**PROJECT ON**

**PHARMACY MANAGEMENT SYSTEM WITH AI INVENTORY PREDICTION**

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# 1. Project Title

Pharmacy Management System with AI-Based Inventory Prediction

# 2. Abstract

The Pharmacy Management System with AI Inventory Prediction is designed to streamline the operations of retail and wholesale pharmacy outlets by automating various core functionalities such as inventory tracking, sales management, supplier and customer handling, and expiry monitoring. Traditional pharmacy management practices often face challenges such as stock mismanagement, manual record keeping, delayed reordering, and poor visibility of medicine expiration. This project aims to overcome these issues by introducing an intelligent, centralized, and user-friendly software solution that not only manages pharmacy operations efficiently but also leverages machine learning to predict inventory requirements based on historical data trends.

The system comprises multiple integrated modules including Inventory, Sales, Receiving, Medicine Master Lists, Supplier and Customer Lists, Expiring Stock Tracker, and dynamic dashboards for data visualization. A web-based interface developed using React.js and Tailwind CSS ensures smooth user interaction, while Flask and PostgreSQL form the robust backend for data handling and RESTful API communication. A key innovation of this system is the AI-based inventory prediction engine that analyzes past purchasing and usage data to forecast future stock requirements, helping avoid both overstocking and stockouts.

Through the development and deployment of this Pharmacy Management System, the project aims to improve pharmaceutical service delivery, reduce wastage, and increase operational accuracy and efficiency. The proposed solution offers significant academic and practical value by demonstrating how AI can be embedded into traditional software systems to enhance decision-making in real-world applications.

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# 3. Introduction

In the evolving landscape of healthcare, pharmacies play a crucial role in ensuring the availability, distribution, and management of medicinal products to the public. However, many pharmacies, especially in developing regions, still rely heavily on manual or semi-automated systems for inventory management, sales tracking, and expiry monitoring. These traditional methods are often error-prone, time-consuming, and inefficient, leading to issues such as stock mismanagement, financial loss due to expired medicines, and delayed customer service. Recognizing these challenges, this project aims to design and develop a comprehensive Pharmacy Management System integrated with AI-based inventory prediction, tailored to meet the modern operational needs of pharmacies.

The project is built upon the foundation of improving accuracy, efficiency, and intelligence in pharmacy operations. By leveraging technologies like React.js for frontend, Flask for backend, and PostgreSQL for database management, the system ensures real-time data handling and a seamless user experience. Furthermore, the incorporation of an AI model capable of learning from historical inventory and sales data brings a predictive edge to the system. This not only enables pharmacies to make informed restocking decisions but also optimizes medicine availability and minimizes waste.

The decision to pursue this project stems from a deep interest in the application of software engineering principles in real-world healthcare scenarios. As a computer science engineering student, building a practical and impactful solution that bridges healthcare and technology provides both academic enrichment and personal satisfaction. Additionally, this project highlights the relevance of AI in solving day-to-day operational problems, aligning with current industry trends and contributing to the ongoing digital transformation in the healthcare sector.

# 4. Project Goals and Objectives

Goals:

The primary goal of this project is to design and implement a full-stack Pharmacy Management System integrated with AI-based inventory prediction. The system aims to streamline the day-to-day operations of a pharmacy by automating essential processes such as medicine inventory management, sales tracking, expiration monitoring, and supplier/customer information handling. Additionally, the inclusion of artificial intelligence will assist in predicting future inventory needs based on historical sales and usage patterns, thereby enhancing decision-making and reducing wastage.

Objectives:

* To develop a responsive and user-friendly web-based UI using React.js integrated with a backend API built in Flask.
* To design and implement a normalized PostgreSQL database schema that efficiently handles data related to medicines, sales, stock-in/out, expiration, suppliers, and customers.
* To build complete CRUD (Create, Read, Update, Delete) operations for all core entities in the pharmacy system including medicines, inventory, and transactions.
* To implement real-time inventory tracking with automatic updates based on stock received, sales made, and expired products.
* To integrate a machine learning model that analyzes historical sales and inventory data to predict future stock requirements, helping in proactive restocking decisions.
* To ensure data consistency, validation, and error-handling mechanisms at both frontend and backend levels.
* To conduct thorough testing and debugging to ensure the accuracy and reliability of all modules.
* To produce comprehensive documentation, including SRS, ER diagrams, UML diagrams, and deployment details for academic submission.

# 5. Project Scope and Methodology

The Pharmacy Management System with AI-Based Inventory Prediction focuses on automating and digitizing the operations of a retail or institutional pharmacy. The scope of this project encompasses the development of a web-based application that handles essential pharmacy modules such as medicine inventory, sales, stock receiving, expiration monitoring, medicine categorization, supplier and customer records, and user management.

This system will support dynamic and real-time updates for medicine stocks, provide expiration alerts, and maintain accurate transaction records. The project also extends its functionality by integrating an AI model that predicts inventory needs based on past sales data and seasonal trends.

Methodology:  
The software development follows an Agile methodology with weekly milestones. Flask (Python) will be used for backend APIs, React.js for frontend UI, and PostgreSQL as the database. AI models will be trained on historical sales data for forecasting.

# 6. Expected Deliverables

- A functional full-stack pharmacy management system (React + Flask).  
- PostgreSQL database schema and tables.  
- RESTful API endpoints for all modules.  
- Basic AI model for inventory prediction.  
- Project documentation including reports, ER diagrams, and UML diagrams.  
- Final presentation and demo video.

# 7. Resources Required

- Hardware: Personal computer with internet access.  
- Software: VS Code, PostgreSQL, Flask, React.js, GitHub.  
- Libraries: Pandas, Scikit-learn, SQLAlchemy, Axios, Tailwind CSS.  
- Data: Sample medicine sales and expiry data for training AI.

# 8 . Potential Challenges and Limitations

1. Limited Data for AI Prediction  
   The AI inventory module depends on historical data, which may be limited or unavailable in real-world scenarios. This can affect the accuracy of predictions.
2. Time Constraints  
   Due to academic deadlines, some advanced features like user roles, extensive reporting, or system optimization may be limited or deferred.
3. Scalability and Performance  
   The system is optimized for small to medium usage. Handling large-scale data or users may require further performance tuning.
4. Security Limitations  
   Basic login and data handling are implemented, but the system lacks robust security features like encryption or role-based access control.
5. Limited Integration  
   The current version does not support third-party integration with payment systems, government APIs, or external pharmacy databases.

# 9 . Expected Outcomes

The Pharmacy Management System with AI-Based Inventory Prediction is expected to result in the development of a functional, web-based platform capable of managing key pharmacy operations such as inventory, sales, receiving, supplier and customer information, and expiry tracking. The AI module will provide smart predictions for restocking based on historical sales and stock data, improving efficiency and reducing wastage.

From an academic standpoint, this project demonstrates the integration of full-stack development with intelligent systems, showcasing practical applications of machine learning in inventory management. It also contributes to understanding how modern technologies like Flask, React.js, PostgreSQL, and predictive analytics can be combined to build scalable and efficient management tools.

The final system will not only serve as a software prototype but also offer insights into pharmacy workflow optimization and data-driven decision-making—skills and concepts highly relevant in both academic research and real-world industry applications.

# 10. References (Preliminary)

- Flask Documentation (https://flask.palletsprojects.com/)  
- ReactJS Official Docs (https://reactjs.org/)  
- PostgreSQL Documentation (https://www.postgresql.org/docs/)  
- Scikit-learn for Machine Learning (https://scikit-learn.org/)