

AI-Driven Medicine Authentication System for Detecting Counterfeit Drugs

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ABSTRACT

The widespread presence of counterfeit medicines has become a critical issue in the healthcare sector, leading to severe risks for patients and reduced trust in pharmaceutical systems. Traditional verification approaches, including manual inspection and barcode systems, often fail to provide accurate and real-time authentication for consumers. This paper presents an intelligent medicine authentication system that utilizes artificial intelligence and mobile technology to detect counterfeit drugs efficiently. The system allows users to scan QR codes or capture images of medicine packaging using a mobile application. The captured data is processed to extract essential details, which are then validated against trusted datasets. Based on the analysis, the system provides a reliability score indicating whether the medicine is genuine or suspicious.

Additionally, the application includes a feature that offers general medicine-related guidance based on user input while encouraging professional consultation. The proposed solution enhances accessibility, improves user awareness, and provides a scalable approach to combating counterfeit medicines.

Keywords: Counterfeit drug detection, artificial intelligence, QR code verification, healthcare security, mobile application

1. INTRODUCTION

Counterfeit medicines represent a serious challenge to global healthcare systems. These fake or substandard drugs may contain incorrect ingredients, improper dosages, or harmful substances, resulting in ineffective treatment and potential health risks. The increasing distribution of such medicines, especially in

developing regions, highlights the need for reliable verification methods.

Existing solutions primarily focus on supply chain monitoring and lack direct interaction with end users. As a result, consumers often have no reliable way to confirm the authenticity of medicines at the point of use.

With the rapid development of mobile applications and artificial intelligence technologies, it is now possible to design systems that provide real-time verification. This research introduces a user-friendly system that enables individuals to authenticate medicines through QR code scanning and image analysis. The system aims to improve safety, reduce risks, and empower users with accurate information.

2. LITERATURE REVIEW

[1] Pranitha G. (2024), in her work *"Fake Drug Detection using QR Codes and Consensus-Based Blockchain"*, proposed a blockchain-driven framework where each medicine is assigned a unique QR code and registered on a distributed ledger. The system relies on consensus mechanisms to validate authenticity and allows consumers to verify drugs through QR scanning. While the approach improves transparency, it mainly focuses on authentication and lacks intelligent analysis. MedGuardAI extends this work by integrating AI-based verification capable of detecting expired and unsafe medicines, along with IPFS-based decentralized storage for preserving scan evidence and audit trails.

[2] Poornima S., Ranjit T. N., Sanjith Sivendra K., Vasana S., and Kawin K. S. (2025), in *"Med Verify: A Blockchain-Based Medicine Verification System for Counterfeit Drug Detection"*, introduced a system combining QR codes or RFID tags with blockchain and AI-driven packaging inspection. Their methodology emphasizes identifying counterfeit drugs through packaging consistency and recorded supply-chain data. However, the system remains largely packaging-centric. MedGuardAI improves upon this by incorporating image recognition and NLP techniques to validate dosage and usage instructions while providing real-time AI-generated safety alerts aimed at patient protection.

[3] Mani V. et al. (2022), in *"Cloud-Based Blockchain Technology to Identify Counterfeits"*, presented a

cloud-supported blockchain architecture using serialization for unique drug identification and IPFS for storing verification evidence. The model ensures scalability and secure backend logging of pharmaceutical data. Although effective in maintaining data integrity, the approach lacks direct user-level intelligence. MedGuardAI enhances this architecture by adding AI-powered analysis that delivers immediate authenticity and safety insights to end users rather than limiting verification to backend records.

[4] Vivek Singh et al. (2019), in *"A Novel Approach for Counterfeit Detection of Medical Drugs using Blockchain"*, proposed the use of RFID tags and blockchain to track medicines throughout the supply chain. Consumers verify authenticity through a mobile application that accesses blockchain-stored transaction data. Despite improving traceability, RFID dependency increases deployment cost and limits accessibility. MedGuardAI replaces hardware dependency with AI-based image and QR scanning, integrates expiry detection and safety warnings, and uses IPFS to store image-based proof for improved transparency.

[5] Chandan Kumar Sahoo et al. (2020), in *"Combating Counterfeit Drugs: A Blockchain and IoT-Based Approach"*, developed a framework that integrates IoT sensors with blockchain and smart contracts to monitor drug movement across the supply chain. Smart contracts enforce compliance at each distribution stage. While effective for logistics monitoring, the system does not focus on patient-level verification. MedGuardAI complements supply-chain integrity by incorporating AI and NLP to deliver patient-centric verification, usage validation, and decentralized cloud and IPFS-based data storage.

[6] Vinay B. Kapse et al. (2021), in *"Blockchain and Machine Learning Based Framework for Counterfeit Drug Detection"*, employed machine learning algorithms to identify anomalies in drug packaging, with blockchain used for storing verification results. The solution primarily operates at the backend level and offers limited real-time user interaction. MedGuardAI advances this concept by providing front-end AI scanning, instant alerts, and visual and NLP-based instruction validation, ensuring both backend security and patient-facing safety.

[7] Mani V. et al. (2022), in another study on cloud-based blockchain counterfeit detection, utilized serialization, blockchain ledgers, IPFS storage, and

cloud infrastructure to ensure scalable and tamper-proof verification. Although the system ensures data integrity, it does not actively assist end users during verification. MedGuardAI integrates AI-powered detection with IPFS-based image storage and presents real-time safety insights directly through a mobile interface, enhancing usability and responsiveness.

[8] Pranitha G. (2024), in a subsequent study on QR code-based counterfeit detection, employed consensus-based blockchain validation to authenticate medicine records during consumer scans. While effective for authentication, the approach lacks contextual safety analysis. MedGuardAI enhances this method by introducing AI-driven risk analysis and decentralized evidence storage using IPFS, making verification more robust and informative for end users.

[9] Poornima S. et al. (2025), in their extended work on *Med Verify*, continued to focus on QR/RFID-based authentication and AI-driven packaging analysis. Their system ensures packaging integrity but offers limited support for patient understanding and safety feedback. MedGuardAI broadens verification by incorporating NLP-based instruction analysis, real-time alerts, and IPFS-backed scan storage, thereby improving user trust and safety awareness.

[10] Nikita Panchal et al. (2022), in "*BlockMed: Blockchain for Drug Supply Chain Integrity*", utilized Ethereum smart contracts to track medicine movement across the pharmaceutical supply chain. The system ensures transaction integrity and traceability but does not actively detect counterfeit medicines at the user level. MedGuardAI extends this work by integrating AI-based scanning, decentralized evidence storage, and immediate safety notifications, enabling real-time counterfeit detection for consumers.

3. SYSTEM OVERVIEW

The proposed system is designed as a mobile-based application that enables users to verify medicines quickly and efficiently. The application provides two primary input methods: QR code scanning and image capture of medicine packaging. Once the input is provided, the system extracts relevant information such as product name, manufacturer details, and labeling patterns. This information is then processed and compared with verified data sources to determine authenticity.

The system generates a confidence score indicating the reliability of the medicine. The result is displayed in a simple format, allowing users to easily understand whether the product is safe to use.

4. METHODOLOGY

The system follows a structured process to ensure accurate verification. Initially, the user inputs data by scanning a QR code or capturing an image of the medicine package. The input is then processed to extract important textual and visual features.

Next, artificial intelligence techniques are applied to analyze the extracted data. The system identifies patterns and detects any inconsistencies that may indicate counterfeit products. The extracted details are cross-checked with trusted pharmaceutical databases.

Based on this analysis, the system classifies the medicine as authentic or suspicious. A confidence score is generated to represent the accuracy of the result. The final output is presented to the user in a clear and understandable format.

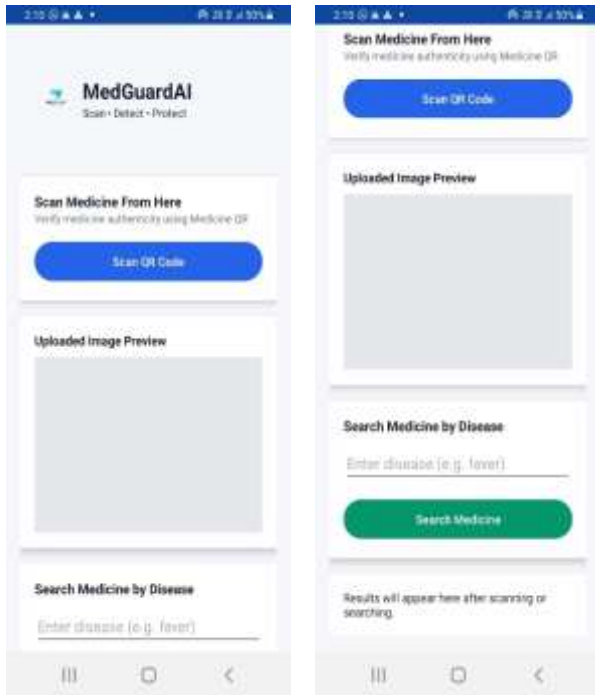
5. IMPLEMENTATION DETAILS

The system is implemented as a mobile application with a simple and intuitive interface. The front-end allows users to interact with the system through scanning and image upload features.

The backend processes the input data and performs analysis using ai-based techniques. Verified datasets are used to ensure reliable comparison and accurate results.

The application also includes a guidance module that provides general medicine-related information. Clear disclaimers are included to prevent misuse and encourage professional medical advice.

6. RESULT AND DISCUSSION



The system was tested using multiple medicine samples and scenarios. The results indicate that the application can effectively identify inconsistencies and provide reliable verification outcomes. The confidence score feature helps users better understand the authenticity level of medicines. Compared to traditional verification methods, the proposed system offers faster response time and improved usability. The integration of AI enhances detection accuracy and provides meaningful insights to users. Overall, the system demonstrates strong potential in improving medicine safety and awareness.

7. FUTURE SCOPE

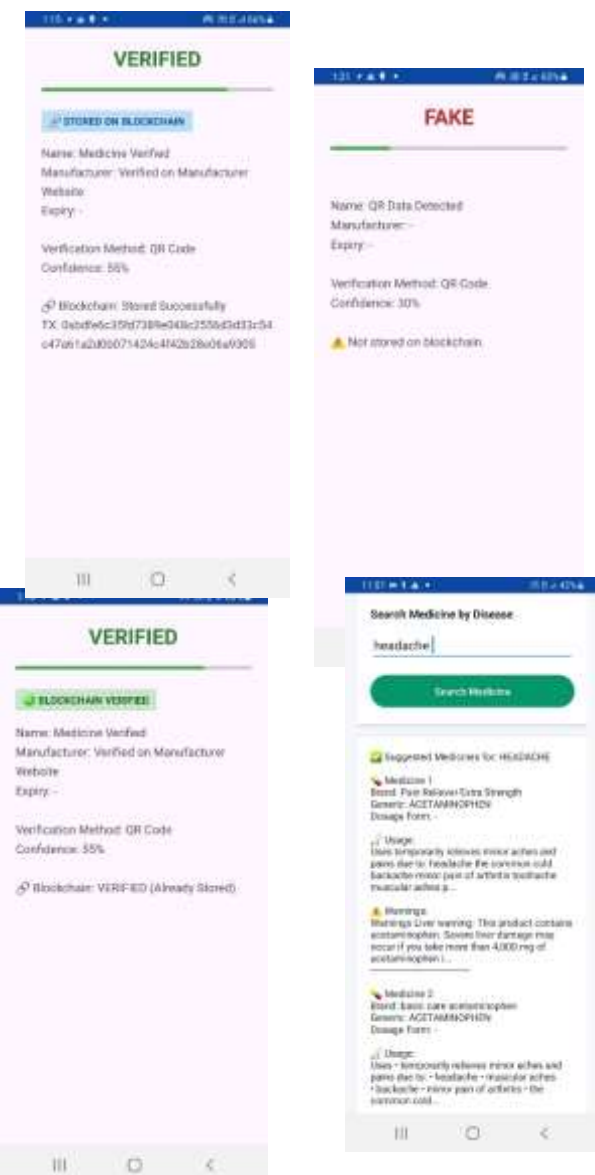
Future improvements may include enhancing the accuracy of detection models using advanced deep learning techniques. The system can also be expanded to support multiple languages for wider accessibility.

Additional features such as offline verification and integration with healthcare systems can further improve usability. Continuous updates and improvements will help in making the system more efficient and reliable.

8. CONCLUSION

This research presents an intelligent solution for detecting counterfeit medicines using artificial intelligence and mobile technology. The system provides a simple and effective way for users to verify medicines through scanning and image analysis.

By delivering clear results and confidence indicators, the system enhances user trust and promotes safer healthcare practices. The proposed approach highlights the importance of integrating AI in healthcare applications to address real-world challenges. By focusing on user safety and awareness, the proposed solution contributes to reducing the risks associated with counterfeit drugs. Overall, this work highlights the importance of leveraging modern technologies to address critical healthcare challenges and improve public trust in pharmaceutical products.



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