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Mediwallet Using Ethereum Blockchain

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ABSTRACT: This paper presents a decentralized approach to managing Mediwallet using Ethereum blockchain technology. Traditional systems suffer from issues such as centralized control, limited interoperability, and potential privacy risks. To address these limitations, this project introduces a blockchain-based system that leverages smart contracts, MetaMask authentication, and IPFS for decentralized data storage. In Phase 1, the system focuses on secure registration and role-based login for doctors and patients using Ethereum wallet authentication. The platform ensures tamper-proof identity management, transparency, and a strong foundation for privacy-preserving healthcare data sharing. The integration of Truffle, Ganache, and MetaMask enables seamless development and interaction with the Ethereum blockchain.

KEYWORDS: Ethereum, EHR, Blockchain, MetaMask, Smart Contract, IPFS, Truffle

I. INTRODUCTION

Modern healthcare increasingly depends on patient medical data for clinical and administrative purposes. However, existing centralized systems lack interoperability and expose sensitive patient information to risks. Blockchain provides a decentralized solution with immutable, transparent, and secure data management.

This project utilizes Ethereum blockchain to implement a decentralized identity and access control system for medical records. It covers decentralized login and registration using smart contracts and Ethereum wallets, laying the groundwork for future data sharing and diagnostic modules.

II. LITERATURE SYRVEY

Blockchain Technology in Healthcare
Various studies have explored the application of blockchain technology in healthcare, particularly in Electronic Health Record (EHR) management. According to Azaria et al. (2016), blockchain offers a decentralized architecture that enhances data integrity, privacy, and security, overcoming the limitations of traditional centralized EHR systems.

Cloud-based vs. Blockchain-based EHR Systems
While cloud computing provides scalability and accessibility, it suffers from centralization and security vulnerabilities. Roehrs et al. (2017) highlighted that blockchain, with its distributed ledger approach, eliminates the need for a central authority and reduces the risk of data tampering, making it a preferable alternative for sensitive health data.

Smart Contracts for Healthcare Automation
Ethereum's smart contract functionality enables the automation of healthcare processes, such as data sharing and access control. Researchers like Zhang et al. (2018) emphasize that smart contracts enhance efficiency by executing predefined rules automatically, reducing administrative overhead and ensuring compliance.

Data Privacy and Interoperability
Patient privacy is a key concern in digital healthcare. Yue et al. (2016) demonstrated that Ethereum blockchain ensures secure access to records through cryptographic mechanisms while facilitating interoperability across different healthcare systems without compromising confidentiality.

Adoption Challenges and Future Trends
Despite its potential, blockchain adoption in healthcare faces challenges such as scalability, interoperability, and

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regulatory compliance. However, continuous research and evolving standards (e.g., HL7, FHIR integration) are paving the way for practical implementations in decentralized EHR systems.

EXISTING SYSTEM

Traditional platforms are centralized, lack standardization, and are prone to data breaches. Patients often do not have control over their own medical records, and records are fragmented across providers.

PROPOSED SYSTEM

This system decentralizes patient and doctor identity management using Ethereum smart contracts. MetaMask-based login removes reliance on passwords. Each role is assigned via wallet address mapping. Smart contracts enforce role verification, while the frontend (React.js) communicates securely using Ethers.js. All interactions are verified on-chain, providing tamper-proof registration.

III. SYSTEM ARCHITECTURE

The architecture consists of:
- Frontend (React.js)
- Smart contracts (Solidity)
- Ethereum development tools (Truffle, Ganache)
- Wallet integration (MetaMask)
- Decentralized storage (IPFS for Phase 2 onward)

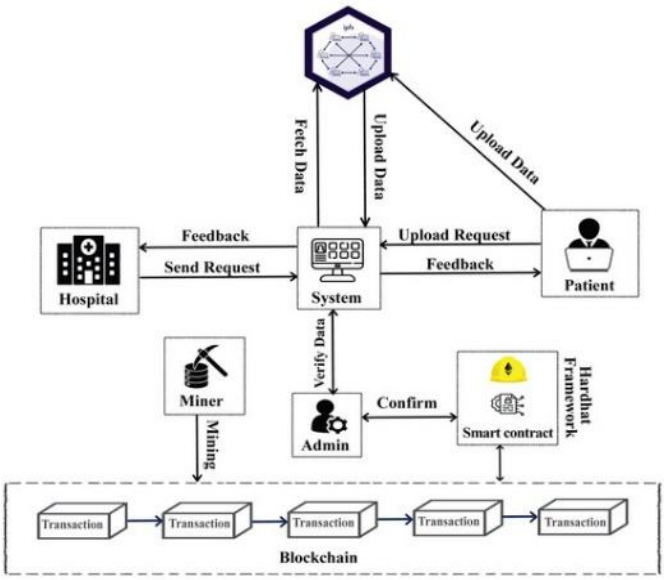

Fig 3.1 System Architecture

IV. METHODOLOGY

Wallet Authentication (MetaMask Integration):

The proposed system leverages MetaMask, a popular Ethereum wallet, to authenticate users through their unique wallet addresses. This method eliminates the need for traditional password-based authentication, enhancing security and user privacy. Users can log in securely without revealing sensitive credentials, and authentication is cryptographically tied to their Ethereum identity.

Role Assignment via Smart Contracts:

Upon first login or registration, the smart contract identifies and assigns the user a role—either as a **Patient** or **Doctor**—based on the context of registration. This information is securely stored on the blockchain, linking the wallet

address to the designated role. This decentralized role registration ensures tamper-proof identity assignment without relying on a centralized database or manual intervention.

Access Control with Role-Based Privileges:
The system employs role-based access control (RBAC) mechanisms to ensure that users can only access functionalities permitted by their roles. For example, **Patients** can upload and manage their health records, while **Doctors** are granted permission to view records only when explicitly authorized by the patient. This strict separation of privileges helps enforce data confidentiality and prevents unauthorized access.

Smart Contract Development and Deployment:
The core logic of the EHR management system is implemented using **Solidity**, a high-level programming language designed for developing smart contracts on Ethereum. These contracts define the rules for user registration, access control, and data sharing. The contracts are developed, tested, and deployed locally using the **Truffle Suite**, a development framework for Ethereum. Deployment occurs on **Ganache**, a personal Ethereum blockchain used to simulate the real network for development and testing purposes.

V. DESIGN AND IMPLEMENTATION

The proposed system utilizes three core smart contracts: **DoctorRegistry.sol**, **PatientRegistry.sol**, and **AccessControl.sol**. These contracts collectively manage user registration, role assignment, and access control logic on the Ethereum blockchain. The **DoctorRegistry** and **PatientRegistry** contracts handle the onboarding of respective users, while the **AccessControl** contract ensures secure, role-based permission management for health record access.
The **frontend application** is developed using **React.js**, providing a dynamic and responsive user interface. The dashboard experience is tailored based on the user's role (Patient or Doctor), ensuring that users only see features relevant to their assigned role.

Key tools and technologies used include **Truffle** for smart contract development, **Ganache** for local blockchain simulation, **MetaMask** for wallet-based authentication, **Ethers.js** for blockchain interaction in the frontend, and **Visual Studio Code (VS Code)** as the primary development environment.

The frontend includes essential pages such as:

- **Wallet Connect Page** for user authentication via MetaMask,
- **Registration Page** for new users to register as either Patient or Doctor,
- **Role-based Dashboard** that dynamically renders views and functionality depending on the authenticated user's role.

VI. OUTCOME OF RESEARCH

The research successfully demonstrates a secure and decentralized user identity management system using Ethereum blockchain technology. Integration with MetaMask wallets eliminates the risks associated with traditional username-password authentication, enhancing both security and user convenience. Smart contracts ensure immutability, transparency, and enforceable access control, providing a tamper-resistant framework for identity verification. The system's architecture is modular and extensible, allowing seamless upgrades and feature additions. This implementation sets a strong foundation for **Phase 2**, which will focus on EHR record uploads, medical diagnostics, and inter-provider data exchange within a decentralized environment.

VII. RESULT AND DISCUSSION

Implementation of the system ensures strict access control by allowing only verified doctors and patients to register and interact with the platform. Ethereum wallet addresses act as unique digital identifiers, with all identity and role data securely stored on the blockchain using smart contracts. Extensive testing on **Ganache**, a local Ethereum environment, has validated critical features such as successful registration, prevention of duplicate entries, and secure, role-based access. The MetaMask-based login flow has demonstrated reliability in practical testing, offering a seamless and intuitive user experience. The current architecture is designed with scalability in mind, enabling easy integration of advanced features like EHR uploads, diagnostics, and data sharing in subsequent development phases.

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VIII. CONCLUSION

The proposed EHR system built on the Ethereum blockchain effectively establishes a decentralized and tamper-proof identity management framework for healthcare stakeholders. By eliminating reliance on centralized servers, it enhances data security, user privacy, and system resilience. Smart contracts automate key functions such as role assignment and access control, ensuring trustless and transparent operations. The system provides a user-friendly interface for both patients and doctors through wallet-based authentication and role-based dashboards. Future development phases will extend the platform to include medical record uploads, diagnostic data management, and secure sharing of records across multiple healthcare providers.

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