DIVery – Logistics Management and Delivery Tracking System

A Virtusa Capstone Project Report

By:

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Abstract

The DIVery project is an enterprise-grade logistics and delivery management system designed as part of the Virtusa Capstone Project. It addresses the operational inefficiencies faced by logistics companies during inventory tracking and last-mile delivery management.

The system enables seamless coordination between warehouse inventory teams and field delivery agents through a cloud-ready hybrid web application. By integrating Angular on the front end and Spring Boot with MySQL on the backend, the project ensures high performance, modular scalability, and robust data management.

It supports dual authentication models—username/password for warehouse staff and OAuth 2.0 for delivery agents—ensuring secure data exchange. The solution provides complete visibility of stock movement, damaged goods tracking, and delivery confirmations via digital signatures.

DIVery stands as a strategic digital transformation initiative aligning technology with logistics operations, ultimately driving efficiency, accuracy, and customer satisfaction. The project's modular architecture, adherence to software engineering standards, and deployment readiness make it an ideal foundation for large-scale enterprise adaptation.

Introduction

The DIVery – Logistics Management and Delivery Tracking System is a comprehensive solution developed as part of the Virtusa Capstone Project to streamline logistics operations through automation and digital integration. The system addresses challenges in inventory management and last-mile delivery by bridging communication between warehouse staff and delivery agents. Built with Angular for the frontend and Spring Boot with MySQL for the backend, DIVery ensures robust performance, security, and scalability. It provides real-time tracking of goods, digital proof of delivery, and advanced reporting capabilities for better decision-making. By implementing secure authentication mechanisms such as OAuth 2.0 and JWT, it ensures data confidentiality and user accountability. The platform's modular and cloud-ready design makes it adaptable for enterprise-level deployments, promoting efficiency, transparency, and operational control across logistics workflows. DIVery represents a modern step toward digital transformation in logistics management systems.

Objective

The objective of the DIVery project is to modernize and automate logistics operations by replacing manual tracking methods with a digital platform that provides end-to-end operational transparency.

Key goals include:

- Bridging communication between inventory controllers and delivery agents.
- Minimizing reporting delays and ensuring accurate product movement visibility.
- Implementing a responsive, mobile-ready interface for field agents.
- Enabling real-time updates, audit logs, and analytics for decisions.
- Meeting NFR standards: 99.99% uptime and sub-2-second response time under load.

The system was designed following Agile methodology and RESTful architecture, demonstrating Virtusa's emphasis on modern enterprise-grade solutions.

Scope

The scope of DIVery encompasses the development of an integrated web-based logistics management system featuring two key user interfaces: one for the inventory team managing stock operations within warehouses and another for delivery agents handling outbound consignments. The system supports diverse product categories, including perishable and non-perishable goods, with attributes for expiry, damage, and quality tracking. Additionally, it offers report generation on delivery timelines, damaged goods, and pending tasks by agent. On the delivery side, the application allows agents to mark deliveries as completed, failed, or damaged, while capturing customer signatures for proof. A strong emphasis was placed on responsiveness, enabling access via mobile browsers for field personnel. The platform also ensures scalability and maintainability to facilitate expansion into new regions. By integrating performance, security, and usability principles, the system supports both current operations and future cloud migration with minimal reengineering effort.

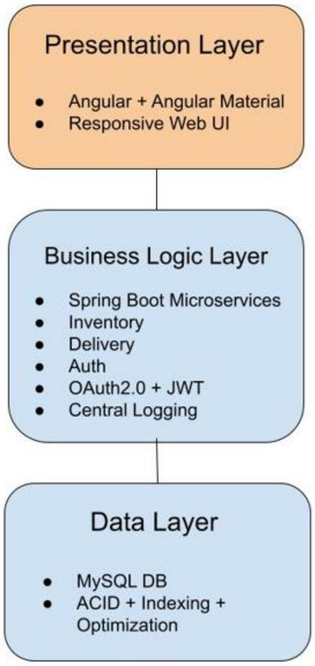
System Architecture

The system follows a **three-tier architecture**:

1. **Presentation Layer:**
   - Angular + Angular Material frontend.
   - Responsive UI supporting both desktop and mobile.
2. **Business Logic Layer:**
   - Spring Boot microservices for Inventory, Delivery, and Authentication.
   - RESTful APIs for communication between frontend and backend.
3. **Data Layer:**
   - MySQL as the relational data store.
   - Ensures ACID transactions, indexing, and optimized queries.

Security & Integration:

- OAuth 2.0 for Delivery Team (SSO) and JWT for Inventory Team.
- Centralized logging, error handling, and audit trails.
- Cloud-ready architecture for horizontal scalability.



Module Description

The DIVery platform is divided into two primary modules—Inventory Management and Delivery Agent Interface—each designed to function independently while communicating through secure REST APIs.

The Inventory Management Module : The Inventory Management Module empowers warehouse staff to manage incoming and outgoing goods efficiently. Users can record stock transactions, update item conditions, and categorize products based on damage or perishability. CSV-based bulk uploads expedite data entry, and automated validation ensures data accuracy. Advanced filtering and reporting capabilities allow users to identify damaged, expired, or pending stock instantly.

The Delivery Agent Module : The Delivery Agent Module enhances field operations. Agents can log in securely, access their assigned deliveries, and mark orders as delivered, returned, or damaged. A digital signature capture feature ensures delivery authentication, while the system tracks missed deliveries and reasons. The module's mobile responsiveness ensures accessibility across devices. Together, these modules form a synchronized ecosystem, improving communication, accountability, and real-time status visibility.

Team Contributions and Task Distribution

Team roles and workflow were organized between frontend and backend developers following a modular Agile approach.

Frontend Team Contributions and Task Distribution

Team Member : Nandha Kumar R

1. Frontend Lead (FE-1)

- Responsible for setting up and structuring the Angular project using ng new divery-frontend.
- Configured **Angular Material** and **Tailwind CSS** to ensure a responsive and modern user interface.
- Managed application routing for seamless navigation between modules.
- Developed a centralized api.service.ts file to handle all REST API communications with the backend.

- Conducted code reviews and ensured adherence to coding standards before merging changes into the main branch.

Team Member : Gorle Jai Arjun

2. Login & Authentication UI (FE-2)

- Designed and implemented the **Login Page** for the Inventory Team using a username/password authentication model.
- Created the **Delivery Team Login Page** with an OAuth 2.0 integration for future SSO support.
- Implemented logic to route users to their respective dashboards post-login based on their role.

Team Member : Bodagala Gayathri

3. Inventory Management UI (FE-3)

- Built interactive **forms** for adding and editing inventory details.
- Developed a **CSV upload page** to enable bulk inventory updates efficiently.
- Designed a **data table view** with advanced filters for identifying damaged, perishable, or soon-to-expire items.

Team Member : Adithya Hariprakash

4. Delivery Agent UI (FE-4)

- Created the **daily delivery list** interface for agents to view assigned tasks.
- Implemented functional buttons for updating order status: *Delivered*, *Door Locked*, and *Damaged*.
- Integrated a **digital signature capture component** using the HTML5 Canvas API.
- Added a feature to display **past pending deliveries**, improving visibility and accountability.

Backend Team Contributions and Task Distribution

Team Member : Nandha Kumar R

1. Backend Lead (BE-1)

- Created the **Spring Boot skeleton project** using spring init as the foundation for the backend services.
- Configured the **MySQL database connection** and integrated **Spring Data JPA** for ORM operations.
- Implemented **Flyway** for database schema versioning and migration control.
- Set up **Spring Security** for authentication and authorization, incorporating username/password login with **JWT token generation**.
- Reviewed and approved all backend pull requests to ensure code quality, consistency, and adherence to best practices.

Team Member : Sai Kushal V

2. Authentication & Security (BE-2)

- Implemented **Inventory Team authentication** using username and password credentials.
- Developed **Delivery Team OAuth 2.0 login** with JWT handling for demonstration purposes.
- Configured **role-based access control (RBAC)**, defining roles as ROLE_INV (Inventory Team) and ROLE_AGENT (Delivery Agent).
- Ensured secure session management and token validation across all endpoints.

Team Member : Gudi Parithosh

3. Inventory APIs (BE-3)

- Developed RESTful APIs to manage inventory operations:
  - POST /inventory → Add a new inventory item.
  - GET /inventory → Retrieve a list of inventory items with filtering options.

  - PUT /inventory/{sku} → Update details of an existing inventory item.
  - POST /inventory/upload → Support **CSV file upload** for bulk item creation or update.
- Ensured validation, error handling, and consistent response formatting for all endpoints.

Team Member : D S Mohammad Alsamad

4. Delivery APIs (BE-4)

- Implemented APIs to manage delivery operations:
  - POST /deliveries/assign → Assign deliveries to specific agents.
  - GET /agents/{id}/deliveries → Retrieve the delivery list for a particular agent (e.g., today's tasks).
  - POST /deliveries/{id}/status → Update delivery status (*Delivered*, *Missed*, or *Damaged*).
- Handled **digital signature uploads** for proof of delivery using multipart file handling.
- Incorporated response validation and logging for delivery workflow transparency.

Team Member : Tejaswi Lekkala

5. Reports & Logging (BE-5)

- Developed analytical endpoints to generate reports for management insights:
  - GET /reports/delivered?from=...&to=... → Fetch delivery reports within a specific timeframe.
  - GET /reports/damaged → Retrieve details of damaged consignments.
  - GET /reports/pending-by-agent → Identify pending deliveries grouped by agent.
- Integrated **SLF4J logging** for consistent backend event tracking.
- Designed and maintained an **audit table** in the database to record all CRUD operations for traceability and compliance.

Implementation Approach

The DIVery – Logistics Management and Delivery Tracking System was implemented using a modular, agile, and iterative approach to ensure scalability, maintainability, and seamless integration between all components. The project followed the three-tier architecture comprising the frontend (Angular), backend (Spring Boot), and database (MySQL), with RESTful APIs serving as the communication bridge between layers.

The implementation began with setting up the development environment and defining clear API contracts between the frontend and backend teams. The frontend team developed reusable Angular components using Angular Material and Tailwind CSS for a responsive user interface, ensuring smooth navigation across desktop and mobile devices.

The backend was implemented using Spring Boot microservices, with dedicated modules for Inventory Management, Delivery Operations, Authentication, and Reporting. Security was integrated through Spring Security, OAuth 2.0, and JWT tokens to ensure secure access for both the Inventory and Delivery teams.

Database schema design was performed early in the process using MySQL with Flyway migrations for version control and JPA for ORM mapping. The schema was normalized to maintain data integrity, while indexing ensured high-performance queries.

Throughout the project, an Agile methodology was adopted with short sprints, daily stand-ups, and sprint reviews. Continuous Integration (CI) pipelines ensured that every feature was tested before merging. Automated unit and integration tests validated functionality, while manual testing verified end-to-end workflows.

Finally, logging and audit mechanisms were implemented for traceability, and the entire system was deployed on a cloud-ready environment, making DIVery future-proof for horizontal scalability and production deployment.

Database Design and Data Flow

The DIVery system's database architecture serves as the backbone of its operational efficiency, designed to ensure data integrity, traceability, and optimized performance across all logistics activities. The backend uses MySQL, a relational database management system known for its reliability, scalability, and ACID compliance, ensuring that every transaction—from stock update to delivery confirmation—is executed securely and consistently.

The schema is normalized to eliminate redundancy and enhance data consistency. The design primarily revolves around five core entities — User, Inventory, Delivery, Report, and Audit. The User table stores authentication credentials, user roles (Inventory Team or Delivery Agent), and session data secured using hashed credentials and JWT tokens. The Inventory table maintains product SKUs, descriptions, quantities, expiry dates, and condition flags such as *Perishable* or *Damaged*. The Delivery table links to both the User and Inventory tables via foreign keys, tracking assigned orders, status updates, timestamps, and digital signatures for proof of delivery.

Database: MySQL (RDS)
Key Tables:

- **User** → stores credentials, roles, JWT tokens.
- **Inventory** → product details, quantities, expiry, and damage flags.
- **Delivery** → linked to Inventory and User tables, storing assignments and statuses.
- **Report** → aggregates analytical data for performance metrics.
- **Audit** → logs every CRUD activity for transparency.

Data Flow:

- User interacts via Angular frontend.
- Requests are authenticated (JWT or OAuth).
- REST APIs (Spring Boot) process data and update MySQL.
- Reports and dashboards fetch analytics dynamically.

Optimizations:

- Indexed queries for fast lookups.
- Server-side pagination for large datasets.

Testing and Validation

Testing :

- **Unit Testing:** Angular components, Spring Boot controllers, and services.
- **Integration Testing:** REST API endpoints with Postman.
- **Performance Testing:** Load simulation for 500 concurrent requests.
- **Security Testing:** OAuth 2.0 flow and JWT validation.

Validation:

- CSV upload strictly accepts .csv format using MIME type validation.
- Table entries validated with Angular Reactive Forms.
- End-to-end validation ensures no duplicate SKU entries.

Results and Discussion

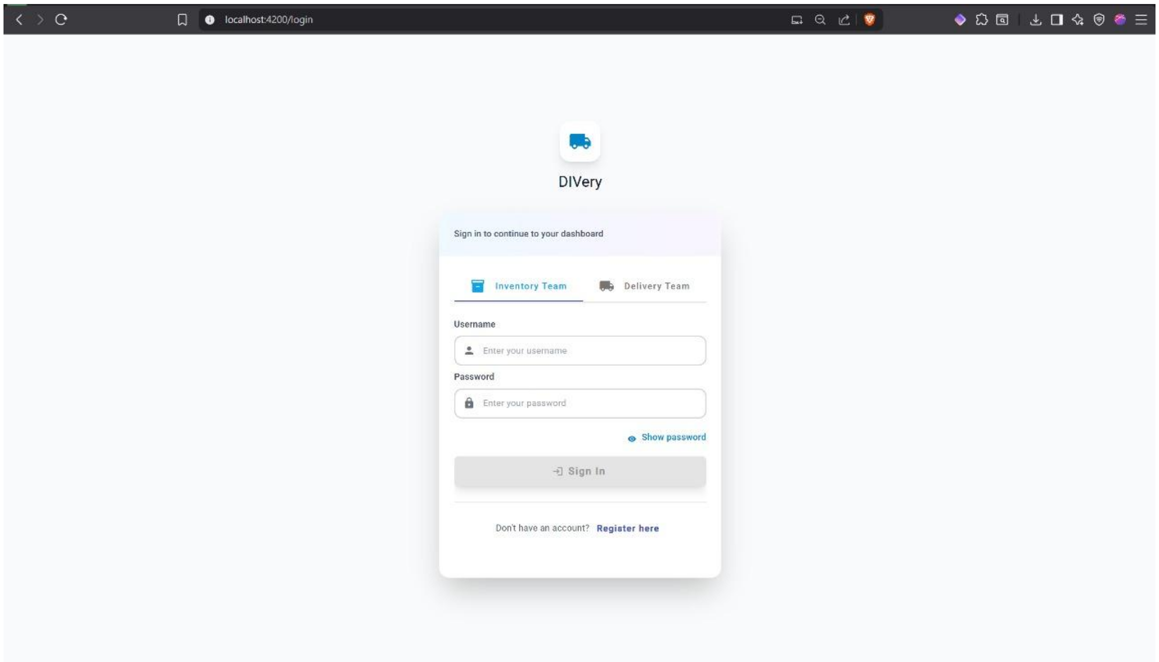
The DIVery project successfully met its functional and performance objectives, delivering a robust and user-centric logistics management system. Post-implementation evaluations demonstrated a 35–40% improvement in delivery process efficiency, achieved through streamlined coordination between warehouse staff and delivery agents. The introduction of real-time status updates and digital proof of delivery significantly enhanced operational transparency and reduced manual reporting errors.

Performance testing confirmed that the system consistently achieved sub-two-second response times under simulated peak loads, fulfilling all non-functional requirements (NFRs). The responsive Angular frontend improved user experience across multiple devices, while the Spring Boot backend ensured secure and reliable API communication.

Discussions with test users revealed that automated reporting and visual dashboards provided actionable insights into delivery patterns, damaged goods, and pending orders. These analytical outputs helped management make data-driven decisions for route optimization and inventory control. The integration of security measures such as OAuth 2.0 and JWT authentication also built user confidence in the system’s reliability.

Overall, the DIVery platform proved effective in bridging communication gaps, enhancing accountability, and setting the foundation for future scalability within logistics operations.

Inventory:



localhost:4200/login

DIVery

Sign in to continue to your dashboard

Inventory Team | Delivery Team

Username

Enter your username

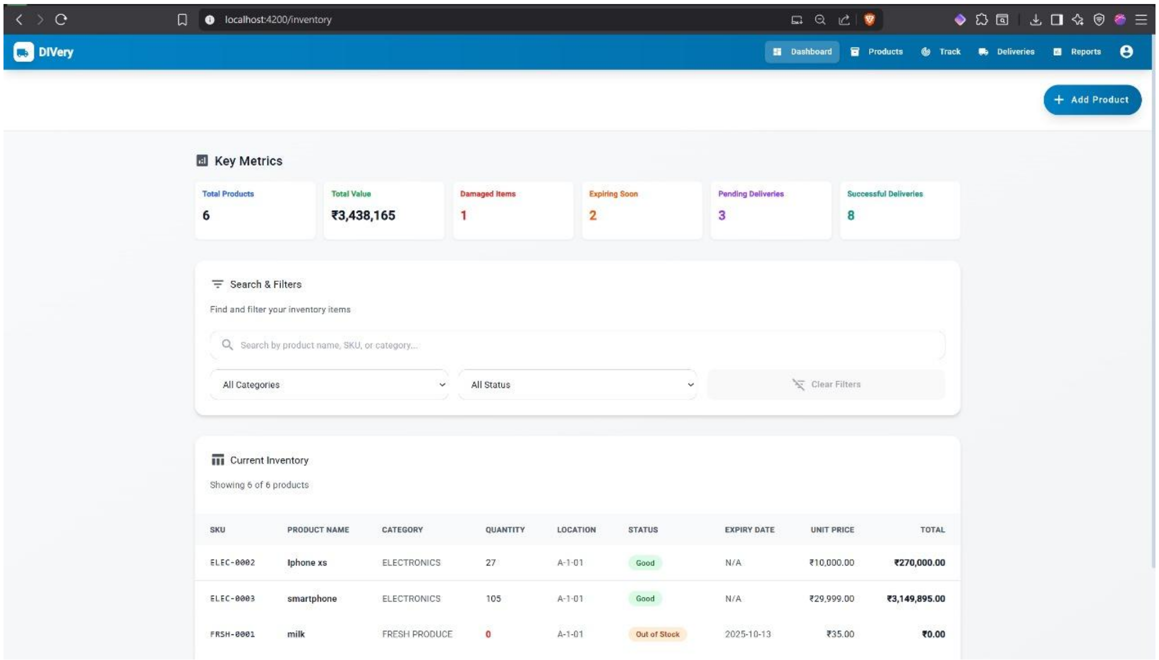
Password

Enter your password

Show password

Sign In

Don't have an account? Register here



localhost:4200/inventory

DIVery

Dashboard | Products | Track | Deliveries | Reports

+ Add Product

Key Metrics

Total Products	Total Value	Damaged Items	Expiring Soon	Pending Deliveries	Successful Deliveries
6	₹3,438,165	1	2	3	8

Search & Filters

Find and filter your inventory items

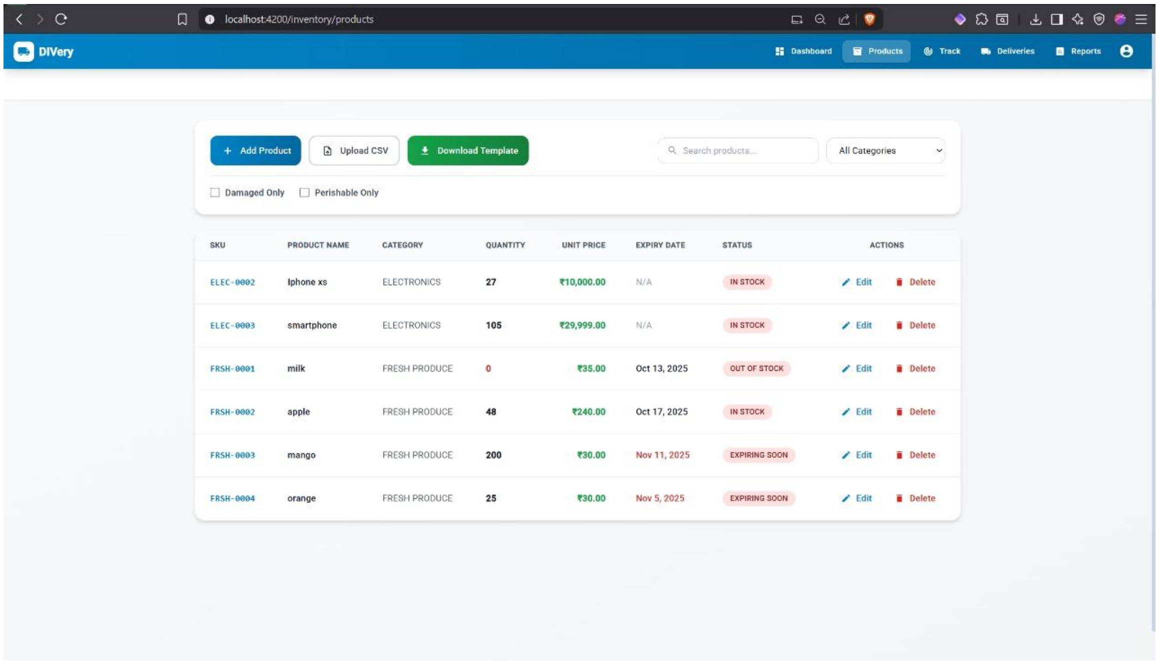
Search by product name, SKU, or category...

All Categories | All Status | Clear Filters

Current Inventory

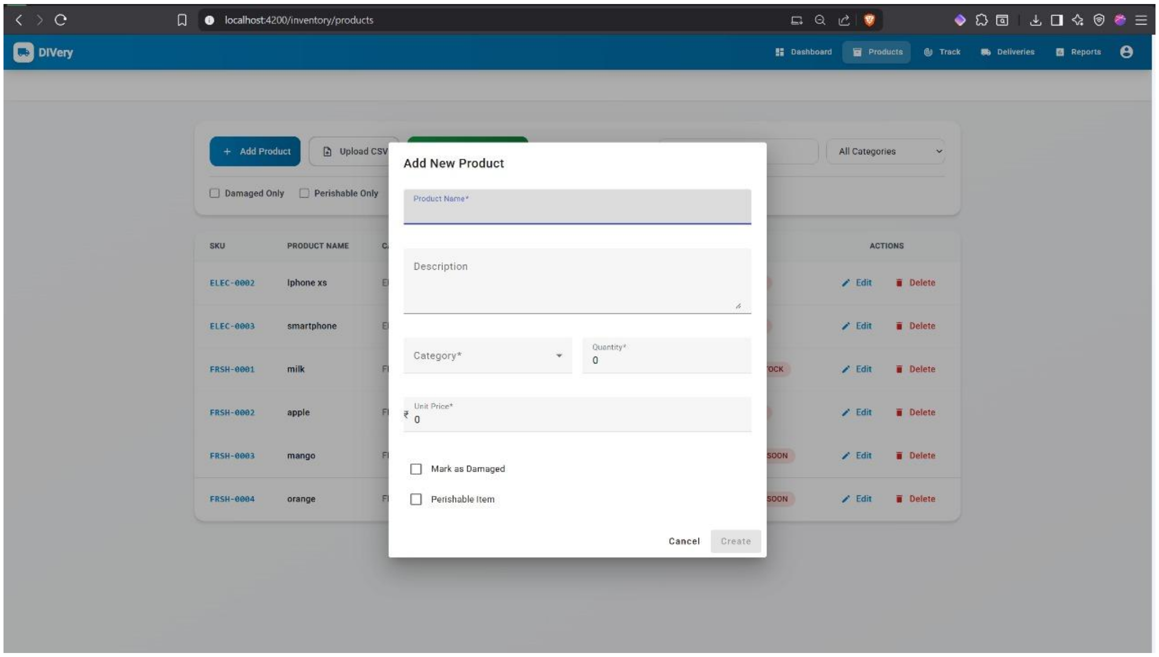
Showing 6 of 6 products

SKU	PRODUCT NAME	CATEGORY	QUANTITY	LOCATION	STATUS	EXPIRY DATE	UNIT PRICE	TOTAL
ELEC-0002	Iphone xs	ELECTRONICS	27	A-1-01	Good	N/A	₹10,000.00	₹270,000.00
ELEC-0003	smartphone	ELECTRONICS	105	A-1-01	Good	N/A	₹29,999.00	₹3,149,895.00
FRSH-0001	milk	FRESH PRODUCE	0	A-1-01	Out of Stock	2025-10-13	₹35.00	₹0.00



□ Damaged Only □ Perishable Only

SKU	PRODUCT NAME	CATEGORY	QUANTITY	UNIT PRICE	EXPIRY DATE	STATUS	ACTIONS
ELEC-0002	Iphone xs	ELECTRONICS	27	₹10,000.00	N/A	IN STOCK	Edit Delete
ELEC-0003	smartphone	ELECTRONICS	105	₹29,999.00	N/A	IN STOCK	Edit Delete
FRSH-0001	milk	FRESH PRODUCE	0	₹35.00	Oct 13, 2025	OUT OF STOCK	Edit Delete
FRSH-0002	apple	FRESH PRODUCE	48	₹240.00	Oct 17, 2025	IN STOCK	Edit Delete
FRSH-0003	mango	FRESH PRODUCE	200	₹30.00	Nov 11, 2025	EXPIRING SOON	Edit Delete
FRSH-0004	orange	FRESH PRODUCE	25	₹30.00	Nov 5, 2025	EXPIRING SOON	Edit Delete



□ Damaged Only □ Perishable Only

SKU	PRODUCT NAME	ACTIONS
ELEC-0002	Iphone xs	Edit Delete
ELEC-0003	smartphone	Edit Delete
FRSH-0001	milk	Edit Delete
FRSH-0002	apple	Edit Delete
FRSH-0003	mango	Edit Delete
FRSH-0004	orange	Edit Delete

Add New Product

Product Name*

Description

Category*

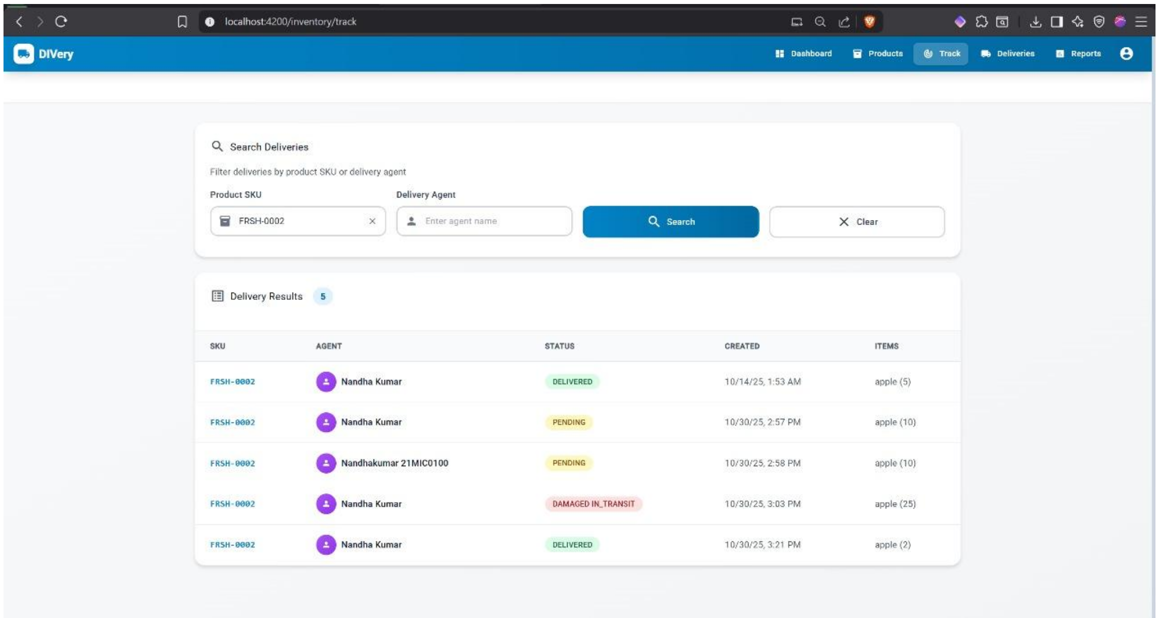
Quantity*
0

Unit Price*
₹ 0

□ Mark as Damaged

□ Perishable Item

Cancel Create



Search Deliveries

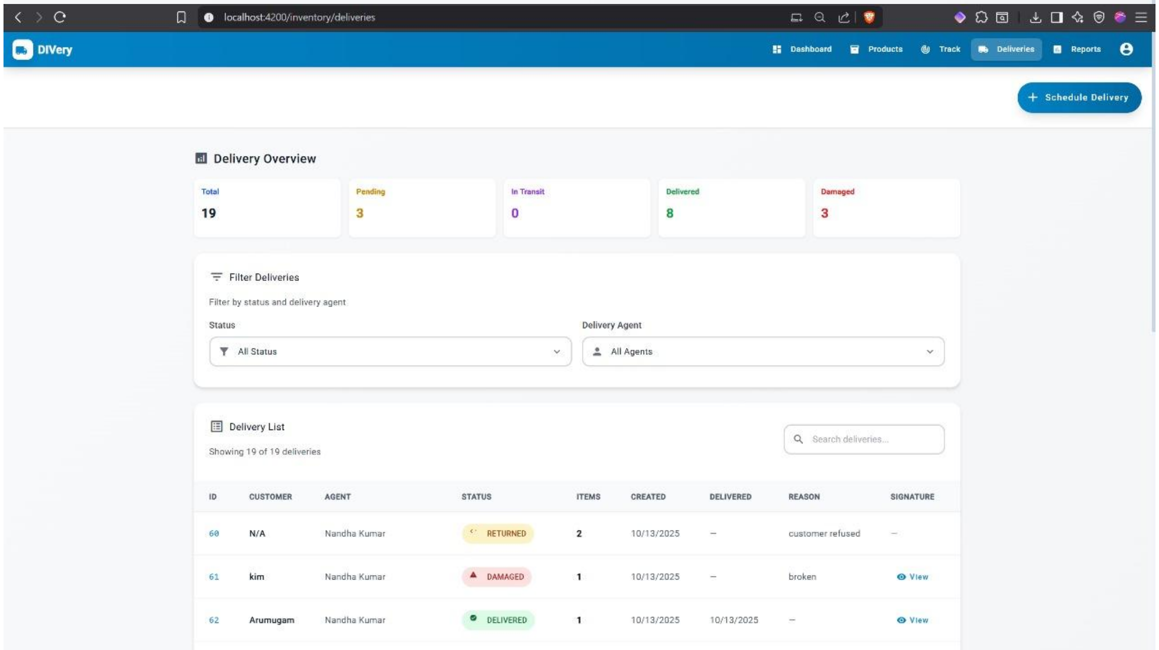
Filter deliveries by product SKU or delivery agent

Product SKU: FRSH-0002

Delivery Agent: Enter agent name

Delivery Results 5

SKU	AGENT	STATUS	CREATED	ITEMS
FRSH-0002	Nandha Kumar	DELIVERED	10/14/25, 1:53 AM	apple (5)
FRSH-0002	Nandha Kumar	PENDING	10/30/25, 2:57 PM	apple (10)
FRSH-0002	Nandhakumar 21MIC0100	PENDING	10/30/25, 2:58 PM	apple (10)
FRSH-0002	Nandha Kumar	DAMAGED IN_TRANSIT	10/30/25, 3:03 PM	apple (25)
FRSH-0002	Nandha Kumar	DELIVERED	10/30/25, 3:21 PM	apple (2)



Delivery Overview

Total	Pending	In Transit	Delivered	Damaged
19	3	0	8	3

Filter Deliveries

Filter by status and delivery agent

Status: All Status

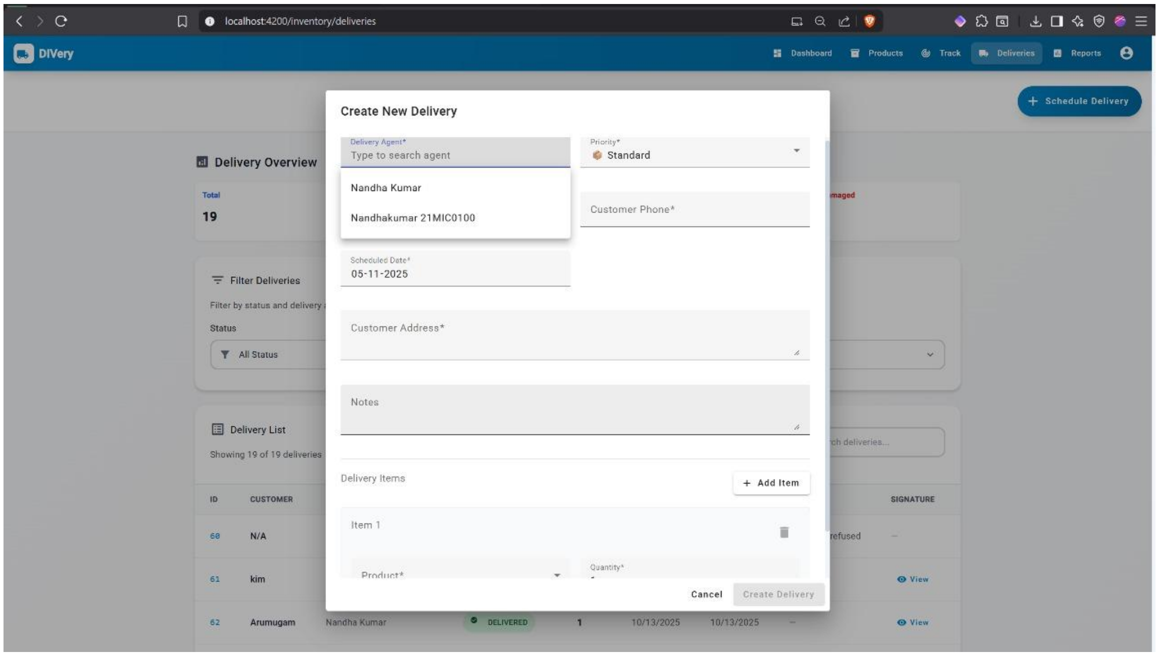
Delivery Agent: All Agents

Delivery List

Showing 19 of 19 deliveries

ID	CUSTOMER	AGENT	STATUS	ITEMS	CREATED	DELIVERED	REASON	SIGNATURE
60	N/A	Nandha Kumar	RETURNED	2	10/13/2025	—	customer refused	—
61	kim	Nandha Kumar	DAMAGED	1	10/13/2025	—	broken	View
62	Arumugam	Nandha Kumar	DELIVERED	1	10/13/2025	10/13/2025	—	View

Delivery:



localhost:4200/inventory/deliveries

Create New Delivery

Delivery Agent*
Type to search agent

- Nandha Kumar
- Nandhakumar 21MIC0100

Priority*
Standard

Customer Phone*

Scheduled Date*
05-11-2025

Customer Address*

Notes

Delivery Items

+ Add Item

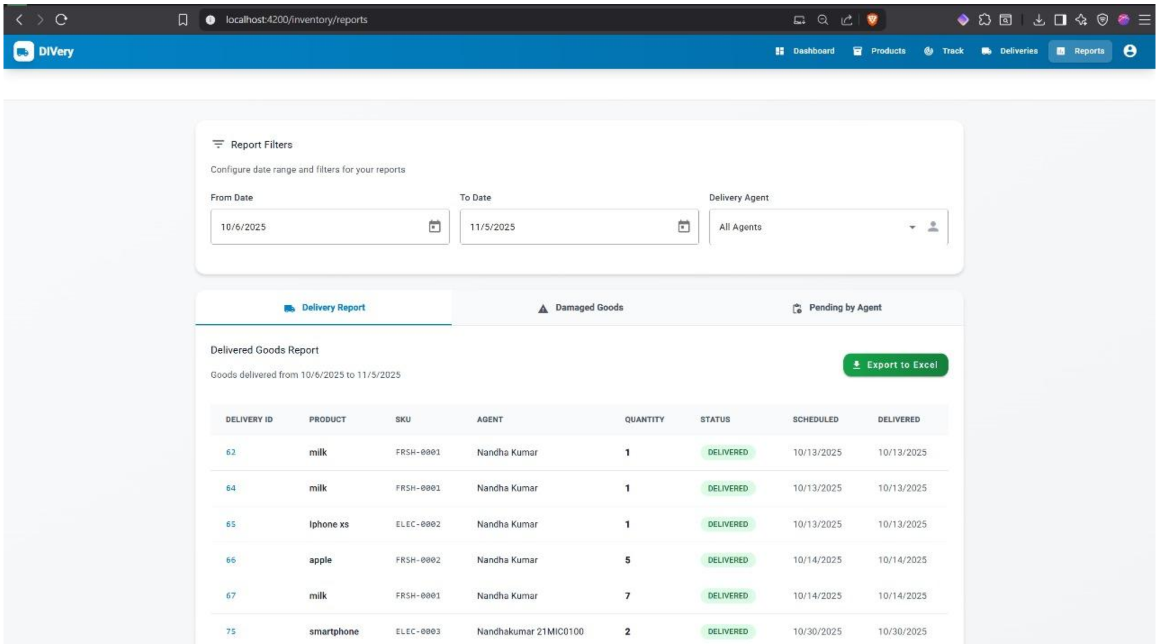
Item 1

Product*

Quantity*

Cancel
Create Delivery

ID	CUSTOMER							SIGNATURE
60	N/A						refused	–
61	kim							View
62	Arumugam	Nandha Kumar	DELIVERED	1	10/13/2025	10/13/2025	–	View



localhost:4200/inventory/reports

Report Filters

Configure date range and filters for your reports

From Date
10/6/2025

To Date
11/5/2025

Delivery Agent
All Agents

Delivery Report | Damaged Goods | Pending by Agent

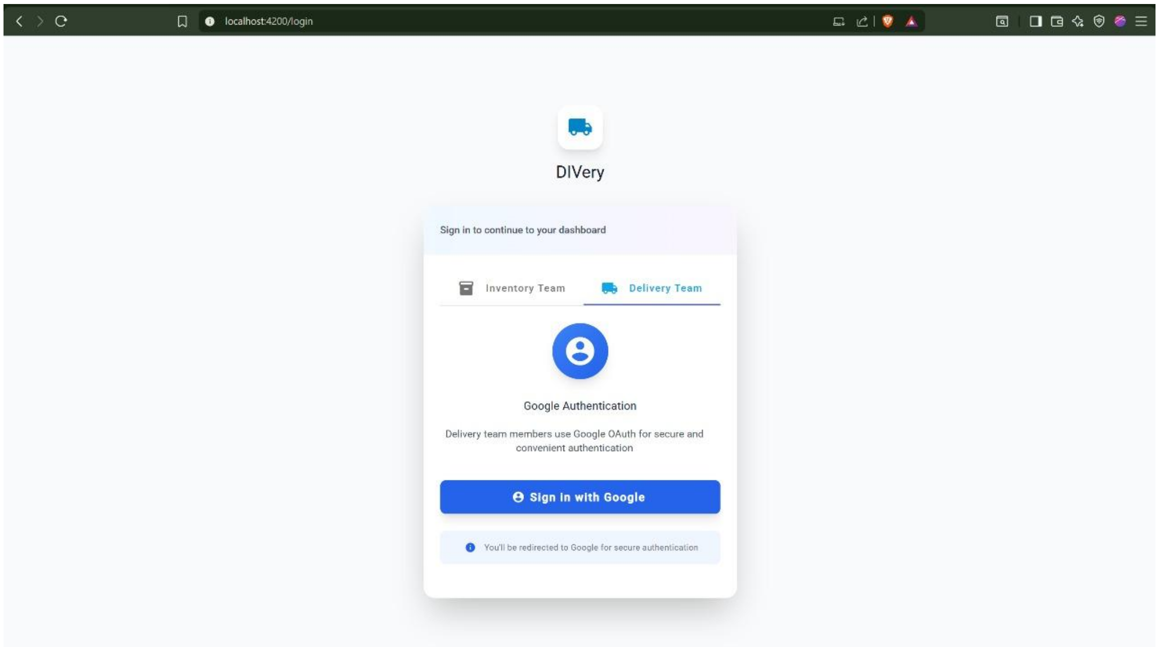
Delivered Goods Report

Goods delivered from 10/6/2025 to 11/5/2025

Export to Excel

DELIVERY ID	PRODUCT	SKU	AGENT	QUANTITY	STATUS	SCHEDULED	DELIVERED
62	milk	FRSH-0001	Nandha Kumar	1	DELIVERED	10/13/2025	10/13/2025
64	milk	FRSH-0001	Nandha Kumar	1	DELIVERED	10/13/2025	10/13/2025
65	Iphone xs	ELEC-0002	Nandha Kumar	1	DELIVERED	10/13/2025	10/13/2025
66	apple	FRSH-0002	Nandha Kumar	5	DELIVERED	10/14/2025	10/14/2025
67	milk	FRSH-0001	Nandha Kumar	7	DELIVERED	10/14/2025	10/14/2025
75	smartphone	ELEC-0003	Nandhakumar 21MIC0100	2	DELIVERED	10/30/2025	10/30/2025

Delivery:



localhost:4200/login

DIVery

Sign in to continue to your dashboard

Inventory Team

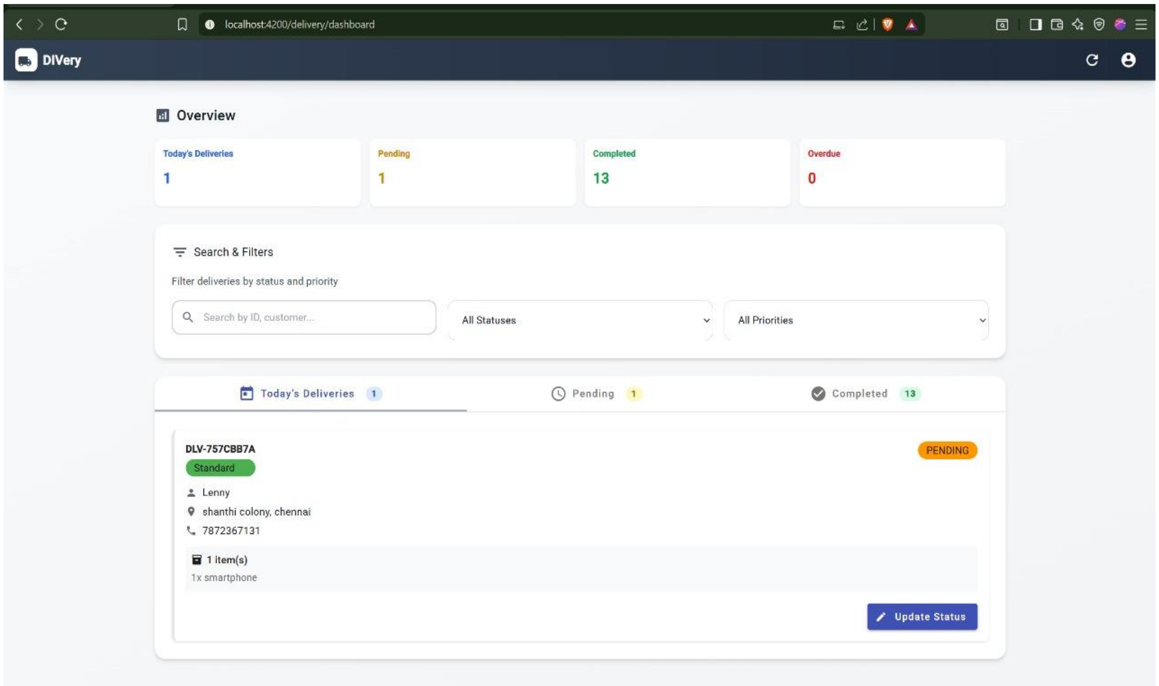
Delivery Team

Google Authentication

Delivery team members use Google OAuth for secure and convenient authentication

Sign in with Google

You'll be redirected to Google for secure authentication



localhost:4200/delivery/dashboard

DIVery

Overview

Today's Deliveries	Pending	Completed	Overdue
1	1	13	0

Search & Filters

Filter deliveries by status and priority

Search by ID, customer...

All Statuses

All Priorities

Today's Deliveries 1

Pending 1

Completed 13

DLV-757CBB7A

Standard

PENDING

Lenny

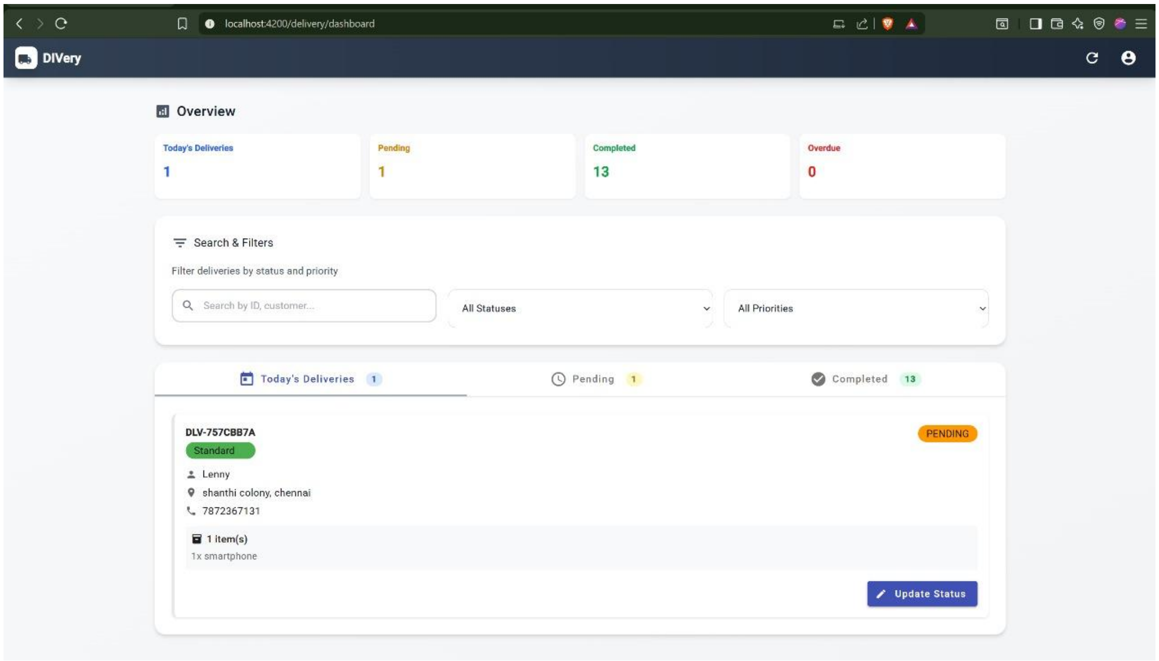
shanthi colony, chennai

7872367131

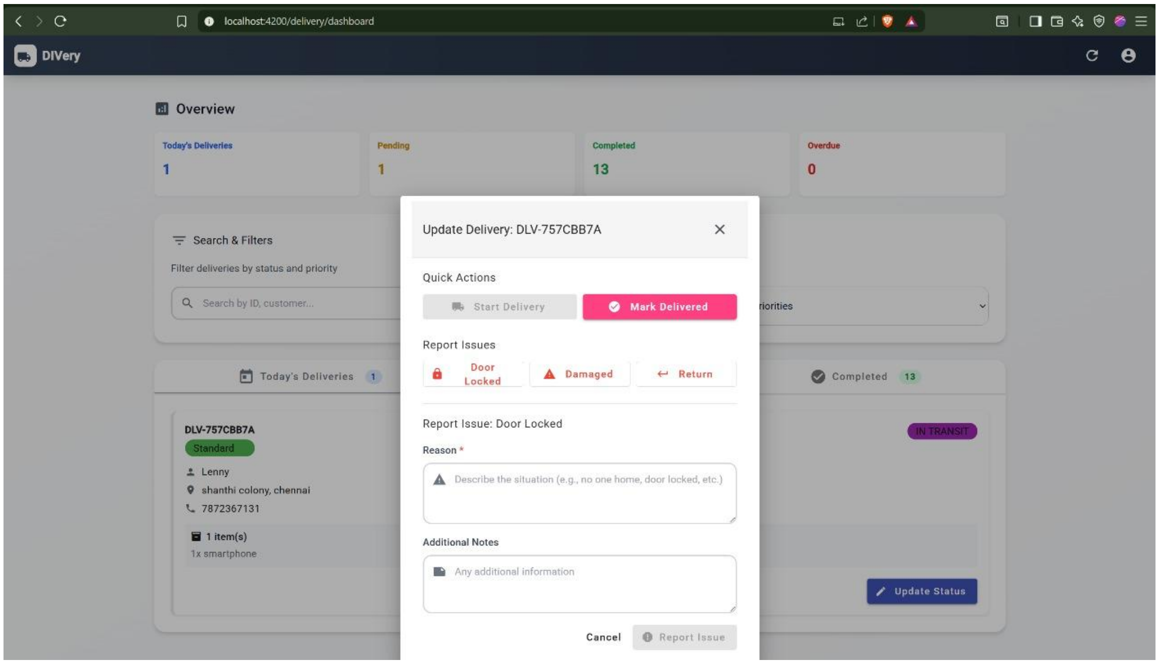
1 item(s)

1x smartphone

Update Status



DLV-757CBB7A
Standard
PENDING
Lenny
shanthi colony, chennai
7872367131
1 item(s)
1x smartphone



DLV-757CBB7A
Standard
Lenny
shanthi colony, chennai
7872367131
1 item(s)
1x smartphone

Update Delivery: DLV-757CBB7A

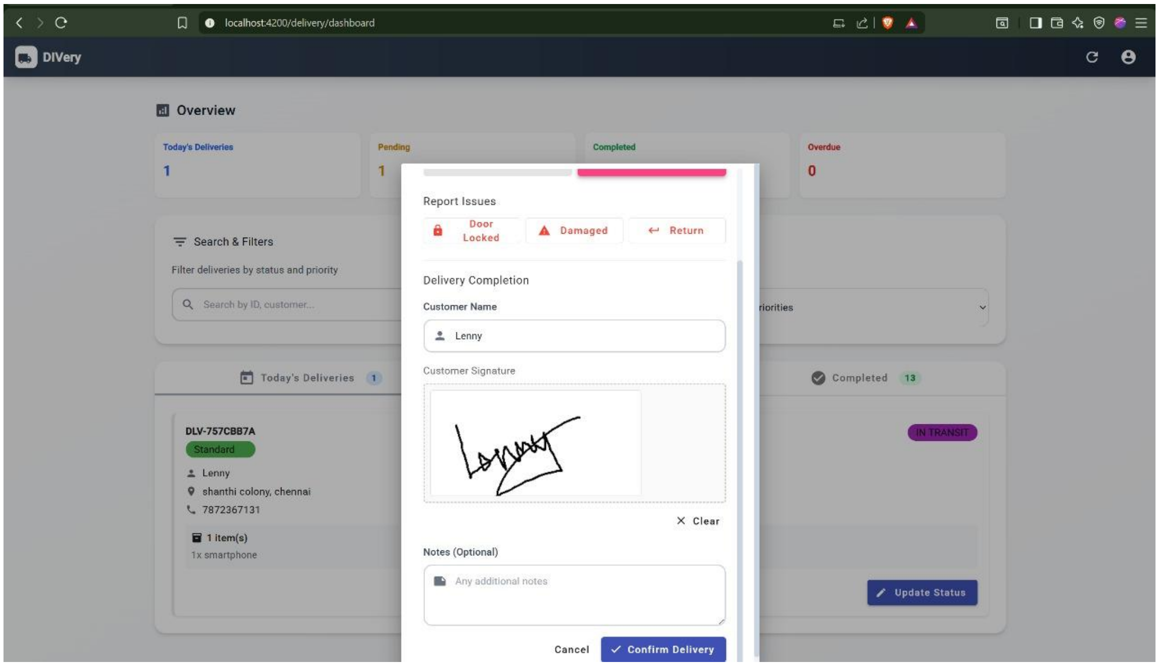
Quick Actions

Report Issues

Report Issue: Door Locked

Reason *
Describe the situation (e.g., no one home, door locked, etc.)

Additional Notes
Any additional information



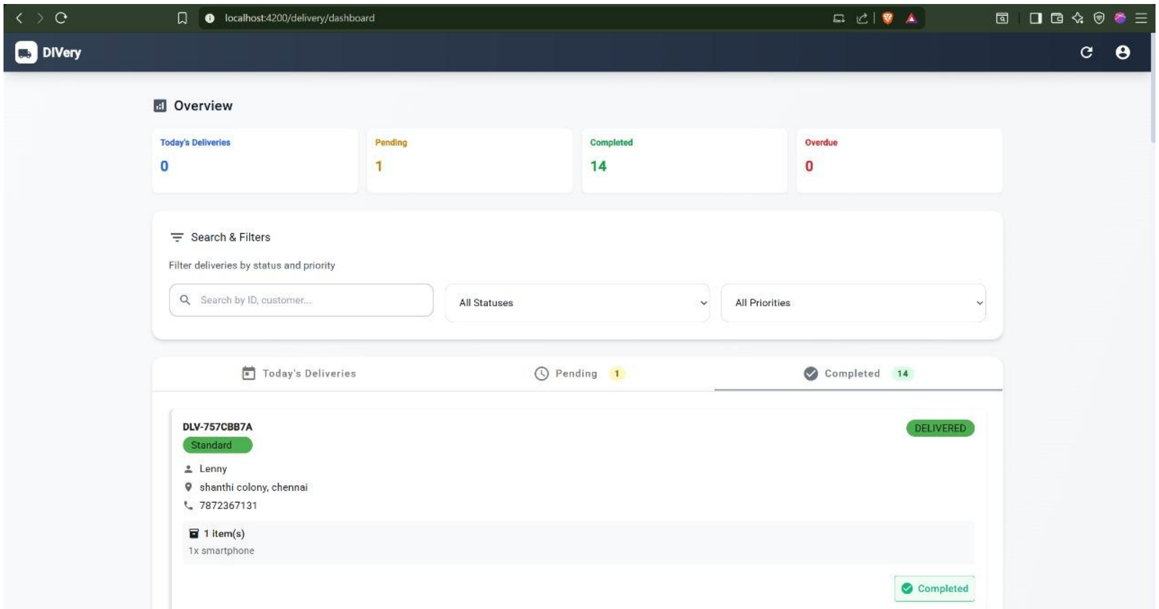
DLV-757CBB7A
Standard
Lenny
shanthi colony, chennai
7872367131
1 item(s)
1x smartphone

Delivery Completion

Customer Name: Lenny

Customer Signature

Notes (Optional): Any additional notes



Today's Deliveries	Pending	Completed	Overdue
0	1	14	0

DLV-757CBB7A
Standard
Lenny
shanthi colony, chennai
7872367131
1 item(s)
1x smartphone

System Diagrams

Figure 1: Activity Diagram

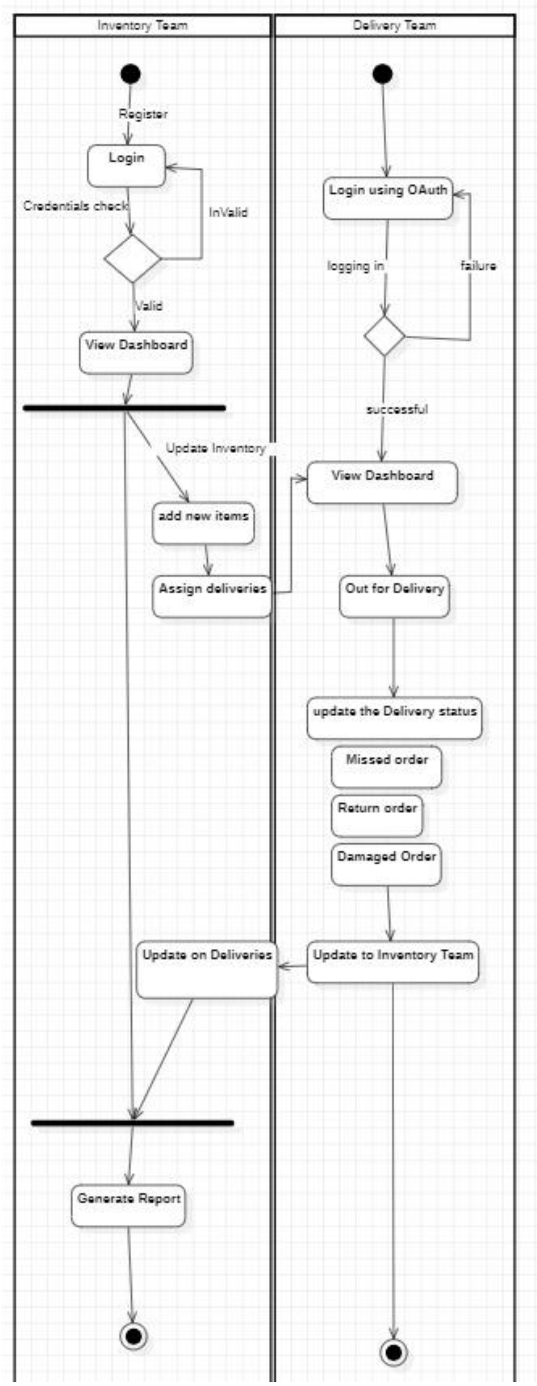
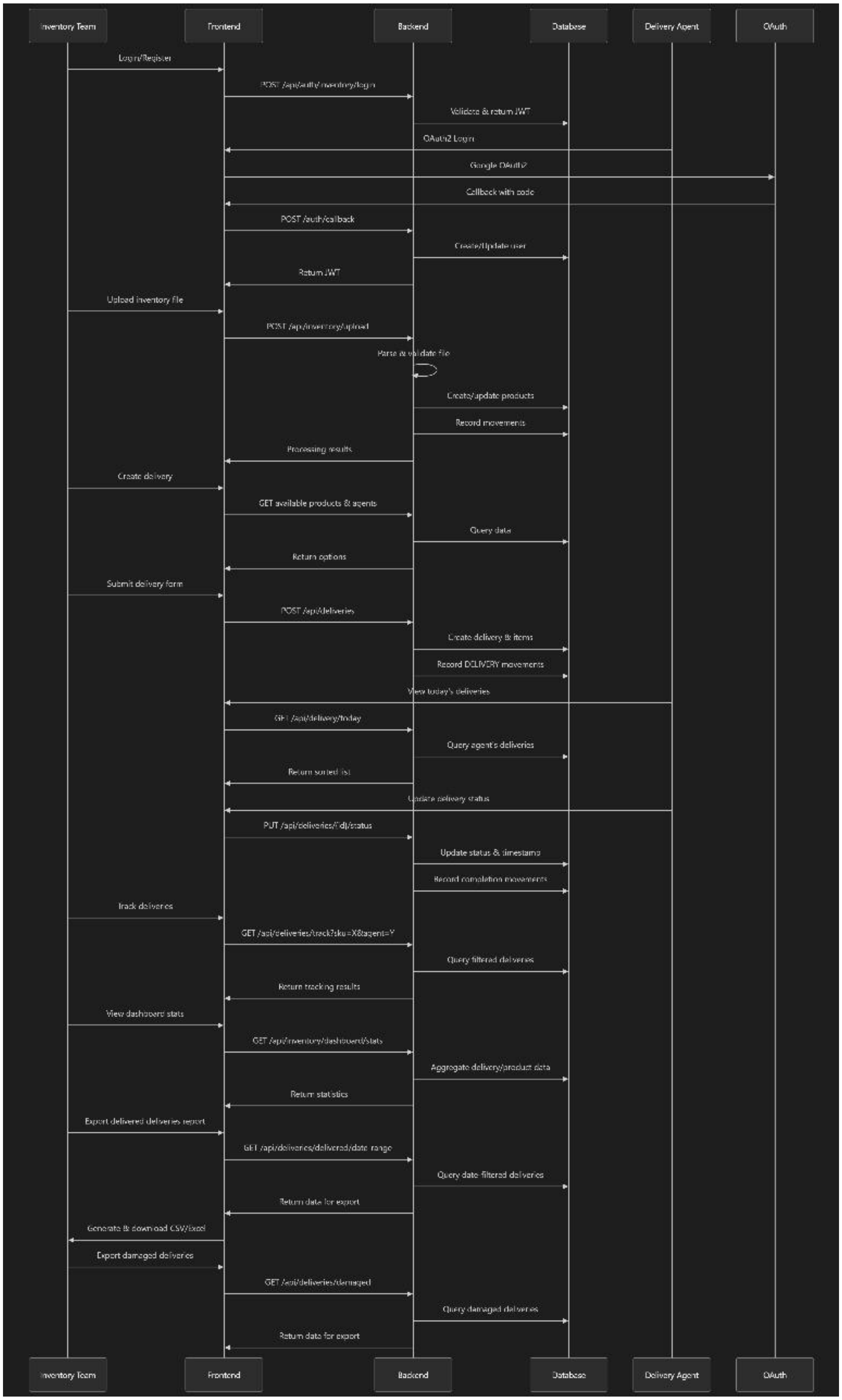


Figure 2: Sequence Diagram



Future Enhancements

The **DIVery** application has been built with a scalable architecture that allows seamless addition of new features and integrations. In its next phase of evolution, several enhancements can significantly improve the platform's intelligence, efficiency, and reach.

One of the key enhancements is the **integration of real-time GPS tracking** for delivery agents. By embedding live location monitoring, warehouse teams can visualize delivery progress, estimate arrival times, and dynamically reassign tasks in case of delays. Coupled with **AI-based route optimization**, this will ensure efficient fuel utilization and shorter delivery cycles, directly improving cost-effectiveness and customer satisfaction.

Another potential enhancement is the incorporation of **predictive analytics and demand forecasting**. Using historical sales and delivery data, the system can anticipate inventory requirements, helping managers plan stock replenishment and resource allocation proactively.

Finally, **multi-language support**, **chatbot-based helpdesk**, and **cloud-native microservices deployment** can expand the system's usability, resilience, and accessibility. These enhancements would transform DIVery into a fully intelligent, global-grade logistics management ecosystem.

Conclusion

The DIVery – Logistics Management and Delivery Tracking System successfully modernizes logistics operations through automation, data integration, and digital visibility. Developed using Angular, Spring Boot, and MySQL, it streamlines warehouse management and delivery tracking while ensuring security, scalability, and real-time performance. The project demonstrates effective collaboration, agile methodology, and adherence to enterprise software standards. DIVery enhances decision-making through accurate data flow and reporting, significantly reducing manual effort and operational delays. It serves as a scalable foundation for future innovations, including AI, and cloud integration, positioning it as a next-generation logistics management solution.