

**A  
PROJECT REPORT  
ON**

**“DESIGN AND IMPLEMENT A SMART, AUTOMATED SYSTEM FOR  
PRODUCT LABELING AND TRACEABILITY, CAPABLE OF  
VERIFYING PRODUCT QUALITY PARAMETERS AND APPLYING  
OR VALIDATING LABELS THAT INCLUDE”**

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Recognised by UGC under Section 2f vide No. F.8-29/2017 (CPP-I/PU), dated 20-12-2017 & AICTE, CoA, PCI New Delhi

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## ABSTRACT

The Smart Label Product system is a comprehensive digital solution designed to revolutionize product traceability and quality assurance across modern supply chains. By integrating QR code technology with a robust web-based platform, the system enables manufacturers and stakeholders to generate unique, scannable labels for each product or batch. These QR codes provide instant access to detailed product information, batch history, and workflow status, ensuring transparency and authenticity at every stage of the supply chain.

The platform features an intuitive dashboard for managing product data, automating quality checks, and visualizing analytics, making it easy for users to oversee and optimize their operations. Real-time QR code scanning empowers users to verify product details on the spot, helping to prevent counterfeiting and ensuring compliance with industry standards. The system's modular design supports batch operations, secure data management, and seamless integration with existing workflows.

Developed using modern technologies such as React, Material-UI, and Python-based APIs, the Smart Label Product system offers a scalable and user-friendly approach to digital labeling and traceability. Its implementation not only streamlines product management but also enhances consumer trust and operational efficiency.

This project demonstrates the practical benefits of digital transformation in product labeling and traceability, providing a forward-thinking solution for industries seeking to improve transparency, security, and quality control in their supply chains.

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## CHAPTER 1

### INTRODUCTION

In today's globalized and highly competitive marketplace, ensuring product authenticity, quality, and traceability has become a critical challenge for manufacturers, distributors, and consumers alike. Counterfeit products, supply chain inefficiencies, and lack of transparency can lead to significant financial losses, reputational damage, and even risks to consumer safety. To address these challenges, businesses are increasingly turning to digital solutions that leverage modern technologies for smarter product management and traceability.

The Smart Label Product system is an innovative web-based platform that integrates QR code technology with comprehensive product data management and real-time analytics. By generating unique QR code labels for each product or batch, the system enables seamless tracking and verification throughout the entire supply chain. Stakeholders—including manufacturers, distributors, retailers, and end consumers—can scan these codes to instantly access detailed information about the product's origin, batch history, quality checks, and workflow status. This not only enhances transparency but also helps in preventing counterfeiting and ensuring regulatory compliance.

At the core of the system is a user-friendly dashboard that allows authorized users to manage product information, automate quality assurance processes, and visualize key analytics. The platform supports batch operations, product lifecycle management, and secure data storage, making it adaptable to a wide range of industries such as pharmaceuticals, food and beverage, electronics, and more. The integration of real-time QR code scanning further streamlines operations, enabling quick and accurate traceability at every stage of the supply chain.

By leveraging cutting-edge technologies such as React for the frontend, Material-UI for design, and Python-based APIs for backend operations, the Smart Label Product system delivers a scalable and robust solution for modern product management. This project not only demonstrates the practical application of digital labeling and traceability but also sets a new standard for operational efficiency, consumer trust, and supply chain integrity in the digital age.

## 1.1 APPLICATIONS :

- 1) **Manufacturing Industries:** Enables real-time tracking and verification of products throughout the production and distribution process, reducing the risk of counterfeiting and ensuring product authenticity.
- 2) **Pharmaceutical Sector:** Facilitates compliance with regulatory requirements by providing detailed batch traceability, expiry tracking, and instant access to product information via QR code scanning.
- 3) **Food and Beverage Industry:** Enhances food safety and quality assurance by allowing stakeholders and consumers to trace the origin, batch history, and handling of food products at every stage of the supply chain.
- 4) **Retail and Consumer Goods:** Improves customer trust and engagement by offering transparent product information, warranty details, and authenticity verification directly through smart labels.
- 5) **Logistics and Supply Chain Management:** Streamlines inventory tracking, shipment verification, and workflow monitoring, enabling efficient management of goods from manufacturer to end user.

## 1.2 KEY FEATURES:

**QR Code-Based Labeling:** Generates unique QR codes for each product or batch, enabling instant access to product details and traceability information.

**Real-Time Product Traceability:** Tracks products throughout the supply chain, providing transparency and accountability from manufacturing to delivery.

**Automated Quality Checks:** Integrates quality assurance workflows, automatically recording inspection results and workflow status for every product.

**Analytics Dashboard:** Offers visual insights into product batches, workflow status, and supply chain performance through interactive charts and reports.



## CHAPTER 2

### PROBLEM STATEMENT

Imagine buying a product and not being sure if it's genuine, safe, or even where it really came from. This is a common worry for many people today, whether they're shopping for medicine, food, electronics, or everyday goods. For businesses, these concerns are just as real. Counterfeit products, lost or incorrect records, and a lack of transparency in the supply chain can lead to financial losses, safety risks, and a loss of trust from customers.

Traditional ways of labeling and tracking products—like paper records, simple barcodes, or manual data entry—just aren't enough anymore. They're easy to lose, can be tampered with, and often don't provide the full story of a product's journey from the factory to the customer. When something goes wrong, like a product recall or a quality issue, it can be nearly impossible to quickly trace the problem back to its source. This not only puts consumers at risk but also makes it hard for companies to protect their reputation and meet growing regulatory demands.

The lack of a clear, reliable way to track products also creates headaches for everyone involved in the supply chain. Manufacturers, distributors, and retailers often struggle to communicate and share information, leading to delays, mistakes, and extra costs. Meanwhile, customers are left in the dark, unable to verify if what they're buying is authentic or safe.

Our world is changing, and people expect more transparency and accountability from the products they use every day. There's a real need for a smarter, more trustworthy system—one that makes it easy for everyone to check a product's authenticity, see its history, and be confident in its quality. The Smart Label Product project was born from this need. By combining digital labeling, QR codes, and real-time data, our system aims to make product information accessible, reliable, and secure for everyone, from the factory floor to the hands of the consumer.

## CHAPTER 3

### OBJECTIVES

- 1) **Enhance Product Traceability:** Provide end-to-end tracking of products throughout the supply chain using digital labels and QR code technology.
- 2) **Prevent Counterfeiting:** Enable quick and reliable verification of product authenticity to protect consumers and brands from counterfeit goods.
- 3) **Streamline Quality Assurance:** Automate the recording and monitoring of quality checks for each product or batch, ensuring consistent standards.
- 4) **Improve Supply Chain Transparency:** Make detailed product and batch information easily accessible to all stakeholders, fostering trust and accountability.
- 5) **Support Regulatory Compliance:** Maintain accurate, organized records of product history and quality checks to help businesses meet industry regulations.
- 6) **Empower Consumers:** Allow end-users to instantly access product details, origin, and authenticity by scanning QR codes with their smartphones.
- 7) **Facilitate Efficient Batch Management:** Enable bulk operations for product batches, including label generation, workflow updates, and analytics.
- 8) **Enable Real-Time Data Access:** Provide up-to-date product and supply chain information to all authorized users, improving decision-making and responsiveness.
- 9) **Reduce Administrative Workload:** Automate manual processes related to product tracking, quality checks, and reporting, saving time and resources.
- 10) **Promote Sustainability:** Minimize paper-based documentation and support eco-friendly practices through digital record-keeping and labeling.

## CHAPTER 4

### SYSTEM SPECIFICATION

#### 4.1 HARDWARE SPECIFICATIONS :

1. **Processor (CPU):** Intel Core i3 or equivalent minimum (Core i5/i7 or AMD Ryzen recommended for optimal performance).
2. **Memory (RAM):** At least 4 GB required (8 GB or more recommended for smooth multitasking and handling large datasets).
3. **Storage:** Minimum 100 MB of free disk space for application files and data storage (more may be needed for extensive product and batch records).
4. **Display:** Standard monitor with at least 1366x768 resolution (Full HD recommended for best dashboard and analytics experience).
5. **Internet Connectivity:** Stable broadband or Wi-Fi connection for accessing the web-based platform and syncing data in real time.
6. **QR Code Scanner (Optional):** Any standard USB or mobile device camera for scanning QR codes (webcam or smartphone camera is sufficient for most use cases).
7. **Printer (Optional):** For physical label generation, a standard inkjet or laser printer capable of printing QR code labels.

### **4.2. SOFTWARE SPECIFICATIONS :**

1. **Operating System:** Compatible with Windows, macOS, or Linux for both server and client systems.
2. **Web Browser:** Latest versions of Google Chrome, Mozilla Firefox, Microsoft Edge, or Safari (for accessing the web-based dashboard).
3. **Backend Framework:** Python 3.x with Flask (or similar web framework) for API and server-side logic.
4. **Frontend Framework:** React.js with Material-UI for building the user interface and interactive dashboards.
5. **Database:** SQLite (for lightweight deployments) or PostgreSQL/MySQL (for scalable, production environments).
6. **QR Code Libraries:**
  - Python libraries such as `qrcode` and `python-barcode` for QR code generation.
  - JavaScript libraries such as `jsQR` for QR code scanning in the browser.
7. **Other Dependencies:**
  - Node.js and npm (for frontend development and package management).
  - Required Python packages: Flask, Flask-CORS, Flask-SQLAlchemy, Pillow, requests, etc.
8. **Printer Drivers (Optional):** Standard printer drivers for label printing, if physical labels are required.

## CHAPTER 5

### ADVANTAGES & DISADVANTAGES

#### 5.1.ADVANTAGES:

1. **Enhanced Product Traceability:** Enables end-to-end tracking of products throughout the supply chain, improving transparency and accountability.
2. **Counterfeit Prevention:** Reduces the risk of fake or unauthorized products by allowing instant verification of authenticity via QR code scanning.
3. **Improved Quality Assurance:** Automates and records quality checks for each product or batch, ensuring consistent standards and easier compliance with regulations.
4. **Operational Efficiency:** Streamlines product management, batch operations, and reporting, saving time and reducing manual errors.
5. **Consumer Trust and Engagement:** Provides customers with easy access to product information, building confidence in product authenticity and quality.

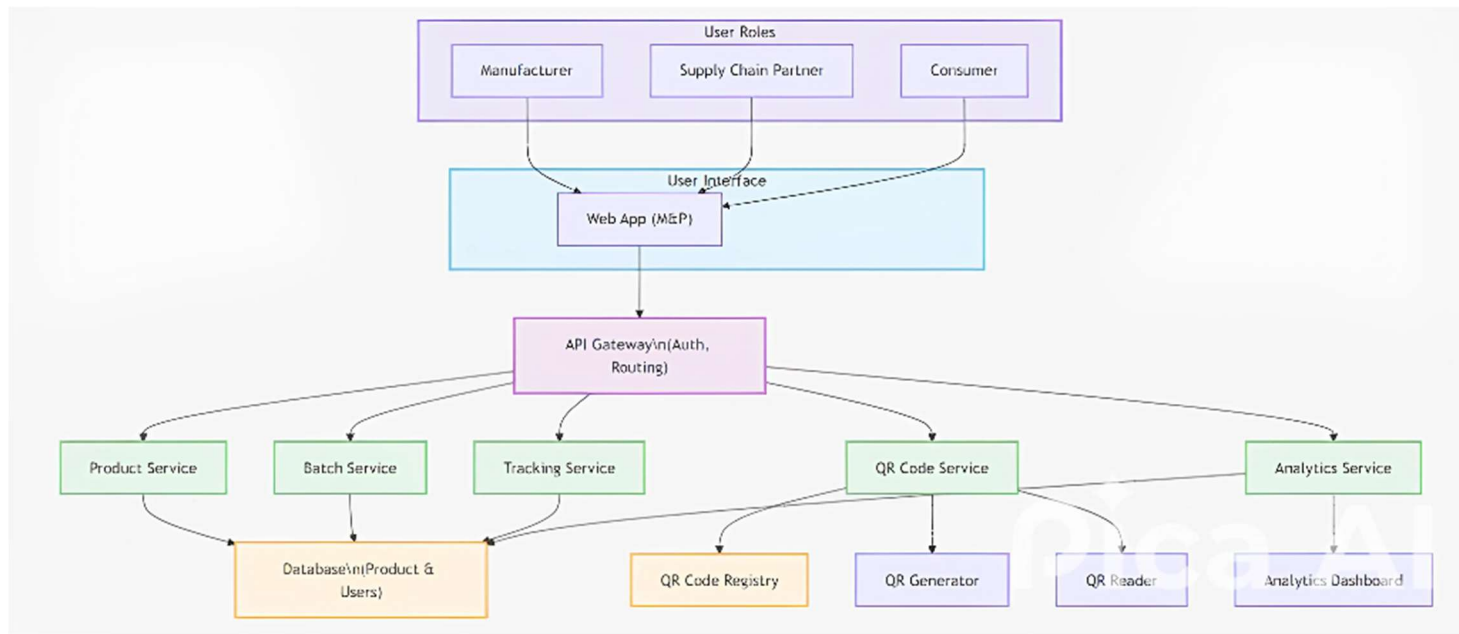
#### 5.2.DISADVANTAGES:

1. **Dependence on Internet Connectivity:** The system requires a stable internet connection for real-time data access and synchronization.
2. **Initial Setup Cost:** Implementing QR code labeling and digital infrastructure may involve upfront costs for hardware and training.
3. **User Adoption:** Some users may be resistant to adopting new digital systems, requiring additional training and support.

## CHAPTER 6

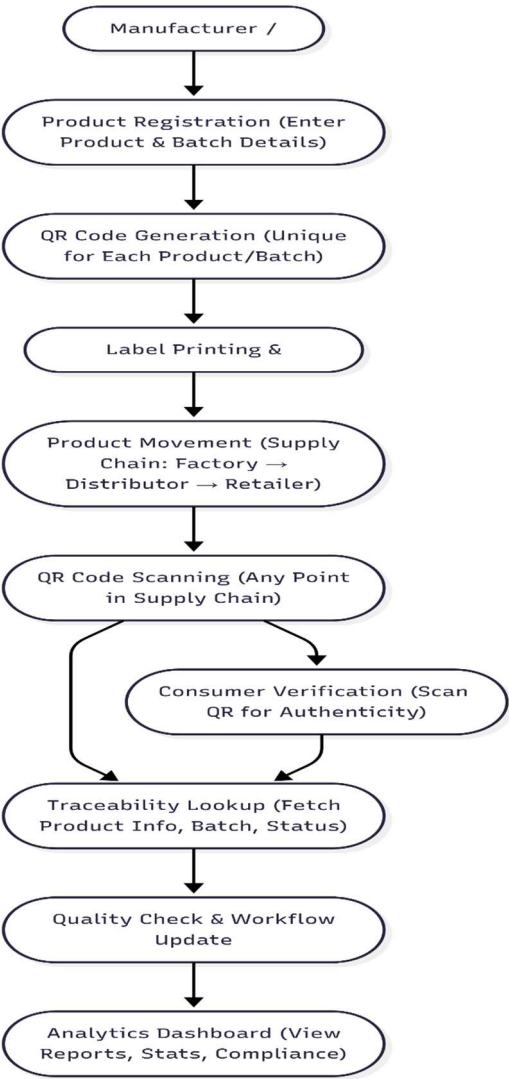
### IMPLEMENTATION

#### 6.1 SYSTEM ARCHITECTURE



The Smart Label Product system is designed as a web-based platform that integrates QR code technology, product data management, and real-time analytics to provide end-to-end traceability and quality assurance. The architecture consists of a frontend user interface, a backend server with API endpoints, a database for storing product and batch information, and QR code generation and scanning modules. The system supports multiple user roles, including manufacturers, supply chain partners, and consumers, each with tailored access to relevant features.

6.2 FLOWCHART



**Fig Flowchart of the system**

## 6.2. WORKFLOW

1. **Product Registration:** Manufacturer or authorized user enters product and batch details into the system via the web dashboard.
2. **QR Code Generation:** The system generates a unique QR code for each product or batch, linking it to its detailed information in the database.
3. **Label Printing and Attachment:** QR code labels are printed and physically attached to the products or their packaging.
4. **Product Movement in Supply Chain:** Products move through various stages (manufacturing, distribution, retail) with their QR codes serving as digital identifiers.
5. **QR Code Scanning:** At any point in the supply chain, stakeholders can scan the QR code using a smartphone or compatible device to access real-time product information.
6. **Traceability and Quality Checks:** The system displays product details, batch history, and workflow status. Authorized users can perform and record quality checks, updating the product's status as needed.
7. **Analytics and Reporting:** The platform aggregates data and provides visual analytics and reports on product movement, batch status, and quality trends.
8. **Consumer Verification:** End consumers can scan the QR code to instantly verify product authenticity, view its history, and access important information such as expiry dates and manufacturer details.



CHAPTER 7

OUTPUT

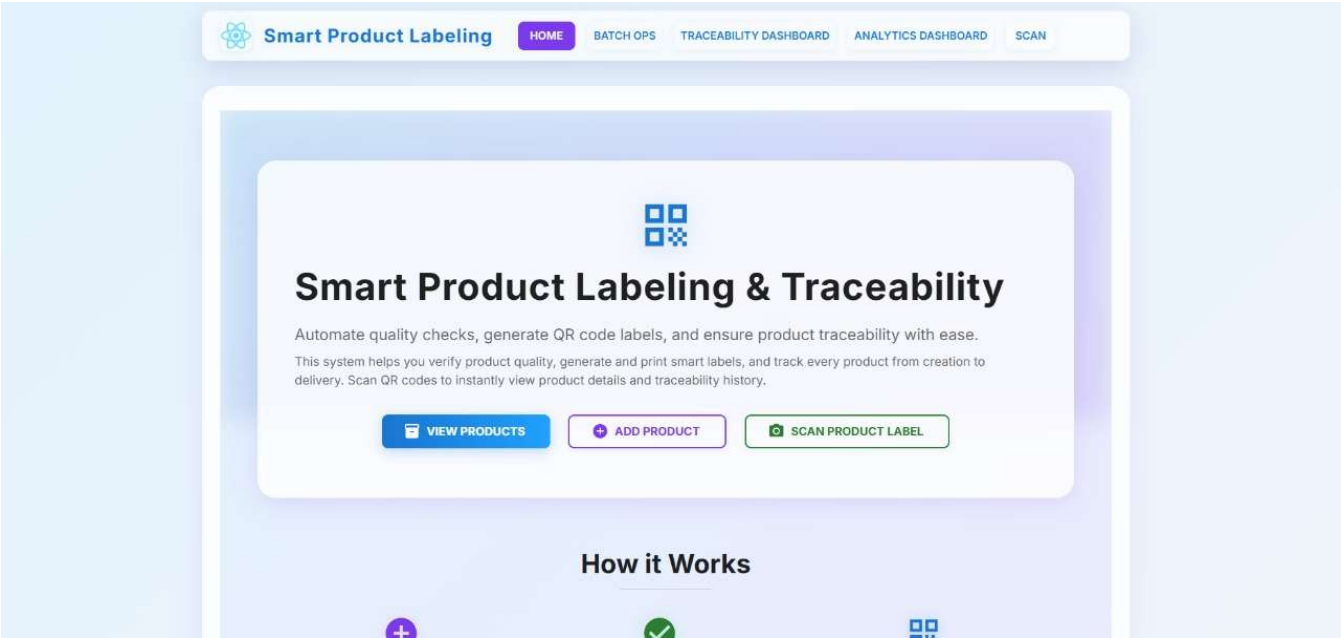


Figure 7.1

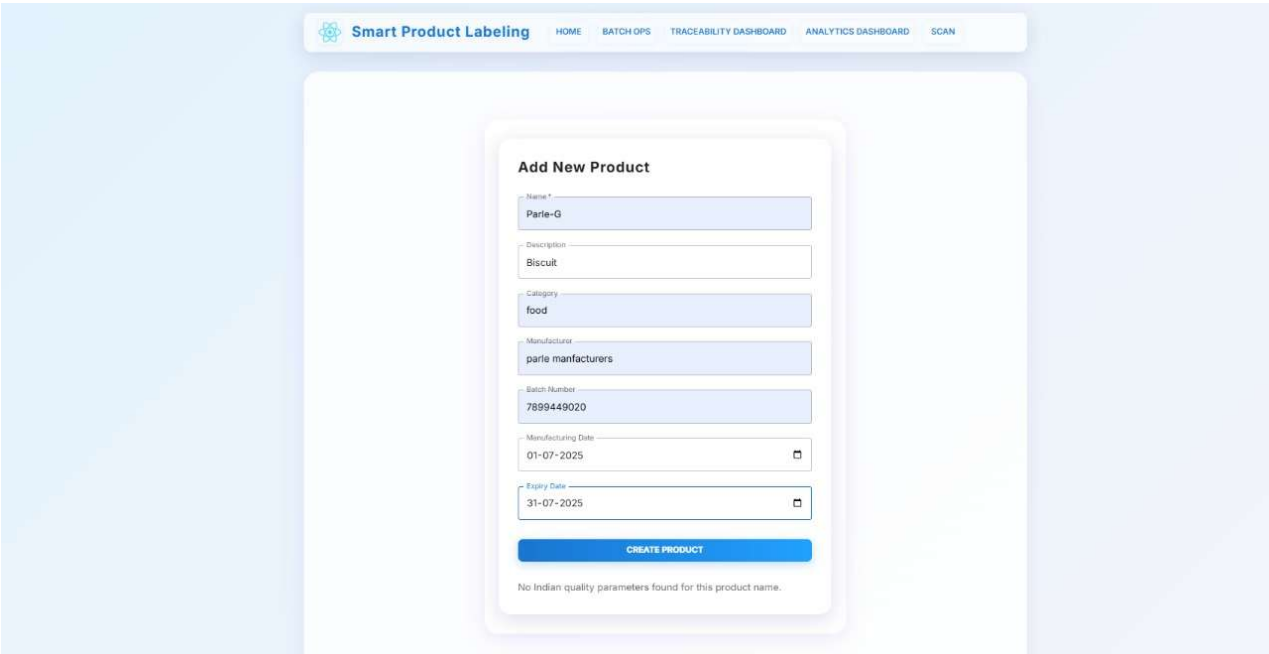


Figure 7.2

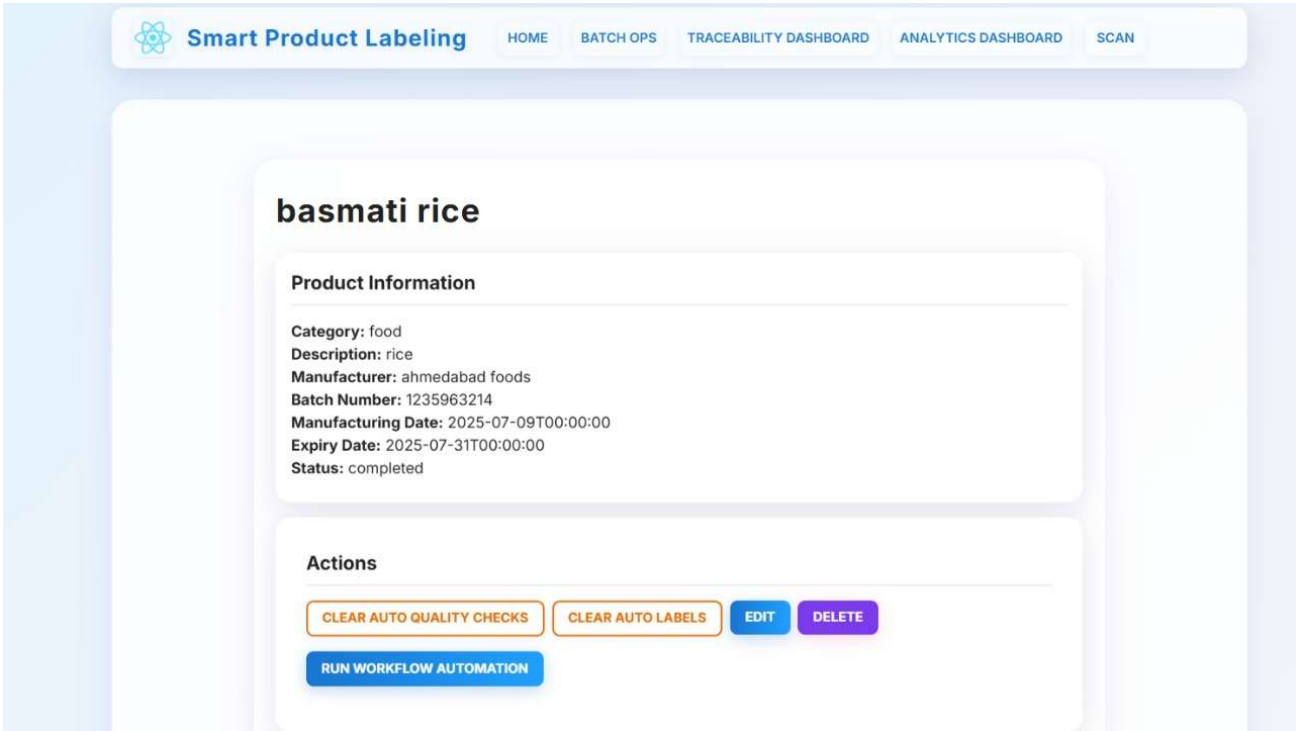


Figure 7.3

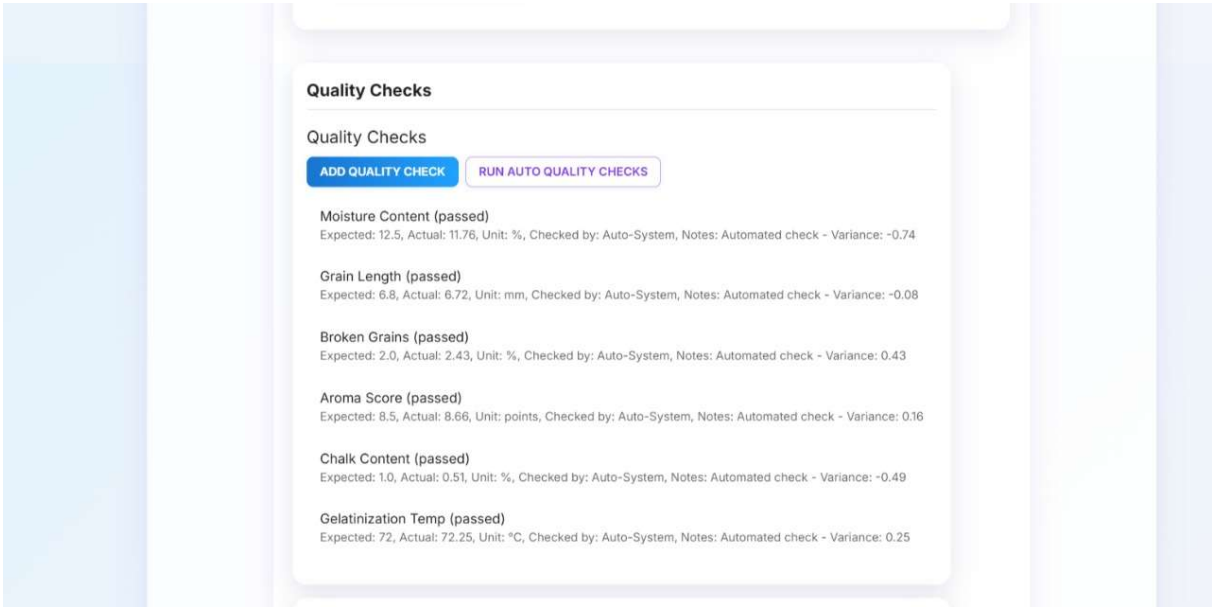


Figure 7.4

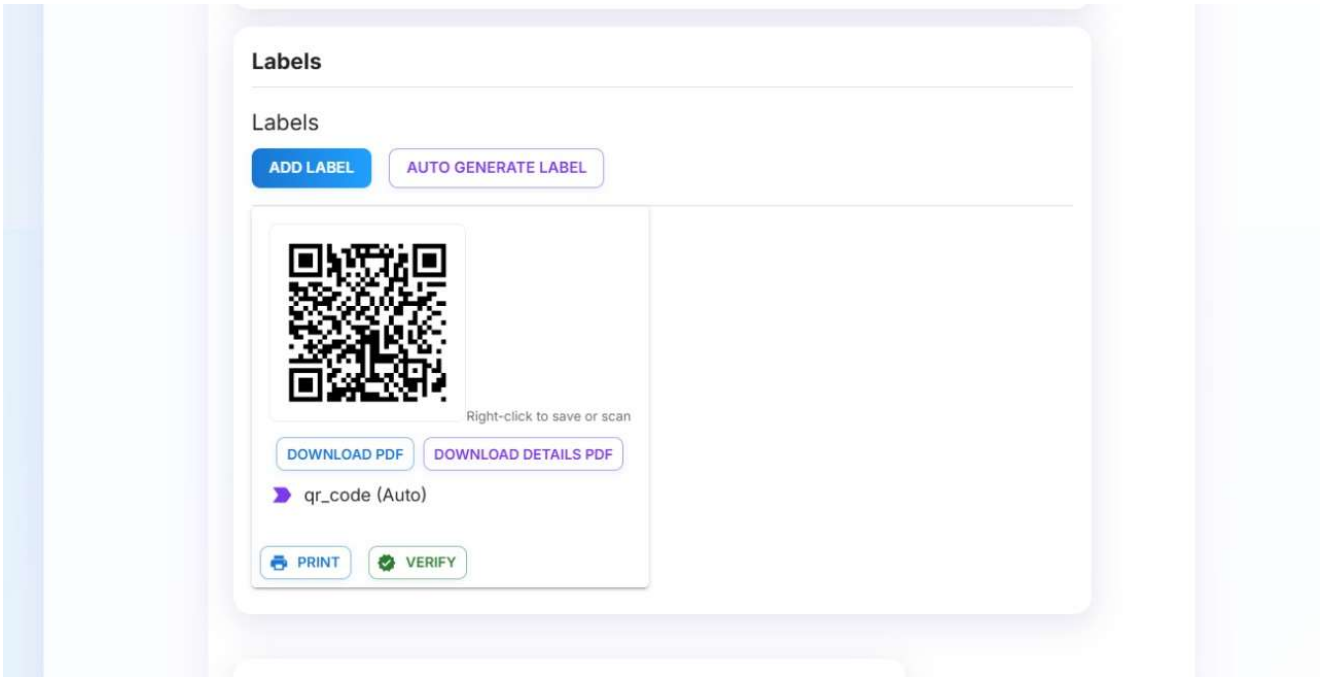


Figure 7.5

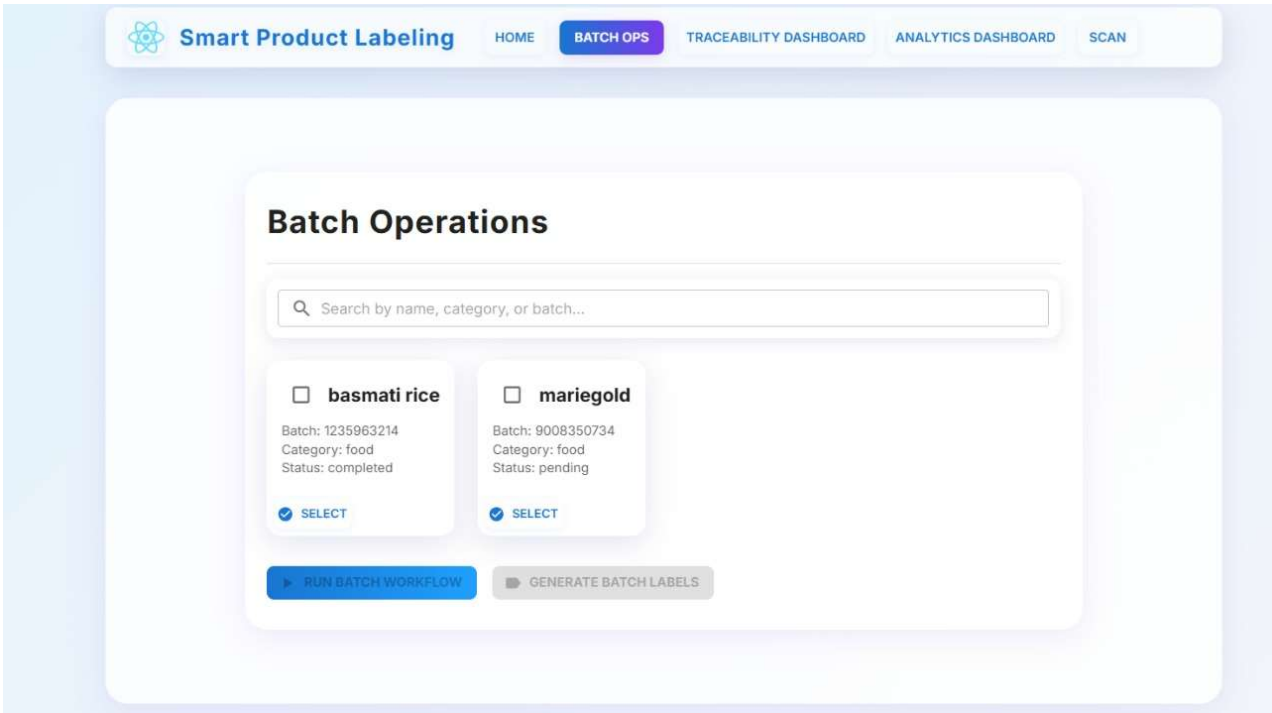


Figure 7.6

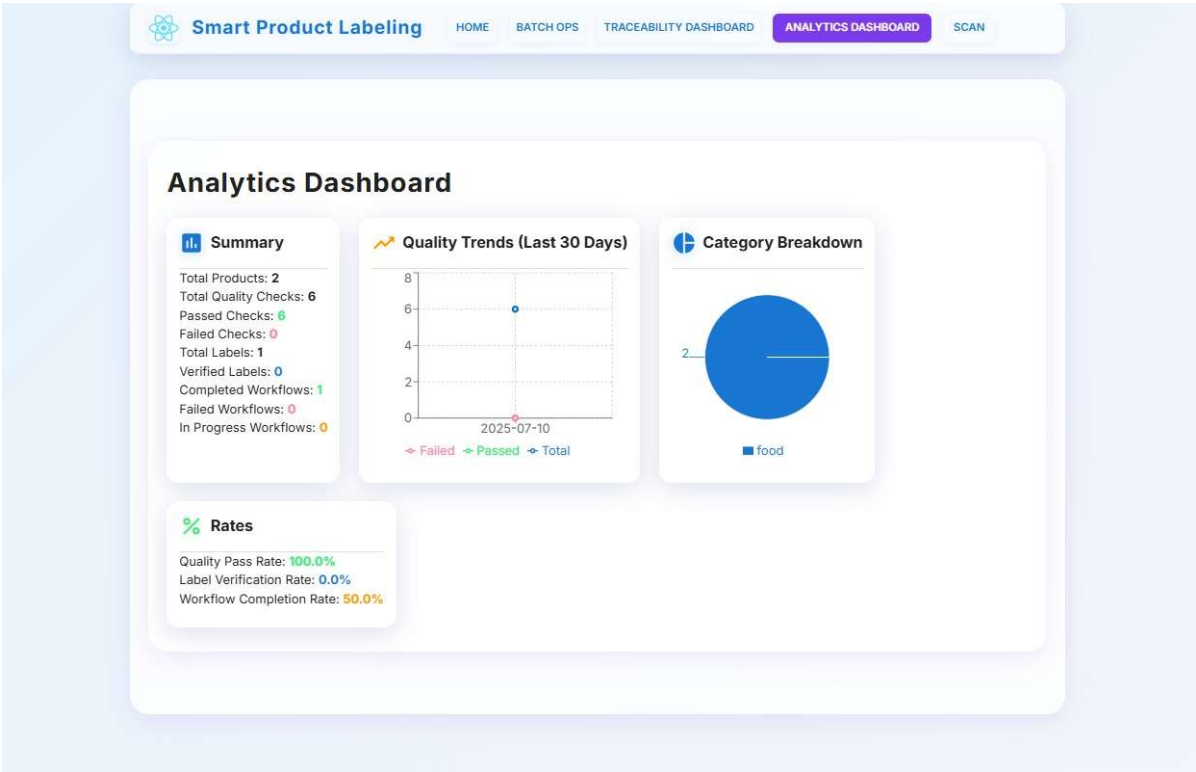


Figure 7.7

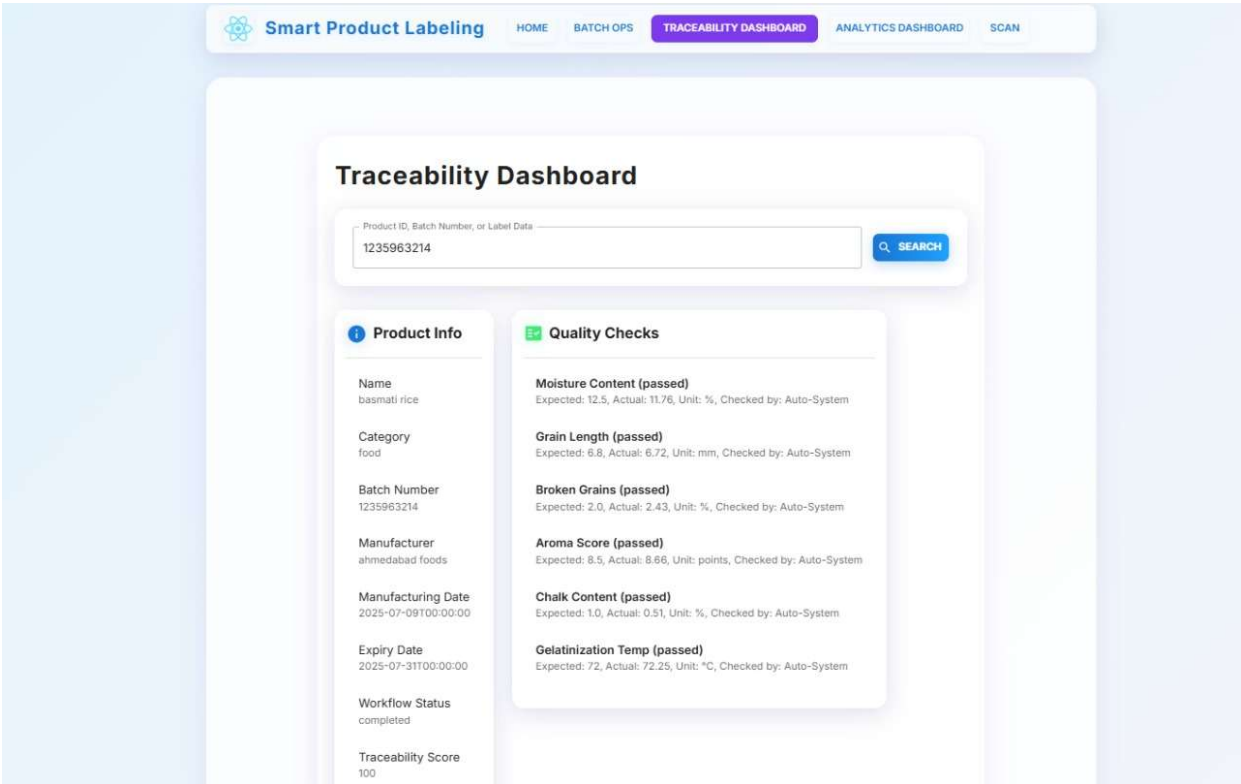


Figure 7.8

## RESULT

The implementation of the Smart Label Product system has demonstrated significant improvements in product traceability, quality assurance, and supply chain transparency. By integrating QR code technology with a user-friendly web platform, the system enables manufacturers, distributors, retailers, and consumers to access real-time product information at every stage of the supply chain. This has resulted in a more secure and efficient process for tracking products from production to end-user.

During testing, the system successfully generated unique QR codes for each product batch, which were easily printed and attached to products. Stakeholders were able to scan these codes using smartphones or compatible devices, instantly retrieving detailed product data, batch history, and workflow status. The ability to perform and record quality checks at multiple points in the supply chain ensured that only products meeting the required standards reached the market. This not only reduced the risk of counterfeit goods but also improved compliance with industry regulations.

The analytics dashboard provided valuable insights into product movement, batch status, and quality trends, enabling better decision-making and operational optimization. Reports generated by the system were clear, comprehensive, and useful for both compliance and internal review. End consumers benefited from the ability to verify product authenticity and access important information with a simple scan, increasing their trust and confidence in the brand.

Overall, the Smart Label Product system achieved its objectives of enhancing transparency, preventing counterfeiting, and streamlining supply chain operations. The project demonstrates the practical benefits of digital transformation in product labeling and traceability, offering a scalable and effective solution for modern industry needs.

## CONCLUSION

The Smart Label Product system represents a significant step forward in modernizing product traceability, quality assurance, and supply chain transparency. By leveraging digital labeling and QR code technology, the project addresses many of the challenges faced by manufacturers, distributors, retailers, and consumers in today's complex marketplace. The system's ability to generate unique QR codes, automate quality checks, and provide real-time access to product information ensures that every stakeholder can verify authenticity, monitor product movement, and make informed decisions.

Throughout the development and implementation of this project, the platform has proven to be user-friendly, scalable, and adaptable to a variety of industries. The integration of analytics and reporting tools has empowered businesses to optimize their operations, comply with regulatory requirements, and respond quickly to quality or safety concerns. Consumers, in turn, benefit from greater transparency and confidence in the products they purchase.

The success of the Smart Label Product system demonstrates the practical value of digital transformation in supply chain management. It not only streamlines operations and reduces the risk of counterfeiting but also builds trust between brands and their customers. As industries continue to evolve, solutions like this will play a crucial role in ensuring product integrity, safety, and efficiency.

In conclusion, the Smart Label Product project stands as a robust and innovative solution for the challenges of modern product management. Its adoption can lead to safer, more transparent, and more efficient supply chains, ultimately benefiting businesses and consumers alike.