IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

AI-Powered Smart Inventory Management System for Retail Shops

Vedashree C R[1], Ankush D[2], B C Vinay Kumar[3], Disha R K[4], Megha R Patil[5]

Assistant Professor Dept. of CSE, Don Bosco Inst. of Tech. Bengaluru, India[1]

Student, Dept. of CSE Don Bosco Inst. of Tech. Bengaluru, India 1DB23CS021[2]

Student, Dept. of CSE Don Bosco Inst. of Tech. Bengaluru, India 1DB23CS031[3]

Student, Dept. of CSE Don Bosco Inst. of Tech. Bengaluru, India 1DB23CS064[4]

Student, Dept. of CSE Don Bosco Inst. of Tech.Bengaluru, India 1DB23CS128[5]

Abstract: Maintaining reliable stock information is a recurring challenge for small retail businesses, where inventory records are often updated through manual counting and periodic shelf inspections. These practices require regular effort and can produce inaccurate records when products are overlooked or their movement is not recorded. This paper presents a vision-based inventory monitoring system that uses object detection to estimate the number of products visible on a retail shelf. A webcam provides the visual input, and a YOLO-based detection model identifies objects in captured frames. The detected labels are processed by an inventory-management mechanism that compares observations across successive frames. A two-second stabilization interval is used before confirming product removal, reducing incorrect updates caused by temporary detection failures. Product additions, removals, and current inventory information are stored in CSV files. A dashboard developed with Dash presents inventory counts, the number of detected item categories, and stock changes. The implementation demonstrates how computer vision can support shelf-level inventory monitoring using a camera and a laptop-based processing environment. Custom product training, automated low-stock notifications, database integration, and demand prediction are possible extensions.

1. INTRODUCTION

Accurate inventory information is important for retail operations because it helps store personnel identify available products and items that require attention. In small shops, inventory is often maintained through handwritten records, spreadsheets, or manual inspections of storage and display shelves. These procedures require repeated human involvement and can become inconsistent when products are moved, sold, or returned without corresponding updates to the stock record.

Computer vision offers an alternative way to obtain inventory information from visual data. A camera can capture shelf images, and an object-detection model can locate products in those images. The detections can then be processed to estimate the visible quantity on the shelf. This approach is relevant to retail environments where frequent manual inspection is difficult to maintain.

This work develops a camera-based inventory monitoring system using YOLO object detection. A webcam captures the shelf area, and the detection model processes incoming frames to identify objects. An inventory-processing module compares the current observation with the previously maintained inventory state. A stabilization mechanism prevents a product from being treated as removed immediately when it temporarily disappears from a frame.The system records inventory activity in CSV files. A Dash dashboard displays the current product count, the number of detected item categories, and recorded additions and removals. This provides a consolidated view of shelf activity without requiring personnel to repeatedly count every visible item. The main contribution is the integration of camera-based object detection with a simple inventory-state management process and dashboard visualization. The implementation demonstrates shelf-level monitoring using a webcam and laptop; it is not intended to represent a complete commercial inventory platform.

2. RELATED WORK

Existing inventory management research covers software-based warehouse management, RFID-based identification, IoT-enabled monitoring, and machine-learning approaches. These methods address different aspects of stock visibility, tracking, and operational management. The studies discussed in this section

 This work is licensed under a Creative Commons Attribution 4.0 International License

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

Mazrouee et al. [1] describe a microservice-based inventory management and analysis system for smart warehouses. Their approach organizes inventory functions into interconnected services, with an emphasis on flexibility and scalability. In contrast, the present work focuses on detecting visible shelf contents from webcam images and using successive detections to update inventory records.

Bousselmi et al. [2] investigate an IoT-based inventory management approach using RFID. Such systems identify tagged items through reader infrastructure. The proposed camera-based approach instead relies on visual detections, avoiding the need for RFID tags in the visual monitoring process.

Rani et al. [3] discussed the role of IoT in the development of Inventory Management 4.0. IoT-based approaches connect devices and inventory information to improve the availability of operational data. Such systems can support monitoring across connected infrastructure. The proposed work instead concentrates on visual observation of a shelf using a webcam and the processing of detected objects to estimate inventory changes.

Manoharan et al. [4] examined an inventory management approach that combines IoT-based data collections with machine-learning techniques. Their work considers the use of collected data to support inventory monitoring and stock-related decisions.

The present implementation uses a different source of information: object detections obtained from camera frames. The detected labels are compared over time to maintain a record of shelf-level additions and removals.

Saillaja et al. [5] developed an IoT-oriented inventory management approach for retail stores. Their work focuses on using connected sensing components to collect inventory information and reduce dependence on manual stock checks. The proposed camera-based system explores visual detection as the primary means of observing shelf contents. It uses a webcam, a YOLO- based detector, inventory processing logic and a Dash dashboard.

Ref	Approach	Performance	Limitations
[1]	Micros ervices + APIs	Improved scalability, flexibility and real-time monitoring	Fixed thresholds; processing limitations
[2]	IoT + RFID	Improved inventory tracking and inventory accuracy	RFID/tag dependency
[3]	IoT- based Invent ory 4.0	Improved inventory visibility and operational efficiency	Cost, security and infrastructure requirements
[4]	IoT + ML	Improved inventory monitoring and stock prediction	Requires IoT devices and large datasets
[5]	IoT sensors	tracking and improved monitoring	Hardware and network dependency

Table I: Summary of Related Work

3. METHADOLODY

The proposed Smart Inventory Vision System uses a webcam to capture shelf images continuously. A YOLO-based object-detection model detects objects within the shelf region and counts their occurrences. The detected products are passed to the Shelf Manager, which applies a two-second timeout and compares detections with the previous stable inventory. The Inventory Manager maintains the current inventory, records additions and removals in CSV files, and supplies information to a web-based Dash dashboard.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

A. System Architecture

The system comprises four modules: camera-based image capture, YOLO-based object detection, inventory management, and dashboard visualization. The webcam acquires shelf images, which are processed by the detection algorithm to locate products. The detected products are stored as inventory observations. The inventory-management module compares the current inventory with the previous stable inventory to identify additions and removals and then updates the dashboard.

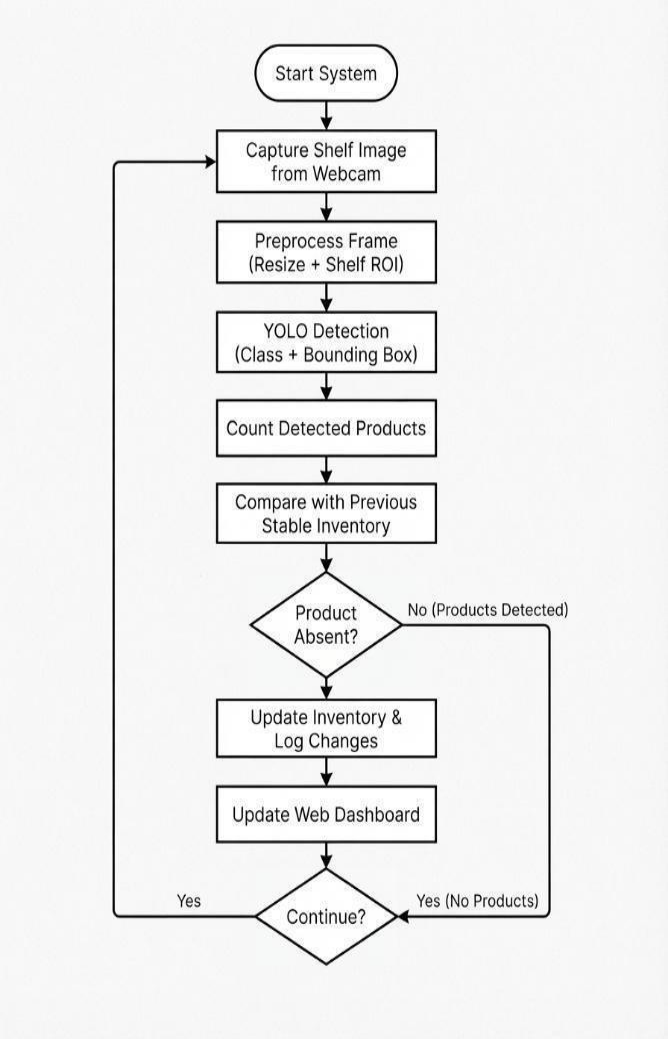


Fig. 1. Overall system architecture of the proposed Smart Inventory Vision System.

B. Image Acquisition and Product Detection

The video camera is positioned to observe the shelf area containing the products. Input video frames are resized to reduce computational load and support processing on a laptop. A lightweight YOLO model is used as the object detector to limit computational requirements. For each input frame, the algorithm detects objects and identifies their labels and confidence scores. Only detections within the shelf region are used for further analysis. A confidence threshold is applied to reduce false detections, and recognized labels are converted into counts by the object counter. The initial implementation uses a pre trained YOLO model to detect objects from the categories it supports. If a store contains products that are not included in the pre trained model, a custom YOLO model should be trained using images of those products.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

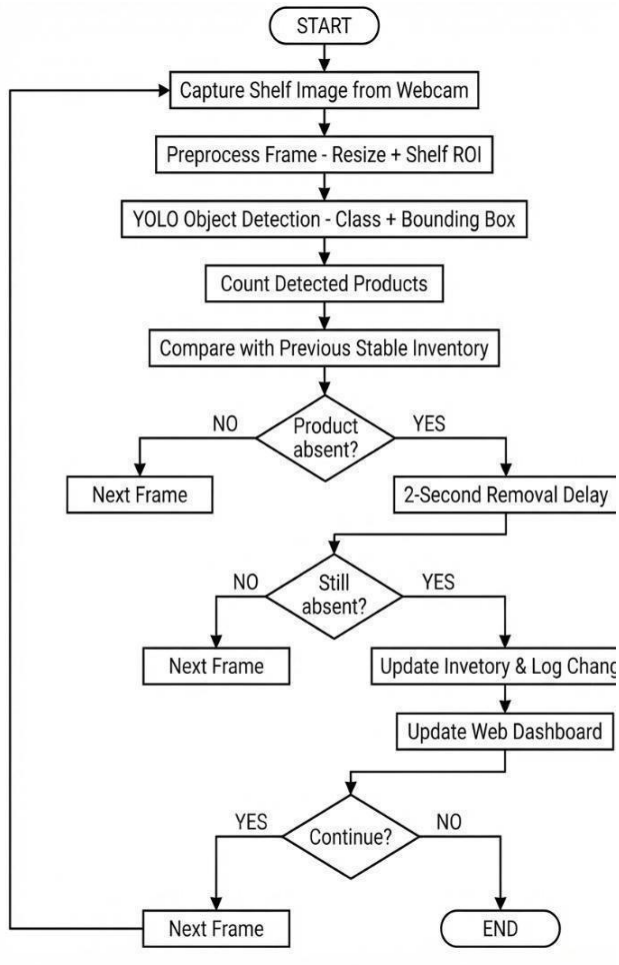


Fig. 2. Inventory monitoring flowchart.

C. Inventory Estimation and Product Removal Detection Detections from the current and previous steps are compared to establish a stable representation of shelf inventory. Rather than removing an item immediately when it is not detected, the algorithm uses a removal delay to track items that were detected in earlier frames but are absent from the current frame. If the item remains absent after the delay, it is removed from the inventory. The Inventory Manager records additions and removals, maintains the current inventory, and stores inventory summaries and event logs in CSV files. This delay is intended to reduce false removals caused by temporary detection failures or camera noise.

D. Real-Time Dashboard and System Output

Processed inventory information is sent to a web-based dashboard built with Dash. The dashboard displays the current stock count, the number of unique detected item categories, counts of additions and removals, and other inventory information. It receives periodic updates from the Inventory Manager, allowing store personnel to review the shelf state without repeatedly checking it manually. The pipeline therefore covers image capture, product detection, inventory estimation, event logging, and visualization.

4. RESULTS

The proposed Smart Inventory Management System provides a web-based interface for monitoring retail products and managing inventory using AI-based object detection. The dashboard uses an interactive layout with separate sections for the

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

home dashboard, live camera feed, current inventory, low-stock monitoring, and administrative controls.

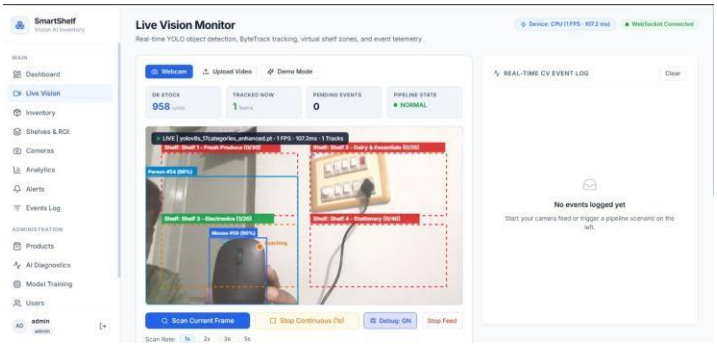


Fig.1. Live Vision Monitor with Real-Time Object Detection

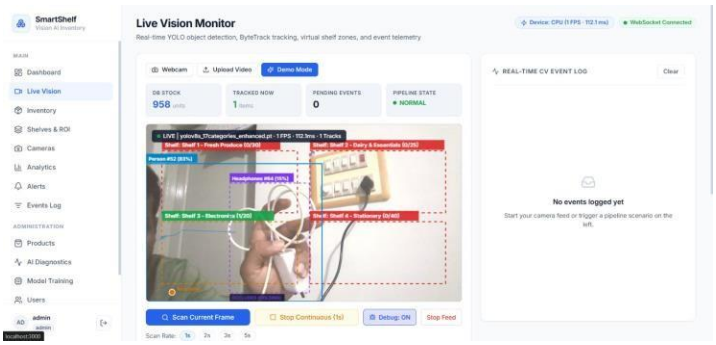


Fig.2. Live Object Detection and Shelf Zone Monitoring

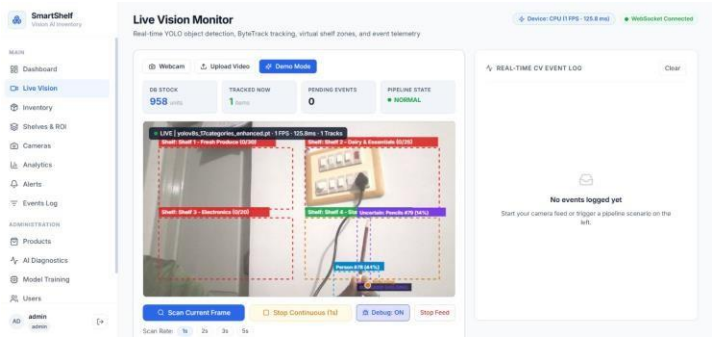


Fig.3. Webcam-Based Product Detection and Tracking

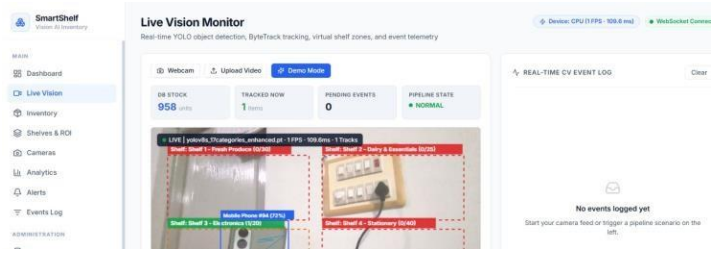


Fig.4. Real-Time Inventory Dashboard

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

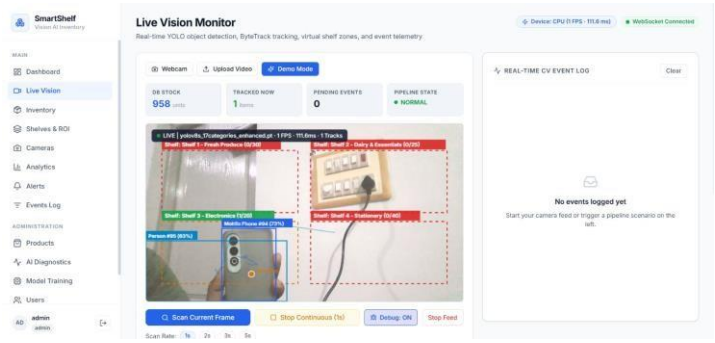


Fig.5. Live Vision Monitoring Interface

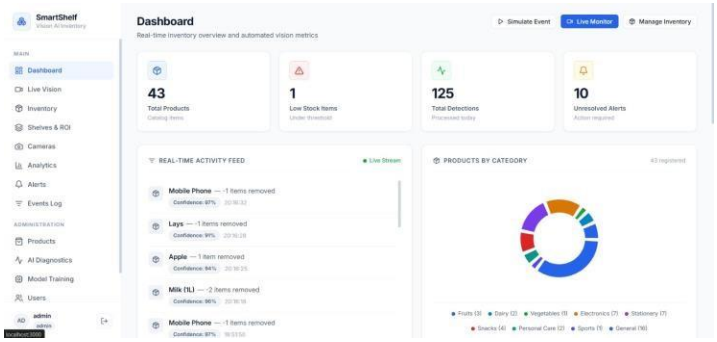


Fig.6. Virtual Shelf Configuration and ROI Zones

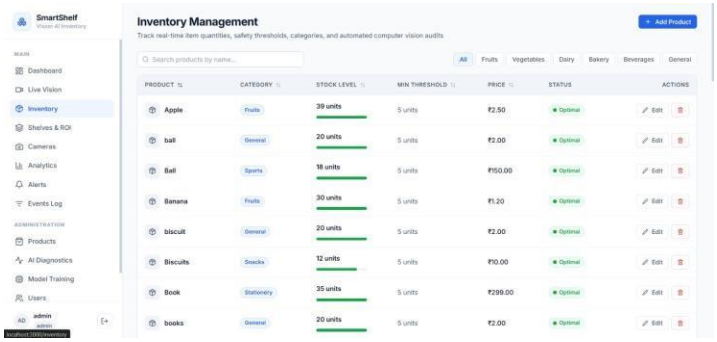


Fig.7. Inventory Management and Stock Level Monitoring

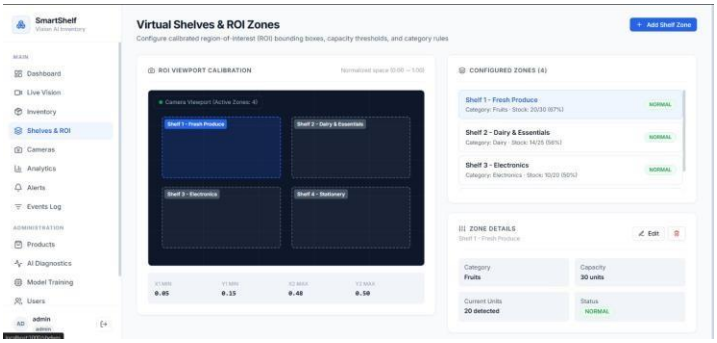


Fig.8. System Alerts and Low-Stock Notifications

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

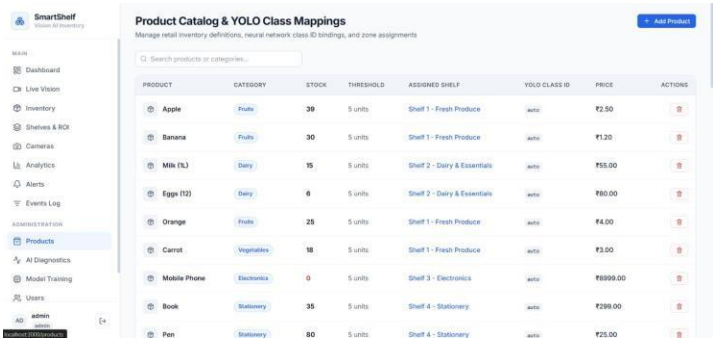


Fig.9. Product Catalog and YOLO Class Mapping

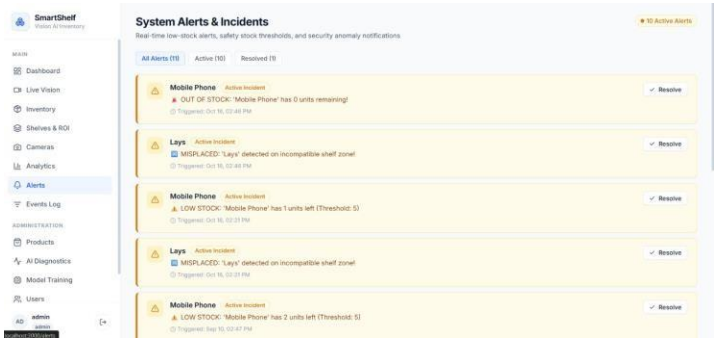


Fig.10. Real-Time Object Detection with Product Classification

5. FUTURE ENHANCEMENTS

The system could be extended by training YOLO on a custom dataset of specific retail products, using higher-resolution cameras and more advanced object-tracking algorithms, and adding automated low-stock alerts and database storage. Further development could include multiple cameras, cloud-based monitoring, and inventory-demand prediction algorithms.

6. CONCLUSION

The proposed Smart Inventory Vision System demonstrates the potential of computer vision and YOLO-based object detection for automated shelf-level inventory monitoring. The system captures shelf images with a webcam, detects objects in near real time, tracks inventory, and identifies possible product removals using a stabilization algorithm. A web dashboard presents inventory information and activity records. This approach may reduce the need for repeated manual stock checks and support more efficient inventory management. However, recognition of specific retail products may require custom YOLO training and improvements to image acquisition. These enhancements would need to be evaluated before the system could be considered suitable for deployment in operational retail settings.

7. ACKNOWLEDGMENT

The authors thank Vedashree C R, Assistant Professor, Department of Computer Science and Engineering, Don Bosco Institute of Technology, Bengaluru, for her guidance, constructive feedback, encouragement, and support during this project. The authors also thank the Department of Computer Science and Engineering for providing the infrastructure required for the work, and their professors and colleagues for their feedback. Finally, the authors thank their families for their continued support.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.311 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 10, October 2026

DOI: 10.17148/IARJSET.2026.131054

REFERENCES

[1] M. H. Mazrouee, F. Nejat, and M. Ezhei, "A Microservice-Based Inventory Management and Analysis System for Smart Warehouses," in 2025 9th International Conference on Internet of Things and Applications (IoT), 2025, doi: 10.1109/IOT69654.2025.11297642.

[2] S. Bousselmi, M. Gannouni, and K. Ouni, "IoT Application for Smart Inventory Management System Based on RFID," in 2024 IEEE International Multi-Conference on Smart Systems & Green Process (IMC-SSGP), 2024, doi: 10.1109/IMC-SSGP63352.2024.10919846.

[3] N. Rani, N. Yamsani, M. K. Sharma, S. V. Akram, S. Kathuria, and R. Balyan, "Revolutionizing Inventory Management: The Role of IoT in Inventory Management 4.0," in 2024 3rd International Conference on Sentiment Analysis and Deep Learning (ICSADL), 2024, doi: 10.1109/ICSADL61749.2024.00110.

[4] G. Manoharan, V. Kumar, A. Karthik, A. V, C. Rama Mohan, and G. Nijhawan, "IoT-Based Smart Inventory Management System Using Machine Learning Techniques," in 2024 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI), 2024, doi: 10.1109/ACCAI61061.2024.10601903.

[5] V. Saillaja, K. Machap, M. Menaka, and V. Kumaravel, "Development of an IoT-based Inventory Management System for Retail Stores," in Proceedings of the International Conference on Sustainable Computing and Smart Systems (ICSCSS), 2023, doi: 10.1109/ICSCSS57650.2023.10169810.

[6] K. Semenchuk, K. Kolesnikova, and L. Chernova, "Designing of Inventory Control Processes Based on the Strategy of Risk Pooling in Supply Chains," in 2024 IEEE 4th International Conference on Smart Information Systems and Technologies (SIST), 2024, doi: 10.1109/SIST61555.2024.10629482.

[7] A. Akshaya Varshini and J. Murugachandravel, "AI-Powered Inventory Optimization with LGBMRegressor," in 2025 International Conference on Engineering, Technology & Management (ICETM), 2025, doi: 10.1109/ICETM63734.2025.11051752.

[8] S. Bailkar, S. Bankar, K. Shenoy, P. More, and A. Bedekar, "Smart Inventory Optimization Using Machine Learning Algorithms," in Proceedings of the 2nd International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT), 2024, doi: 10.1109/IDCIOT59759.2024.10467512.

[9] N. Dhaliwal, P. K. Tomar, A. Joshi, G. S. Reddy, A. Hussein, and M. B. Alazzam, "A Detailed Analysis of Use of AI in Inventory Management for Technically Better Management," in Proc. 3rd Int. Conf. Advance Computing and Innovative Technologies in Engineering (ICACITE), 2023, doi: 10.1109/ICACITE57410.2023.10183082.

[10] M. Arora, A. Nain, H. Agarwal, R. Kaparwan, P. Kumar, and V. Ahmad, "AI-Driven Models for Inventory Optimization in Smart Factories," in Proc. 3rd Int. Conf. Advances in Computation, Communication and Information Technology (ICAICCIT), 2025, doi: 10.1109/ICAICCIT68829.2025.11434309.

[11] P. Bajaj, L. Kumar, A. Anuradha, A. Nainwal, K. M. Muni, and M. Singh, "AI-Powered Inventory Management: Enhancing Forecast Accuracy and Operational Efficiency in Modern Supply Chains," in Proc. IEEE 1st Int. Conf. on Smart Innovations in Systems, Infrastructure, Mechanical, Power, AI and Computing Technologies (SISIMPACT), 2025, pp. 541–547, doi: 10.1109/SISIMPACT.2025.82.

[12] M. S. Javaid, R. Chauhdary, A. Waleed, F. Ahmad, M. Zubair, and O. Tariq, "AI-Powered Smart Inventory Management: Enhancing Efficiency Through Predictive Analytics and Automation," in Proc. Int. Conf. on Emerging Technologies in Electronics, Computing, and Communication (ICETECC), 2025, doi: 10.1109/ICETECC65365.2025.11070285.

[13] D. Srinivas, N. Misra, M. Sharma, A. Dimri, K. Udayai, and V. Ahmad, "Digitalizing Inventory Systems with Quantum Blockchain and AI," in Proc. 5th Int. Conf. on Internet of Things: Smart Innovation and Usages (IoT-

© IARJSET This work is licensed under a Creative Commons Attribution 4.0 International License

DOI: 10.17148/IARJSET.2026.131054

SIU), 2025, doi: 10.1109/IOT-SIU65919.2025.11402776.

[14] J. K. Kiruthika, S. Manikandan, U. Nithya, M. Preethika, and S. Poorna, "IOT-Based Smart Inventory Management System," in Proc. Int. Conf. on Computer Communication and Informatics (ICCCI), Coimbatore, India, Jan. 23–25, 2023, doi: 10.1109/ICCCI56745.2023.10128211.

[15] S. Bailkar, K. Shenoy, A. Bedekar, S. Bankar, and P. More, "Smart Inventory Optimization Using Machine Learning Algorithms," in Proc. 2nd Int. Conf. on Intelligent Data Communication Technologies and Internet of Things (IDCIoT), 2024, doi: 10.1109/IDCIOT59759.2024.10467512.

[16] H. A. Chavan and P. P. Nitnaware, "Smart Retail Solutions Through Edge Computing and IoT Automation: Implementing Dynamic Pricing and Real-Time Customer Engagement," in Proc. 14th IEEE Int. Conf. on Communication Systems and Network Technologies (CSNT), 2025, p. 1244, doi: 10.1109/CSNT.2025.209.

[17] K. Poongothai, G. Devika, D. Sweety Brisila, and S. Yogesh, "Smart Retail Using Machine Learning for Demand Forecasting and Inventory Optimization," in Proc. Int. Conf. on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSES), 2024, doi: 10.1109/ICSES63760.2024.10910874.

[18] K. Singhal, V. Singh, and A. Kaul, "Smart Retail: Utilizing Machine Learning for Demand Prediction, Price Strategy, and Inventory Management," in Proc. 16th IEEE Int. Conf. on Computational Intelligence and Communication Networks (CICN), 2024, p. 485, doi: 10.1109/CICN63059.2024.10847534.