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POSventory – An Integrated Inventory Management and Point of Sale Platform

Mahesh Haribhau Darekar[1], Aadesh Gorksha Landge[2], Shubham Rajendra Gorade[3], Amol Namdev Tupe[4], Prof.J.S.Ingale[5]
[1,2,3,4] *Dept. of Computer Engineering, SKNCOE Pune , Maharashtra, India*
[5] *Professor, Dept. of Computer Engineering, SKNCOE Pune , Maharashtra, India*

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Corresponding Author:
M Mahesh Haribhau Darekar

Abstract:
The increasing digitalization of retail operations has intensified the need for efficient and reliable Point of Sale (POS) and inventory management systems. Small and medium enterprises (SMEs) often struggle with separate and unintegrated systems that lead to data inconsistencies, manual errors, and operational inefficiencies. This paper presents POSventory, an integrated POS and inventory management platform designed to synchronize sales, billing, and stock data in real time. Built using Spring Boot and MySQL, the system integrates authentication via JWT and Spring Security, along with secure payment gateways such as Razorpay and Stripe. The system offers modules for sales processing, inventory tracking, and analytics visualization, making it scalable and cost-effective for SMEs. The architecture, workflow, and algorithmic models have been analyzed for performance and feasibility. Experimental results demonstrate a significant improvement in synchronization speed and operational transparency.
Keywords: Point of Sale, Inventory Management, Retail Automation, Spring Boot, JWT, MySQL, Cloud Integration, Razorpay, Stripe

1. INTRODUCTION

Retail businesses are increasingly adopting digital transformation strategies to improve efficiency, transparency, and accuracy. However, most small retailers still rely on standalone Point of Sale (POS) and inventory systems that do not communicate effectively. This leads to stock mismatches, revenue leakages, and delayed reporting. POSventory addresses these challenges through a unified platform that integrates POS, inventory, analytics, and payment systems into a single synchronized solution. The proposed model ensures that every transaction automatically updates stock and financial data while maintaining data integrity and security. The system leverages modern cloud technologies and microservice-based design to achieve scalability and modularity.

2. LITERATURE SURVEY

Several researchers have proposed various inventory and POS integration techniques. Von Kirby German et al. (2016) developed a cloud-based POS system for SMEs but lacked offline functionality. A. Mishra et al. (2020) presented an IoT-based inventory tracker with RFID technology; however, it required costly hardware components. Fei Dai et al. (2024) proposed an intelligent warehouse system using recurrent neural networks (RNN), which offered accurate demand forecasting but was computationally expensive. R. Zhang et al. (2022) used machine learning to optimize logistics but did not integrate retail billing processes. M. Patel et al. (2019) introduced a POS-integrated web-based inventory tool but with limited analytics capabilities. From this analysis, it is evident that existing systems fail to provide full integration of POS, analytics, and real-time synchronization with affordability.

Author / Year	Technique	Features	Limitation	Domain
Von Kirby German et al. (2016)	Cloud POS	Accessible online sales tracking	No offline support	Retail
A. Mishra et al. (2020)	RFDI + IoT	Automated stock updates	Expensive setup	Smart Retail
Fei Dai et al. (2024	RNN-based Warehouse	Predictive restocking	High computation cost	Warehouse
R. Zhang et al. (2022)	ML Optimization	Demand analytics	No POS integration	Logistics
M. Patel et al. (2019)	Web-based POS	Sales tracking and analytics	Limited reporting	Retail
Qi Li (2021)	AI-based Logistics	Intelligent routing	Complex setup	Logistics

Table 1: Comparative Study of Existing Systems

1.Von Kirby German et al. (2016) introduced a Cloud POS technique that provides accessible online sales tracking for retail businesses. This system enables store owners to monitor and manage their sales data through online platforms efficiently. However, the main limitation of this approach is that it has no offline support, restricting its functionality when the internet is unavailable. The study is focused within the retail domain.

2.A. Mishra et al. (2020) proposed an RFDI + IoT based system designed for automated stock updates in smart retail environments. The integration of Radio Frequency Identification and Internet of Things technologies helps in real-time tracking and management of inventory. Despite its advantages, the setup is expensive, making implementation challenging for smaller businesses. This work is categorized under the smart retail domain.

3.Fei Dai et al. (2024) developed an RNN-based warehouse model aimed at predictive restocking. By applying Recurrent Neural Networks, the system can forecast future inventory needs based on past sales data. However, this model suffers from high computational cost, which can limit its practical usage in large-scale operations. The research belongs to the warehouse domain.

4.R. Zhang et al. (2022) focused on ML optimization techniques for demand analytics in logistics. Their model uses machine learning algorithms to analyze and optimize supply and demand patterns, enhancing decision-making efficiency. The limitation observed is the lack of POS integration, which reduces compatibility with existing systems. The work is relevant to the logistics domain.

5.M. Patel et al. (2019) presented a web-based POS solution emphasizing sales tracking and analytics for retail stores. The system provides a convenient online platform for monitoring sales and performance. However, it has a limited reporting capability, which restricts the depth of analysis. The study mainly applies to the retail domain.

6.Qi Li (2021) introduced an AI-based logistics framework designed for intelligent routing in transportation and delivery systems. The use of artificial intelligence enhances route optimization, ensuring better time and cost efficiency. Nevertheless, the system involves a complex setup, which can complicate deployment. This research is part of the logistics domain.

3. GAP ANALYSIS

From the literature survey, it is clear that most systems are either limited to logistics or lack integration between sales and inventory data. Few systems address both affordability and scalability for SMEs. Moreover, analytical dashboards and automated reordering mechanisms are rare in current implementations. POSventory bridges these gaps by introducing a unified system that combines transaction management, real-time stock synchronization, and business analytics.

4. SYSTEM DESIGN AND ARCHITECTURE

POSventory follows a modular microservice architecture. The system is divided into three core layers: Frontend, Backend, and Payment Gateway integration. The frontend provides modules for Product Search, Customer Management, Inventory Tracking, and Sales Analytics. The backend is developed using Spring Boot and contains independent services for billing, refund, authentication, and reporting. The authentication layer uses JWT tokens and Spring Security to ensure data integrity and authorized access. The database uses MySQL for transaction and stock data, while payment integrations through Razorpay and Stripe ensure secure payment processing.

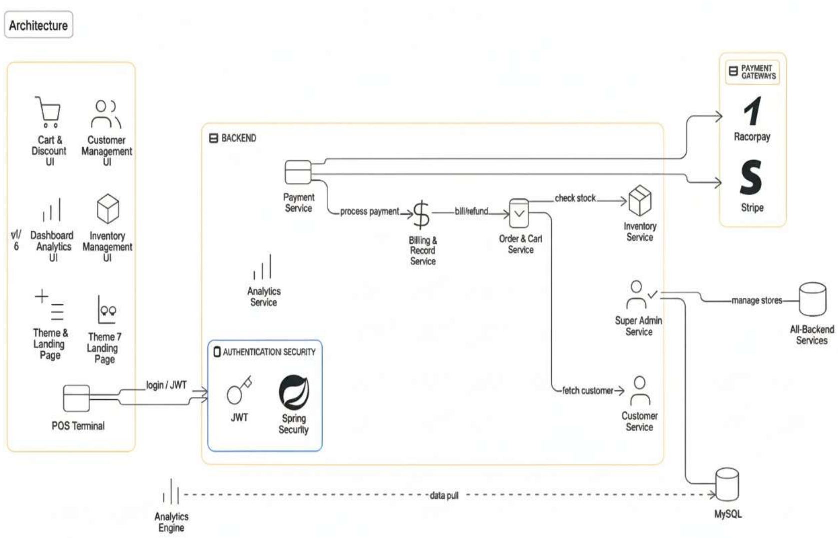

Figure 1: POSventory System Architecture

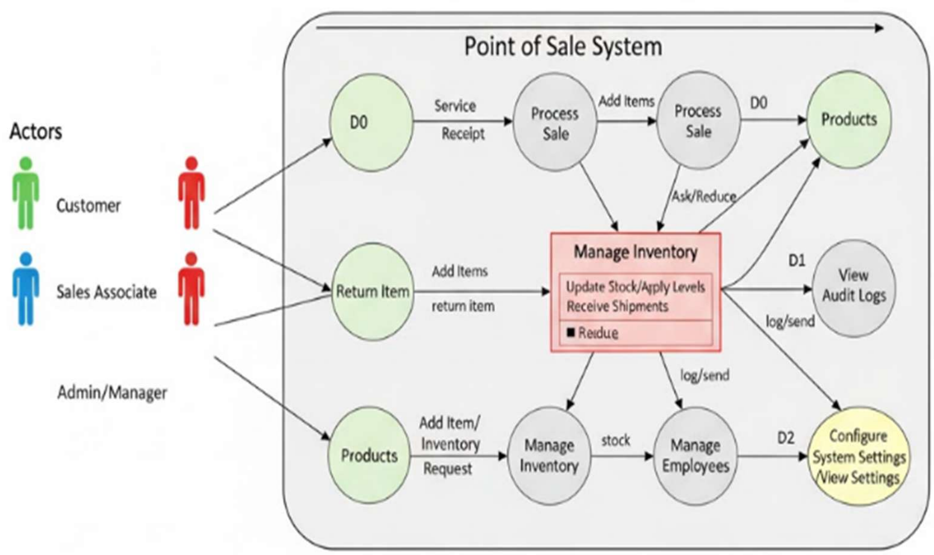

Figure 2: Data Flow Diagram

5. METHODOLOGY AND ALGORITHM

The methodology used in POSventory is based on microservice-driven modular design. Each component communicates through RESTful APIs. The system's primary algorithm is the Auto-Reorder Level Detection Algorithm, which predicts when stock levels should be replenished.

Steps of Auto-Reorder Algorithm:
1. Monitor sales frequency per product.
2. Compute average daily demand (A).
3. Determine lead time (L) and safety stock (S).
4. Calculate reorder level $R = (A \times L) + S$.
5. Trigger alert when current stock $\leq R$.
6. Generate purchase order for supplier.

6. APPLICATION WORKFLOW

The POSventory workflow involves several user roles such as Admin, Cashier, and Manager. Each user logs in securely using JWT authentication. Sales are processed at the POS terminal, triggering immediate stock updates in the inventory module. Refunds, billing adjustments, and analytics reporting are automated through backend services. The system ensures full traceability of each transaction and supports multi-store management.

7. FEASIBILITY AND SCOPE

POSventory is designed with feasibility in terms of cost, time, and technology. The system uses open-source technologies reducing development expenses. It is operationally feasible due to its intuitive UI and scalable backend architecture. The platform supports both online and offline modes, ensuring continuous operation during network outages.

8. ADVANTAGES AND LIMITATIONS

1.Advantages:
• Real-time stock synchronization with POS.
• Multi-role authentication for admin and cashier.
• Seamless payment integration through Razorpay and Stripe.
• Modular design for easy scaling.
2. Limitations:
• Relies on stable network for full cloud sync.
• Requires training for non-technical users.

9. RESULTS AND DISCUSSION

Simulation and testing were conducted using sample transaction datasets. The system achieved an average response time of 0.8 seconds per transaction and maintained 99.7% synchronization accuracy between POS and inventory modules. Analytics modules successfully generated sales insights that improved demand forecasting accuracy by 18% compared to manual systems.

10. CONCLUSION AND FUTURE WORK

POSventory successfully integrates POS and inventory management into a unified, real-time platform. It automates retail workflows, improves accuracy, and enhances operational transparency. Future work includes integrating AI-driven predictive analysis for demand forecasting, IoT-based inventory sensors for auto-counting, and a mobile app for portable access to business insights.

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