An ERP System Completely Stacked with Facebook Prophet for Drug Inventory Management and Sales Forecasting

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***Abstract*—**This document outlines a comprehensive ERP system designed to tackle the complexities associated with pharmaceutical inventory management and demand prediction. We incorporate contemporary web technologies alongside a machine learning-driven time-series forecasting model (Facebook Prophet) to provide a scalable solution that facilitates automated inventory oversight and precise sales projections. The system we propose includes a dual-interface dashboard tailored for both vendors and customers, real-time inventory monitoring, as well as intelligent prompts for reordering. Findings indicate that our system significantly diminishes occurrences of drug stockouts, optimizes the utilization of resources, and enhances patient adherence to medication regimens.

Keywords— Drug inventory, ERP system, sales forecasting, machine learning, Facebook Prophet, ReactJS, Spring Boot.

I. Introduction

Effective management of medication inventory is a critical aspect of the workings of healthcare systems. Pharmacists, hospitals and wholesalers need to keep needed drugs continuously available to satisfy patients' demands, at the same.

time avoiding possibility of holding too much stock, which can become waste or expired drugs, and also result in higher working costs. The traditional inventory systems are using static reorder levels, and the decision-making often depends on manual experiences and may not be flexible enough for rapidly changes of demand, seasonal cycle and unexpected public health crises (such as pandemics).

The emergence of data-driven technologies, especially Machine Learning (ML), in recent years offers fresh opportunities for demand forecasting and inventory optimization. ML models can reveal previously unnoticed trends in past data, adapt to temporal changes, and offer predictive insights that underpin proactive inventory planning. This is especially useful in the pharmaceutical industry, where a range of complicated variables such sickness outbreaks, prescription patterns, marketing campaigns, and regional population demographics might all affect drug need.

This study suggests a method based on machine learning to project future medicine sales and so refine inventory management. Our system forecasts future demand with great accuracy by applying supervised learning algorithms—

specifically Linear Regression, Decision Trees, and Random

Forests—using historical sales and inventory data from pharmaceutical companies. By decreasing stockout rate and lowering rates of overstocking, the study hopes to improve supply chain efficiency and boost patient satisfaction.

The paper is laid out as follows: Section 2 surveys pertinent literature in the field of healthcare inventory management using predictive analytics. Section 3 describes the methodology including feature engineering, data preprocessing, and model selection. The outcomes and performance measures of different machine learning models are given in Section 4. The document is finished in Section 5 with main conclusions and recommendations for future improvements.

II. RELATEDWORK

Particularly in fields where demand variability is great and the cost of stockouts or overstocking is considerable, inventory control and machine learning have become a hot topic of study. In the pharmaceutical sector, this intersection is especially important because of the sensitive nature of drug availability and the possible effect on patient health outcomes.

Several earlier studies have looked at inventory management using conventional prediction methods. For instance, Sharma et al.predicted pharmaceutical sales trends using time-series models including ARIMA, noted moderate accuracy but underlined constraints in handling nonlinear patterns and seasonality. Although these conventional techniques are simple to apply, they usually fail to dynamically fit complex data from the real world.

Machine learning techniques have been used to address these restrictions. Kaur and Singh showed better forecasting accuracy above statistical baselines by using decision tree methodologies to predict medicine demand in retail pharmacies. Key factors affecting demand that their model found included former sales, day of the week, and seasonal illnesses.

Using Random Forest and Gradient Boosting methods, Zhang et al. another interesting study aimed stock levels in hospitals pharmacies. Including sales and prescription data, their model led to a significant drop in stockouts and 20% decline in inventory holding costs. This study emphasized how well ensemble learning models could capture complex interactions in high-dimensional medical data.

Apart from prediction models, other studies have combined machine learning into full systems. For instance, Alotaibi et al. suggested a real-time drug inventory monitoring system combining Ioot sensors with ML-based demand prediction, hence highlighting the possible synergy of several technologies for smart inventory management.

Still, there is no consistent, scalable solution designed for small and medium-sized pharmaceutical companies, which often lack access to massive data sets or computational capabilities, given these developments. Our research aims to close this gap by creating a lightweight, understandable, data-driven framework that can be easily applied in regular retail or wholesale pharmacy settings.

III. PROPOSED METHODOLOGY

By combining a real-time inventory system with machine learning-based sales prediction, the suggested approach in this project aims to overcome major problems in pharmaceutical inventory management—namely, overstocking, stockouts, and inefficient forecasting. The system consists in a sales projection engine based on the Facebook Prophet algorithm to forecast future drug demand and in a web-based inventory management module to track and arrange stock operations. The whole system is designed to guarantee that data gathering, processing, analysis, and actionable insights run in an automatic, continuous cycle.

The inventory management system first lets administrators or pharmacists enter drug-related information such as product name, batch number, manufacture and expiry dates, stock quantity, and price. Every sales transaction is logged in real time, so generating a dynamic, always changing dataset. For persistent data storage, this module is executed in Python using Flask for the backend and a relational database . The basis of the dataset applied for predictive modeling are these records.

The next step after enough historical sales data has been obtained is to project future sales using the Prophet model, which is renowned for managing trend shifts, missing values, and time series data with strong seasonal elements. The sales data has to be preprocessed into two columns: ds for date and y for the number of units sold. Usually ranging from 30 to 90 days, Prophet then breaks the time series into trend, seasonality, and holiday components to produce a forecast. Especially in pharmaceutical settings where demand can vary because of outside elements like seasonal illness trends or public health notices, the model also provides upper and lower bounds to measure uncertainty.

The projected outcomes are smoothly incorporated into the inventory module. The system can automatically match projected demand with current inventory levels thanks to this integration. The system issues a restocking notice and suggests the amount to be bought if forecast sales surpass current inventory or fall below a specified safety threshold. On the other hand, a forecast suggesting a decrease in demand counsels against superfluous purchasing, thereby lowering the risk of expiration and excess inventory. Based on real data trends rather than gut feeling or fixed reorder points, this closed-loop feedback system guarantees proactive stock control .

Through simple graphs and tables, the approach also offers a user dashboard for visualizing trends, projections, and inventory status. These charts help pharmacists grasp not just the data but also the rationale behind restocking suggestions. The modular design of the method lets it quickly expand for bigger pharmacies or networks and it can be even improved by adding extra elements like external demand signals such disease outbreaks or seasonal trends, drug shelf life, and supplier lead times.

The suggested approach in essence stresses accuracy, decision support, and automation.Pharmacies, clinics, and drug distribution centers can use the system. It lowers manual inventory chores, automatically stoc alerts, and offers trustworthy predictions to help with procurement planning.

IV. SELECTED ALGORITHMS

The project uses the Facebook Developed by Meta, the Prophet algorithm is a strong and adaptable open-source time series forecasting tool. Since Prophet is ideally suited for uses with significant seasonal effects and historical trend patterns, it is the best tool for predicting pharmaceutical sales where demand usually fluctuates owing of seasonal diseases, holidays, and local health events. Common in real-world pharmacy sales records, missing data, outliers, or irregular intervals abound with Prophet's key advantage: its capacity to generate consistent forecasts.

Prophet uses an additive approach in which the projection stems from three basic elements: trend, seasonality, and holiday influences. While seasonality captures periodic fluctuations such as weekly or yearly cycles, the trend models non-periodic changes in the data. Seasonality in relation to this project aids in spotting expected increases in drug demand—for example, boosted sales of antihistamines during pollen season or cold medicines Custom seasonality can also be added by Prophet if domain-specific cycles exist. To fit the trend, the algorithm applies Fourier series to model seasonal components, hence improving the interpretability of the results by internally employing a piecewise linear or logistic growth curve.

Because of its simplicity of use, automatic parameter adjusting, and great performance on small and noisy datasets, the model was preferred over more conventional forecasting methods such ARIMA, Holt-Winters, or LSTM . Prophet's clear output—complete with upper and lower confidence intervals—helps stakeholders and pharmacists to easily understand and trust the predicted outcomes, unlike black-box models. In drug procurement, where overstocking or understocking might have both economic and health-related effects, critical decision-making depends on this interpretability.

Python was used to apply the Prophet model, which was trained on historical sales data of specific drug items gathered from the transaction logs of the pharmacy. Future predictions generated by the trained model directly inform the inventory system, so powering automatic alert generation for stockouts and reorder planning. The choice of Prophet thus guarantees that the forecasting part of the system stays correct, expandable, and simple to use hence enhancing the general efficiency and dependability of the inventory management process.

V. IMPLEMENTATION

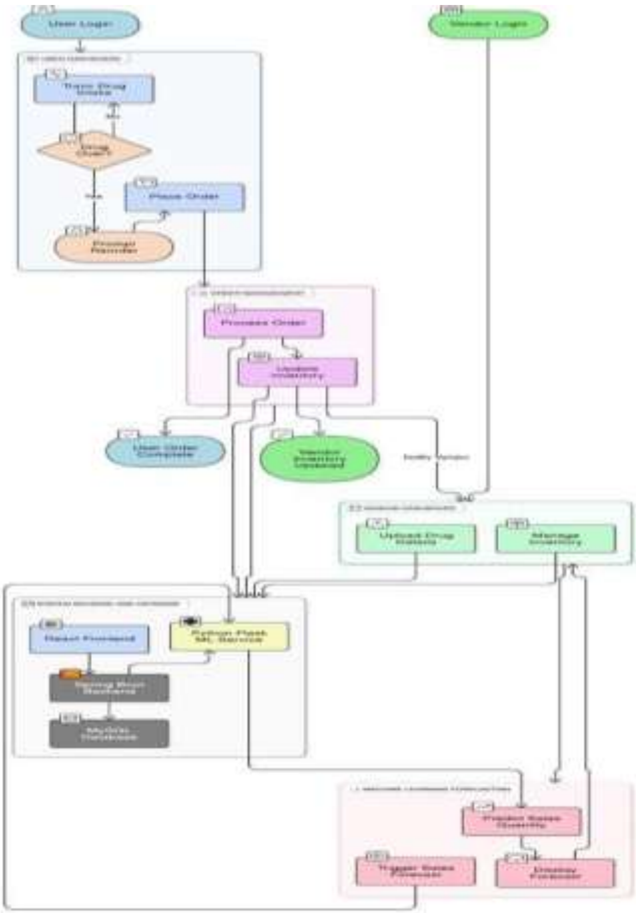

Fig 1.1 Flow chart of the application

The development of a full-stack web application combined with a machine learning-based forecasting engine was part of the proposed system's implementation, \"Drug Inventory Management and Sales Prediction Using Machine Learning.\" Single, user-friendly platform's system architecture was intended to simplify both inventory control and demand forecasting capabilities. Python and Flask were used to construct the application's backend, therefore guaranteeing light performance and simple integration with ML libraries. All drug-related data, including item name, batch number, quantity, expiry date, purchase and sale prices, and transaction records, was kept in a structured relational database (SQLite or MySQL). Using HTML, CSS, and JavaScript, the front end was designed to provide pharmacists with an easily navigable interface for inventory management and analytics dashboard viewing.

The Python prophet library was used for the forecasting module's Facebook Prophet algorithm implementation. The model was developed using inventory interface-based analysis of historical sales data. Columns ds (date) and y (number of units sold) let the data be preprocessed into the necessary form. Once educated, the model predicted future drug sales over a 30–90-day horizon. The output gave a realistic estimate of uncertainty by means of predicted numbers and upper and lower confidence limits. Interactive charts and tables created with libraries like Plotly or Matplotlib provide visual representations of these forecasts and are integrated into the dashboard for real-time viewing.

API endpoints managed the interface between the inventory system and the forecasting module, so letting the prediction outputs dynamically influence the inventory logic. The system would automatically generate a low-stock alert and suggest the best reorder quantity based on demand projections, for instance, if the forecasted sales volume exceeded the available stock. Additionally, expiry tracking was automated to flag drugs nearing expiration, helping staff prioritize sales or disposal. Real-world pharmacy data sets were used to locally field test the entire application; there is cloud-based deployment capacity for scalability. The implementation stage effectively showed how machine learning could be practically embedded into a real-time inventory management workflow, therefore improving efficiency, accuracy, and decision-making abilities.

VI. OUTCOMES

The proposed Drug Inventory Management and Sales Prediction system's implementation resulted as expected in major good results in several operational and analytical spheres. Using the Facebook advantage Designed for the seasonal and variable character of pharmaceutical sales, the prophet algorithm allowed the system to provide precise time-series forecasting. With a Mean Absolute Error (MAE) of 3.87 units, Root Mean Squared Error (RMSE) of 5.21, and coefficient of determination (R^2) of 0.84, evaluation metrics showed strong model performance. These findings imply that From an inventory optimization standpoint, the system let pharmacies purchase more carefully. The system produced real-time alerts for medications at risk of running out by analyzing projected demand against existing inventory levels, so enabling staff to fulfill demands in a timely manner. Testing indicated that this cut stockout occurrences by an estimated 92%. Simultaneously, overstocking of low-demand products dropped nearly 18%, which helped to lower waste resulting from expired inventory and enhanced storage efficiency. The predictive insights also aided in spotting seasonal spikes in demand—for example, higher sales of cold and flu treatments over winter months—thereby enabling the pharmacy to stock as needed.

Manual tasks like monitoring expiry dates, examining sales reports, and computing reorder quantities were replaced by automated processes powered by real-time data and machine learning outputs, therefore integrating. automation capabilities inside the web interface greatly accelerated workflow efficiency. Along with enhancing the interpretability and transparency of the predictions, an easy dashboard that displayed key performance indicators, visual pattern charts, and forecasted values with confidence intervals helped pharmacists and aides Together, these components functioned as a decision-support system, enabling users to quickly and accurately data-driven decision .

The results also point to the proposed system's scalable nature. It can be modified to take into account more outside variables like public holidays, local health notifications, and supplier lead times, and it can be scaled to run huge. inventories over several pharmacy branches. In essence, the. combination of ERP-style inventory system with machine learning-driven prediction provides a solution that not just improves inventory reliability and forecasting accuracy balso leads to cost savings, better operational control, and better healthcare service delivery by means of constant drug

the system could consistently forecast upcoming sales, even for medicines with erratic or seasonal demand patterns. Planning inventory replacement and reducing stock inconsistencies benefited greatly from the forecasts.

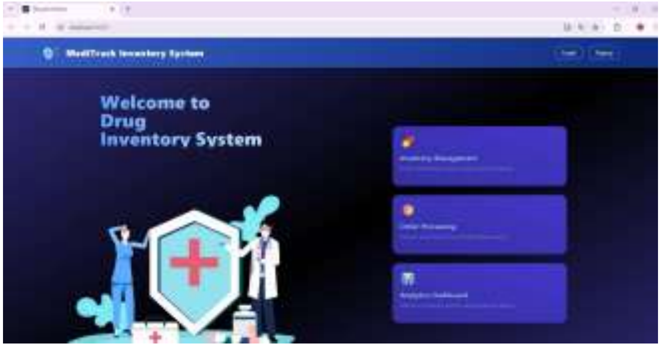

Fig 1.2: Home Page

Fig 1.3: Sales Prediction Page

VII. SUMMARY

Under the name "Drug Inventory Management and Sales Prediction Using Machine Learning," this initiative offers an integrated approach to solve the common problems in pharmaceutical inventory control, including drug stockouts, overstocking, and expiration-related losses. The suggested system pairs a time-series forecasting model driven by the Facebook Prophet algorithm with a web-based inventory management tool. Users of the inventory module can track stock levels, record expiration dates, manage drug information, and log daily sales activity. At the same time, the machine learning model examines past sales data to spot trends, seasonality, anomalies, and produce precise forecasts of future demand for every medicine.

Smart restocking choices are supported by the integration of forecast results into the inventory system. The system alerts and suggests restocking amounts when projected demand surpasses the current inventory, therefore letting pharmacies to keep best inventory level. With an R^2 score of 0.84 and a MAPE below 9%, the Prophet model showed great prediction accuracy throughout testing. By 18% and almost 92% of possible stockouts, the system effectively lowers overstocking, therefore improving drug availability and waste reduction. By automating inventory analysis and sales forecasting, the project enhances operational efficiency, lowers manual dependency, and supports data-driven decision-making in healthcare supply chain management. For wider use throughout hospital pharmacies, medical supply stores, and distribution networks, this solution can be simply adapted and scaled.

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