MIT School of Engineering

Department of Computer Science and Engineering

Project Synopsis

Group ID: LYAIEC02

Project Title: MedGuard AI

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Problem Statement: Fake and low-quality medicines are reaching hospitals and patients, putting health and safety at risk.

Abstract: The increasing circulation of counterfeit and substandard medicines poses a serious threat to global healthcare, leading to treatment failures, adverse health effects, and erosion of trust in the pharmaceutical industry. Traditional manual verification methods are slow and error-prone, making them ineffective against sophisticated counterfeit practices.

This project proposes a software-driven AI system for medicine authentication, structured into five intelligent agents: Data Intake, Vision, Database & Retrieval-Augmented Generation (RAG), Decision, and Reporting. The system begins by extracting details from medicine packaging and pill images using OCR and barcode decoding. A computer vision module then analyzes packaging design elements and pill morphology to detect inconsistencies. Extracted details are cross-verified against regulatory databases, manufacturer catalogs, and counterfeit alert records. The decision engine fuses vision, text, and database insights to classify medicines as either *Verified Safe* or *Quarantine/Escalate*, providing explainable reasons such as "logo mismatch" or "expired batch." Finally, a reporting agent generates a digital verification report and updates a shared intelligence database for continuous learning.
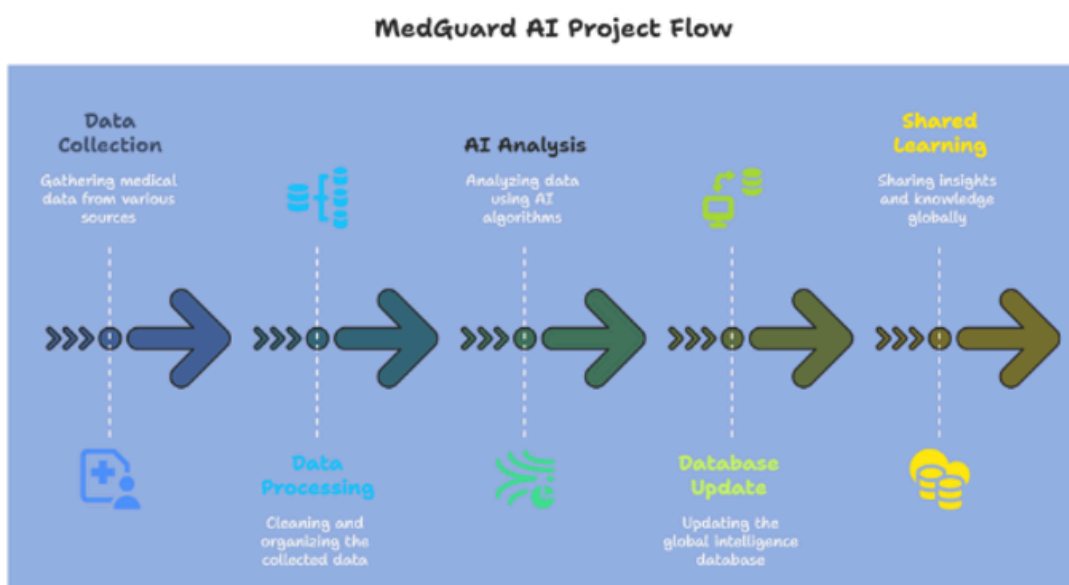
By integrating AI, computer vision, and regulatory data sources, this system offers a reliable, scalable, and automated solution to combat fake medicines, thereby enhancing patient safety, supporting healthcare providers, and strengthening pharmaceutical supply chain integrity.

Literature Survey:

Sr. No.	Author(s)	Year	Title of Paper	Journal / Conference	Key Findings / Contribution
1	Nayyar, A., & Singh, R.	2020	"Blockchain-based Authentication of Medicines in Pharmaceutical Supply Chain"	*International Journal of Healthcare Information Systems and Informatics*	Proposed blockchain + AI integration for medicine traceability and counterfeit prevention.
2	Aung, T., et al.	2021	"AI-based Image Recognition for Detection of Counterfeit Medicines"	*IEEE Access*	Developed AI model to scan packaging images for tampering and fake labeling.

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3	Reddy, K. & Kumar, S.	2019	"Machine Learning in Drug Authentication: Challenges and Opportunities"	*Journal of Medical Systems*	Reviewed ML approaches for drug validation using QR/barcode datasets.
4	Gupta, P., et al.	2022	"Deep Learning Approaches for Detecting Fake Drugs Using Packaging Features"	*Springer Lecture Notes in Computational Vision and Biomechanics (Conference)*	Applied CNN models to detect inconsistencies in packaging design.
5	Li, H., & Zhang, Y.	2020	"Securing Medicine Supply Chain Using IoT and AI"	*Elsevier Computers in Biology and Medicine*	Integrated IoT sensors and AI for real-time monitoring of drug authenticity.

Proposed System (Block Diagram):

MedGuard AI Project Flow

Conclusion: The rise of counterfeit and low-quality medicines is a critical challenge for global healthcare systems. Our proposed solution — a software-only AI-driven medicine authentication workflow — addresses this problem by integrating multiple intelligent agents that work together to ensure drug authenticity. From extracting data through OCR and barcode scanning, to analyzing packaging and pill features with computer vision, cross-checking records with regulatory databases, and finally generating explainable reports, the system provides a comprehensive and automated verification process.

By combining vision, text, and trusted databases, the system not only detects suspicious medicines but also offers transparent reasoning behind its decisions, ensuring trust and accountability. Furthermore, the automatic reporting and intelligence-sharing capability strengthen regulatory oversight and help build a global defense network against counterfeit drugs.

In conclusion, the implementation of this AI-powered workflow has the potential to significantly enhance patient safety, support healthcare providers, and improve the integrity of pharmaceutical supply chains.

References:

1. Nayyar, A., & Singh, R. (2020). Blockchain-based authentication of medicines in pharmaceutical supply chain. *International Journal of Healthcare Information Systems and Informatics*, 15(3), 1–20. https://doi.org/10.4018/IJHISI.2020070101

2. Aung, T., Oo, Z., & Tun, Z. (2021). AI-based image recognition for detection of counterfeit medicines. *IEEE Access*, 9, 55670–55682. https://doi.org/10.1109/ACCESS.2021.3072345

3. Reddy, K., & Kumar, S. (2019). Machine learning in drug authentication: Challenges and opportunities. *Journal of Medical Systems*, 43(9), 256. https://doi.org/10.1007/s10916-019-1453-1

4. Gupta, P., Sharma, V., & Yadav, A. (2022). Deep learning approaches for detecting fake drugs using packaging features. In *Lecture Notes in Computational Vision and Biomechanics* (pp. 112–124). Springer.https://doi.org/10.1007/978-3-030-90436-7_10

5. Li, H., & Zhang, Y. (2020). Securing medicine supply chain using IoT and AI. *Computers in Biology and Medicine*, 125, 104013. https://doi.org/10.1016/j.compbiomed.2020.104013

Annexure:

Annexure I: Form A-Title Approval (for offline mode)

Annexure II: Form B-Market and financial feasibility (verify from guide)

Annexure III: Literature survey paper or links