



A Scalable Supply Chain Management System Using Modern Web Technologies

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Abstract

This document focuses on the Supply Chain Dashboard. It is a system that assists small and medium enterprises in managing their supply chains. The traditional method is insufficient. Those methods can lead to errors and misconceptions. So this project named Supply Chain Dashboard is made to address those issues so that the small and medium size enterprises can have transparency in their work ensuring smooth flow of goods and product. The primary element of the supply chain dashboard is AI Analytics Module. The Python Backend utilizing FastAPI manages essential functions and drives the AI Analytics Module. Our whole data is stored in PostgreSQL. Also we have used the Typescript for seamless operations on the supply chain activities.

Index Terms: Supply Chain Management (SCM), AI-Powered Dashboard, Predictive Analytics, Demand Forecasting, Inventory Optimization, Real-Time Monitoring, IoT, FastAPI, PostgreSQL, React.

1. INTRODUCTION

Supply Chain Management (SCM) is important for the businesses, ensuring the smooth flow of goods, information, and finances from suppliers to customers. In the growing technology, modern businesses need centralized platform to manage key process such as tracking inventory, overseeing transportation, and monitoring Key Performance Indicators for managing orders.

But the problem is small and medium scale businesses works on the traditional methods in this advanced world, for supply chain management things does not go that smoothly. Those who are admins in supply chain activities often do not have a clear picture of what is happening at any given time. They make mistakes frequently. These mistakes can cause problems. For example, they have a hard time figuring out how much of something they will need, so they either run out or have too much. It is also hard to maintain or to measure the temperature of certain products while they are being moved. Some products are having concerns regarding maintaining the temperature, so that they can work properly.

So, this creates an issue which deals with the product quality and delays in getting them where they need to go.

If these issues are ignored then it can be very costly to deal with those because it is unable to overcome from this situation. The solution is AI Powered supply chain dashboard.

It has several features which will help to address these problems which will overall reduce the problems for the business models. These features include managing orders, tracking inventory, analyzing numbers, monitoring transportations, and overseeing the temperature of sensitive goods. The AI based supply chain dashboard uses Artificial Intelligence to make predictions. It helps us to

anticipate what people will want, identify delays, choose the best routes, and utilize the resources more efficiently.

2. PROBLEM STATEMENT

In today's highly competitive business environment, the supply chains have become increasingly complex, involving multiple stakeholders, extended networks and large volume of networks. Phenomena such as demand distortion, inefficient inventory management, lack of real time visibility and delayed decision making continue to negatively impact the supply chain performance. Hence, there is a need for an advanced supply chain management that approach data analytics to improve accuracy, enhance transparency, and optimize overall supply chain performance.

3. LITERATURE SURVEY

[1] explored the role of information technology in enhancing supply chain management efficiency. Their work highlights how IT systems improve the coordination, data sharing, and decision-making across supply chain operations. [2] study examines various applications of supply chain management across industries. The authors focus on how SCM improves operational efficiency, cost reduction, and customer satisfaction. [3] investigated integration of Artificial Intelligence in supply chains to improve sustainability. Their work demonstrates how AI enables predictive Analytics, automation, and smarter decision-making. [4] emphasizes the importance of data in supply chain management. It discusses how accurate data collection and analysis enhance forecasting, planning, and overall supply chain performance. [5] focuses on integrating the human intelligence with advanced technologies for improved collaboration and adaptability. [6] provides an overview of operations and supply chain management concepts. It highlights key strategies for optimizing production, distribution and logistics processes. [7] explored Logistics 4.0 and the integration of the Arrowhead Framework in supply chains. Their work demonstrates how IoT-based systems enable smart, interconnected, and automated logistics operations. [8]

presents a bibliometric review of Artificial Intelligence applications in supply chain management. The authors analyse research trends, key contributions, and future directions in AI-driven SCM. [9] proposed the use of blockchain technology in supply chain management. Their work highlights improved transparency, traceability, and security in supply chain transactions. [10] focuses on automated supply chain management systems. The author discusses early approaches to automation for improving efficiency and reducing manual intervention. [11] developed a smart supply chain model using big data analytics and machine learning. Their work demonstrates improved demand forecasting, optimization, and decision-making. [12] presents a simulation-based approach to supply chain management. The authors use modelling techniques to analyze and optimize supply chain performance under different scenarios. [13] proposed a real-time supply chain management model using co-modelling techniques. Their work focuses on improving responsiveness and real-time decision-making.

[14] explores the use of Generative AI and Internet of Behaviors in supply chain management. The authors highlighted how these technologies enable intelligent automation and behavior-driven decision systems. [15] conducted a systematic literature review on AI in supply chain management. Their work identifies key research gaps and provides future directions for AI-driven supply chain innovations.

III. RELATED WORK & MOTIVATION

A. Related Work

This project is based on research that shows how Artificial Intelligence can improve Supply Chain Management in a real and practical way. Many studies say Artificial Intelligence helps supply chains work better, become stronger, and give more accurate results. It is useful for simple tasks like tracking inventory, managing transportation, and predicting future demand. Artificial Intelligence is good at making predictions and automating work. With Machine Learning, we can study past data and estimate what may happen next. A method called Long Short-Term Memory helps predict future results using past patterns, and Genetic Algorithms help find the best solution from many options. This helps reduce cost, avoid delays, and deliver orders to customers on time, making the supply chain faster and more reliable.

B. Motivation (Problem Statement)

The main reason for this project comes from the common problems seen in current supply chain systems, especially in small and medium businesses. Many businesses still depend on manual work, so they do not get real time visibility of their operations. Wrong demand prediction often causes stock to run out or become too much, which leads to loss. Poor transport planning and lack of temperature monitoring also create delays and sometimes damage product quality. This project aims to build a simple and easy to use platform that connects everything in one place and uses Artificial Intelligence to solve these problems. It provides real time insights and better predictions so businesses can make faster and smarter decisions.

I. REQUIREMENTS AND DESIGN GOALS

The AI Powered Supply Chain Dashboard was designed to meet important business needs. It gives centralized visibility by bringing all supply chain activities into one simple dashboard. It uses predictive analytics with Artificial Intelligence and Machine Learning to forecast demand and use resources in a better way. It also supports real time tracking, such as monitoring location and temperature of goods, and provides automated alerts with instant notifications and useful suggestions based on data. The system was designed with a layered and microservices based structure so it can grow easily in the future. It is built to run smoothly with low resource usage and has clear connection points so new Artificial Intelligence and Machine Learning features can be added later without difficulty.

II. SYSTEM ARCHITECTURE

The system has three main layers. It combines real time data with Artificial Intelligence models to understand current situations and predict future results.

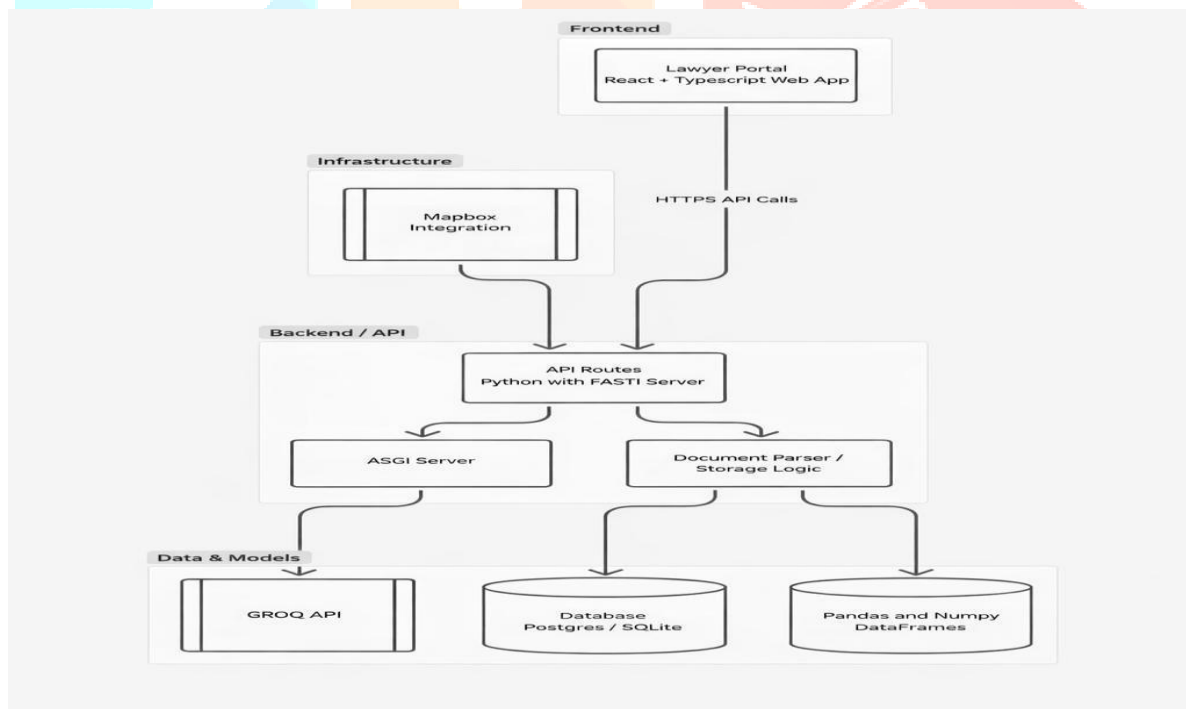


Fig. 1. High-level architecture of AI Powered Supply Chain Dashboard.

A. Block Diagram

The block diagram in Figure 2 shows how data moves and how the system works in the AI Powered Supply Chain Dashboard. First, the system collects internal and external data. Then the data is cleaned and prepared before sending it to the Predictive Analytics Engine. This engine uses different

management components to support better decisions and improve supply chain management with the help of Artificial Intelligence.

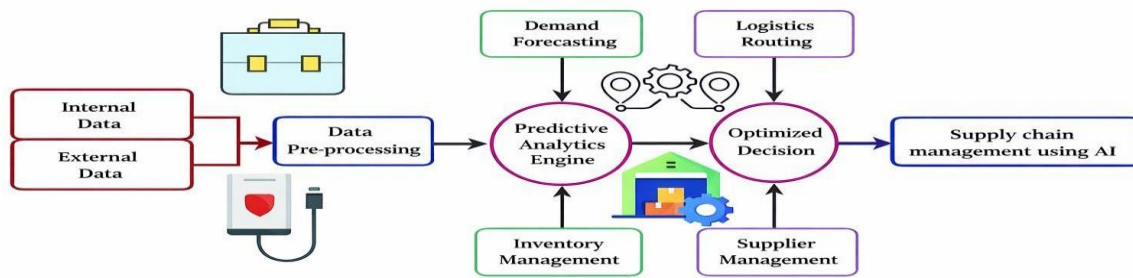


Fig. 2. Flow Diagram of the AI Powered Supply Chain Dashboard's Data Flow and Processing.

B. Data Layer and Persistence

The project uses a simple method to keep the system stable and smooth. It combines a database with cloud storage. PostgreSQL is used to store important data like order details, inventory levels, performance records, and transport logs. The system also uses Cloudinary AI to store files such as images, videos, product photos, and transport documents in the cloud. Large files needed for Artificial Intelligence model training are also kept there. The Python FastAPI microservice accesses this cloud data when training or retraining the predictive Artificial Intelligence and Machine Learning models.

C. Communication

Communication in the system is based on reliable web protocols so data can move easily between the client, the main application, and the Artificial Intelligence parts. These protocols help all parts of the system work together smoothly and exchange data in an efficient way. The React TypeScript frontend communicates with the server to get the required information. It acts like a messenger, sending requests and showing the results to the user. The Python FastAPI backend uses RESTful APIs to handle data, process user actions, and send responses back to the frontend.

D. Security

Security is used to keep the system safe and protect data from unauthorized access. The system uses JSON Web Tokens to manage user login and verify identity. It also controls access to REST endpoints by using role-based permissions, so users can only access what they are allowed to see or do. Important security steps are followed to prevent unauthorized access. Input sanitization is used to clean user data and avoid harmful input, and file type validation ensures only safe and allowed files are accepted. These measures help protect the system from common web security risks.

FLOWCHART AND IMPLEMENTATION

The Inventory Management module follows a clear step by step process. Figure 3 shows how the system works when new stock is received and how orders are processed. This helps the inventory process run smoothly and without confusion.

A. Frontend

The Single Page Application is built using React and TypeScript. It is divided into small modules. The Auth module handles storing and managing JSON Web Tokens for login. The Dashboard module shows important information like performance indicators, real time maps, and alerts, along with special

interfaces for order management and inventory tracking. The interface is responsive and works on different screen sizes. State is managed using React context and local caching to reduce repeated network requests.

B. Backend

The backend is built with Python and FastAPI and handles the main system logic. It provides REST APIs with clear endpoints such as API orders, supports authentication using JSON Web Tokens, connects to a PostgreSQL database for create read update delete operations, and manages Artificial Intelligence prediction functions.

C. AI Microservice

The AI Microservice runs inside the Python FastAPI backend. It uses tools like Scikit learn, Prophet, and ARIMA to run trained machine learning models. Its main tasks are Demand forecasting, which predicts what customers may need, and optimization, which improves inventory planning and transport routes.

D. AI Driven Predictive Analytics and Automated Optimization

The dashboard includes an Artificial Intelligence based prediction system. It studies past data to estimate future demand and helps use resources in the best possible way. This improves planning, reduces delays, and keeps the supply chain running smoothly

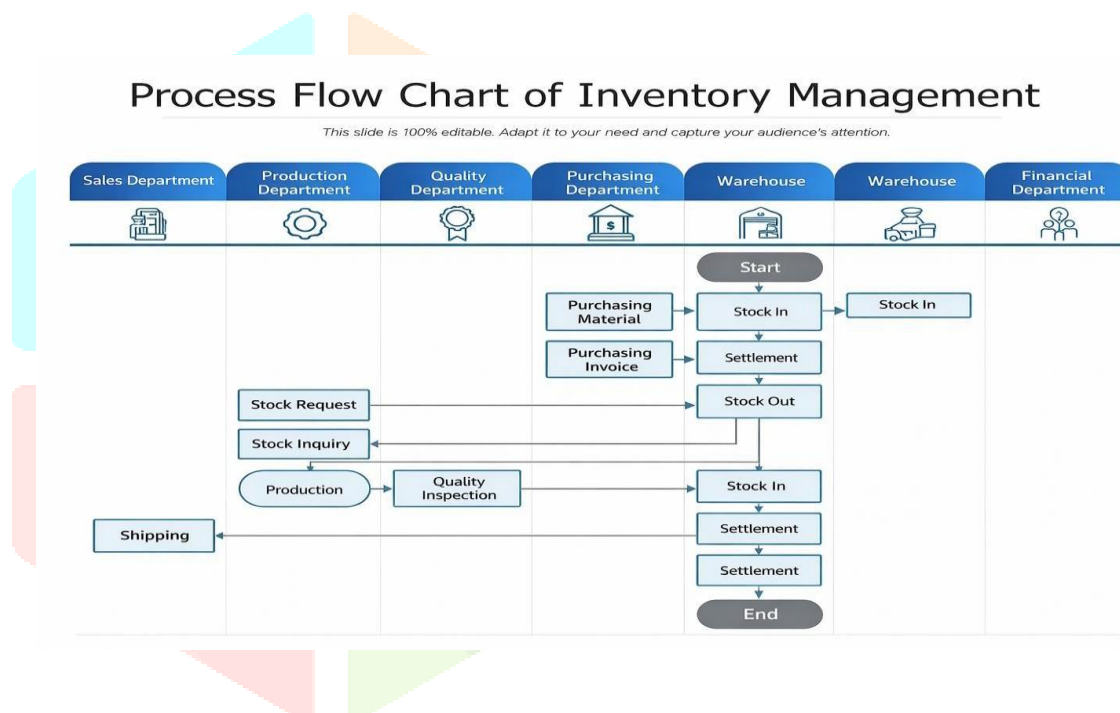


Fig 3. Process Flowchart of Inventory Management

4. RESULTS

Outcomes of AI Powered Dashboard and Testing. The next sub section contains performance and metrics that will include forecasting accuracy, optimization efficiency, etc. as well as the screenshots from the dashboard showing key features such as real-time tracking; KPI visualization; and alert creation. Quantitative analysis will be provided which shows how the system has helped reduce operational costs; improve delivery times and improve effectiveness in managing inventories.

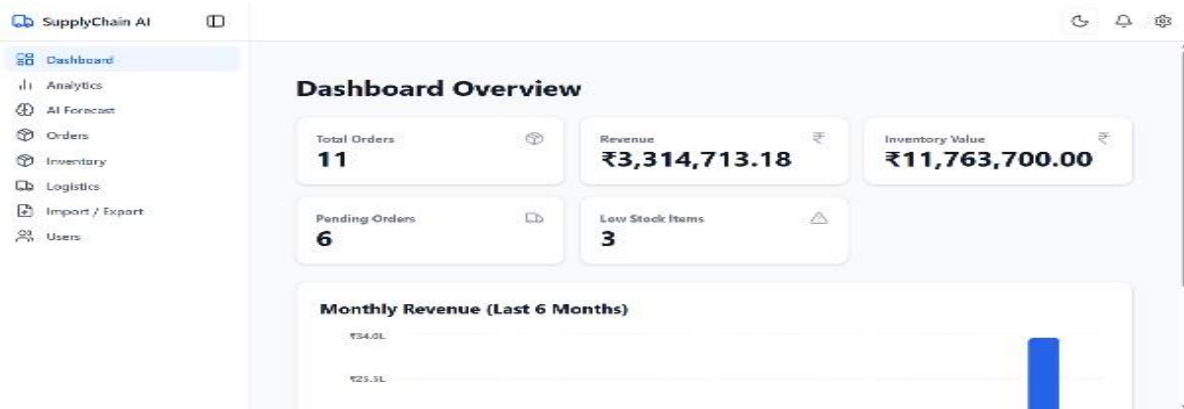


Fig 4. Main Dashboard

The AI-Powered Inventory Management Dashboard serves as the Central interface for real-time monitoring of products, orders, and logistics. It provides unified visibility across the entire supply chain using Mapbox integration for live fleet tracking and stock movement.

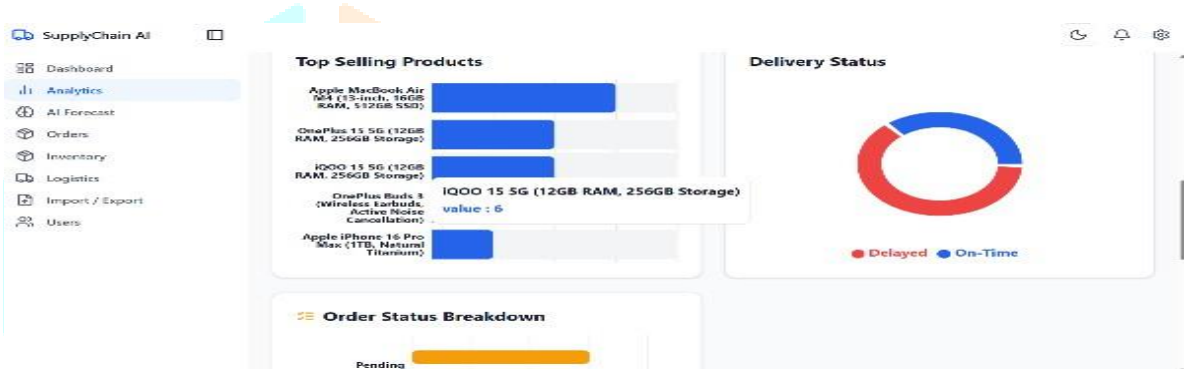


Fig 5. Analytics & Reports

The Analytics and Reports module is really useful for seeing how well our supply chain is doing. It helps people look at the information and make decisions. We can see things like which products we are selling and which ones are the most popular. For example, the Analytics and Reports module shows us a bar chart of the Top Selling Products such as Organic Bananas, Whole Milk, and Avocados.

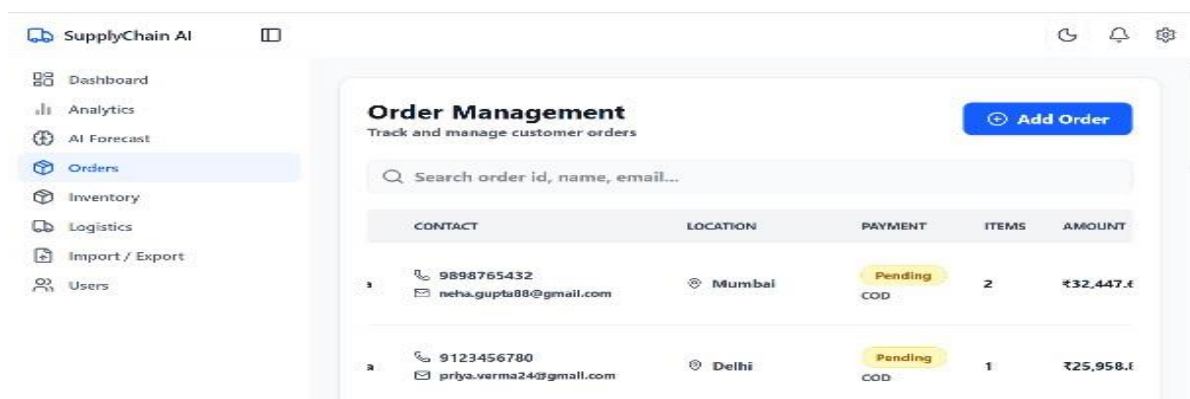


Fig 6. Order Management

The above figure no 6 shows where you can keep track of customer orders and manage them. You can make an order by clicking the “Add New Order” button. You can also do things like add, change, or delete orders using the “Actions” column.

SKU	STOCK	STOCK VALUE (COST)	STATUS	ACTIONS
APL-IP16P-12S-NT	20 units	₹23,98,000.00	Low Stock	
APL-NBA-04-16-512	11 units	₹12,98,000.00	Low Stock	
IQ15-12-256-BLK	26 units	₹12,22,000.00	In Stock	
OP15-12-256-BLK	19 units	₹9,88,000.00	Low Stock	

Fig 7. Inventory Management

The above figure no. 7 functions as the central hub for monitoring and controlling product stock levels. It provides real-time data on available quantities and stock value, ensuring accurate inventory tracking. Color-coded status alerts (In Stock, Low Stock, Out of Stock) highlight replenishment needs.

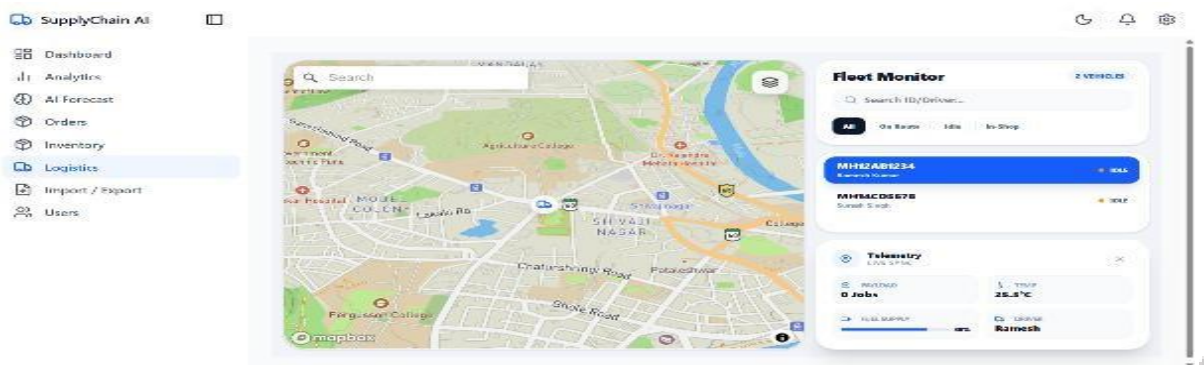


Fig 8. Logistics Management

The above figure no. 8 shows the vehicle management panel to find a vehicle and sort them by what they are doing like if they are on Route, Idle or In-shop. When you pick a vehicle you can see all sorts of information about it, like who the driver's what orders they have hot or cold it is and how much fuel they have. This is because of the Internet of Things which helps you see what is going on with your operations. The fleet and fulfillment operations are very important.

5. CONCLUSION

The inventory system for stores is an excellent solution for small businesses because it is designed specifically for them. The system truly helps retailers manage their stock levels. It does this by using mathematics to predict future needs. This means they do not have too much or too little of any item. The system also assists retailers in making decisions when they purchase more products.

The Groq AI SDK is also part of the system. This is a tool that helps create effective product descriptions. It does this automatically, which saves a considerable amount of time. The descriptions are also high-quality, making the products more appealing to potential buyers. The system with the Groq AI SDK is very beneficial for retailers and their product.

The inventory system for stores uses computers to make managing stock easier. It shows how computers can help with this task. The system uses computer languages like React and Typescript to make it user-friendly. It also uses FastAPI and Python to ensure everything runs smoothly behind the scenes. The system employs tools like scikit-learn, pandas, and NumPy to analyze the numbers and make accurate predictions about what will happen next. This makes the inventory system intelligent and able to grow with retailers, similar to the inventory system for the small stores.

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