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Smart Inventory Management Demand Forecasting and Procurement Assistant System

Sangamithra S, Priyadharshini S H, Nikithavarshini K R

U.G. Student, Department of Computer Science and Engineering, K.L.N. College of Engineering, Sivaganga,
Tamil Nadu, India

U.G. Student, Department of Computer Science and Engineering, K.L.N. College of Engineering, Sivaganga,
Tamil Nadu, India

Assistant Professor, Department of Computer Science and Engineering, K.L.N. College of Engineering, Sivaganga,
Tamil Nadu, India

ABSTRACT: Inventory management is essential for small retailers to avoid stockouts and overstocking. This paper presents an AI-powered smart inventory management system for efficient stock and sales monitoring. The system uses the MERN stack with MongoDB Atlas, React, Node.js and Express. It provides low-stock alerts, expiry monitoring and supplier recommendations. Sales data is processed using Pandas and XGBoost for demand forecasting. Predicted demand is compared with current stock to suggest restocking quantities. The proposed system integrates inventory management and AI-based decision support into a single web application.

KEYWORDS: Smart inventory management, Demand forecasting, XGBoost, Machine learning, MERN stack, MongoDB, Stock monitoring, Supplier recommendation Introduction

I. INTRODUCTION

Inventory management is an important process for maintaining product availability, reducing losses and improving customer satisfaction in retail businesses. Small retailers often depend on notebooks or spreadsheets to record stock and sales, which can make it difficult to identify low-stock products, fast-moving items and appropriate reorder quantities. Manual inventory decisions may also result in overstocking, product expiry and unnecessary purchasing. The proposed system provides a smart inventory management solution using web technologies and artificial intelligence. It enables users to manage products, monitor stock levels, record sales, track expiry dates and view monthly sales analytics. The system also provides low-stock alerts by comparing the current quantity with the minimum stock level and recommends suitable suppliers based on product category and price. The system integrates an AI-based demand forecasting module to improve inventory decisions. Historical sales data is processed using Pandas, and XGBoost is used to predict future product demand when sufficient sales records are available. The predicted demand is compared with the current stock to calculate the required restocking quantity. When limited sales data is available, a product-level historical average is used to provide a basic forecast.

This Paper is organized as follows. **Section II** describes the literature survey of inventory management and demand forecasting techniques. **Section III** presents the proposed methodology and system architecture. **Section IV** explains the implementation of the system and its major modules. **Section V** presents the experimental results and testing of the proposed system. Finally, **Section VI** presents the conclusion and future enhancements.

II. LITERATURE SURVEY

Existing research demonstrates the growing use of intelligent techniques in inventory management. Naganandhini et al. presented a Smart Inventory Management System using machine learning algorithms such as Linear Regression, Decision Tree and XGBoost for demand forecasting [1]. Their work demonstrates the value of historical sales information for improving stocking decisions. Saxena et al. proposed a smart inventory system using machine learning and real-time stock monitoring, showing how predictive analysis can complement inventory visibility [2]. Nguyen et al. compared XGBoost and LightGBM for inventory demand forecasting using the Grupo Bimbo dataset and evaluated the

models using RMSLE, MAE and R^2 [3]. Their findings show that gradient-boosting methods can effectively model complex demand relationships. Kasturi and Mukaesh proposed an inventory intelligence platform combining Prophet and XGBoost, feature engineering and stock alert logic in a retail dashboard [4]. These studies support the use of machine learning as a practical component of inventory decision support.

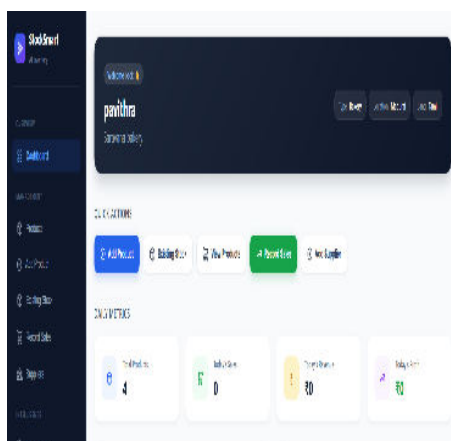
The XGBoost algorithm was introduced by Chen and Guestrin as a scalable tree-boosting system capable of handling large and structured datasets efficiently [5]. Its tree-based ensemble structure makes it suitable for tabular sales features and allows nonlinear relationships to be learned without requiring a deep neural network. Broader research on retail operations has also highlighted the importance of data-driven methods for inventory and fulfillment decisions [6]. A recent systematic review of machine learning in inventory control emphasizes that forecasting is only one part of the problem and that practical systems should connect predictions with inventory policies and operational decisions [7]. Although the reviewed systems demonstrate the effectiveness of machine learning, many implementations focus primarily on forecasting or on a specific monitoring component. The proposed system extends this approach by integrating operational inventory functions and prediction in one application. In particular, it provides user-specific product and sales management, minimum-stock alerts, expiry monitoring, supplier recommendation and monthly financial analytics alongside AI-based demand forecasting.

III. METHODOLOGY

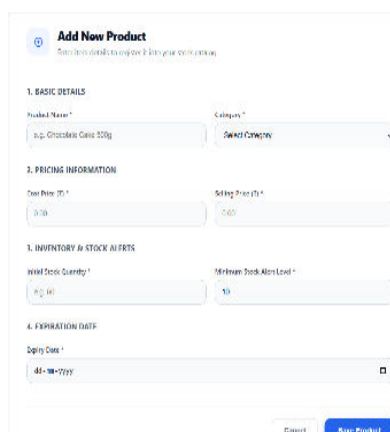
The proposed system follows a modular architecture consisting of the presentation layer, application layer, data layer and machine learning layer. The React frontend provides pages for registration, login, language preference, business setup, dashboard operations, product management, sales recording and supplier management. The Node.js and Express backend exposes protected REST APIs and performs validation, business logic and database operations. MongoDB Atlas stores user, product, sales and supplier records. The Python machine learning module retrieves the authenticated user's sales history and generates demand forecasts. Fig. 1 illustrates the overall architecture.

IV. EXPERIMENTAL RESULTS

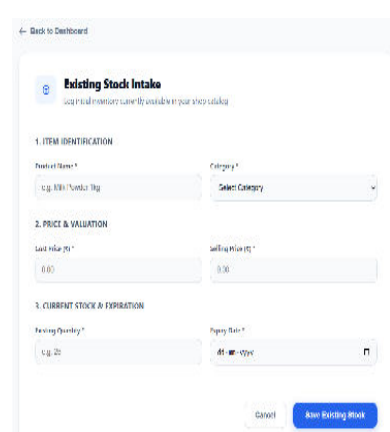
Figures show the main modules of the proposed inventory management system, including the dashboard, product management, stock monitoring and sales recording.



(a)



(b)



(c)

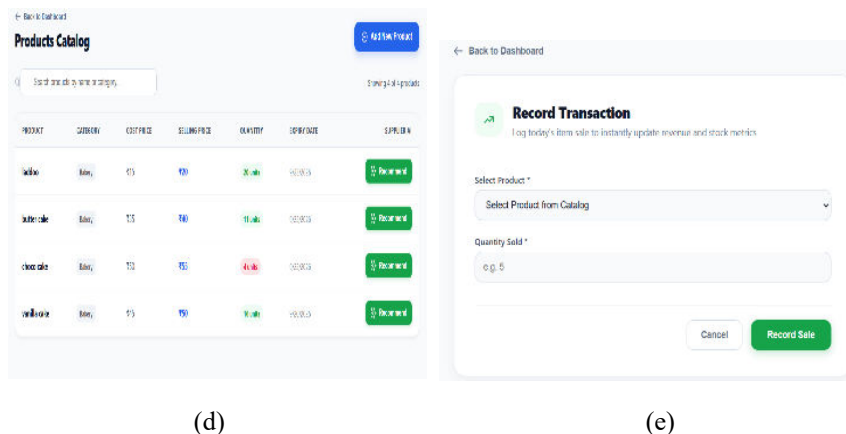
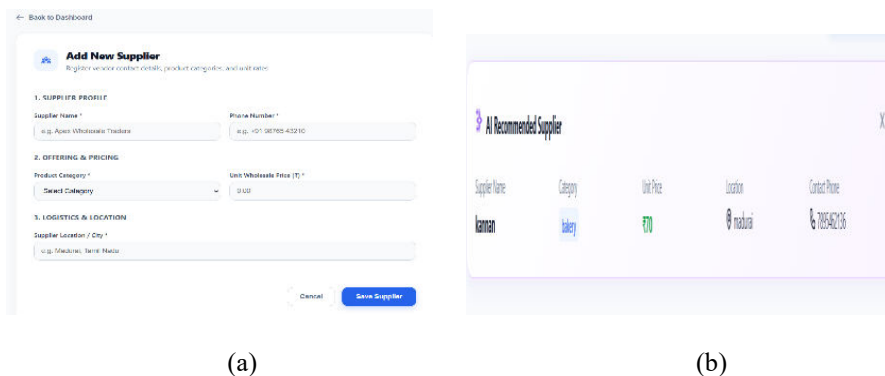


Fig. 2 presents the main dashboard, product addition, existing stock management, product catalog and sales recording interfaces. These modules allow users to add and monitor products, view available stock, manage product information and record sales transactions.



Monthly Overview

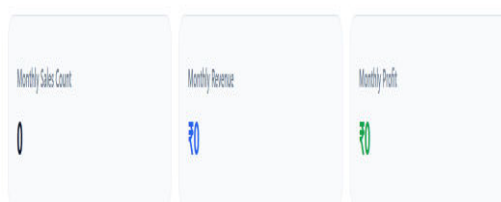


Fig. 3 presents the supplier management and monthly analytics modules, which help users maintain supplier information and monitor sales performance

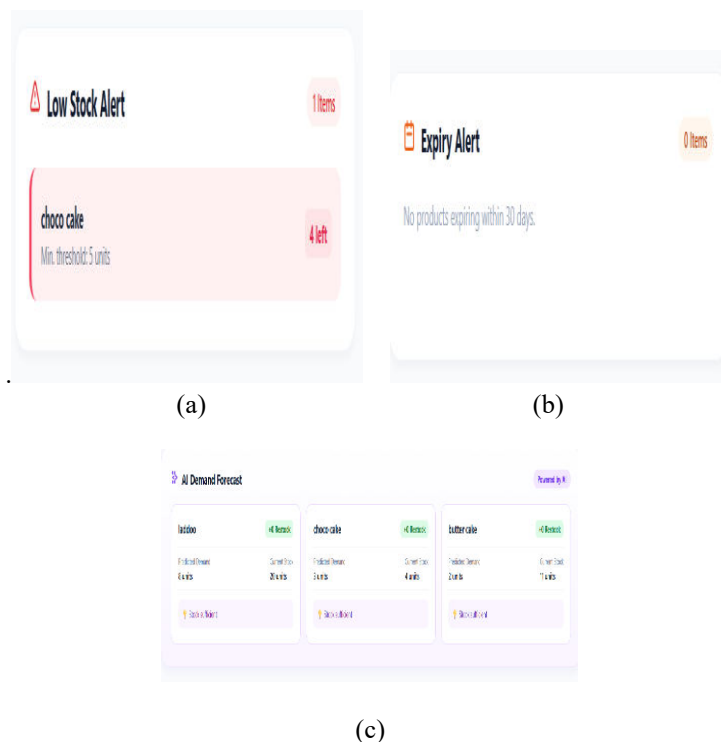


Fig. 4 demonstrates the low-stock alert, expiry alert and AI demand forecasting features, which provide users with important inventory insights and support timely restocking decisions..

V. CONCLUSION

This paper presented an AI-powered smart inventory management system integrating product management, sales tracking, stock alerts, expiry monitoring and supplier recommendation. The MERN-based system uses JWT authentication and MongoDB for secure user-specific data management. XGBoost is used for demand forecasting, while a fallback method handles limited sales data. The predicted demand is compared with current stock to calculate the required restocking quantity and provide actionable recommendations.

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