

Smart Solution for Small Warehouse Using AI

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Abstract— *Small warehouses often face challenges like inventory inaccuracies, manual errors, and lack of real-time tracking. Our Smart Inventory Management System tackles these issues through automation and intelligent monitoring. QR/barcode scanning reduces data entry mistakes, while IoT-based ultrasonic sensors ensure real-time stock tracking. An automated cart system updates inventory instantly during item movement. Smart shelving helps keep products neatly organized, making it quicker and easier to find items and restock them when needed. Expiry-based prioritization ensures near-expiry items are sold first, minimizing waste. A centralized dashboard with Tamil voice guidance offers live analytics and restocking alerts. Daily to yearly reporting supports operational analysis. An interactive chatbot answers common queries, improving staff productivity. Advanced analytics and theft detection enhance security and decision-making.*

Keywords: *Smart Inventory Management, Warehouse Automation, Real-Time Tracking, QR/Barcode Scanning, IoT Sensors, Automated Cart System, Expiry Management, Dashboard Analytics, Tamil Voice Assistance, Theft Prevention, Sales Forecasting, Inventory Optimization, Chatbot Support.*

I. INTRODUCTION

The truth is, small and mid-sized warehouses don't always have the resources to invest in huge, complex systems. But that doesn't mean they don't need smarter tools. If anything, they need them more. Having something that gives a real-time view of what's on the shelves, alerts you when stock is low, or tracks expiry dates can make a huge difference. It's not just about being modern—it's about saving time, reducing stress, and keeping things running without surprises. When things are running smoothly, it frees people up to focus on the bigger picture instead of constantly putting out fires caused by inventory errors.

We built our Smart Inventory Management System (or SIMS for short) because we kept running into the same problems again and again—too much manual work, no way to see what's in stock in real time, and a lot of wasted time moving things around inefficiently. It just didn't make sense to keep relying on outdated methods like paper logs or spreadsheets when better tools are out there. So, we decided to take action and make a change.

With SIMS, we've tried to cut out as much guesswork as possible. We brought in QR and barcode scanning so that every item, whether it's just been added to the shelves or has been sitting there for a while, can be tracked easily and accurately. That one step alone already clears up a lot of the confusion you normally get when people are entering things by hand. It's a small change, but it has a big impact—less room for mistakes, faster updates, and a smoother process overall.

We also brought in an automated cart that helps with moving products around. When it's time to restock or pick something from the shelves, the cart grabs the product info on the go and updates the system as it moves. It might sound simple, but it really speeds things up. Staff don't have to stop and scan or type in every item. Everything flows faster, and there's way less chance of something getting missed or logged wrong.

In a lot of warehouses, organizing products isn't something people think about too much—it's just kind of assumed that it'll all work out. But having a system that actually keeps everything in order makes a huge difference. It might not sound like a big deal, but trust me, it really cuts down on the time spent hunting for items. That's why we came up with the smart shelving feature. It's simple but effective products stay where they should be, and workers can grab what they need and get things restocked in no time.

The dashboard is really the heart of the system—it brings everything together. It shows real-time data, gives restocking alerts, and even has Tamil voice guidance. This makes it easy for everyone, even those who prefer regional languages, to use the system without needing extra training. Plus, it comes with a reporting feature that breaks down sales and purchases by day, week, month, and year. This way, warehouse managers can get a clear picture of how things are really going and make decisions based on what the numbers are telling them.

To make things easier for employees, we've added a chatbot that helps with common questions—like where a product is, how much stock is left, or what the top-selling items are. Unlike heavy AI systems, this chatbot uses simple, rule-based logic, so it doesn't slow things down but still gets

the job done. That way, warehouse staff can get quick answers without having to stop what they're doing or disrupt the flow of work.

Finally, the system uses data to spot trends in sales, predict demand, and track seasonal patterns. This helps with inventory planning and also gives businesses a better understanding of what customers want and how products are performing. For extra security, the system sends automatic alerts whenever there's any unusual or unauthorized movement of products. This helps prevent theft and misuse, keeping things secure.

In summary, our Smart Inventory Management System is a scalable, technology-driven solution tailored for small warehouses. It addresses core inefficiencies while enhancing accuracy, usability, and operational transparency.

II. RELATED WORKS

R. Gupta et al. [1] proposed an intelligent warehouse management system that integrates barcode scanning and automation technologies to minimize human errors in inventory tracking. The study demonstrates how real-time stock monitoring can improve order accuracy and reduce stock discrepancies. This research provides a foundation for our system, which enhances inventory management through barcode scanning and automated alerts.

A study by L. Tanaka et al. [2] explores the application of smart automation in warehouse logistics, focusing on the role of ultra-sonic sensors for precise inventory measurement. The research highlights the effectiveness of non-contact sensing technologies in detecting stock levels and optimizing storage space. Our project builds upon this concept by incorporating ultra-sonic sensors for real-time inventory tracking and shelf space management.

The work by S. H. Lee et al. [3] investigates the benefits of voice-guided systems in warehouse operations, particularly for enhancing accessibility and efficiency among workers. The study indicates that multi-language voice guidance improves workflow accuracy and reduces training time for new employees. Our system integrates Tamil voice guidance to ensure ease of use for a diverse workforce and streamline warehouse operations.

A research study by D. M. Brown et al. [4] discusses automation-driven warehouse optimization, focusing on predictive analytics for inventory forecasting. The findings show that data-driven decision-making helps businesses avoid overstocking and understocking issues. Our project adopts this approach by providing detailed analytics and automated reorder alerts to assist warehouse managers in maintaining optimal inventory levels.

Another study by P. Kumar et al. [5] Looks into how automation affects warehouse efficiency and boosts worker productivity. The research emphasizes how automated stock tracking systems free up employees for higher-value tasks. Our system follows a similar approach by reducing manual

processes, allowing workers to focus on strategic operations and improving overall productivity.

The research conducted by J. Fernandez et al. [6] explores the role of cloud-based warehouse management applications in enhancing operational transparency. The study suggests that centralized data access enables better coordination and faster decision-making. Our project aligns with this by implementing a cloud-integrated system that provides real-time stock updates and detailed reporting tools.

Lastly, K. Nakamura et al. [7] examine sustainable inventory management practices and emphasize how digitalization can decrease reliance on paper and improve energy efficiency. Our solution similarly promotes sustainability through digital record-keeping and by adopting energy-efficient automated processes wherever possible

III. METHODS

1. User Management:

1.1 User Sign-Up & Sign-In:

Getting started with the system is simple. New users just need to fill out a quick form with basic details like their name, email address, phone number, role (whether they're an admin, a manager, or warehouse staff), and a password. Once submitted, this information gets stored safely in MongoDB, so everything stays secure behind the scenes.

To make sure it's really them signing up, the system sends a one-time password (OTP) to their phone or email during registration. This extra step helps keep fake accounts out and adds another layer of protection.

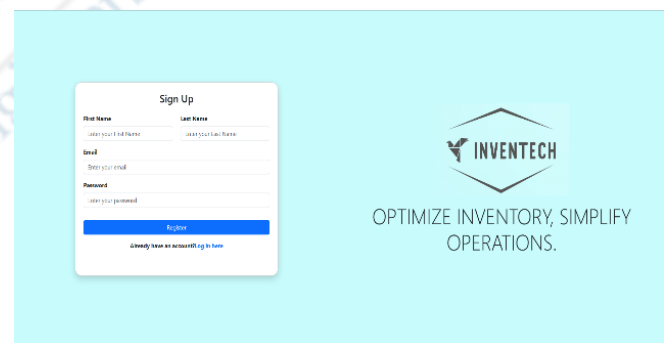


Figure 1: User Signup & Login

After signing up, users can log in using their email or username along with their password. Depending on their role, they'll only see the parts of the system meant for them. This setup keeps everything organized, limits access to sensitive info and makes sure each person has the tools they need—nothing more, nothing less.

1.2 User Profile Management:

Us Each user has access to a personal profile page where they can update their contact information, switch roles if needed, or reset their password. It's designed to be simple and easy to use, so making changes doesn't feel like a chore.

process of restocking becomes faster and more efficient, improving overall inventory management. When the stock reaches a critical point, the page displays a message saying, "பங்குகள் குறைவாக உள்ளது, விரைவில் நிரப்பவும்" (Stocks are low, restock quickly) in Tamil. This ensures local staff can quickly understand the urgency and take the necessary steps to replenish the stock. The system's real-time alerts help avoid

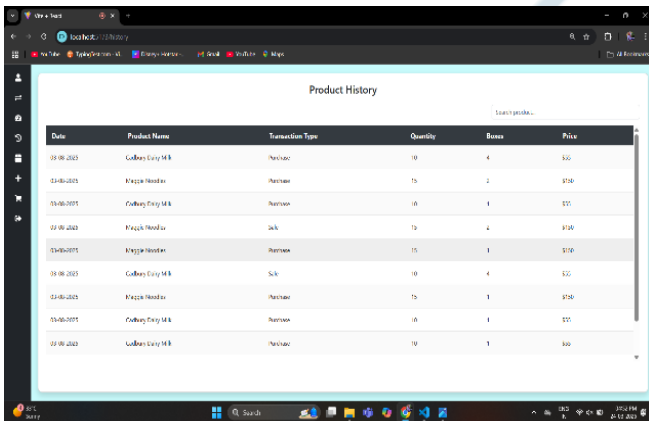
5. Product Expiry & Stock Prioritization:

5.1 Expiry Date Tracking:

Products are labelled with **expiry dates** to ensure proper handling. Items approaching their expiration date are flagged for priority retrieval, and warehouse managers receive automatic notifications to ensure they are dispatched promptly.

6. History Page:

The History Page records all transactions related to sales, purchases, and stock movements, offering a complete, searchable transaction log. This feature ensures easy auditing, compliance, and analysis of historical inventory activities.



Date	Product Name	Transaction Type	Quantity	Boxes	Price
01-08-2023	Colony Curry Milk	Purchase	10	4	500
01-08-2023	Kappa Mandu	Purchase	75	1	8700
01-08-2023	Colony Curry Milk	Purchase	10	4	500
01-08-2023	Kappa Mandu	Sale	75	1	8700
01-08-2023	Kappa Mandu	Purchase	15	1	9100
01-08-2023	Colony Curry Milk	Sale	10	4	500
01-08-2023	Kappa Mandu	Purchase	75	1	8700
01-08-2023	Colony Curry Milk	Purchase	10	4	500
01-08-2023	Colony Curry Milk	Purchase	10	1	500

Figure 6: History Page

7. Security & Theft Prevention:

7.1 Inventory Movement Tracking:

In our warehouse setup, we've added RFID tags and ultrasonic sensors to keep an eye on where things are always. This setup helps us track items as they move around, making it easier to avoid mix-ups or lost products. If something gets moved without proper tracking or if the system spots anything unusual, it immediately notifies the manager so they can check it out. Every item movement gets logged too, so there's always a clear history of what happened. It's a simple but effective way to cut down on errors, improve security, and give staff more confidence in the system.

8. Role-Based Access Control:

Secure authentication ensures different levels of access to the system based on user roles, with detailed activity logs that

track user interactions. This layer of security safeguards sensitive information and system integrity.

9. Data Analytics & Business Insights:

9.1 AI-Driven Demand Forecasting:

The system leverages AI to analyse historical sales data and predict future demand patterns. Warehouse managers receive AI-powered stock recommendations that help optimize inventory levels based on predicted trends.

10. Seasonal Trend Analysis:

The system conducts detailed seasonal trend analysis, examining past sales patterns to adjust inventory levels according to market demand. This prevents overstocking, stockouts, and missed revenue opportunities by aligning stock with demand fluctuations.

11. Automated Cart System:

11.1 Real-Time Order Processing:

We've added an automated cart to help move items from storage shelves to the dispatch area. As it transports products, the system updates the stock levels automatically, so there's no need for someone to enter the data manually. This not only cuts down on physical work but also makes the order-packing process quicker. With everything being tracked as it happens, it's easier to keep tabs on where items are, and there's less chance of anything going missing.

It's especially helpful during busy hours when the workload is high, and staff are stretched thin. By handling routine movements, the cart allows the team to focus more on quality checks and faster dispatch.

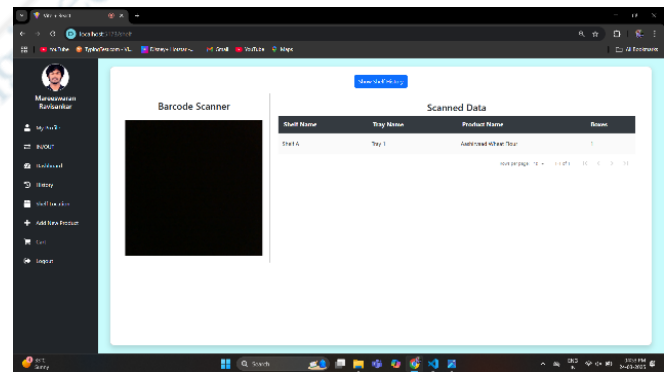


Figure 7: Automated Cart

12. Report Filtering:

12.1 Real-Time Data Filtering:

Reports are generated in real-time, ensuring that the data presented is always up to date. Users can filter data instantly without waiting for manual updates, allowing for quick access to accurate and current information. This reduces delays, enabling teams to respond faster to stock demands or sales trends.

12.2 Detailed Purchase and Sales Insights:

The system provides comprehensive insights into inventory performance, tracking both purchases and sales. By analysing this data, users can identify top-performing products, slow-moving stock, and seasonal trends, which are crucial for forecasting and improving order planning.

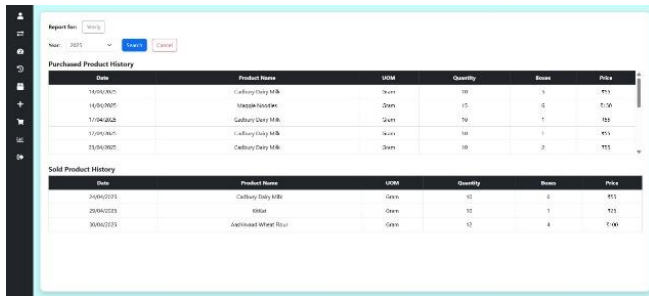


Figure 8: Report Filtering

13. Automatic Chatbot:

The chatbot is a helpful tool for warehouse workers. It answers common questions like where products are located, how much stock is on hand, and which items are popular. This way, employees don't have to search through records or ask colleagues for this information. The chatbot is very easy to use because of its simple interface, so anyone can start using it without any trouble. With less time spent on routine tasks, the overall operation runs more smoothly. By simplifying these processes, the chatbot boosts daily work efficiency in the warehouse.

14. Database & Storage:

We use MongoDB to ensure everything in the system runs smoothly and efficiently. It stores all essential data, such as login details, inventory levels, and sales records, keeping everything updated in real time. When users check the inventory or access a profile, the system retrieves the latest information within seconds. Each product is assigned a unique QR code or barcode, along with a timestamp of when it was received, making it easy to track how long items have been in stock. To ensure privacy, sensitive information, like login credentials and order history, is encrypted, restricting access to authorized personnel only. MongoDB's scalability guarantees that as data grows, the system remains fast and responsive. This also allows for easy integration of new features without concerns about data limitations. Ultimately, MongoDB ensures the system stays organized, secure, and ready to expand as the business evolves.

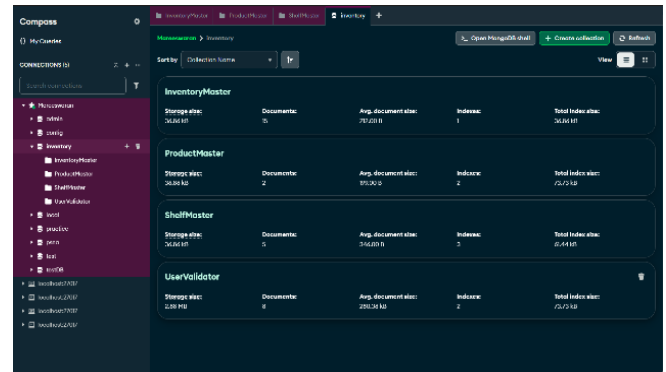


Figure 9: Database Tables

IV. CONCLUSION

Running a small warehouse can get pretty overwhelming—especially when things are moving fast, and it feels like there's always something slipping through the cracks. That's why we came up with the Smart Inventory Management System. It's designed to take some of that stress off by automating the tedious stuff and giving you a clearer picture of what's going on in real-time. With QR and barcode scanning, we've cut down on the usual mistakes people make when entering data. Plus, the IoT sensors track stock as it moves, and the automated cart system updates everything instantly when products are picked or restocked. We also made sure that product organization is a breeze with smart shelving, so items are easy to grab and put back in the right place. One of the coolest parts is how the system automatically flags items that are nearing their expiry date and pushes them to the front—cutting down on waste and making sure customers always get fresh stock. Everything is controlled from one simple dashboard, which gives live updates, tracks trends, and sends alerts when things need restocking. For the team, there's Tamil voice guidance built right in, making the whole thing easy to use without extra training. The system also has daily, weekly, and yearly reporting to give managers a full picture of how things are going. To keep things secure, the system keeps track of stock movements and sends an alert if anything seems off. There's also a chatbot built in that can quickly answer questions, so the team doesn't lose time searching for info. With all these features working together, everything runs more smoothly, faster, and with fewer mistakes—no need for anyone to have tech expertise to use it.

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