatbots within the Ethereum blockchain framework. The GPT chatbot will offer personalized healthcare advice, medication recommendations, and preliminary diagnoses while

safeguarding data security and patient privacy. Nevertheless, challenges such as the elevated cost of Ethereum transactions and the need for regulatory compliance must be addressed to facilitate successful implementation.

1. 3 Use of Blockchain and AI Chatbot in Healthcare

Blockchain technology has demonstrated significant potential in the healthcare sector by providing improved data security, transparency, and integrity. The primary characteristic of blockchain in this regard is its application of hash algorithms to authenticate and protect transactions. Each transaction is connected to its predecessor, forming a chain that is virtually impossible to modify. This renders blockchain an immutable, append-only ledger, where once data is incorporated, it cannot be altered or reversed. Moreover, all transactions are time-stamped, guaranteeing accountability and transparency.

In the realm of healthcare, these attributes are especially advantageous for maintaining the integrity and security of patient health records. The decentralized nature of blockchain ensures that even if one node within the network is compromised, the overall ledger remains unaffected, providing substantial levels of data protection. Additionally, blockchain employs public-private key encryption, which safeguards patient identities while permitting secure data sharing among various healthcare stakeholders. Furthermore, blockchain facilitates smart contracts, empowering patients to exert control over how their health data is accessed and disseminated, thereby ensuring privacy and consent management.

When integrated with AI-driven chatbots such as Generative Pre-Trained Transformers (GPT), this framework can further elevate healthcare by delivering real-time, personalized support. AI chatbots can furnish patients with medication suggestions, preliminary diagnoses, and healthcare guidance based on their symptoms and medical history. By combining these chatbots with blockchain technology, healthcare systems can offer both secure and intelligent healthcare solutions that enhance patient engagement, optimize medical workflows, and uphold data privacy and security.

1.4 Motivation

1) **Patient Control Over Data:** The blockchain provides patients with control regarding the utilization and sharing of their medical information, enabling them to regulate access to their records through smart contracts.
2) **Authorization Verification:** The blockchain guarantees that any entity attempting to access a patient's medical data can validate that they possess the necessary authorization, employing cryptographic techniques and public-private key encryption.
3) **Guaranteed Data Security:** Once medical records are recorded on the blockchain, they are secured, immutable, and resistant to tampering, thereby ensuring the integrity of patient data.
4) **AI-Powered Assistance via GPT:** The integration of a GPT-based AI chatbot improves healthcare delivery by offering personalized advice, medication suggestions, and initial diagnoses, all while maintaining data security and privacy on the blockchain.

1.5 Objective

1) **Data Security and Integrity:** Blockchain guarantees secure, immutable storage of medical records, thereby enhancing the accuracy and integrity of patient data.
2) **Patient Control:** Blockchain empowers patients with control over their medical records, enabling them to manage access and uphold privacy.
3) **Healthcare Data Interoperability:** Blockchain facilitates seamless access to patient data across various healthcare providers, thereby improving data sharing and collaboration.
4) **Personalized Healthcare Assistance:** A GPT-based chatbot delivers personalized advice, medication recommendations, and preliminary diagnoses, thereby enhancing patient care.
5) **Efficiency Optimization:** Blockchain and GPT optimize healthcare management, minimize administrative costs, and enhance overall system efficiency.
6) **Cost Reduction:** The system diminishes healthcare data management expenses by eliminating intermediaries and automating interactions, all while preserving data security.

1.6 Issues and Challenges

Integrating blockchain technology within the healthcare sector encounters challenges such as elevated transaction costs, data privacy apprehensions, interoperability obstacles, and the necessity for data standardization. AI-driven chatbots evoke concerns regarding trust and accuracy, whereas the energy consumption associated with blockchain and issues of legal liability further complicate its adoption. Moreover, the expenses and intricacies of implementation render it difficult for smaller providers to adopt these technologies on a large scale.

1.7 Security and Privacy Analysis

In this architecture, we assess the security and privacy features of the proposed blockchain-based healthcare system by emphasizing the CIA triad (Confidentiality, Integrity, and Availability), thereby confirming that the system can endure diverse attacks and safeguard patient data proficiently.

Confidentiality: Encryption guarantees that only authorized individuals are able to access patient information.Communication among modules is secured to safeguard user data from unauthorized access.

Integrity: Blockchain assures the immutability of healthcare information, thereby preventing tampering.Accurate predictions of patient flow are derived from unmodified historical medical data.

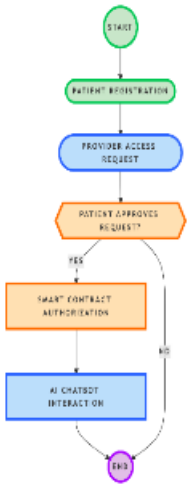
Availability: Decentralized blockchain ensures that data continues to be accessible, even in the event of partial network failures.Constant access to essential healthcare information is preserved at all times.

1.8 Proposed System

This proposed system integrates the security advantages inherent in blockchain technology with the sophisticated functionalities of an AI-driven chatbot to establish a robust, secure, and efficient healthcare management platform. The system guarantees that patient data remains secure, transparent, and readily accessible, while also offering intelligent, personalized healthcare assistance.

1) **Patient Registration:** The patient establishes their account on the blockchain and receives a unique address for secure data storage.
2) **Provider Access Request:** A healthcare provider submits a data access request, which the patient must approve. Once authorized, the data is shared utilizing smart contracts.
3) **AI-Driven Chatbot Interaction:** The GPT chatbot provides personalized recommendations, preliminary diagnoses, and responses to health-related inquiries based on the patient's stored data.
4) **Transaction Tracking:** Patients can examine the history of who accessed their data and when, ensuring complete transparency and control.
5) **Data Privacy and Security:** The blockchain guarantees that patient data is securely stored and cannot be altered, while the AI chatbot aids in delivering intelligent healthcare services.

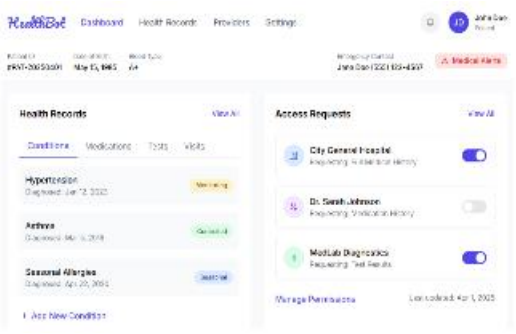
1.9 Proposed Methodology Architecture



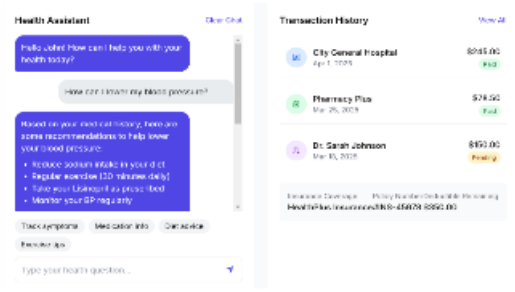
II. IMPLEMENTATION

1. **Blockchain Infrastructure for Data Storage and Security**

- **Blockchain Platform Selection**: Choose a suitable blockchain platform like Ethereum or Hyperledger for creating decentralized and secure patient data storage.
- **Smart Contracts**: Implement smart contracts to automate the process of granting and revoking access to patient data based on patient consent.
- **Patient Registration**: Each patient creates an account on the blockchain, with a unique identifier (wallet address) generated. The patient's medical data is then encrypted and securely stored on the blockchain using techniques like encryption and hashing.
- **Data Access Control**: When healthcare providers request access to patient data, a request is sent to the patient, and the smart contract verifies and grants access only with the patient's explicit consent.

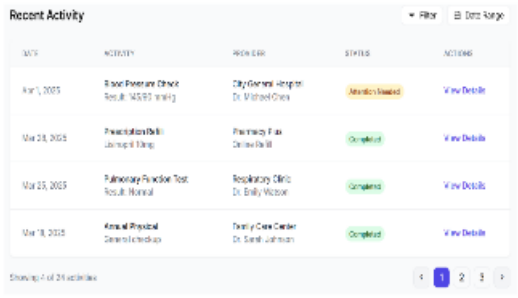


2. **AI-Driven Chatbot for Personalized Healthcare Assistance**
   - **AI Model Selection**: Leverage an advanced AI model like GPT-4 to design the chatbot. The AI chatbot should be able to process the patient's medical history (from the blockchain) and provide tailored responses, preliminary diagnoses, and recommendations.
   - **Integration with Blockchain**: Use the blockchain data to allow the chatbot to retrieve patient information (e.g., medical records, history) securely via an authorized smart contract.
   - **Personalization**: The AI chatbot should be able to offer responses based on patient-specific data. For example, the AI chatbot could recommend medications, remind the patient about appointments, or suggest lifestyle changes based on data analysis.



3. **Transaction Tracking for Data Transparency**

   - **Blockchain Transactions**: Record every interaction involving patient data on the blockchain, including data requests by healthcare providers. These transactions are logged in a way that allows patients to track who accessed their data, when, and for what purpose.
   - **Interface for Transparency**: Provide an easy-to-use interface where patients can monitor and view their transaction history. This adds an extra layer of transparency and accountability to the system.



4. **Data Privacy and Security**
   - **Encryption and Tokenization**: Use cryptographic methods like AES-256 encryption for patient data storage. Tokenization could be used to anonymize sensitive information, ensuring privacy while still allowing necessary data to be accessible to healthcare professionals.
   - **Access Control**: Smart contracts will manage and validate access to the patient's data. The contract ensures that only the appropriate healthcare provider can access relevant data after patient consent.
   - **Decentralized Storage**: Using IPFS (InterPlanetary File System) or other decentralized file systems for storing large medical records off-chain, ensuring that the actual content is not stored directly on the blockchain, which would be inefficient.

5. **System Integration and Workflow**
   1. Patientregisters on the platform and securely stores their data on the blockchain.
   2. Healthcare provider requests access to patient data.
   3. The patient receives the request and approves/rejects access via the system interface.
   4. If access is granted, a smart contract executes the data sharing securely.
   5. The AI chatbot provides responses based on the data from the blockchain (preliminary diagnosis, recommendations, etc.).
   6. Data access transactions are recorded on the blockchain for transparency.

I. EXPERIMENTAL RESULTS

Features	[4]	[5]	[3]	Proposed System
Availability	Yes	Yes	Yes	Yes
Decentralized	No	Yes	Yes	Yes
Data Privacy	Yes	Yes	Yes	Yes
Patient-Centric	Partially	No	Yes	Yes
Immutability	Partially	Yes	Yes	Yes
Integrity	Yes	Yes	Yes	Yes
Trustful	Partially	Yes	No	Yes
Smart Contracts	No	Yes	Yes	Yes
AI Integration	Yes	Partially	No	Yes
Storage Flexibility	No	No	No	Yes

1. Availability:

The system guarantees round-the-clock accessibility, facilitating uninterrupted healthcare services. Patients and healthcare providers are able to securely access medical records and AI-driven healthcare assistance at any time.

2. Decentralized:

In contrast to conventional centralized healthcare systems, blockchain disperses data across numerous nodes, eliminating single points of failure and providing secure, tamper-proof storage.

3. Data Privacy:

The security attributes of blockchain, in conjunction with smart contracts, protect patient data. Access management guarantees that only authorized individuals—such as patients and approved medical practitioners—can view or alter records, thereby preventing unauthorized entry.

4. Patient-Centric:

Patients retain complete control over their medical records, overseeing approvals for data sharing. The proposed system empowers them to determine which healthcare providers may access their information, thereby promoting autonomy and privacy.

5. Immutability:

Once medical data is uploaded to the blockchain, it is immutable and cannot be modified or altered. This ensures accuracy, prevents fraud, and upholds the integrity of patient records.

6. Integrity:

Blockchain guarantees the secure and tamper-proof exchange of medical data among authorized users. Given that records cannot be modified, healthcare professionals can rely on the accuracy and trustworthiness of patient information.

7. Trustful:

The system is predicated on trust, as only the patient has the power to confer or withdraw access. This eliminates third-party intervention and ensures that data remains secure and under the control of the patient.

8. Smart Contracts:

The system employs smart contracts to automate and enforce access control policies. These contracts ensure that patient consent is necessary prior to healthcare providers accessing or updating medical records, thereby enhancing transparency and security.

9. AI Integration:

A GPT-based AI chatbot has been integrated to assist patients by offering medication recommendations, preliminary diagnoses, and symptom-based medical advice. This integration enhances both healthcare accessibility and efficiency.

10. Storage Flexibility:

The system efficiently governs blockchain storage without reliance on external file storage solutions. Medical records are securely stored and accessed directly through the blockchain framework, thereby ensuring high levels of security and efficiency.

IV. DISCUSSION

Blockchain technology possesses the capability to transform healthcare by delivering the utmost level of data security and privacy. In this framework, the Ethereum blockchain guarantees that patient data is stored securely and that patients maintain complete control over their medical records. This methodology empowers patients to either grant or deny access to their healthcare information, encompassing medical histories and updates. By centering the process around patients, the system improves the security, confidentiality, and transparency of their data.

With blockchain, patients are relieved from the concern of carrying physical records or the threat of their data being altered or deleted. Once recorded on the blockchain, patient data becomes immutable, signifying it cannot be changed or erased without the patient's consent. However, a challenge associated with blockchain is the storage and processing of substantial volumes of data. As more data is added to the blockchain, its size increases, which can impose strain on the system's resources. Furthermore, as additional data is transferred and processed, the costs of maintaining the blockchain escalate. Although these issues are present, the decentralized nature of blockchain ensures that data remains secure across numerous nodes, even in the event of a failure of a single node.

To further enhance patient care and security, this system incorporates a Generative Pre-Trained Transformer (GPT)-based AI chatbot. The GPT-powered assistant offers valuable healthcare support by providing medication recommendations, preliminary diagnoses, and personalized healthcare advice based on the patient's symptoms and medical history. This integration not only elevates patient engagement but also delivers a more intelligent and responsive healthcare experience, guiding patients through common healthcare challenges in a secure and reliable manner.

The Ethereum blockchain, notwithstanding its scalability challenges and elevated transaction costs, continues to be a viable solution for secure patient data storage and management. The fusion of blockchain's immutable record-keeping and the GPT chatbot's capacity to offer personalized, context-conscious care can significantly enhance healthcare systems. As blockchain technology advances, it is anticipated that the expenses related to maintaining Ethereum-based systems will diminish, rendering large-scale implementation increasingly feasible.

In conclusion, this patient-centered model promotes transparency, efficiency, and security, while enabling patients to determine who accesses their data. The integration of AI-driven solutions such as GPT augments the overall experience by delivering proactive healthcare assistance, ensuring that patients receive personalized and immediate support. This system lays the groundwork for a more efficient, transparent, and secure healthcare ecosystem, establishing a foundation for the future of healthcare management.

V. ACKNOWLEDGMENT

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