© April 2026 | IJIRT | Volume 12 Issue 11 | ISSN: 2349-6002

Smart Godown: Warehouse Management System

Dr. G. J. Sawale[1] Ms. Shravani M. Wankhade[2], Isha M. Raut[3], Sonal P. Patil[4], Atharv M. Raut[5]
[1]*Professor, Prof. Ram Meghe Institute of Technology & Research, Badnera.*
[2,3,4,5]*Student, Prof. Ram Meghe Institute of Technology & Research, Badnera.*

***Abstract*— Numerous small and medium-sized vendors continue to depend on traditional methods like notebooks, paper registers, or spreadsheets for recording and managing their inventory data. This practice often results in various problems, such as human errors, lost records, challenges in tracking items, and increased time spent searching for specific product details. Moreover, storing records physically takes up space and becomes inefficient for data management as the business expands. To tackle these issues, this project suggests an online inventory management system that digitizes the entire process of data storage and tracking. In this system, all product-related details such as item name, quantity, price, supplier information, and stock status-will be kept in a centralized online database. This setup enables vendors to easily access, update, and manage their inventory data from a digital platform. A notable feature of the system is the automatic creation of a unique QR code for each item added to the inventory. Each QR code will be directly linked to the item's stored information in the database. By scanning the QR code with a mobile device or QR scanner, the system will quickly retrieve and display the item details. This removes the need to manually search through records and greatly reduces the time needed to find product information. The proposed system also enhances space optimization since all records are stored digitally rather than physically. It minimizes the likelihood of errors from manual entry and boosts overall accuracy in stock management. Additionally, faster search capabilities and QR-based item identification assist vendors in managing large quantities of products more effectively.**

***Index Terms*—Object Detection, YOLO-CBAM, global commerce, Deep Learning, Computer Vision, Data Pipelines, RealTime Detection**

I. INTRODUCTION

Conventional warehouses continue to depend largely on manual methods for managing inventory, such as using handwritten records and spreadsheets., and manual verification. These outdated practices are prone to human errors like incorrect data entry, inaccurate stock counts, and misplaced items. They also slow down operations such as inventory updates, stock verification, and product retrieval. Additionally, traditional warehouses often suffer from poor space utilization due to a lack of optimization strategies, leading to operational inefficiencies, increased costs, and delays in order fulfillment. With the rapid growth of global commerce, especially in ecommerce, retail, and manufacturing, there is an increasing demand for faster, more accurate, and scalable warehouse operations. Modern supply chains require real-time visibility of inventory, efficient storage management, and quick order processing to meet rising customer expectations for faster delivery and product availability transparency. However, traditional warehouse systems struggle to meet these demands due to limited monitoring capabilities and inefficient manual processes, creating a need for smart, technology-driven solutions. Smart Godown is proposed as an intelligent warehouse management platform designed to modernize traditional inventory systems through automation and real-time monitoring. It uses QR code–based item identification, dashboard-driven analytics, and SMS notifications to improve inventory tracking, operational visibility, and decision-making. The system also employs dynamic storage optimization by placing frequently used items in accessible locations to reduce retrieval time and improve efficiency. With a flexible architecture capable of integrating future technologies such as IoT sensors, blockchain, and advanced optimization algorithms, Smart Godown helps transform conventional warehouses into smart, efficient, and data-driven inventory hubs.

III. RELATED WORK

In recent years, automation and digital transformation have had a profound impact on warehouse management systems. Researchers have delved into various technologies, including IoT, cloud computing, artificial intelligence, and computer vision, to boost the efficiency and precision of warehouse operations. An early contribution to this area was made by Atieh et al. in their paper titled Performance Improvement of Inventory Management System Processes by an Automated Warehouse Management System‖ [1]. This study aimed to enhance traditional inventory processes through the use of warehouse automation. The authors illustrated that automated warehouse systems can greatly minimize human errors, accelerate order processing, and improve the accuracy of inventory tracking. However, the research mainly concentrated on operational efficiency and did not delve into the integration of emerging intelligent technologies like machine learning or computer vision. Lee et al. explored the application of IoT technologies in warehouse management in their study Design and Application of Internet of Things-Based Warehouse Management System for Smart Logistics‖ [10]. They proposed a system enabled by IoT that gathers real-time data through sensors and connected devices. The study revealed that IoT-based monitoring can improve the visibility of warehouse operations and facilitate real-time tracking of goods. Despite its benefits, the system required substantial infrastructure investment and complex device integration.

In their paper Towards a Smart Warehouse Management System‖ [11], Hamdy et al. introduced a conceptual framework aimed at enhancing warehouse operations. Their approach involved the use of digital technologies to automate the processes of monitoring and inventory control. The authors emphasized that this system could lead to greater operational efficiency and less need for manual intervention. However, the framework lacked comprehensive real-world implementation and performance testing. Zˇ unic´et al. also presented a conceptual framework in their study Smart Warehouse Management System Concept with Implementation‖ [13]. This research proposed an integrated architecture for managing warehouses through modern digital technologies. It demonstrated that intelligent monitoring systems could enhance productivity and decision-making in warehouses. Nonetheless, the study primarily concentrated on system design rather than on practical implementation on a large scale. Rashid et al. explored the use of cloud databases and identification technologies in their paper Smart Warehouse Management System with RFID and Cloud Database‖ [18]. They developed a prototype system that utilized RFID tags for tracking inventory items, while cloud databases were employed to store real-time operational data. This method improved the visibility of inventory and the ability to monitor remotely. However, the costs associated with RFID implementation and reliance on hardware were significant limitations. In a similar vein, Mbida Mohamed introduced a hybrid intelligent framework in his study titled Smart Warehouse Management Using Hybrid Architecture of Neural Network with Barcode Reader 1D/2D Vision Technology‖ [19]. This research integrated barcode scanning technology with neural network models to enhance the identification and classification of products in warehouses. Although this method improved recognition accuracy and automation efficiency, the complexity involved in deploying neural networks and the computational demands presented challenges for practical use. Additionally, Sai Chitti Subrahmanyam and colleagues explored the integration of automation technologies and intelligent monitoring systems in warehouse settings in their paper Smart Warehouse Management System‖ [15]. They emphasized how digital systems can boost operational productivity and lessen reliance on manual labor. However, their research was more focused on conceptual architecture rather than actual industrial implementation. Van Geest et al. provided a thorough discussion on smart warehouse technologies in their paper Smart Warehouses: Rationale, Challenges and Solution Directions‖ [3]. They examined the reasons for adopting smart warehouses and pointed out challenges such as technological integration, system complexity, and high implementation costs. The study also proposed future directions, including AI-based automation and intelligent robotics. As large-scale data systems become increasingly vital, Nambiar and Mundra investigated enterprise data architectures in their study titled An Overview of Data Warehouse and Data Lake in Modern Enterprise Data Management‖ [12]. Their research detailed how contemporary organizations employ data warehouses and data lakes for effective data storage and analysis. While the study offered significant insights into enterprise data management, it did not specifically address warehouse automation applications. In a separate study, Harby and Zulkernine explored the shift from traditional data systems in their paper From Data Warehouse to Lakehouse: A Comparative Review‖ [17]. Their research contrasted various data storage architectures and emphasized the advantages of the lake house model, such as enhanced scalability and advanced analytical capabilities. However, adopting these architectures necessitates specialized infrastructure and technical expertise. Sahara and Aamer examined real-time data integration in warehouse settings in their study Real-Time Data Integration of an Internet-of Things-Based Smart Warehouse: A Case Study‖ [6]. Their research illustrated how IoT-based systems can merge multiple data sources to facilitate real-time warehouse monitoring. Although this approach greatly enhanced operational visibility, it also revealed challenges related to network reliability and data synchronization. The authors Ogeawuchi et al., evaluated the governance and security of data infrastructures in their work titled Systematic Review of Advanced Data Governance Strategies for Securing Cloud-Based Data Warehouses and Pipelines, ‖ [20]. They conducted a systematic review on the significance of data governance frameworks for securing and providing reliability to cloud-based data warehouses. While strong governance strategies are critical to security, their implementation can lead to increased complexity of the system. Warehouse Automation Future Trends were discussed by Min in her work ‖Smart Warehousing as a Wave of the Future. ‖ [4] Min's paper discussed the growing role of digital technologies, including robotics, artificial intelligence and advanced analytics, to transform warehouse operations. However, the author also identified barriers to successful implementation, including high costs of implementation and workforce skill gaps. An overarching systematic review of intelligent warehouses was performed by Tubis and Rohman in the review of literature entitled ‖Intelligent Warehouse in Industry 4.0- Systematic Literature Review‖ [5]. They looked at the literature on warehouse operations using Industry 4.0 technologies, and concluded that the combination of IoT, AI and hyperphysical systems can improve warehouse efficiency very much, but there is a significant interoperability issue among all three technologies. Additionally, new research has been conducted on using video camera systems for automating warehouses. Li et al. proposed a method for detecting multiple QR codes using computer vision techniques in ‖Detection and Recognition of Multiple QR Codes Based on YOLO-CBAM Algorithm‖ [8]. The results of that research showed that the YOLO-CBAM model improved the accuracy and speed of detecting QR codes relative to previous methods. However, the YOLO-CBAM model requires significant computational resources as well as optimally configured hardware to operate effectively in real time. Likewise, the research titled ‖Detecting Barcodes and QR Codes Using YOLO11: A Comparative Study of Accuracy and Efficiency‖ [7] studied the ability of YOLO11 to detect bar codes and QR codes. They found that the YOLO11 detection system improved detection accuracy and also improved how fast it was able to detect codes, which would allow for its use for automated inventory tracking systems; however, issues such as light and camera resolution could adversely affect detection performance. Lastly, Selamat and nor published the paper ‖Smart Technology Usage on Warehouse Management Performance‖ [21]. Their study showed that the use of smart technologies increased the performance of warehouses in relation to efficiency, accuracy in inventory management and the ability to make good decisions with the correct data. There were a number of variables that impacted the use of smart technologies such as a company's readiness for implementation of the technology, the availability of appropriate infrastructure and the amount of training provided to enough employees to make the technology work effectively. Research Gap Identification: Although these methods show good results, they usually need a lot of computational power and are optimized only for specific environments to achieve stable real-time performance. Moreover, from the literature, it can be seen that many papers deal with just one element of a smart warehouse system, that is, IoT monitoring, architectures for data storage, or barcode detection technologies. On the other hand, we can hardly find any work trying to merge those technologies into one integrated system that is able to perform real-time monitoring, intelligent product identification, and efficient data management simultaneously. Hence, the major research gap revealed by the literature is a lack of a combined, economically feasible, and smart warehouse management system that integrates computer vision-based product detection with real-time data processing and automated inventory monitoring. Closing this gap would noticeably enhance the efficiency, accuracy, and scalability of modern warehouse operations. Our study proposes Smart Godown, an intelligent and economical inventory management system created especially for small and medium-sized vendors, in order to address the shortcomings found in previous research. The suggested system uses a QR code-based identification mechanism integrated with a centralized digital database to enable fast and accurate retrieval of product information without requiring expensive hardware, in contrast to many earlier solutions that rely on pricey technologies like RFID infrastructure, intricate IoT architectures, or large-scale automation systems that are challenging for small businesses to adopt. Every inventory item is given a unique QR code that links directly to its stored details. This reduces manual searching and human error in record management by enabling users to instantly access product information through simple scanning. Smart Godown also incorporates dashboard-based analytics, automated SMS notifications, and real-time inventory monitoring to improve operational visibility and expedite decision-making. Additionally, the system facilitates dynamic storage optimization based on product usage trends, which enhances space utilization and speeds up item retrieval. The suggested method provides a workable, effective, and cost-effective solution that gets around the main drawbacks of current warehouse management systems and permits more efficient inventory control for expanding companies by integrating digital record management, QRbased item identification, intelligent monitoring, and scalable system design into a single platform. Research Gap Identification Most of the research work is done using GPU-enabled setups, and the models are tested on well-organized data. However, in the context of unpredictable Indian road conditions, with high traffic, mixed modes of transport, and rapidly changing lighting conditions, these models often face challenges in dealing with such complex and messy scenarios. This paper fills this gap by modifying a YOLOv8 model to better handle the complexity of unstructured road environments while maintaining the feasibility of intelligent monitoring.

III. PROPOSED SYSTEM METHODOLOGY

In Indian traffic conditions, detecting vehicles and people is done through a system that utilizes YOLOv8. This is intended for scenarios where there is a lot of activity and objects vary in size. Instead of relying on a combination of various software, it directly searches for images or videos to locate the precise positions. After the positions have been identified, the identities can be the same if motion tracking is applied. A. System Architecture: server architecture that consists of two major components: the frontend interface and the backend processing system. The frontend acts as the primary interaction platform through which users communicate with the system. It allows users such as warehouse managers or operators to input inventory data, view stored items, and perform various management operations. The backend system, developed using the Python programming language, handles the core logic and processes the data received from the frontend. The backend is responsible for executing system operations, storing data in the database, and applying decision-making logic. This separation of frontend and backend components ensures that the system remains scalable, maintainable, and capable of handling multiple user requests efficiently. B. User Interaction Through Frontend The frontend of the Smart Godown system is designed to provide a simple and user-friendly interface that enables users to interact with the warehouse management system without requiring technical expertise. Through the frontend, users can perform several operations such as adding new items to the inventory, checking the availability of items, viewing zone allocations, and accessing stored information. When a user enters or modifies data, the frontend sends the request to the backend server for processing. This interaction ensures that all system operations are centrally managed and controlled by the backend logic. The system follows the following allocation rules: Zone A (High Priority Zone): If the access frequency of an item becomes reater than 70, the system automatically.

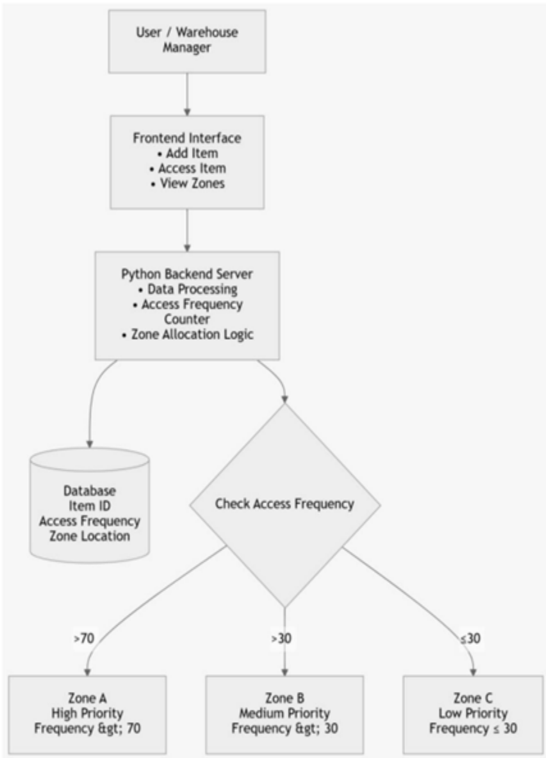

Fig. 3.1: System architecture

assigns the item to Zone A. This zone is reserved for highly demanded items that are accessed very frequently. Placing such items in Zone A ensures that they are stored in the most accessible area of the warehouse, thereby minimizing retrieval time and improving operational efficiency. Zone B (Medium Priority Zone): If the access frequency of an item is greater than 30 but less than or equal to 70, the system assigns the item to Zone B. This zone is designed for items that have moderate usage. These items are accessed regularly but not as frequently as those in Zone A. Therefore, Zone B provides a balanced storage location that maintains accessibility without occupying the highest-priority storage space. Zone C (Low Priority Zone): If the access frequency of an item is less than or equal to 30, the system assigns the item to Zone C. This zone is used for newly added items and items that are accessed infrequently. Since these items are not required frequently, storing them in Zone C helps conserve high-priority storage areas for more frequently accessed items. C. Initial Item Placement: Whenever a new item is introduced into the Smart Godown system through the frontend interface, the backend automatically assigns the item to Zone C by default. This is done because the system initially has no information about how frequently the item will be used. Assigning all new items to Zone C ensures that the system starts with a consistent default storage location. At the same time, the system initializes an access counter for the item, which will be used to monitor how often the item is retrieved or accessed by users. D. Access Monitoring and Tracking: A key component of the Smart Godown system is its ability to monitor how frequently each item is accessed. Every time a user retrieves or interacts with an item, the backend automatically increments the access counter associated with that item. This access tracking mechanism enables the system to maintain an accurate record of item usage patterns. Over time, the accumulated access data helps the system determine whether the current zone assigned to the item is appropriate or whether it should be relocated to a different zone. E. Dynamic Zone Reassignment: The Smart Godown system uses the collected access data to dynamically reassign items to different zones based on their usage frequency. If an item located in Zone C begins to be accessed more frequently and its access count crosses a predefined threshold value, the backend automatically updates its location to Zone B. Similarly, if the item continues to be accessed very frequently and surpasses a higher threshold, it may be moved further to Zone A, which is reserved for high-demand items. This dynamic reallocation ensures that frequently used items remain easily accessible while less frequently used items are stored in lower-priority areas. F. Zone Downgrading Mechanism: In addition to promoting items to higher-priority zones, the system also supports zone downgrading. If the frequency of access for an item decreases over time, the backend may reassign the item to a lower-priority zone. For example, an item currently located in Zone B may be moved back to Zone C if it is no longer accessed frequently. This process ensures that the warehouse storage system remains optimized and adapts continuously to changing usage patterns. G. Automated Condition-Based Execution: The Smart Godown system relies on automated condition-based logic implemented in the backend. The system constantly checks whether specific conditions related to access frequency have been met. When a predefined condition becomes true, a particular block of code is triggered automatically. This code then updates the zone classification of the item and modifies the database accordingly. Because these operations are automated, the system reduces manual intervention and minimizes the chances of human error.

IV. WORKFLOW

The Smart Godown web-based warehouse management system presents its operational workflow which shows how users access the system and tracks the flow of data through the backend system while displaying how warehouse inventory items move between different storage areas. The system operates through user interface interaction which connects to backend systems that process data while database systems handle storage operations and automated zone classification systems work to achieve proper inventory management.

Fig. 4.1: Workflow of Smart Godown System

STEPS:

Step 1: User Access and Login Authorized users log into the SmartGodown frontend, gaining access to the management dashboard.

Step 2: User Request Submission Users perform inventory operations via the frontend, which sends requests to the backend.

Step 3: Backend Processing The backend validates and processes requests using Python logic, handling data storage, updates, or retrieval.

Step 4: Database Interaction The backend updates or fetches inventory data from the database, maintaining item details and access metrics.

Step 5: Initial Item Placement New items are automatically assigned to Zone C with an initialized access counter.

Step 6: Item Access Monitoring Each interaction increments the item's access counter.

Step 7: Access Frequency Evaluation The backend evaluates access counts against thresholds to classify items into Zones A, B, or C

A. Qualitative Results

The Smart Godown system was assessed using a database derived from the actual inventory housed in the warehouse. This dataset included a variety of products organized by type, along with details such as the item name, product category, and the total quantity of each item in stock. Each distinct product in the warehouse was given a unique entry in the centralized database, and a corresponding QR code was automatically created and linked to the stored information of that item. This setup enabled the system to handle multiple product categories while keeping precise records of item counts and stock levels. By scanning the generated QR code, the system could quickly access the related product details from the database, showcasing efficient data retrieval and precise item identification.

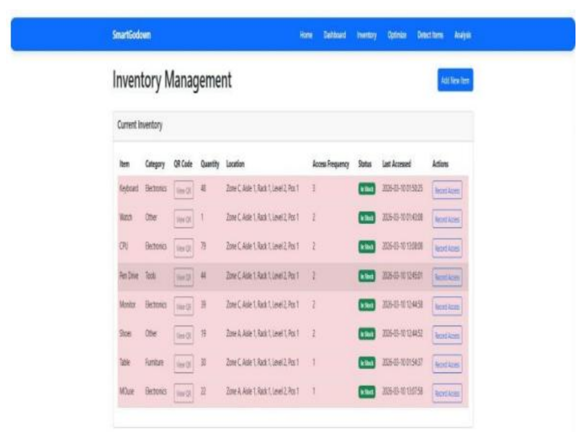

Fig. 4.2: Smart Godown Current Inventory Overview

This table presents a catalog of products housed in the warehouse, detailing their category, quantity, storage location, frequency of access, and stock status. It facilitates the monitoring of inventory in real-time and enables swift retrieval of product information via QR code scanning.

Zone Utilization

Zone	Total Locations	Occupied	Utilization %
A	36	2	5.6%
B	36	0	0.0%
C	36	1	2.8%

Fig. 4.3: Warehouse Zone Utilization overview

This table illustrates the usage status of various warehouse zones by comparing the total number of storage locations to the number of those currently occupied.

Relocation Recommendations

Based on access frequency and item dimensions, we recommend the following relocations

Apply All Recommendations

Item	Access Frequency	Current Location	Suggested Location	Action
Keyboard	3	Zone C, Aisle 1	Zone C, Aisle 1	Apply
Watch	2	Zone C, Aisle 1	Zone C, Aisle 1	Apply
CPU	2	Zone C, Aisle 1	Zone C, Aisle 1	Apply
Pen Drive	2	Zone C, Aisle 1	Zone C, Aisle 1	Apply
Monitor	2	Zone C, Aisle 1	Zone C, Aisle 1	Apply
Shoes	2	Zone A, Aisle 1	Zone C, Aisle 1	Apply
Table	1	Zone C, Aisle 1	Zone C, Aisle 1	Apply
MOuse	1	Zone A, Aisle 1	Zone C, Aisle 1	Apply

Fig. 4.4: Item-wise relocation recommendation

In this table, relocation recommendations are given for a better optimization and accessing for each item

Access Frequency by Category

Category	Item Count	Avg. Frequency
Tools	1	2.0
Other	2	2.0
Electronics	4	2.0
Furniture	1	1.0

Fig. 4.4: Category-wise access frequency analysis

Above table displays the quantity of items within each product category and their average frequency of access in the warehouse. This information aids in determining which product categories are accessed more often, facilitating improved inventory organization and storage planning.

V. ANALYTICAL DISCUSSION

Analysis of Smart Godown can be done by drawing meaningful insights from the dashboard of the system application. The Smart Godown system was analyzed to evaluate its effectiveness in managing warehouse inventory, monitoring item usage, and optimizing storage space. The system provides a centralized dashboard that displays key warehouse metrics such as the number of unique items, total quantity of stored goods, space utilization percentage, and high-frequency accessed items. These metrics allow warehouse administrators to obtain a quick overview of operational performance and inventory distribution. The inventory management module maintains detailed records of warehouse items, including item name, category, quantity, storage location, QR code reference, and access frequency. The integration of QR code functionality enables efficient item identification and retrieval, thereby reducing manual search efforts. Additionally, the access tracking feature records how frequently each item is retrieved, which helps in identifying high-demand products and understanding usage patterns within the warehouse. The system also incorporates a data visualization component that presents analytical insights through charts and graphical dashboards. These visualizations illustrate the most frequently accessed items and provide a comparative view of zone-wise space utilization. Such graphical representations simplify data interpretation and support better decision making in warehouse management. A key component of the system is the optimization module, which analyzes item access frequency and warehouse layout to recommend improved storage locations. Frequently accessed items are suggested to be placed in easily accessible zones to reduce retrieval time.

VI. CONCLUSION

In conclusion, the Smart Godown online inventory management system offers an efficient remedy to the drawbacks of conventional manual inventory methods employed by numerous vendors. By substituting notebook and register-based record-keeping with a centralized digital database, this system enhances data organization, minimizes human errors, and facilitates quicker access to product information. The incorporation of QR code-based item identification enables users to swiftly obtain product details through simple scanning, greatly enhancing the efficiency and accuracy of inventory tracking. The primary contribution of this work is the creation of a cost-effective and practical digital inventory platform that merges centralized data management with QR-based product identification, making it ideal for small and medium-sized vendors. Nonetheless, the current system has certain limitations, such as the need for manual product entry during the initial setup and restricted real-time environmental monitoring capabilities. Future research could focus on incorporating IoT sensors for automated warehouse monitoring, advanced analytics for demand forecasting, and improved security measures like blockchain-based inventory records to further enhance system efficiency and scalability.

REFERENCES

[1] R Girshick, J. Donahue, T. Darrell, and J. Malik, "Rich Feature Hierarchies for Accurate Object Detection and Semantic Segmentation," in *Proc. IEEE Conf. Comput. Vis. Pattern Recognit. (CVPR)*, 2014, pp. 580–587.

[2] S. Ren, K. He, R. Girshick, and J. Sun, "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 39, no. 6, pp. 1137–1149, 2017.

[3] M. Atieh *et al.*, "Performance Improvement of Inventory Management System Processes by an Automated Warehouse Management System," *Procedia CIRP*, 2016.

[4] S. Selamat and S. S. M. Nor, "Smart Technology Usage on Warehouse Management Performance," *Int. J. Res. Innov. Soc. Sci. (IJRISS)*, vol. 9, no. 11, 2025.

[5] M. van Geest, B. Tekinerdogan, and C. Catal, "Smart warehouses: Rationale, challenges and solution directions," *Appl. Sci.*, vol. 12, no. 1, p. 219, 2021.

[6] H. Min, "Smart Warehousing as a Wave of the Future," *Logistics*, vol. 7, no. 2, p. 30, 2023.

[7] Tubis and J. Rohman, "Intelligent warehouse in industry 4.0—systematic literature review," *Sensors*, vol. 23, no. 8, p. 4105, 2023.

[8] R. Sahara and A. M. Aamer, "Real-time data integration of an internet-of-things-based smart warehouse: a case study," *Int. J. Pervasive Comput. Commun.*, vol. 18, no. 5, pp. 622–644, 2022.

[9] S. Redolar Soldado, "Development and Evaluation of a System for Detecting Barcodes and QR Codes using YOLO11: A Comparative Study of Accuracy and Efficiency," 2025.

[10] J. Li *et al.*, "Detection and recognition of multiple QR codes based on YOLO-CBAM algorithm," *Int. J. Bio-Inspired Comput.*, vol. 23, no. 3, pp. 179–188, 2024.

[11] W. Liu *et al.*, "SSD: Single Shot MultiBox Detector," in *Proc. Eur. Conf. Comput. Vis. (ECCV)*, Springer, 2016, pp. 21–37.

[12] K. M. Lee *et al.*, "Design and application of Internet of things-based warehouse management system for smart logistics," *Int. J. Prod. Res.*, vol. 56, no. 8, pp. 2753–2768, 2018.

[13] W. Hamdy, N. Mostafa, and H. Elawady, "Towards a smart warehouse management system," in *Proc. Int. Conf. Ind. Eng. Oper. Manag.*, 2018, pp. 2555–2563.

[14] Nambiar and D. Mundra, "An overview of data warehouse and data lake in modern enterprise data management," *Big Data Cogn. Comput.*, vol. 6, no. 4, 2022.

[15] E. Žunić *et al.*, "Smart warehouse management system concept with implementation," in *Proc. 14th Symp. Neural Netw. Appl. (NEUREL)*, IEEE, 2018, pp. 1–5.

[16] M. G. Khan, N. U. Huda, and U. K. U. Zaman, "Smart warehouse management system: Architecture, real-time implementation and prototype design," *Machines*, vol. 10, no. 2, 2022.

[17] V. S. C. Subrahmanyam *et al.*, "Smart warehouse management system," in *Recent Trends in Renewable Energy Sources and Power Conversion*, Springer, 2021, pp. 99–114.

[18] K. Dewi and R. N. Shofa, "Development of warehouse management system to manage warehouse operations," *Int. J. Appl. Inf. Syst. Inform.*, vol. 1, no. 1, 2023.

[19] Majid, S. Ali, M. Iqbal, and N. Kausar, "Deep Learning Techniques for Vehicle Detection and Classification from Images/Videos: A Survey," *Sensors*, vol. 23, no. 10, p. 4832, 2023.

[20] M. Rashid *et al.*, "Smart warehouse management system with RFID and cloud database," in *Proc. ICIEV & icIVPR*, IEEE, 2019, pp. 218–222.

[21] Z. Ge, S. Liu, F. Wang, Z. Li, and J. Sun, "YOLOX: Exceeding YOLO Series in 2021," *arXiv preprint arXiv:2107.08430*, 2021.

[22] M. Mohamed, "Smart Warehouse Management using Hybrid Architecture of Neural Network with Barcode Reader 1D / 2D Vision Technology," *Int. J. Intell. Syst. Appl. (IJISA)*, vol. 11, no. 11, pp. 16–24, 2019.

[23] C. Ogeawuchi *et al.*, "Systematic review of advanced data governance strategies for securing cloud-based data warehouses and pipelines," *Iconic Res. Eng. J.*, vol. 6, no. 1, pp. 784–794, 2022.

[24] S. Selamat and S. S. M. Nor, "Smart Technology Usage on Warehouse Management Performance," *Int. J. Res. Innov. Soc. Sci. (IJRISS)*, vol. 9, no. 11, 2025.