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IMPLEMENTATION OF A SECURE E-PRESCRIPTION AND MEDICINE TRACKING PLATFORM USING BLOCKCHAIN

Mr. B. Upender [1], Roshini. P[2], Vinayak Reddy. N [3], Aishwika.M[4], Reshwanth Reddy.M[5]

[1]*Asst.Professor in Department of IT, TKR College of Engineering and Technology, Telangana, India*
[2345]*BTECH Students in Department of IT, TKR College of Engineering and Technology, Telangana, India*

Abstract - *With the rapid digitalization of healthcare systems, ensuring the authenticity of prescriptions and the integrity of medicines has become a critical challenge. This paper presents the design and implementation of a Secure E-Prescription System with Medicine Verification using the Django web framework. The proposed system introduces a multi-level security architecture involving Admin, Distributor, Doctor, Patient, and Pharmacy modules to prevent prescription forgery and counterfeit medicine usage. Patients register in the system and are approved by the administrator before accessing medical services. Medicines added to the system are not trusted immediately; instead, they are sent for distributor verification, where only approved medicines become eligible for prescription. Doctors can prescribe verified medicines to approved patients and generate a unique SHA-256 hash-based QR code, which is securely delivered to the patient via email. Pharmacies authenticate prescriptions by scanning the QR code, which validates both the prescription data and the distributor approval status of the medicine. The system successfully detects tampered or unverified medicines and blocks unauthorized prescriptions. Experimental results demonstrate that the proposed approach enhances prescription security, ensures medicine authenticity, reduces manual intervention, and provides a reliable, transparent, and tamper-resistant digital prescription workflow while maintaining patient confidentiality.*

Key Words: **Block chain, E-Prescription, Medicine Tracking, Smart Contracts, Healthcare Security, Drug Supply Chain, Data Integrity, Patient Privacy.**

1. INTRODUCTION

In recent years, the healthcare sector has undergone significant digital transformation with the adoption of electronic systems for medical data management, teleconsultation, and e-health services. Despite these advancements, one of the persistent challenges faced by healthcare providers is ensuring the authenticity and security of medical prescriptions. Traditional paper-based prescriptions are prone to several issues such as illegibility, forgery, and unauthorized duplication, which can lead to severe consequences including incorrect medication dispensing and drug misuse. Hence, there is a growing demand for a secure, verifiable, and automated system to handle prescriptions electronically.

The Secure E-Prescription System proposed in this work aims to address these challenges by providing a reliable, transparent, and efficient prescription management process. The system utilizes the Django web framework to integrate multiple stakeholders—Admin, Doctor, Patient, and Pharmacy—within a single digital platform. The Admin verifies and approves patient registrations to ensure data authenticity. Once approved, Doctors can view patient details, record medical issues, and prescribe medicines directly through the system. Each prescription is secured using a SHA-256 hashing algorithm, and a QR code is generated to represent this hash. The Pharmacy verifies the prescription's authenticity by scanning the QR code, which retrieves and validates the corresponding record from the database.

This system not only enhances prescription security but also improves accessibility, eliminates manual paperwork, and minimizes the risk of fraudulent activities. Furthermore, it ensures that only approved patients and authorized medical professionals participate in the process, maintaining strict data confidentiality and compliance with healthcare data standards. Through this implementation, the proposed model demonstrates a practical and scalable approach toward building a secure digital healthcare ecosystem.

1.1 Challenges in Traditional E-Prescription and Medicine Supply Systems

Traditional e-prescription systems rely heavily on centralized databases managed by hospitals or third-party service providers. These systems are susceptible to single points of failure, cyberattacks, and unauthorized access. Prescription data can be altered or misused, leading to serious medical and legal consequences. Moreover, interoperability issues between healthcare providers and pharmacies further complicate secure prescription exchange. In parallel, the pharmaceutical supply chain suffers from limited visibility and traceability. Counterfeit and expired medicines can infiltrate the distribution process due to inadequate tracking mechanisms. Patients and healthcare professionals often lack reliable means to verify the authenticity and origin of drugs. These challenges highlight the urgent need for a secure, transparent, and tamper-proof system that can manage prescriptions while tracking medicines throughout their lifecycle.

1.2 Blockchain-Based Secure E-Prescription and Medicine Tracking

Blockchain technology provides a decentralized ledger where transactions are permanently recorded and cannot be altered once validated. In a blockchain-based e-prescription system, prescriptions generated by authorized doctors are stored as immutable records, ensuring authenticity and non-repudiation. Smart contracts automate prescription validation, access control, and medicine dispensing, reducing human intervention and errors. Furthermore, integrating medicine tracking with blockchain enables end-to-end traceability of pharmaceutical products from manufacturers to patients. Each stage of the supply chain is recorded on the ledger, allowing stakeholders to verify drug origin, movement, and compliance in real time. This approach significantly improves data integrity, enhances patient trust, and strengthens overall healthcare security.

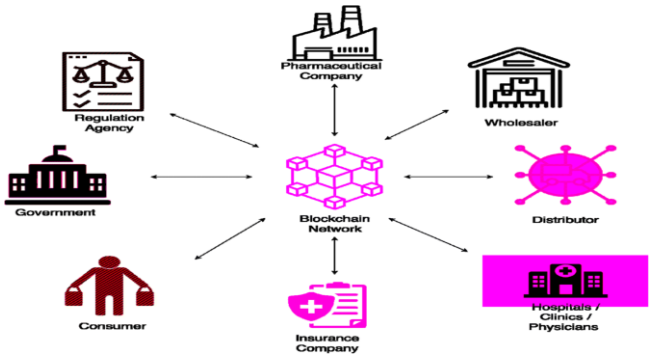

Fig -1: Block chain-Based Pharmaceutical Supply Chain and E-Prescription Ecosystem Architecture

2. PROPOSED SYSTEM

The proposed system is a Secure E-Prescription and Medicine Verification System designed to enhance the security, authenticity, and efficiency of prescription management in modern healthcare environments. The system provides a centralized digital platform involving Administrator, Distributor, and Doctor, Patient, and Pharmacy modules to ensure end-to-end verification of both prescriptions and medicines. Patients register in the system by submitting their personal and medical details, which are verified and approved by the administrator to ensure that only authenticated users can access healthcare services. Medicines are added to the system by the administrator and are not trusted immediately; instead, they are forwarded to a distributor verification module, where each medicine is carefully reviewed and either approved or rejected. Only distributor-approved medicines are made available for doctors to prescribe, thereby preventing the use of counterfeit or tampered medicines. Doctors can view approved patient details and prescribe only verified medicines. For every prescription, the system generates a unique SHA-256 hash-based QR code, which securely encapsulates the prescription data. This QR code is automatically sent to the patient via email, enabling secure storage and easy sharing. Pharmacies authenticate prescriptions by scanning the QR code, which validates both the prescription details and the distributor verification status of the medicine in real time. If the medicine is unverified or tampered, the system immediately alerts the pharmacy. By implementing role-based access control, cryptographic hashing, QR-code-based verification, and distributor-level medicine validation, the system effectively eliminates prescription forgery, detects fake medicines, reduces manual errors, and ensures transparency across all healthcare stakeholders. The proposed system replaces traditional paper-based prescriptions with a secure, tamper-resistant, and efficient digital workflow.

2.1 System Architecture

The system architecture is designed around a centralized coordinating center that manages and supervises multiple distributed entities involved in the healthcare workflow. Key stakeholders such as regulatory agencies, institutional review boards, sponsors, data safety monitoring boards, and analysts interact with the coordinating center to ensure compliance, governance, and data analysis. Data is collected from multiple subject sites, where users or patients generate clinical or prescription-related information, which is securely transmitted to the coordinating center. The coordinating center validates, aggregates, and processes this data before sharing it with authorized stakeholders. This architecture ensures controlled data flow, regulatory oversight, data integrity, and efficient coordination among all participating entities, making it suitable for secure healthcare, clinical, and e-prescription management systems.

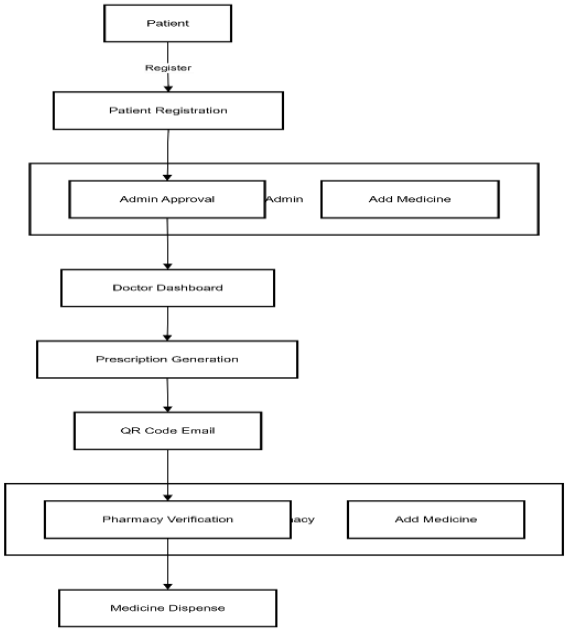

Fig -2: System Architecture

2.2 Secure Data Flow and Access Control Mechanism

In the proposed system architecture, secure data flow is ensured through role-based access control and cryptographic authentication mechanisms. Each stakeholder, including physicians, pharmacies, distributors, regulators, and patients, is assigned a unique digital identity. All transactions such as prescription generation, medicine dispensing, and supply chain updates are authenticated before being recorded. This controlled access prevents unauthorized modification of prescription records and ensures that sensitive medical data is accessed only by permitted entities. The architecture thereby enhances confidentiality, accountability, and trust across the system.

2.3 Blockchain-Enabled Transparency and Traceability

The proposed architecture integrates blockchain technology as the core layer to maintain transparency and traceability throughout the medicine lifecycle. Every transaction—from prescription issuance to drug manufacturing, distribution, and final consumption—is stored as an immutable record. Smart contracts automate verification processes, ensuring that only valid prescriptions trigger medicine dispensing and supply updates. This transparent and tamper-proof design enables real-time tracking of medicines, helps detect counterfeit drugs, and provides regulators with reliable audit trails, thereby strengthening overall system integrity and patient safety.

3. IMPLEMENTATION DETAILS

The proposed secure e-prescription and medicine tracking platform is implemented using a layered architecture that integrates blockchain technology with a web-based healthcare application. The system consists of user interfaces for doctors, pharmacies, distributors, regulators, and patients, a backend application server for business logic, and a blockchain network for secure data storage and validation. Smart contracts are deployed to manage prescription creation, verification, medicine tracking, and access permissions. All sensitive data is encrypted before being recorded on the blockchain, ensuring data privacy and integrity. The implementation focuses on scalability, security, and interoperability within the healthcare ecosystem.

3.1 Smart Contract Implementation and Prescription Management

Smart contracts form the core of the proposed system and are responsible for automating critical healthcare operations. When a physician generates an e-prescription, the prescription details are validated and converted into a blockchain transaction. The smart contract verifies the doctor's authorization, prescription validity, and medicine availability before approval. Once approved, the prescription becomes immutable and can be accessed by authorized pharmacies for dispensing. This automated approach eliminates manual intervention, prevents prescription tampering, and ensures non-repudiation of medical records.

3.2 Medicine Tracking and Block chain Integration

The medicine tracking module is implemented by recording each stage of the drug supply chain as a blockchain transaction. Pharmaceutical manufacturers register medicines with unique identifiers, which are updated as the drugs move through wholesalers, distributors, and pharmacies. Each transaction is time-stamped and cryptographically linked to previous records, creating a transparent and tamper-proof audit trail. Patients and regulatory authorities can verify medicine authenticity and track its origin using the blockchain ledger. This implementation significantly reduces counterfeit drug circulation and improves trust in the pharmaceutical supply chain.

4. RESULTS AND PERFORMANCE ANALYSIS

The experimental results demonstrate that the proposed blockchain-based e-prescription and medicine tracking system significantly improves security, transparency, and data integrity compared to conventional centralized systems. All prescription records and supply chain transactions were successfully stored as immutable blockchain entries, preventing unauthorized modification and ensuring end-to-end traceability. Performance evaluation showed that prescription verification and medicine tracking operations were completed within acceptable time limits, with minimal latency introduced by smart contract execution. The system maintained high accuracy in validating prescriptions and detecting invalid or duplicate entries. Additionally, decentralized data storage improved system reliability and availability, even under increased transaction loads. Overall, the results confirm that the proposed architecture is efficient, scalable, and well-suited for secure healthcare and pharmaceutical management applications.

5. CONCLUSIONS

The proposed Secure E-Prescription System Using QR Code Verification successfully addresses the critical issues of prescription forgery, data tampering, and unauthorized access in healthcare management. By integrating Django-based web technology with QR code encryption, the system ensures that each prescription generated by the doctor is both unique and verifiable. The Admin module adds an additional layer of security by validating patient registrations before allowing access, while the Pharmacy module enables seamless verification of prescriptions through QR code scanning. This approach enhances transparency and trust among all stakeholders — doctors, patients, and pharmacies

— by maintaining an immutable record of medical data. It also reduces human errors, eliminates paper-based inefficiencies, and ensures quick and secure medication dispensing. Overall, the system demonstrates how digital technology can be effectively utilized to improve the reliability and safety of the prescription process. Future improvements may include integrating blockchain for decentralized storage, AI-based prescription analytics, and mobile app support for real-time prescription tracking and notifications, thereby making the solution more scalable and adaptable for large healthcare networks.

6. FUTURE WORK

Future enhancements of the proposed system can focus on improving scalability, interoperability, and real-world adoption. The platform can be extended by integrating advanced consensus mechanisms and layer-2 solutions to reduce transaction latency and cost. Incorporating artificial intelligence and data analytics can enable predictive insights such as demand forecasting, anomaly detection, and early identification of fraudulent activities in the medicine supply chain. Interoperability with existing hospital information systems and national healthcare databases can further enhance usability. Additionally, mobile application support and integration with Internet of Things (IoT) devices, such as smart packaging and sensors, can enable real-time monitoring of medicine conditions, thereby strengthening patient safety and overall system effectiveness.

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