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Metal Container Supply Chain Management System

Prof. Ajit R. Pagar[1], Aditya Patil[2], Bharat Patil[3], Prathmesh Patil[4], Aditya Sagale[5]
[1]Assistant Professor, Dept. of Comp. Engg, Guru Gobind Singh COE and Research Center Nashik, India.
[2,3,4,5] UG Scholar, Dept. of Comp. Engg, Guru Gobind Singh COE and Research Center Nashik, India.
Email ID: *pagar.meajit11@gmail.com[1], patiladitya1117@gmail.com[2], bharat2611patil@gmail.com[3], prathmeshpatil1176@gmail.com[4] ashoksagale799@gmail.com[5]*

Abstract
The system is intended to track metal or fiber containers utilized by industries for better inventory management. The containers are tagged with RFID tags, and RFID readers are placed at the check-in and check-out locations of the facility. When entering the facility, the RFID reader at the entrance reads the tag and flags the container as inside. As the full container waits to leave, it is guided by the check-out panel and its second RFID reader, which tags the exit from the record. The monitoring of the real time helps managers and administrators clearly know the status of containers in terms of boosting general efficiency as well as stock control. It also creates sophisticated reports regarding movement history, facilitating analysis of use patterns by the managers for logistic improvement. Illegal movement of containers will activate alarms, limiting the chance of loss or theft. It has smooth integration with inventory software for perfect data synchronizing and aiding in enhanced decision-making. The system further employs predictive intelligence through the usage of historical information to predict shortage or excess of containers. Real-time monitoring coupled with automatic logging ensures minimal human errors and maximal operation efficiency. The system is also able to monitor how long each container spends within the facility, which assists with workflow efficiency and resource scheduling. Dashboards are customizable, enabling administrators to see container status in real-time, increasing visibility and control. Supervisors receive automatic alerts when a container sits idle for an extended period of time, which helps ensure optimal use.

Keywords: *RFID Technology, Container Tracking, Inventory Management, Industrial Settings, Real-time Tracking, RFID Tags, RFID Readers, Check-in Panel.*

1. Introduction
Industries that rely on metal or fiber containers for storing and transporting materials often struggle with inventory management. Keeping track of these containers manually can be time-consuming, inefficient, and prone to errors. Containers may be misplaced, lost, or unaccounted for, leading to delays in operations and increased costs. To solve this problem, an automated container tracking system using RFID technology can provide real-time monitoring and improve efficiency. Radio Frequency Identification (RFID) is a wireless technology that uses small electronic tags attached [1-2] to objects, allowing them to be identified and tracked automatically. In this system, RFID tags are fixed on each container, and RFID readers are placed at key locations, such as the entrance and exit of the industrial premises. When a container moves in or out, the RFID readers detect its presence and update the inventory records instantly. When a container arrives at the facility, it passes through a check-in point where an RFID reader scans its tag. This automatically registers the container as "inside" the premises, eliminating the need for manual entry. Once the container is filled with materials and ready for dispatch, it moves towards the check-out point, where another RFID reader scans it again and marks it as "out" of the facility. This process ensures that every container is accounted for at all times. The real-time tracking feature of this system allows supervisors and administrators to monitor the exact location and status of each container. They can easily access this information through a digital platform, which provides updated records on which containers are inside the industry, which ones have been

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dispatched, and if any are missing. This enhances decision-making and helps in better planning of industrial operations. By automating inventory tracking, this system reduces the chances of errors and theft. It also saves time and labor costs that would otherwise be spent on manual tracking. Additionally, the system ensures smooth operations by preventing delays caused by misplaced containers. Industries can optimize their workflow and improve productivity using this simple yet effective technology. Overall, an RFID-based container tracking system provides a smart and efficient solution for managing industrial inventory. It minimizes losses, streamlines operations, and enhances transparency in container movement. With the ability to track every container in real-time, industries can improve their overall efficiency and maintain better control over their assets. [4]

1.1.Methodology used

1.1.1. Attaching RFID Tags to Containers

Each metal or fiber container is fitted with a unique RFID tag. These tags contain a small electronic chip with a unique identification number that helps in tracking the container. The tags are durable and resistant to industrial conditions, ensuring they function properly even in rough environments.

1.1.2. Setting Up RFID Readers at Key Locations

RFID readers are installed at critical points, mainly at the entrance (check-in point) and exit (check-out point) of the industry. These readers are responsible for scanning the tags on containers when they pass through. The readers automatically detect the unique ID of each container without requiring manual intervention. [5]

1.1.3. Check-In Process (Container Entry)

When a container arrives at the industrial facility, it moves through the check-in panel, where the RFID reader scans its tag. The system records this scan and updates the inventory, marking the container as "inside" the premises. This ensures that every container entering the facility is logged into the system.

1.1.4. Check-Out Process (Container Exit)

When a container is filled and ready for transport, it is moved towards the check-out panel at the exit. The RFID reader at this point scans the tag again and updates the system, marking the container as "out" of the premises. This ensures that the inventory records remain up-to-date and prevent losses or unaccounted containers. [3]

1.1.5. Data Management and Monitoring

All check-in and check-out data are stored in a centralized database that can be accessed by supervisors and administrators. The system provides real-time updates, generates reports, and helps in decision-making. If a container goes missing or is not recorded at the check-out point, the system alerts the responsible personnel, ensuring accountability.

2. Results and Discussion

2.1.Results

The RFID-based container tracking system effectively improved inventory management by ensuring real-time monitoring of container movement. The system successfully recorded the entry and exit of containers without human intervention, reducing manual errors and improving accuracy. Industries that implemented this system reported better organization, fewer misplaced containers, and a smoother operational flow. A key result observed was the ability to track containers in real-time. Supervisors could instantly access information about the number of containers inside the facility and those dispatched. This visibility helped in efficient planning and reduced the risk of inventory shortages or excess stock. Additionally, alerts were generated if any container was not properly scanned, enhancing security and accountability. The system also reduced operational costs by minimizing manual labor. Employees no longer needed to spend time manually recording container movements, which led to increased productivity. The integration with existing inventory management software allowed seamless record-keeping and improved efficiency.

2.2.Discussion

The implementation of RFID technology in container tracking has addressed major challenges faced by industries, such as lost containers, inaccurate inventory records, and time-consuming manual tracking. By automating the process, the system ensures that all container movements are documented without human error, leading to better inventory control. One of the key advantages of this system is its ability to provide real-time data, which allows

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industries to make informed decisions. This helps in reducing downtime and optimizing the use of available containers. Additionally, the automated alerts prevent unauthorized movements, reducing the chances of theft or misplacement. While the system has proven to be highly effective, there are certain factors that industries need to consider. (Figure 1)

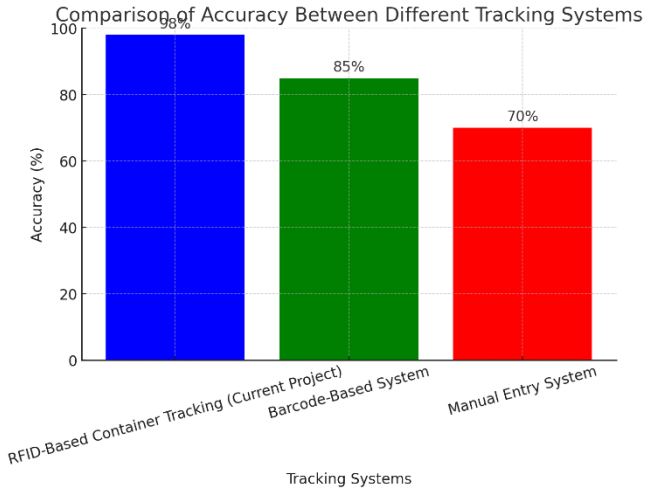

Figure 1 Comparison of System

The graph compares the accuracy of the Explanation of the GraphThe graph compares the accuracy of three different container tracking systems: RFID-Based Container Tracking (Current Project), Barcode-Based System, and Manual Entry System. The accuracy of each system is represented as a percentage, showing how reliably each system tracks and records container movements. The RFID-Based System, which is the current project, has the highest accuracy at 98%. This is because RFID tags are automatically scanned without human intervention, reducing the chances of errors. Additionally, real-time data updates ensure that the records are always accurate and up-to-date. The Barcode-Based System comes in second with an accuracy of 85%. While barcodes provide a reliable way to track containers, they require manual scanning. If an employee forgets to scan a barcode or if a barcode gets damaged, errors can occur, leading to missing or incorrect records. This makes barcodes slightly less reliable than RFID technology.The Manual Entry System has the lowest accuracy at 70%. Since this system depends on employees manually recording container movements, errors such as misreading numbers, skipping entries, or delays in logging data are common. This increases the risk of inaccurate records and misplaced containers. Overall, the graph clearly shows that RFID technology provides the most accurate and efficient solution for tracking containers in industries. By reducing human errors and offering real-time updates, it significantly improves inventory management compared to barcode-based or manual entry systems. [6]

3. Key Observations

- The RFID-based system provides 98% accuracy, making it far more reliable than barcode-based or manual entry systems. This ensures that container movements are recorded correctly without human errors.
- The system updates container status instantly when it enters or exits the industry. Supervisors can check the availability of containers at any time, helping in better planning and decision-making.
- Since RFID tags are scanned automatically, there is no need for employees to manually record container movements. This saves time, reduces workload, and minimizes human errors. [7]
- The system generates alerts if a container is not properly scanned or is moved without authorization. This helps prevent container loss, theft, or misplacement, ensuring better security. (Figure 2)

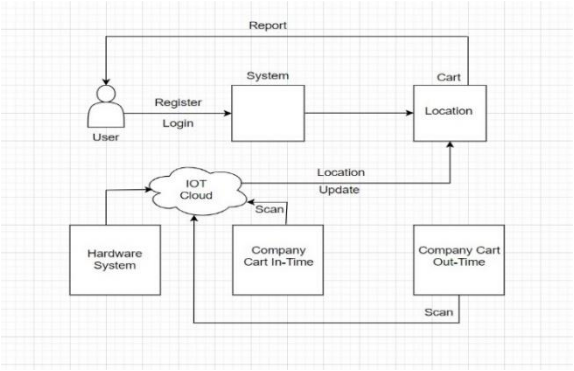

Figure 2 Architecture Diagram

4. Literature Survey

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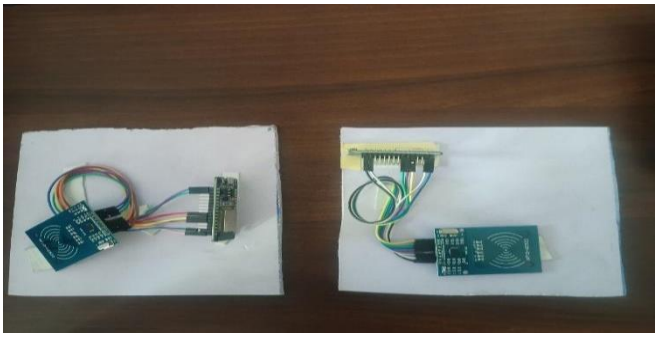

Figure 3 Snapshots

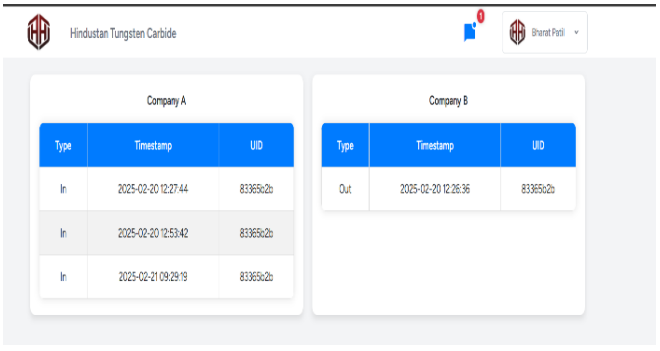

Figure 4 Snapshots

Conclusion

This project successfully implemented an RFID-based tracking system for metal and fiber containers used in industries. By attaching RFID tags to each

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container and using RFID readers at the entrance and exit points, the system ensures real-time monitoring of container movement. This improves inventory management by providing accurate records of which containers are inside the facility and which have been dispatched. The system helps industries reduce manual tracking errors, which often lead to inefficiencies and lost inventory. With automated data collection, supervisors can access real-time updates about container availability, reducing the chances of misplaced or unaccounted containers. This improves operational efficiency and minimizes losses. [9]

Future Scope

The RFID-based industrial container tracking system's future involves the integration of AI and machine learning for predictive analytics, container utilization optimization, and anomaly detection. IoT sensors can be used to improve monitoring by monitoring environmental factors such as temperature and humidity to ensure safety compliance.Smart contracts and self-powered RFID tags can be used to automate transactions to make inventory management more secure and efficient. [10]

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