International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Blockchain Based Hospital Rental App

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Abstract

In modern healthcare systems, the timely availability and affordability of critical medical equipment are paramount for effective patient care and crisis response. However, hospitals, clinics, and small-scale healthcare providers—especially in remote or
under-resourced regions—face significant challenges in acquiring and maintaining costly hospital equipment such as ventilators, infusion pumps, portable X-ray machines, or
ECG monitors. These challenges are further magnified during public health emergencies like pandemics, natural disasters, or sudden surges in patient load, where demand for
specific equipment can skyrocket within hours. Traditional equipment procurement and rental systems are plagued by centralized control, bureaucratic delays, lack of transparency, manual paperwork, inflated costs due to intermediaries, and trust issues between suppliers and renters.

Index Terms: Wallet Integration, Smart Contract Logic, Equipment Listing, Secure Payment System, Frontend Interface..

1. Introduction

Access to critical medical equipment is a cornerstone of modern healthcare delivery. However, many healthcare institutions, especially those in rural or economically constrained regions, struggle to procure essential medical devices due to high upfront costs, lack of availability, and bureaucratic procurement procedures. In emergency
situations such as pandemics, natural disasters, or mass casualty incidents, this equipment gap becomes a matter of life and death.

The traditional rental system for hospital equipment is often centralized, time-consuming, and opaque. It relies heavily on intermediaries and manual documentation, leading to inefficiencies, inflated costs, delayed access, and frequent disputes. There is a growing need for a system that ensures seamless, secure, and immediate rental transactions without relying on third-party trust.

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2. Literature Review

The integration of blockchain technology into the healthcare sector is a relatively recent yet transformative innovation. Multiple research efforts and technological advancements have laid the foundation for decentralized applications (dApps) and smart contract-based platforms that enable secure, transparent, and efficient systems. The following literature provides insights into related technologies, blockchain applications, and healthcare logistics systems relevant to this project.

In [1], Zhang et al. (2020) proposed a blockchain-based framework for medical data sharing that enables secure, patient-centric record management. Their decentralized architecture ensures data immutability and access control using smart contracts, offering foundational concepts applicable to hospital equipment rental management. While their focus is on data privacy, the structural use of Ethereum smart contracts aligns with the rental logic used in our platform.

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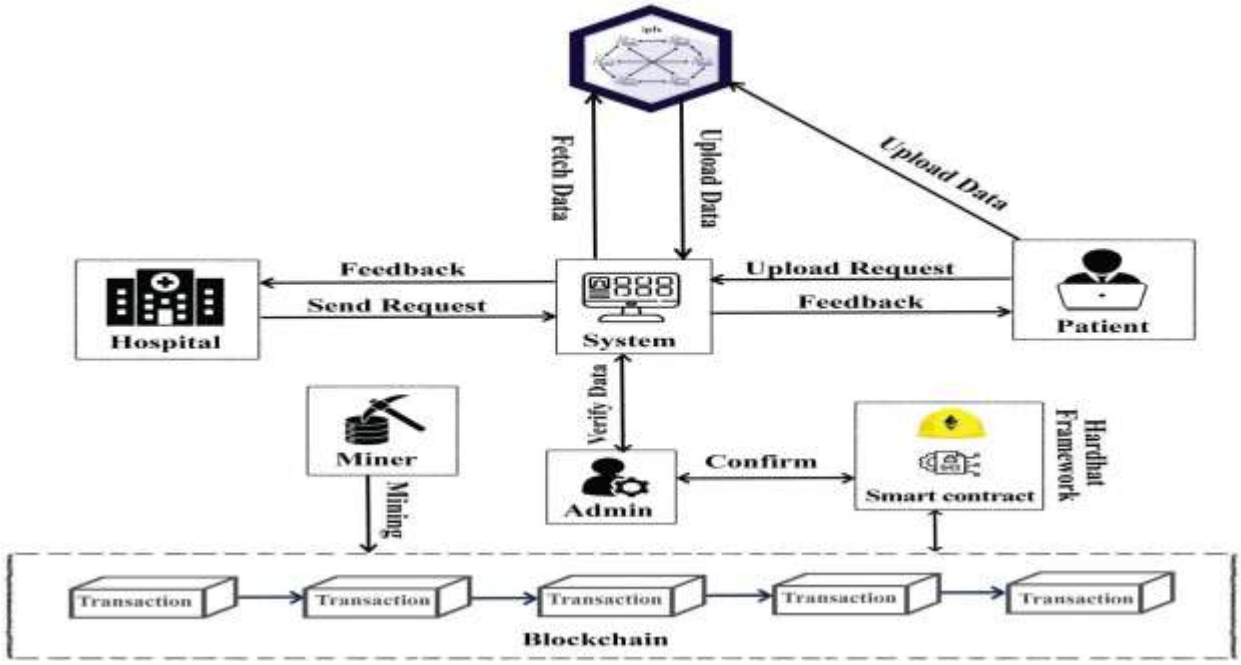
3. Proposed Methodology

The system architecture integrates the following key components:



3.1 System Design Overview: Smart Contracts: Self-executing code written in Solidity to govern the rules of equipment rental, payment handling, and lifecycle management.
Frontend Interface: A React.js-based web application that interacts with smart contracts using Ethers.js or Web3.js.

3.2 Smart Contract Development: Write and test smart contracts using Solidity in the Hardhat or Truffle framework.
Define core functions: registerEquipment(), rentEquipment(), completeRental(), getAvailableEquipment().
include payment handling and event emissions (e.g., RentStarted, RentCompleted).

3.3 Frontend Application Design: Create UI wireframes and flowcharts. Implement the user interface using React.js. Use Ethers.js or Web3.js for blockchain interactions. Integrate features like wallet connection, transaction prompts, and equipment dashboards.

3.4 Wallet Integration: Use MetaMask for user authentication and transaction signing. Display wallet status (connected, account info, balance).Handle user permissions and blockchain confirmations.

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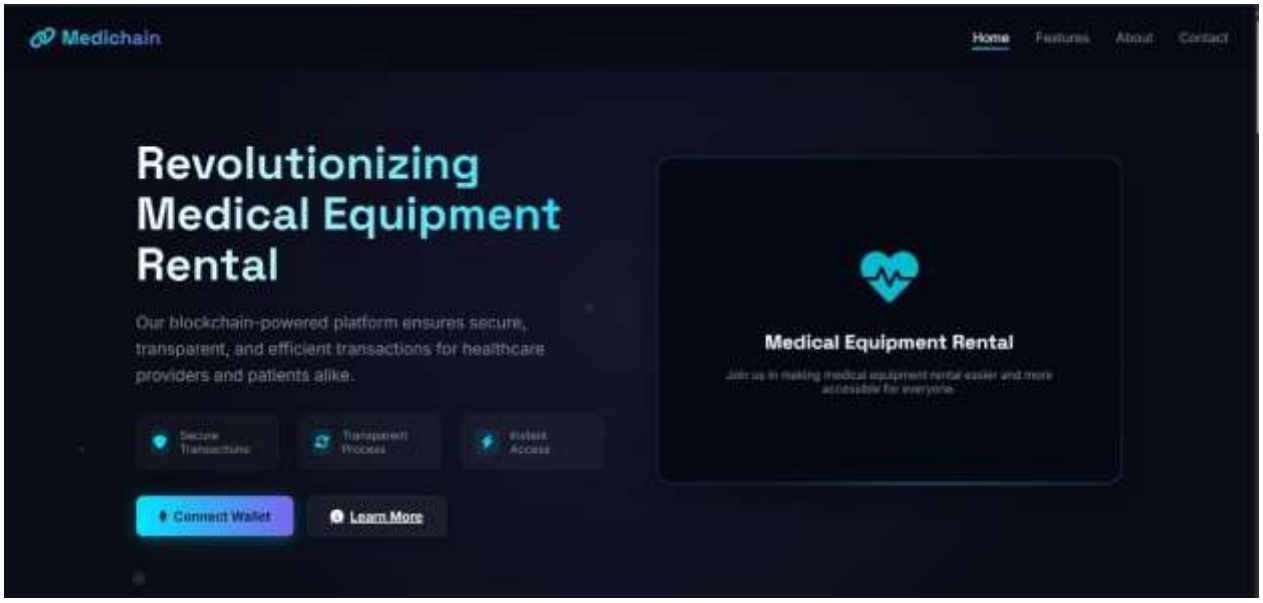
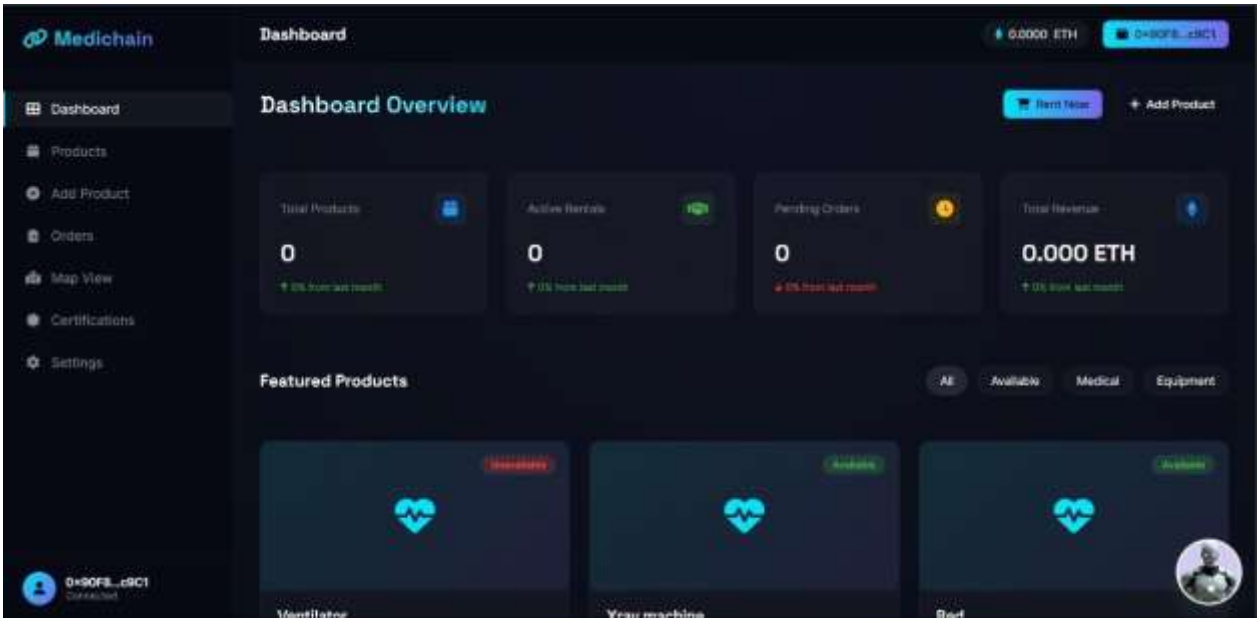
4. Implementation and Results

4.1 System Workflow

The system follows these steps:

1. Smart Contract Development: Smart contracts were written in Solidity and deployed to the Ethereum testnet (Rinkeby or Sepolia)
2. Frontend Interface: The frontend was built using React.js to provide a responsive and user-friendly experience..
3. Geo-Radius Filtering Logic: As smart contracts do not support native geolocation capabilities, a lightweight off-chain mechanism was used to filter listings based on a 5 km rental radius.
4. Testing and Validation: Successful deployment and initialization of contracts





4.2 Key Features

- **Decentralized Equipment Listing** The platform enables hospital equipment owners (e.g., hospitals, clinics, suppliers) to list available medical devices on a public blockchain.
- **Smart Contract-Powered Rental Transactions**: Rental agreements are automated through Ethereum smart contracts.
- **Web3 Wallet Integration** The application supports wallet-based authentication via MetaMask or other Web3-compatible wallets.

- **Dynamic Payment Calculation:** Rental charges are calculated based on the user's input of hourly usage.
- **Immutable Rental Records**: All rental actions—including listings, payments, timestamps, and contract outcomes—are stored immutably on the blockchain.

4.3 Results

The Blockchain-Based Hospital Equipment Rental Application was tested in a simulated environment using Ethereum's Testnet and MetaMask wallets. The system successfully demonstrated its key capabilities, proving both its technical viability and practical applicability. The results are categorized below based on core functionalities and test cases.

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5. Conclusion and Future Scope

This project also showcases the potential for applying decentralized technologies to real-world problems outside of finance. By creating a working prototype, it has proven that critical healthcare infrastructure can be made more accessible, responsive, and fair using blockchain. Though limited to testnet environments and basic geolocation logic,
the system offers a strong foundation for more sophisticated deployments. Additionally, this project contributes to the broader discourse on how decentralized applications can address global challenges such as resource underutilization, lack of transparency, and operational inefficiencies.

- Real-time Equipment Tracking and IoT Integration
- Advanced Geolocation and Logistics Support
- Multi-Chain and Tokenization Support
- Insurance and Dispute Resolution

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