World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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StockSense: An intelligent inventory management system for retail stores using machine learning-based demand forecasting

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World Journal of Advanced Research and Reviews, 2026, 30(01), 241-251

Publication history: Received on 24 February 2026; revised on 01 April 2026; accepted on 03 April 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.30.1.0833

Abstract

The retail sector, particularly small and medium-sized enterprises (SMEs), faces challenges such as inefficient inventory management, stock imbalances, and product wastage. Traditional methods lack real-time visibility and fail to support data-driven decision-making. This project aims to develop an Intelligent Inventory Management System for Retail **Stores** that improves operational efficiency and reduces losses through automation and predictive insights.The proposed system is a web-based application that integrates a Point of Sale (POS) interface for real-time inventory updates. It incorporates Machine Learning-based demand forecasting to analyze historical sales data and predict future product requirements. Additionally, a smart expiry management module monitors product shelf life and generates alerts for near-expiry items, enabling timely actions such as discounts to minimize wastage. The system also provides dashboards and reports to support better decision-making.The results demonstrate improved accuracy in inventory tracking, reduced stock-outs, and effective management of perishable goods. By automating key processes and integrating predictive analytics, the system enhances efficiency and reduces manual effort.

Keywords: Inventory Management; Machine Learning; Predictive Analytics; Demand Forecasting; Retail Automation; Expiry Tracking

1. Introduction

1.1. Background Motivation

The retail industry is rapidly evolving with increasing competition and changing customer demands. Efficient inventory management has become essential to ensure product availability, reduce wastage, and maintain profitability. However, many small and medium-sized retail stores still rely on traditional methods, which often lack real-time tracking and accuracy.

Manual inventory systems and basic billing tools are not capable of handling the complexity of modern retail operations. These approaches frequently lead to issues such as stock shortages, overstocking, and poor management of perishable goods. As a result, store owners face challenges in making timely and informed decisions.

1.2. Need for the Study

The absence of intelligent systems in retail inventory management limits the ability to analyze sales patterns and predict future demand. Without proper forecasting, businesses struggle to maintain optimal stock levels, leading to financial losses and inefficiencies.

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There is a growing need for a system that not only automates inventory tracking but also provides predictive insights and real-time monitoring. Such a system can significantly improve operational efficiency and reduce dependency on manual processes.

1.3. Objectives of the Study

The main objectives of this project are:

- To develop a real-time inventory management system using a Point of Sale (POS) interface
- To implement Machine Learning techniques for demand forecasting
- To design a smart expiry management module to reduce product wastage
- To provide dashboards and reports for data-driven decision-making
- To improve overall efficiency, accuracy, and scalability of retail operations

2. Literature review

Existing inventory management systems mainly focus on basic stock tracking and POS integration, offering limited support for intelligent decision-making. Some recent approaches use Machine Learning and Predictive Analytics for demand forecasting, which helps reduce stock imbalances but often lacks real-time integration with inventory systems. Other solutions address specific issues like expiry tracking but are limited to simple alerts without actionable insights. Overall, most existing systems handle individual aspects of inventory management rather than providing a complete solution. This highlights the need for an integrated system that combines real-time tracking, demand forecasting, and expiry management to improve efficiency and reduce wastage.

2.1. Halil et al. (2025). Desktop-Based Expiry Date Application for Retailers Inventory Management.

This study proposes a desktop-based system to track product expiry dates and reduce wastage in retail inventory. It uses rule-based alerts to notify retailers about near-expiry items, improving visibility of perishable goods. However, it lacks predictive analytics, real-time integration, and scalability, limiting its effectiveness in modern retail environments.

2.1.1. Methodologies and Algorithms

The system uses a desktop-based architecture with a centralized database to store inventory data. It applies rule-based logic to monitor expiry dates and generate alerts for near-expiry products. The approach focuses on simplicity without using advanced Machine Learning or predictive techniques.

2.1.2. Accuracy and Limitations

The study does not provide specific accuracy metrics as it mainly focuses on functionality. While it effectively tracks expiry dates, it lacks real-time integration and predictive capabilities. Its desktop-based nature also limits scalability and accessibility in modern retail systems.

2.2. Riazi et al. (Year). Improving the Sales Process of Profitable Perishable Goods: An Inventory Control Strategy in a Planned Economy

This study focuses on optimizing the sales and inventory management of perishable goods to improve profitability. It highlights the importance of structured inventory control strategies in reducing waste and maximizing revenue. However, it mainly emphasizes theoretical models rather than practical system implementation.

2.2.1. Methodologies and Algorithms

The study uses mathematical and inventory control models to manage perishable goods efficiently. It analyzes demand patterns and applies optimization techniques to improve stock handling. The approach is more analytical and model-driven than system-based.

2.2.2. Accuracy and Limitations

The study provides theoretical validation but lacks real-time system implementation and practical evaluation. It does not include automation or integration with retail systems. Its applicability in dynamic retail environments is limited.

2.3. Agusfen et al. (2023). Analysis of Damaged and Expired Return Goods Procedures for Merchandise Inventory Internal Control System

This study examines procedures for handling damaged and expired goods in retail inventory systems. It focuses on improving internal control mechanisms to reduce losses and maintain accountability. The work emphasizes operational processes rather than technological solutions.

2.3.1. Methodologies and Algorithms

The study uses process analysis and internal control frameworks to evaluate return procedures. It identifies inefficiencies in handling damaged and expired goods. The approach is procedural and does not involve advanced algorithms or automation.

2.3.2. Accuracy and Limitations

The study lacks quantitative accuracy measures and focuses mainly on qualitative analysis. It does not propose an automated or intelligent system. Limited scalability and absence of predictive features are key limitations.

2.4. KV et al. (2022). A Study of Inventory Control Techniques to Optimize Revenue in Small Retail Stores

This study explores various inventory control techniques aimed at improving revenue in small retail stores. It highlights methods to balance stock levels and reduce losses. The research provides insights into traditional inventory practices

2.4.1. Methodologies and Algorithms

The study analyzes classical inventory control techniques such as EOQ and stock level management. It evaluates their effectiveness in small retail environments. The approach is based on traditional models rather than modern data-driven techniques.

2.4.2. Accuracy and Limitations

The study does not include real-time implementation or performance metrics. It lacks integration with modern technologies like Machine Learning. Its reliance on traditional methods limits adaptability in dynamic retail scenarios.

2.5. Rexhaj (2019). Perishable Inventory Management Solutions and Challenges of Kosovo FFRs

This study discusses challenges faced in managing perishable inventory and proposes solutions to reduce product expiration. It highlights the importance of efficient stock monitoring and handling practices in retail environments. The focus is on identifying real-world challenges.

2.5.1. Methodologies and Algorithms

The study uses case-based analysis and observational methods to understand inventory issues. It examines existing practices in retail stores and suggests improvements. No advanced algorithms or automated systems are implemented.

2.5.2. Accuracy and Limitations

The study lacks quantitative evaluation and focuses on descriptive analysis. It does not provide a technological solution or predictive approach. Limited automation and scalability reduce its practical impact.

2.6. Scalability Comparison of Existing and Proposed Systems

Figure 1 The graph shows that existing systems have limited scalability due to their static or theoretical nature, while the proposed system achieves higher scalability due to its web-based architecture and real-time processing capabilities.

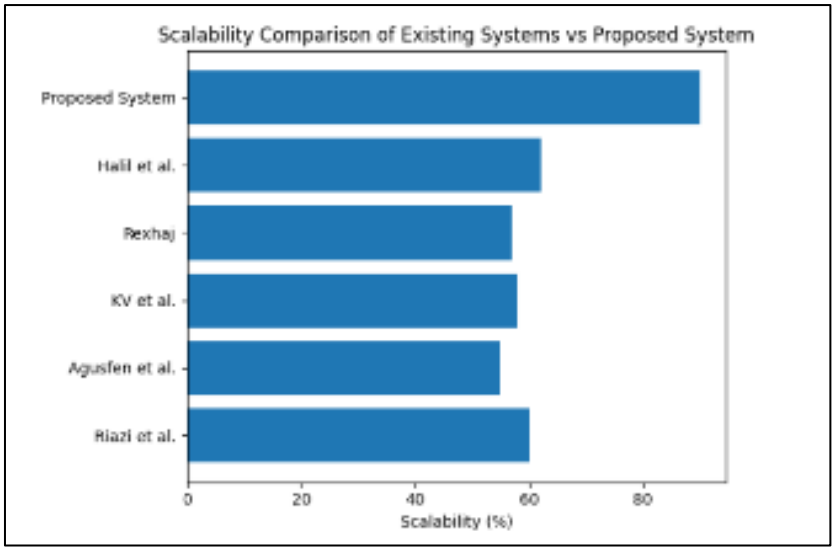

Figure 1 Comparison of Scalability of Existing and Proposed Systems

2.7. Comparison of Accuracy of Existing and Proposed Systems

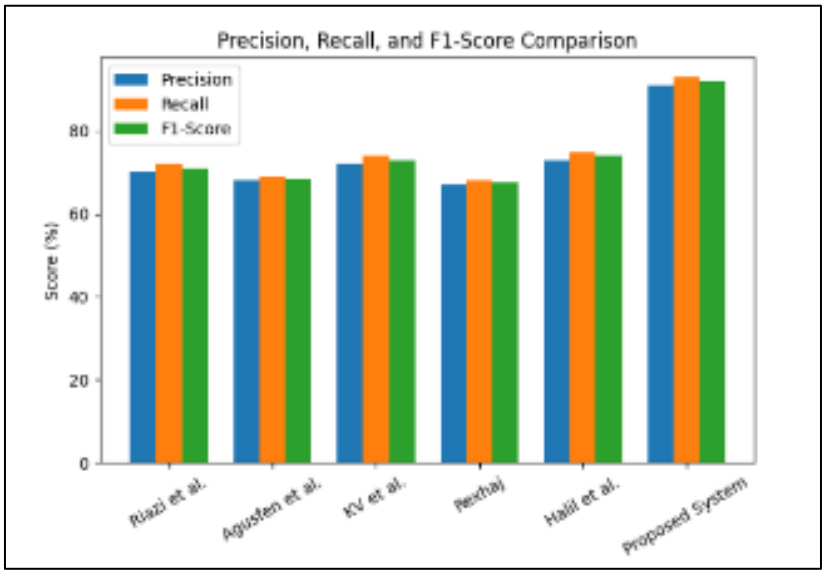

Figure 2 Comparison of Precision, Recall, F1-Score of Existing and Proposed Systems

Figure 2 The graph compares Precision, Recall, and F1-Score of existing inventory management approaches with the proposed system. Existing methods show moderate performance due to limited automation and lack of predictive intelligence. In contrast, the proposed system achieves higher Precision, Recall, and F1-Score by integrating Machine Learning and real-time inventory tracking, ensuring more accurate and reliable decision-making.

2.8. Comparative Analysis of Existing Systems with Proposed Model

As evident from Table 1, while several existing systems provide moderate effectiveness in managing inventory and reducing product wastage, most of them focus on individual aspects such as expiry tracking, traditional inventory control methods, or procedural analysis. These approaches lack real-time integration, predictive capabilities, and scalability required for modern retail environments. In contrast, the proposed system addresses these limitations by integrating real-time inventory tracking with Machine Learning-based demand forecasting and smart expiry management. By combining multiple functionalities into a unified platform and enabling data-driven decision-making, the system improves accuracy, reduces wastage, and enhances overall operational efficiency, making it more suitable for practical deployment in dynamic retail scenarios.

Table 1 Comparative Analysis of Existing Research on Inventory Management Systems

Name of the Paper	Year	Techniques Used	Accuracy	Limitations
Desktop-Based Expiry Date Application for Retailers Inventory Management	2025	Rule-based expiry tracking, Desktop system	Moderate	No predictive analytics, no real-time integration, limited scalability
Improving Sales Process of Perishable Goods	2024	Inventory control models, Demand analysis	Moderate	Theoretical approach, no real-time system implementation
Analysis of Damaged and Expired Goods	2023	Internal control procedures, Process analysis	Moderate	No automation, lacks intelligent features
Inventory Control Techniques	2022	EOQ, traditional stock control	Moderate	No ML integration, not adaptive
Perishable Inventory Management	2019	Case study, observational analysis	Moderate	No system implementation, lacks prediction

3. Methodology

The proposed system consists of multiple modules, including Point of Sale (POS), Inventory Management, Demand Forecasting, Expiry Management, User Interface, and Analytics & Reporting, which are integrated into a unified web-based framework. These modules work together in a structured workflow, starting from data collection through the POS system and storage in a centralized database, followed by processing and analysis. The system continuously monitors inventory levels, predicts future demand using Machine Learning, tracks product expiry, and generates alerts and reports. This integrated approach enables efficient, automated, and data-driven inventory management in retail environments.

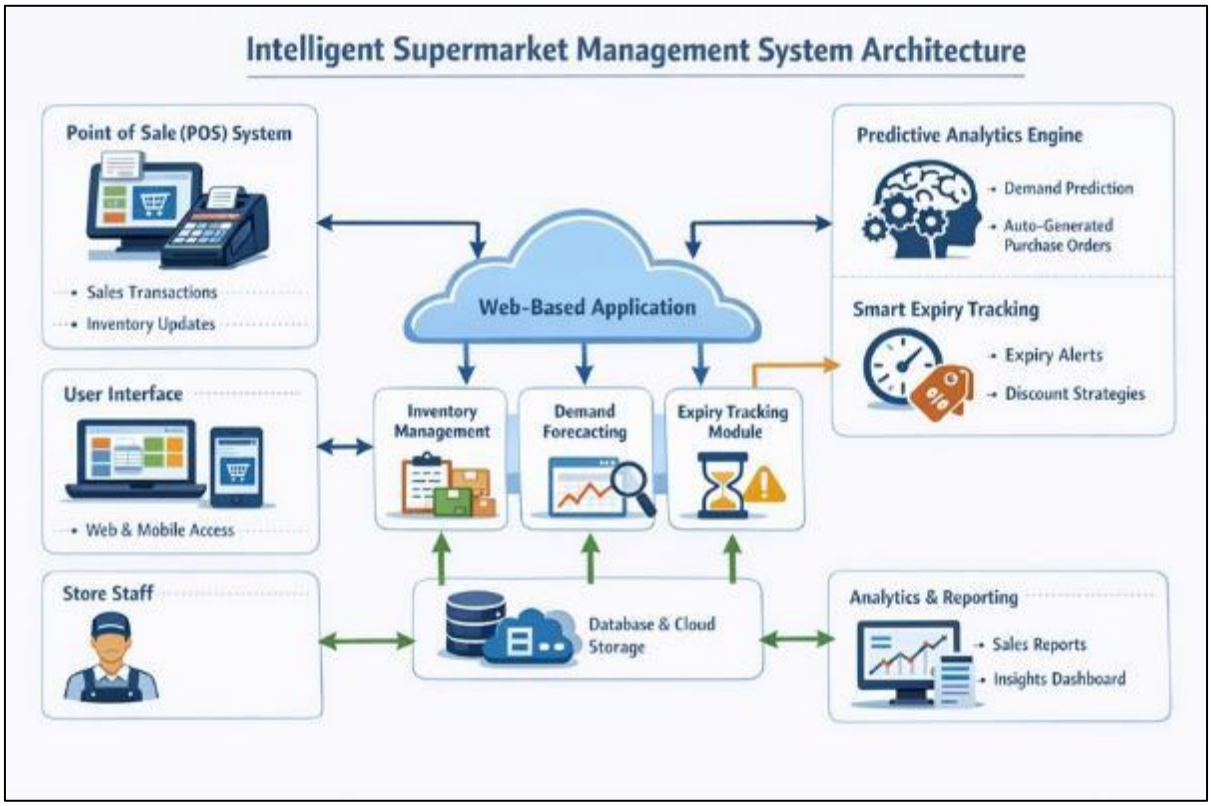

Figure 3 System Architecture for Proposed System

The proposed system follows a structured workflow that integrates real-time inventory tracking, Machine Learning-based demand forecasting, and expiry management to ensure efficient retail operations.

- Step 1: User Login and Authentication

Users (Admin/Staff) log into the system to access inventory and sales modules.

- Step 2: Product and Inventory Setup

Products are added with details such as name, category, price, quantity, and expiry date, which are stored in the database.

- Step 3: Sales Processing through POS

During a sale, items are selected and billed through the POS interface, and inventory is automatically updated in real time.

- Step 4: Real-Time Inventory Monitoring

The system continuously monitors stock levels and identifies low-stock or overstock conditions.

- Step 5: Data Collection for Analysis

Sales and inventory data are collected and stored to be used for further analysis and prediction.

- Step 6: Demand Forecasting (ML Module)

Machine Learning algorithms analyze historical sales data to predict future demand for each product.

- Step 7: Expiry Tracking and Monitoring

The system tracks product expiry dates and identifies items nearing expiration.

- Step 8: Alert and Notification System

Alerts are generated for low stock, predicted high demand, and near-expiry items to notify users.

- Step 9: Smart Recommendations

The system suggests restocking quantities and discount strategies based on demand predictions and expiry status.

- Step 10: Dashboard and Reporting

Interactive dashboards display sales trends, inventory status, and performance insights for decision-making.

- Step 11: Decision Making and Optimization

Based on insights and alerts, users can take appropriate actions to optimize inventory and reduce wastage.

4. Results and discussion

The proposed system was tested under various simulated conditions to evaluate its performance in inventory management and decision support. The system integrates a web-based interface, real-time POS updates, Machine Learning-based demand prediction, and expiry monitoring to ensure efficient operation. The results demonstrate that the system effectively maintains accurate stock levels, reduces product wastage, and provides meaningful insights for decision-making across different scenarios such as low stock detection, demand variation, and expiry management.

4.1. Initial Display

Figure 4 Initial Display

The above figure 4 displays the system home screen with navigation options and entry points for users to access the platform.

4.2. Admin Dashboard

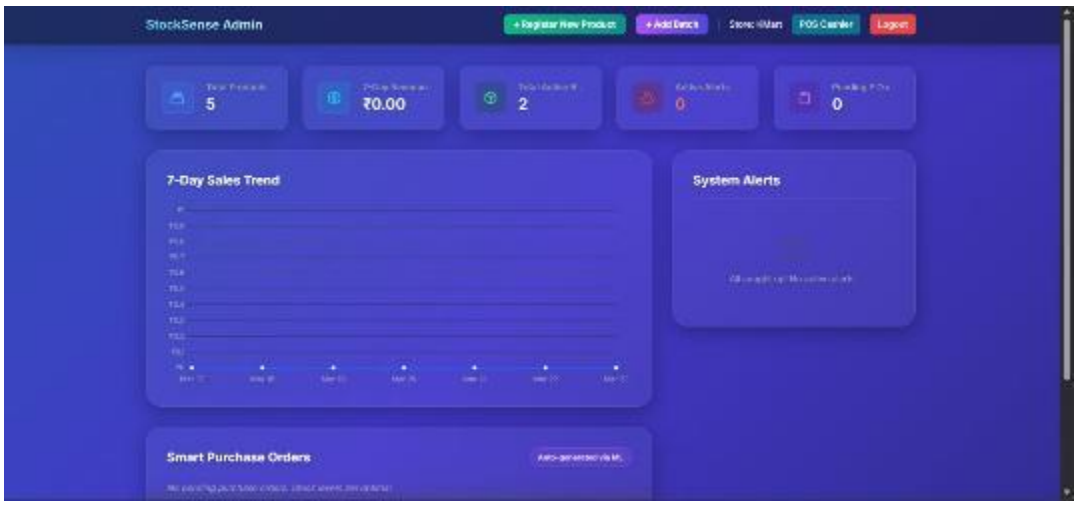

Figure 5 Admin Dashboard

The above figure 5 displays the admin dashboard showing total products, revenue, active batches, alerts, and pending purchase orders. It includes features such as registering new products, adding batches, accessing the cashier dashboard, viewing sales trends, system alerts, and smart purchase order generation.

4.3. Cashier Dashboard

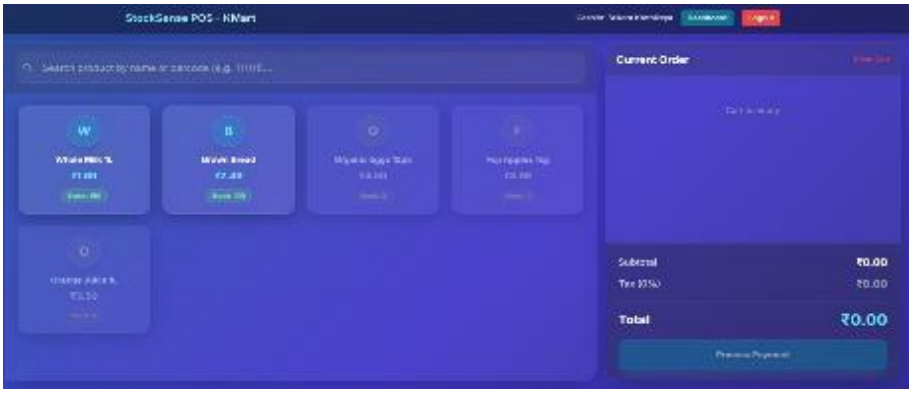

Figure 6 Cahier Dashboard

The above figure 6 displays the cashier dashboard where products can be searched and added to the cart for billing. It includes features such as product listing, real-time stock display, order summary, and payment processing.

4.4. Register New Product

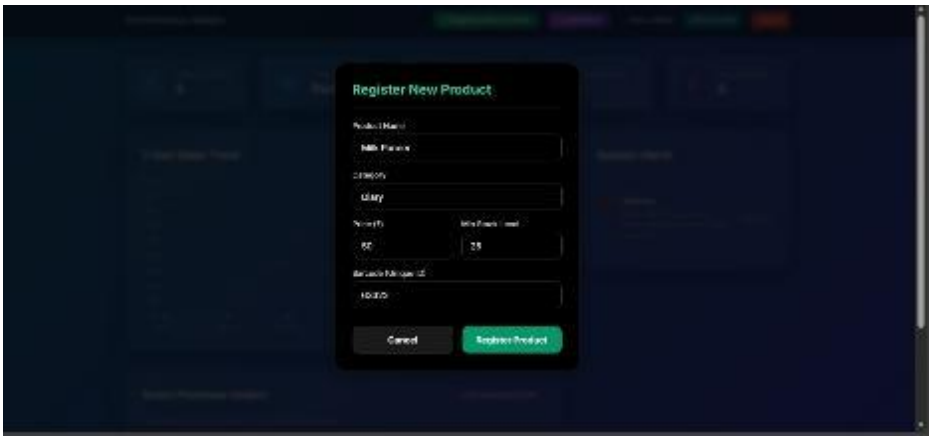

Figure 7 Register New Product

The above figure 7 displays the product registration form where users can add new products by entering details such as name, category, price, stock level, and barcode.

4.5. Stock alerts

Figure 8 Stock alerts

The above figure 8 displays system alerts indicating low stock levels for products, helping users take timely action.

4.6. Expiry alerts

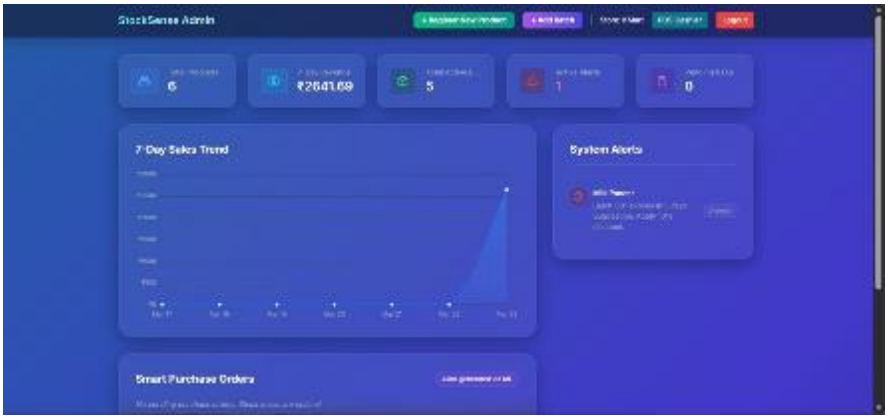

Figure 9 Expiry alerts

The above figure 9 displays alerts for products nearing expiry, helping users take necessary actions such as applying discounts.

Table 2 Functional and Performance Testing of the Proposed System

Test Case ID	Module	Test Description	Expected Output	Status
TC-001	Authentication	Valid user login	Valid user login	Pass
TC-002	Authentication	Invalid login attempt	Error message displayed	Pass
TC-003	Product Module	Add new product	Product added successfully	Pass
TC-004	Product Module	Delete product	Product removed from list	Pass
TC-005	Batch Module	Add new batch	Batch added with expiry details	Pass
TC-006	POS Module	Process sale transaction	Bill generated and inventory updated	Pass
TC-007	Inventory Module	Low stock condition	Alert generated	Pass
TC-008	Expiry Module	Near-expiry product detection	Expiry alert displayed	Pass
TC-009	ML Module	Demand prediction	Forecast generated successfully	Pass
TC-010	Recommendation Module	Generate purchase order	Suggested restocking displayed	Pass
TC-011	Dashboard	Display sales trend	Graph displayed correctly	Pass

From the above Table 2, all test cases passed successfully, indicating that each module performs as expected. The system demonstrates stable, accurate, and reliable performance under different conditions.

5. Conclusion

The proposed Intelligent Inventory Management System demonstrates how Machine Learning and Predictive Analytics can improve efficiency and decision-making in retail inventory management. By integrating real-time inventory tracking, demand forecasting, and smart expiry management, the system reduces product wastage and ensures better stock control.

The system achieves its core objectives, including:

- Accurate real-time inventory tracking
- Demand forecasting using Machine Learning
- Effective expiry management to reduce wastage
- Automated alerts and smart recommendations
- Scalable and efficient system performance

Overall, the system provides a reliable and practical solution for modern retail environments, enabling data-driven and intelligent inventory management.

5.1. Future enhancement

The system can be further enhanced by integrating barcode scanning for faster billing, developing a mobile application for better accessibility, and deploying the system on the cloud for scalability and secure data management. Advanced Machine Learning techniques can be incorporated to improve demand forecasting accuracy, while online payment integration can make transactions more convenient. Additionally, features such as multi-store management, real-time notifications for stock and expiry alerts, and advanced reporting and analytics can further improve system performance and support better decision-making.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Bottom of FormHalil, Nur Hazwani Ahmad, Suzi Seroja Sarnin, Nani Fadzlina Naim, Azlina Idris, Wan Norsyafizan W. Muhamad, Darmawaty Mohd Ali, Mohd Nor Md Tan et al. "Desktop-Based Expiry Date Application for Retailers Inventory Management." (2025).

[2] Riazi, Hamid, Mahmood Doroodian, and Behrouz Afshar-Nadjafi. "Improving the sales process of profitable perishable goods: an inventory control strategy in a planned economy." International Journal of Retail & Distribution Management 52, no. 6 (2024): 721-735.

[3] Agusfen, Tubel, and Asepma Hygi Prihastuti. "Analysis of damaged and expired return goods procedures for merchandise inventory internal control system at Pt Indomarco Adi Prima Pekanbaru Branch." Utility: Journal of Economics Managemant and Accounting 1, no. 1 (2023): 37-58.

[4] KV, Sneha, Aashish Pandey, and Sridevi Polasi. "A STUDY OF INVENTORY CONTROL TECHNIQUES TO OPTIMISE REVENUE IN SMALL RETAIL STORES." Journal of Pharmaceutical Negative Results 13 (2022).

[5] Rexhaj, Betim. "Perishable Inventory Management Solutions and Challenges of Kosovo FFRs: Avoiding Product Expiration at Retails Shelves." (2019).

[6] Shajema, Ivy Ivionna. "Effect of inventory control practices on performance of retail chain stores in Nairobi County, Kenya." Journal of International Business, Innovation and Strategic Management 2, no. 1 (2018): 18-38.

[7] Li, Qing, Peiwen Yu, and Xiaoli Wu. "Shelf life extending packaging, inventory control and grocery retailing." Production and Operations Management 26, no. 7 (2017): 1369-1382.

[8] Chiadamrong, Navee, and Rigzin Lhamo. "Inventory management of perishable products in a retail business: a comparison with and without in-store replenishment policies under different purchasing batch sizes." International Journal of Logistics Systems and Management 26, no. 2 (2017): 224-252.

[9] Biswas, S. K., C. L. Karmaker, Ariful Islam, Nazmul Hossain, and Shamim Ahmed. "Analysis of different inventory control techniques: a case study in a retail shop." Journal of Supply Chain Management Systems 6, no. 3 (2017): 35.

[10] Nzuza, Zwelihle Wiseman. "Factors affecting the success of inventory control in the Stores Division of the eThekwini Municipality, Durban: a case study." PhD diss., 2015.

[11] van Donselaar, Karel, Tom Van Woensel, R. A. C. M. Broekmeulen, and J. Fransoo. "Inventory control of perishables in supermarkets." International journal of production economics 104, no. 2 (2006): 462-472.