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SmartStock: An AI-Driven Inventory & Logistics Management System for MSMEs

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ABSTRACT: Micro, Small, and Medium Enterprises (MSMEs) in remote locations face challenges in tracking inventory, preventing stockouts, and optimizing logistics due to limited technological infrastructure. *SmartStock* is a web-based application developed using the MERN stack that provides real-time inventory tracking, demand forecasting, and automated logistics management. By integrating AI-driven insights, barcode/QR-based tracking, and supplier coordination, *SmartStock* helps MSMEs improve operational efficiency, reduce losses, and ensure timely deliveries, ultimately enhancing business sustainability.

KEYWORDS: : MSMEs, remote locations, inventory management, stockout prevention, logistics optimization, real-time tracking, supply chain management, demand forecasting, digital solutions, small business support, delivery efficiency, smart logistics, sustainable business, resource-constrained environments.

I. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) are the backbone of many developing and emerging economies, contributing significantly to employment, innovation, and local commerce. However, MSMEs operating in remote and rural areas often lack access to the infrastructure and technology needed to manage their supply chains effectively. These businesses face unique challenges, including limited connectivity, resource constraints, and logistical inefficiencies, which impede their ability to scale and compete with larger enterprises. Without robust systems in place, even basic operations such as tracking inventory or coordinating deliveries become difficult, leading to disruptions in service and customer dissatisfaction. One of the most pressing issues for MSMEs in remote settings is the inability to track inventory in real-time. Traditional, manual inventory management methods are error-prone and often lead to inaccurate stock levels, which can result in either overstocking or stockouts. Frequent stockouts, in particular, can severely impact sales, damage customer trust, and create bottlenecks in the supply chain. To address this, the proposed system integrates digital inventory tracking tools that provide accurate, up-to-date insights into stock levels. Coupled with demand forecasting algorithms, the system can proactively predict restocking needs and suggest optimal procurement timelines, helping MSMEs maintain a steady flow of goods. In addition to inventory control, logistics remains a critical bottleneck for MSMEs in hard-to-reach areas. Poor infrastructure, lack of reliable transportation, and inefficient route planning often lead to delayed deliveries and increased operational costs. The proposed solution tackles this challenge through a smart logistics module that uses route optimization and scheduling algorithms to ensure timely and cost-effective deliveries. By considering real-world constraints such as geography, delivery windows, and resource availability, the system supports better planning and execution of delivery operations. Together, these features create a comprehensive, technology-driven framework that empowers MSMEs to operate more efficiently and sustainably, even in resource-limited environments.

II. LITERATURE SURVEY

Effective inventory and logistics management has long been a cornerstone of operational efficiency in enterprises. However, for Micro, Small, and Medium Enterprises (MSMEs) operating in remote or infrastructure-poor regions, adopting traditional inventory control systems and enterprise resource planning (ERP) tools remains a major challenge due to cost, complexity, and connectivity constraints. Several studies have highlighted the importance of digitizing

supply chains for MSMEs to improve competitiveness and reduce waste [1]. According to Rajan et al. (2020), poor inventory visibility and delayed restocking are key contributors to lost revenue and customer dissatisfaction in rural enterprises [2]. Previous approaches in the literature have primarily focused on large-scale supply chain automation and centralized inventory management systems, which often assume high-speed internet access, technical expertise, and scalable IT infrastructure [3]. These assumptions make such solutions unsuitable for MSMEs in rural or semi-urban locations. In contrast, lightweight systems using mobile applications, cloud-based dashboards, and GSM-based communication have shown promise in bridging this digital divide [4]. Several low-cost, IoT-based inventory systems have also been proposed to provide real-time stock monitoring and automatic replenishment triggers. For example, Kumar et al. (2021) presented a GSM-integrated inventory tracker for small retailers that sends alerts when stock levels fall below predefined thresholds [5]. While these systems improve responsiveness, they often lack integration with logistics or supplier communication workflows. Other studies have attempted to use GPS-enabled vehicle tracking and route optimization algorithms to support last-mile delivery in constrained areas, improving delivery accuracy and reducing fuel costs [6]. Recent research has also emphasized the need for role-based user interfaces to support different stakeholders such as suppliers, administrators, and business owners. This ensures a contextual flow of data and enhances decision-making at each node of the supply chain [7]. Technologies like Flask, Firebase, and lightweight SQLite databases have been identified as effective building blocks for scalable and modular solutions in low-resource environments [8]. The proposed Smart Inventory and Logistics Management System builds upon these insights, offering a modular, cloud-synced, mobile-accessible platform tailored for MSMEs in remote regions. It addresses both inventory visibility and delivery optimization challenges while being mindful of technological and infrastructural limitations faced by rural enterprises.

III. EXISTING SYSTEM

The Most Micro, Small, and Medium Enterprises (MSMEs), particularly those operating in remote areas, currently depend on traditional inventory management methods such as manual record-keeping, spreadsheet-based tracking, or basic desktop software. These approaches are outdated and inefficient, lacking real-time visibility, automation, and data-driven insights. Logistics management is also handled manually, making it difficult to coordinate deliveries, track shipments, or respond promptly to supply chain disruptions. These traditional systems are reactive in nature and often fail to prevent stockouts, overstocking, and delivery delays—leading to loss of sales, wastage, and customer dissatisfaction.

IV. PROPOSED SYSTEM

The proposed system, Smart Stock, is a web-based inventory and logistics management platform specifically designed for MSMEs in remote areas. Developed using the MERN stack (MongoDB, Express.js, React.js, and Node.js), Smart Stock offers a responsive and scalable interface for seamless inventory control and logistics coordination.

Smart Stock integrates AI-powered demand forecasting, barcode/QR code-based inventory tracking, and automated logistics management. The system enables real-time data entry, stock movement tracking, delivery scheduling, and supplier coordination—all through a centralized dashboard accessible from any internet-enabled device.

By incorporating predictive analytics through machine learning, Smart Stock forecasts inventory needs based on sales trends and lead times. It also generates automated alerts for low-stock items, expiring products, or delayed shipments. Cloud-based architecture ensures multi-location support, data security, and continuous accessibility, even in infrastructure-constrained environments.

V. METHODOLOGY

OVERVIEW OF THE PROJECT

SmartStock is a web-based inventory and logistics management system developed to address the challenges faced by Micro, Small, and Medium Enterprises (MSMEs) in remote and underserved locations. These businesses often operate with limited technological infrastructure, making it difficult to track stock levels, prevent stockouts, forecast demand, and coordinate deliveries effectively. SmartStock leverages the capabilities of modern web technologies and artificial intelligence to offer a cost-effective, scalable, and intelligent solution for inventory and supply chain optimization.

The system is built using the MERN stack (MongoDB, Express.js, React.js, Node.js) and integrates AI-driven demand forecasting and QR/barcode-based tracking to streamline inventory control. SmartStock continuously monitors stock data across products and locations, helping users forecast future demand, detect anomalies like low stock or oversupply,

and automate restocking workflows. Logistics coordination is enhanced through real-time delivery tracking and supplier integration, minimizing delivery delays and inventory mismatches.

A user-friendly dashboard provides real-time inventory visibility, trend analysis, and role-based secure access for employees, suppliers, and administrators. SmartStock empowers MSMEs with real-time insights and automation, resulting in better operational efficiency, cost savings, and business continuity.

MODULES:

- Inventory Data Collection
- Data Storage and Preprocessing
- Demand Forecasting and AI Module
- Alert and Notification System
- Dashboard and Visualization

5.2 MODULE DESCRIPTION**Inventory data collection**

This module captures real-time stock information using QR/barcode scanners during product check-in, check-out, and delivery. It records product IDs, quantities, timestamps, and transaction types (e.g., sale, purchase, transfer), ensuring accurate tracking of every item in the inventory. Data can be collected at multiple sites simultaneously and is transmitted to the backend database through the web interface.

Data Storage and Preprocessing

All inventory-related data is securely stored in a MongoDB database. This module is responsible for cleaning and preprocessing data by handling duplicates, missing values, and data normalization. The structured data serves as the foundation for analytics, ensuring consistent and reliable inputs for the AI module.

Demand Forecasting and AI Module

Using Python and Scikit-learn, this module applies a Random Forest regression model to forecast product demand based on historical sales trends, seasonality, and current stock levels. It helps MSMEs avoid both stockouts and overstocking by predicting future inventory requirements. The model also identifies unusual patterns such as sudden drops or surges in demand, supporting smarter decision-making.

Alert and Notification System

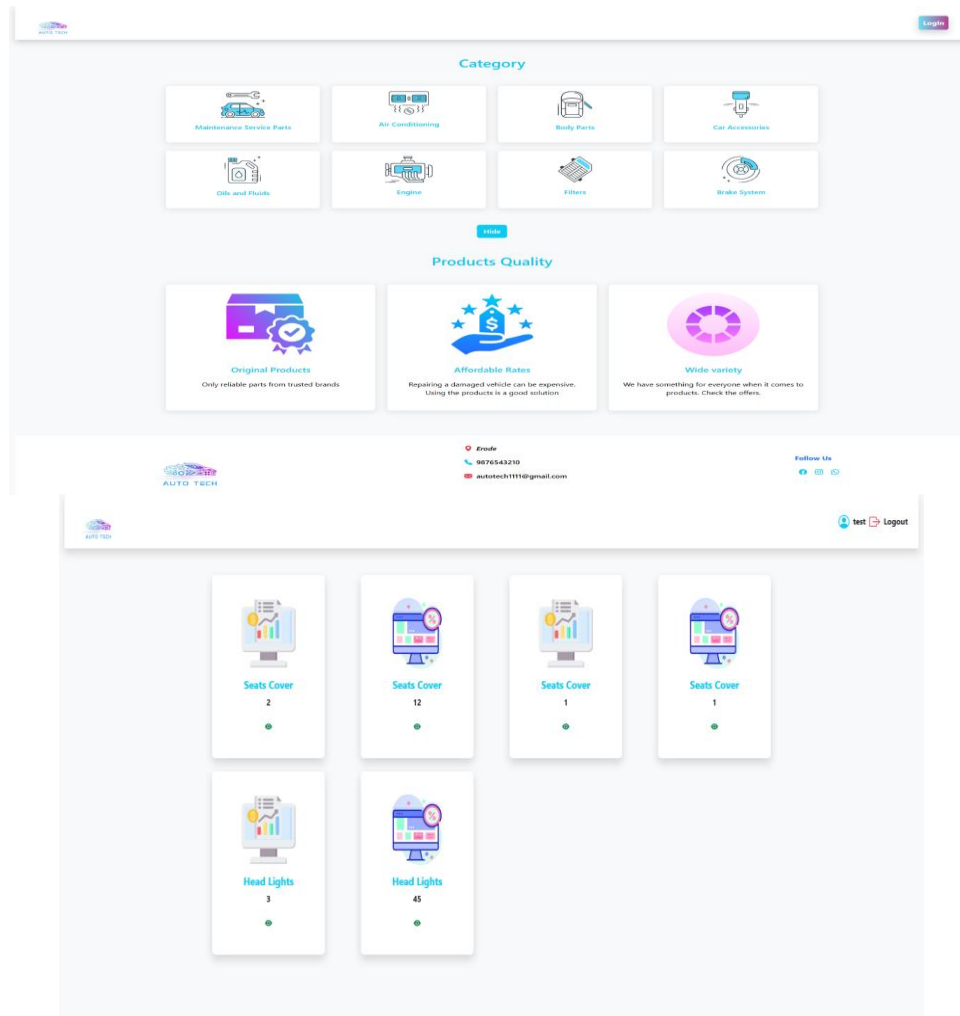
The alert system automatically generates email and dashboard notifications when critical conditions are detected—such as low inventory, demand surges, expired items, or delayed deliveries. Alerts are sent to relevant stakeholders including warehouse staff, suppliers, or administrators, enabling timely action and reducing operational disruptions.

Dashboard and Visualization

This module delivers a React.js-powered dashboard that presents real-time visualizations of inventory levels, product movement, supplier performance, and demand trends. It includes interactive charts, low-stock indicators, and historical reports. The dashboard supports multiple user roles with secure authentication and access control, allowing MSME owners to manage their operations remotely and efficiently.

VI. EXPERIMENTAL RESULTS

Home page



VII.CONCLUSION

SmartStock offers a cutting-edge, web-based solution for inventory and supply chain management, specifically designed to meet the requirements of Micro, Small, and Medium Enterprises (MSMEs). By incorporating real-time stock tracking, automated restocking notifications, role-specific access control, and efficient communication with suppliers, the system greatly improves operational efficiency and transparency. The platform minimizes manual errors, avoids stock shortages, and delivers valuable data insights that facilitate enhanced business decision-making. Featuring a user-friendly interface and scalable architecture, SmartStock enables MSMEs—particularly those in remote or resource-limited settings—to adopt digital transformation and gain improved control over their inventory management. In summary, SmartStock plays a vital role in enhancing resource planning, fostering stronger supplier relationships, and promoting more resilient supply chain practices—key elements for business growth in the current competitive landscape.

VIII. FUTURE WORK

While SmartStock already offers core functionalities essential for MSMEs, there are several avenues for future development to further enhance its effectiveness and scalability:

- **Mobile Application Support:** Developing a dedicated mobile app for Android and iOS would provide warehouse staff and business owners with more flexible, on-the-go access to inventory data and alerts.
- **Advanced Analytics and Reporting:** Integration of machine learning for demand forecasting and stock optimization could enable smarter procurement and reduce overstock/understock scenarios.
- **Barcode and QR Code Integration:** Implementing barcode or QR code scanning for inventory check-in/check-out can speed up warehouse operations and improve accuracy.
- **Multi-warehouse Management:** Adding support for managing multiple warehouse locations would make SmartStock suitable for businesses with distributed storage and operations.
- **Supplier Portal and API Integration:** Enabling suppliers to directly access order details or integrate with their ERP systems via APIs can further streamline the restocking process.
- **Offline Mode and Syncing:** For MSMEs operating in remote areas with intermittent internet access, implementing offline capabilities with data synchronization can improve system reliability.
- **Enhanced Security Features:** Implementing multi-factor authentication, audit logs, and role-specific permissions can ensure secure handling of sensitive business data.

By implementing these enhancements, SmartStock can evolve into a comprehensive, intelligent inventory ecosystem that adapts to the growing and changing needs of MSMEs.

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