Parcel Delivery System Development Report

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1. Executive Summary

The Parcel Delivery System is a robust platform designed to streamline parcel management, from parcel creation to final delivery confirmation. This solution improves operational efficiency, reduces human errors, and enhances real-time tracking for both customers and delivery agents. By integrating multiple stakeholders (Admin, Agent, Customer), the system ensures faster deliveries and greater transparency, improving customer satisfaction while reducing operational costs.

2. Project Overview

2.1 Problem Statement

Current manual parcel delivery workflows are prone to delays, errors, and lack of visibility. This results in SLA breaches, poor customer experiences, and inefficient resource management.

2.2 Objectives

Objective	Target
Improve on-time delivery rate	≥ 95%
Reduce human error	Automated assignment and tracking
Increase operational transparency	Real-time customer tracking

2.3 Scope

In-Scope	Out-of-Scope
Parcel creation, assignment, status tracking	Payment integration
Admin, Agent, and Customer views	Route optimization

2.4. Functional Requirements

ID	Title	Description	Priority	Acceptance Criteria
FR-01	Create Parcel	Sender/receiver, addresses, weight, COD, notes	High	201 + ID & tracking; validation errors handled
FR-02	Assign Parcel	Assign/unassign agent	High	Agent availability checked; audit recorded
FR-03	Update Status	Lifecycle updates	High	Transitions enforced; timestamps; actor
FR-04	Track Parcel	Public tracking by code	High	Status timeline; PII masked
FR-05	Search & Filter	List parcels	Medium	Status/agent/date; pagination
FR-06	Exports	CSV exports	Medium	Date filters; selected columns

2.5. Non-Functional Requirements

Category	Target	Notes
Performance	P95 GET < 300ms; P95 write < 600ms	Baseline RPS to be defined
Availability	99.5% monthly	Single region + daily backups
Security	JWT, Crypto-js, input validation	OWASP ASVS L1–L2
Privacy	PII encrypted at rest & in transit	Data retention & minimization
Observability	Structured JSON logs; alerts	Error rate < 1%

3. System Design & Architecture

3.1 High-Level Overview

The Parcel Delivery System consists of three main actors: Customer, Admin, and Delivery Agent. It includes features such as parcel creation, status updates, real-time tracking, and exportable reports.

3.2 Technology Stack

Component	Technology
Backend	Node.js + Express
Database	MongoDB
Frontend	React
Authentication	JWT + bcrypt
Containerization	Docker

4. Development Methodology

4.1 Agile Approach

The development followed an Agile approach, using 2-week sprints. Continuous feedback loops, daily standups, and sprint reviews ensured flexibility in meeting business needs.

4.2 Phases

Phase	Activities	Duration
Design	System architecture, database design	2 days
Development	Feature implementation, API design	5 days

5. Testing & Quality Assurance

5.1 Testing Strategy

The system underwent unit testing, integration testing, and user acceptance testing (UAT). Automated test cases were written for critical paths, and manual testing was performed for UI and edge cases.

5.2 Key Results

Test Type	Coverage	Results
Unit Testing	80% code coverage	Passed all unit tests
Integration Testing	All core features	Passed with minor adjustments

5.3. API Testing

Name	Method	Path	Auth	Req Body (summary)	Resp (summary)	Rate Limit	Idempotent
Register	POST	/api/auth/register	Public	name,email,phone,password,role?	201 user	Low	Yes (Idempotency-Key)
Login	POST	/api/auth/login	Public	email,password	200 tokens	Medium	Yes
Me	GET	/api/auth/me	Bearer	—	200 user	Medium	—
Create Parcel	POST	/api/parcels	Admin/Customer	parcel payload	201 parcel	Medium	Yes
List Parcels	GET	/api/parcels	Admin	query filters	200 list	High	—
Get Parcel	GET	/api/parcels/find/:id	Admin/Agent	—	200 parcel	High	—
Update Parcel	PUT	/api/parcels/:id	Admin	mutable fields	200 parcel	Low	—
Status Update	PATCH	/api/parcels/:id/status	Agent/Admin	status,notes,location	200 parcel	Medium	Yes
Assign	PATCH	/api/parcels/:id/assign	Admin	agentId	200 assignment	Low	Yes

5.4. Error Catalog & Response Contract

HTTP	Code	Message	Body (JSON)
400	BAD_REQUEST	Validation failure	{"error":{"code":"BAD_REQUEST","message":"...","details":[...]}}
401	UNAUTHORIZED	Missing/invalid token	{"error":{"code":"UNAUTHORIZED","message":"..."}}
403	FORBIDDEN	Insufficient permissions	{"error":{"code":"FORBIDDEN","message":"..."}}
404	NOT_FOUND	Resource not found	{"error":{"code":"NOT_FOUND","message":"..."}}
409	CONFLICT	Invalid status transition	{"error":{"code":"CONFLICT","message":"..."}}
422	VALIDATION_ERROR	Field-level issues	{"error":{"code":"VALIDATION_ERROR","fields":{"field":"reason"}}}
500	INTERNAL	Unexpected error	{"error":{"code":"INTERNAL","message":"Error id=XYZ"}}

6. Challenges & Solutions

6.1 Challenges

1. Managing status transitions across multiple user roles.

2. Ensuring real-time performance during peak traffic hours.

3. Migrating legacy data from old systems.

6.2 Solutions

1. Implemented a robust RBAC system for clear role permissions.

2. Optimized database queries and used Redis caching for performance.

3. Performed data mapping and migration in stages.

8. Project Outcomes

8.1 Results

The project was delivered on time .

9. Future Work & Recommendations

9.1 Next Steps

1. Implement payment processing integration for COD.

2. Introduce route optimization algorithms for agents.

9.2 Enhancements

1. Mobile app for customer and agent interfaces.

2. Support for international shipping tracking.

10. Conclusion

The Parcel Delivery System has successfully met the core objectives of streamlining parcel operations, improving tracking, and providing clear visibility to customers and delivery agents. Future iterations will focus on expanding the system's reach and efficiency.

Appendices

A. UI Gallery (Placeholder for 7–8 pages of UI Screenshots)

B. Full Test Cases & Postman Collections

C. Data Model (ERD)

D. Environments & Configuration (Environment variables and .env sample)

UI Screenshots: Insert full-page screenshots here.

Admin Dashboard

Fig.1 Home

Fig.2 Parcels List

Fig.3 User List
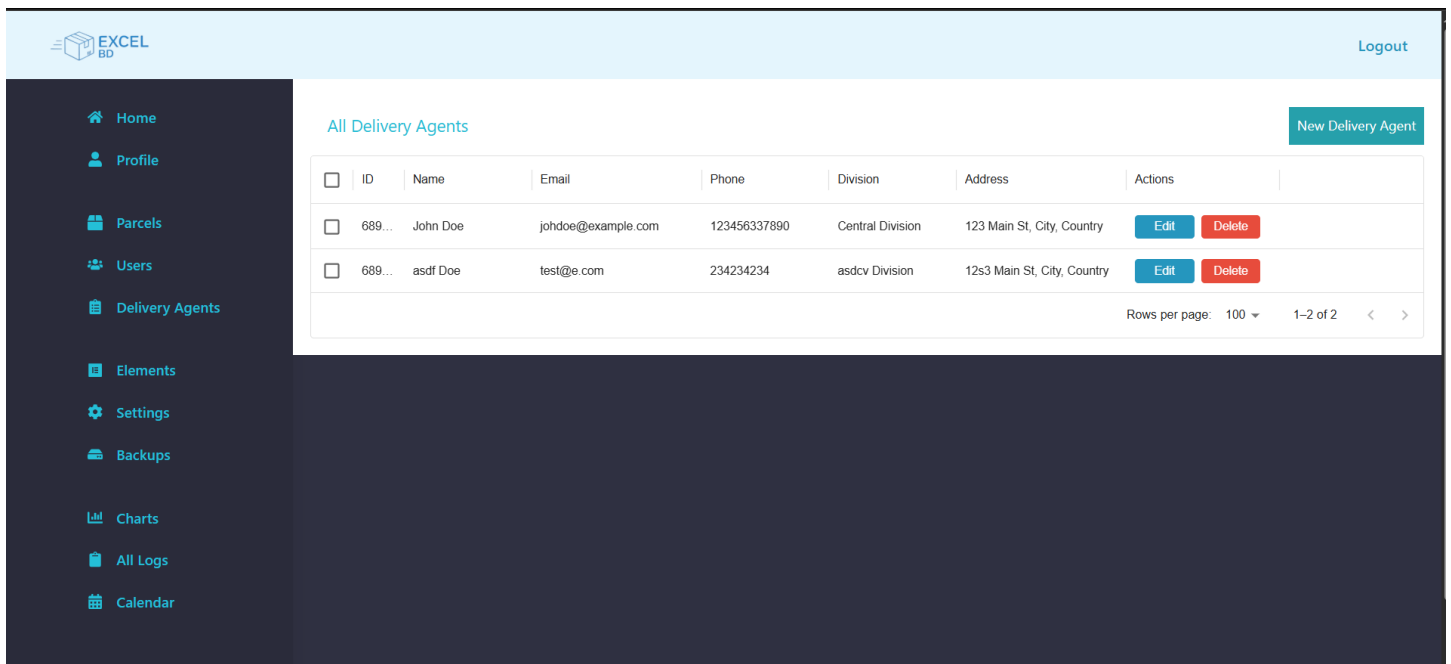
Fig.4 Delivery Agent List

Fig.5 Add New Delivery Agent

Fig.6 Update Delivery Agent Info

Fig.7 Add New Customer

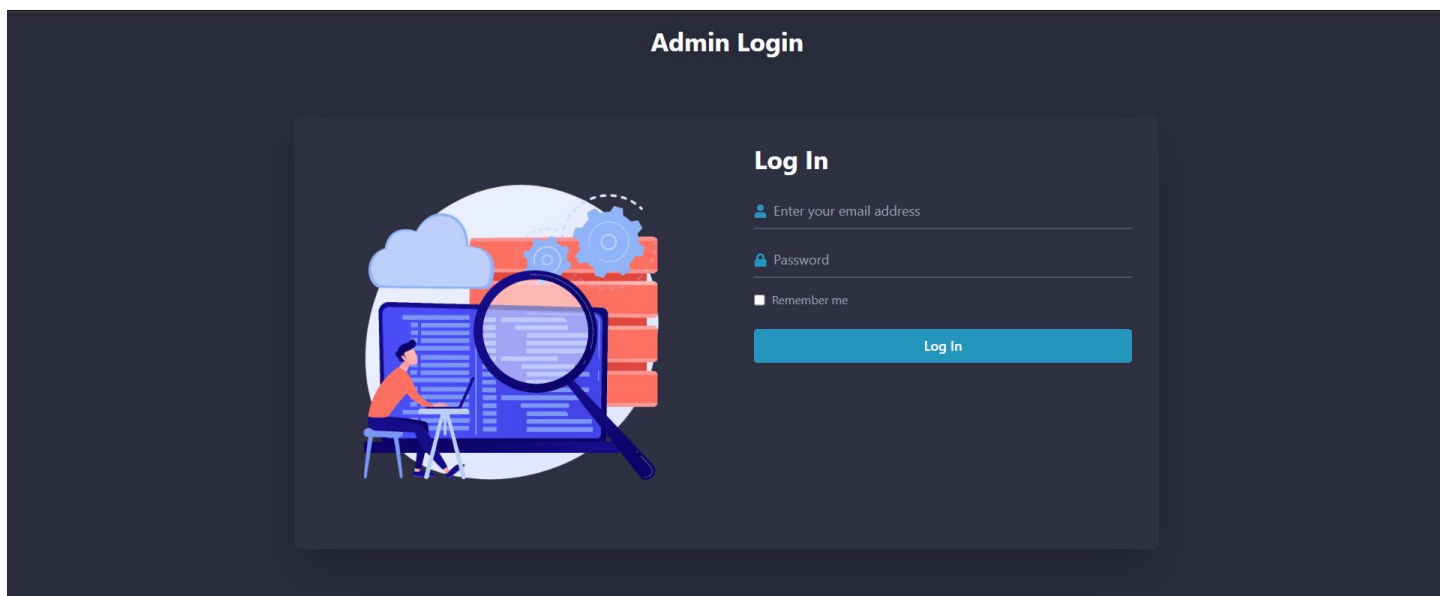Fig.8 Update Parcel Info & Delivery-Agent Assign

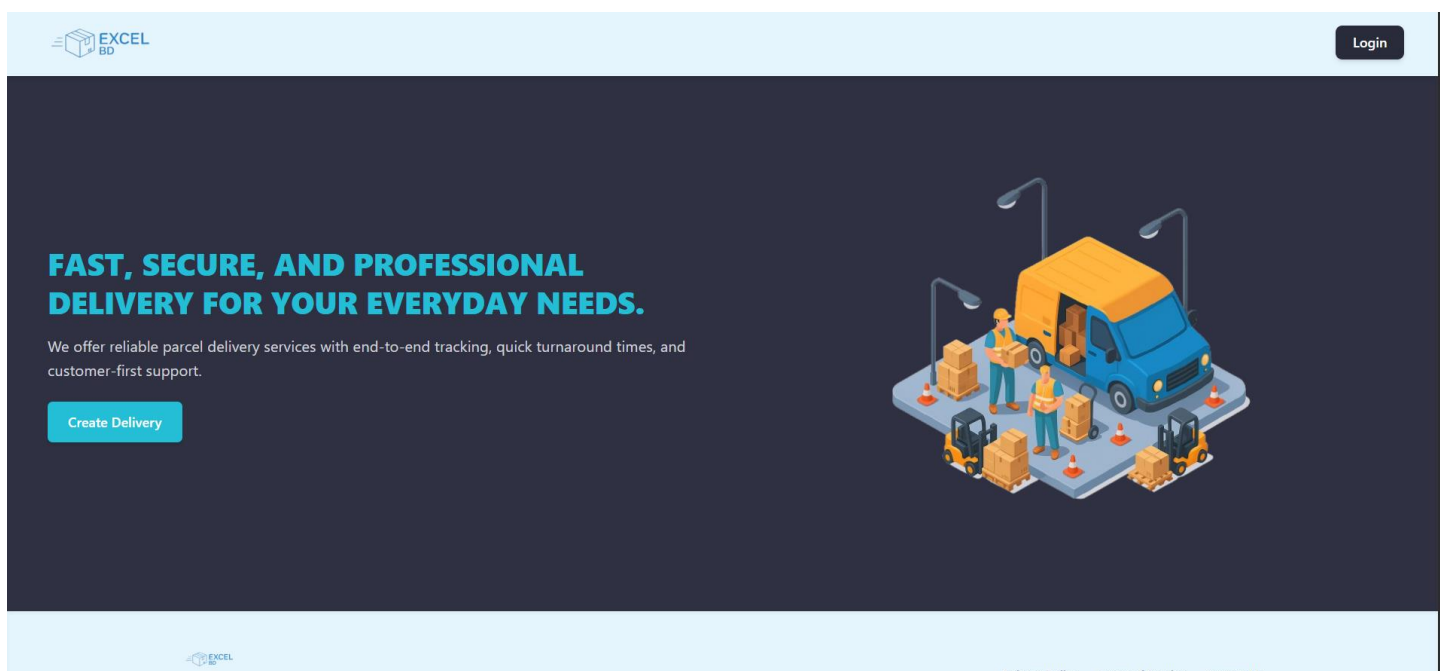Fig.9 Export As CSV

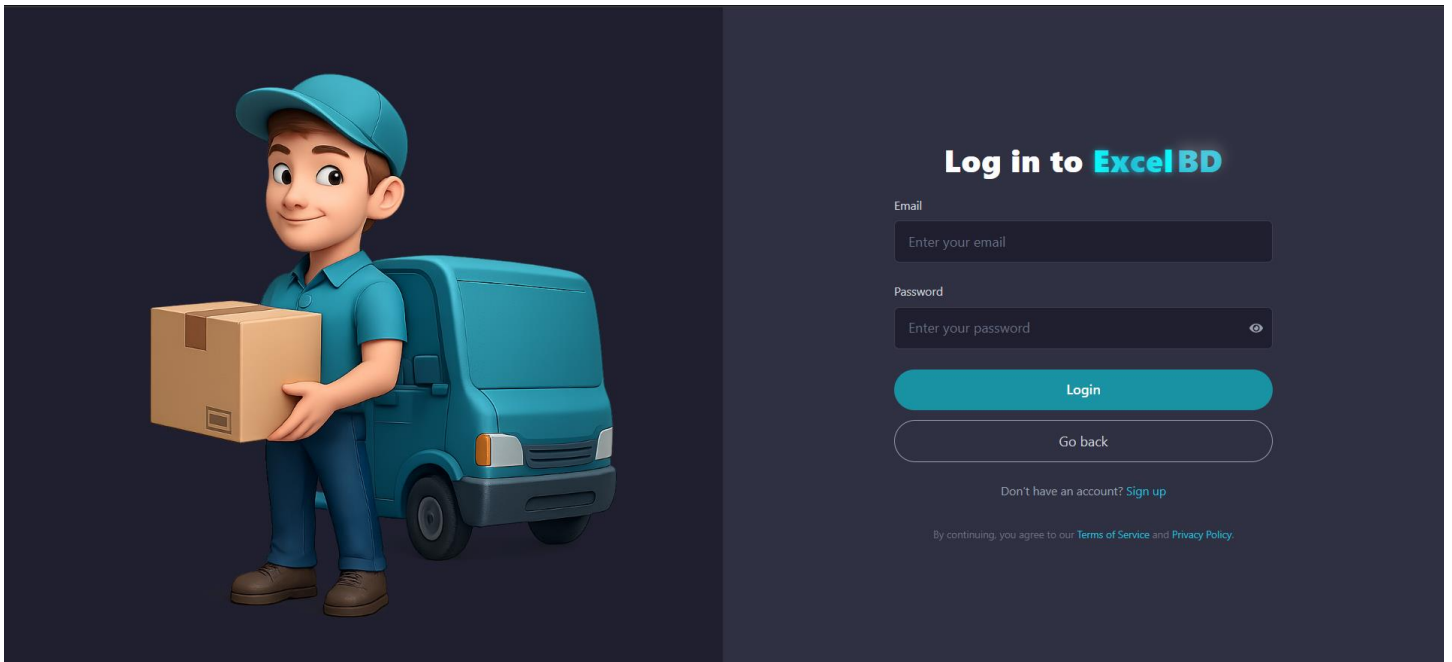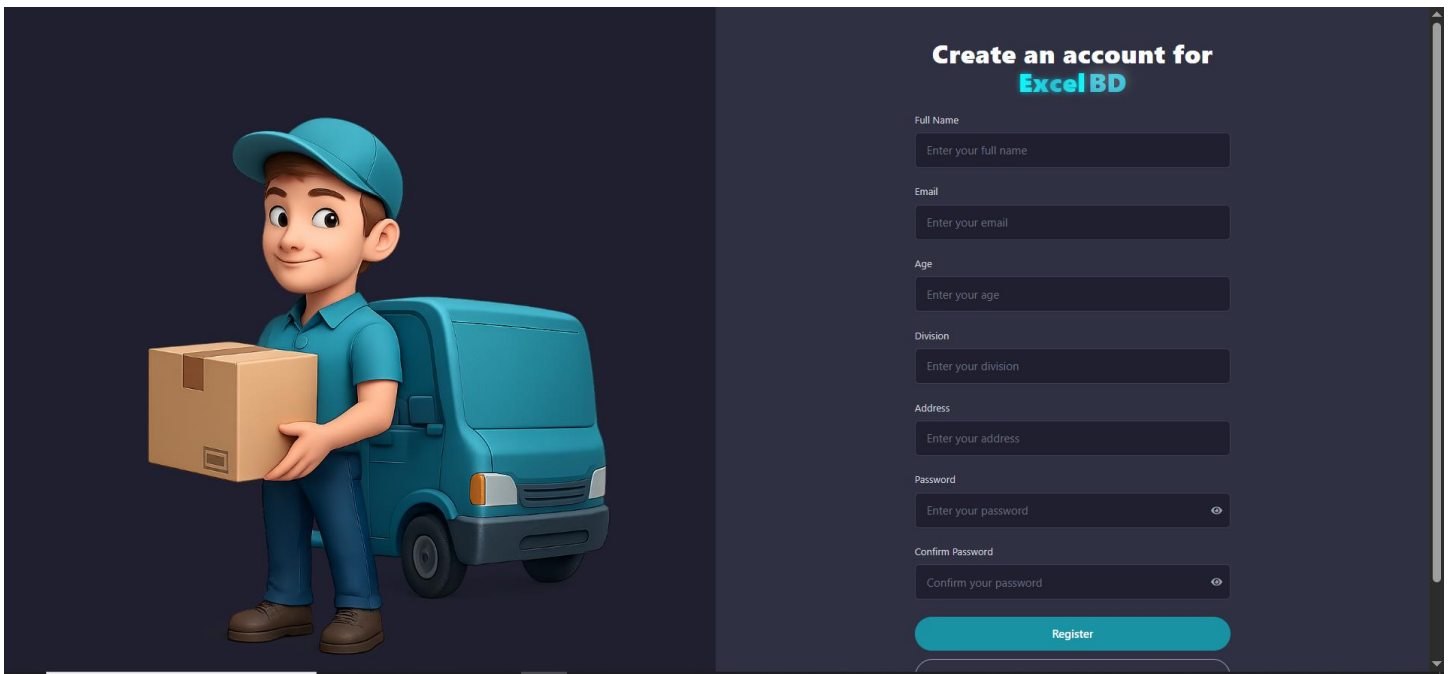Fig.10 Admin Login Page

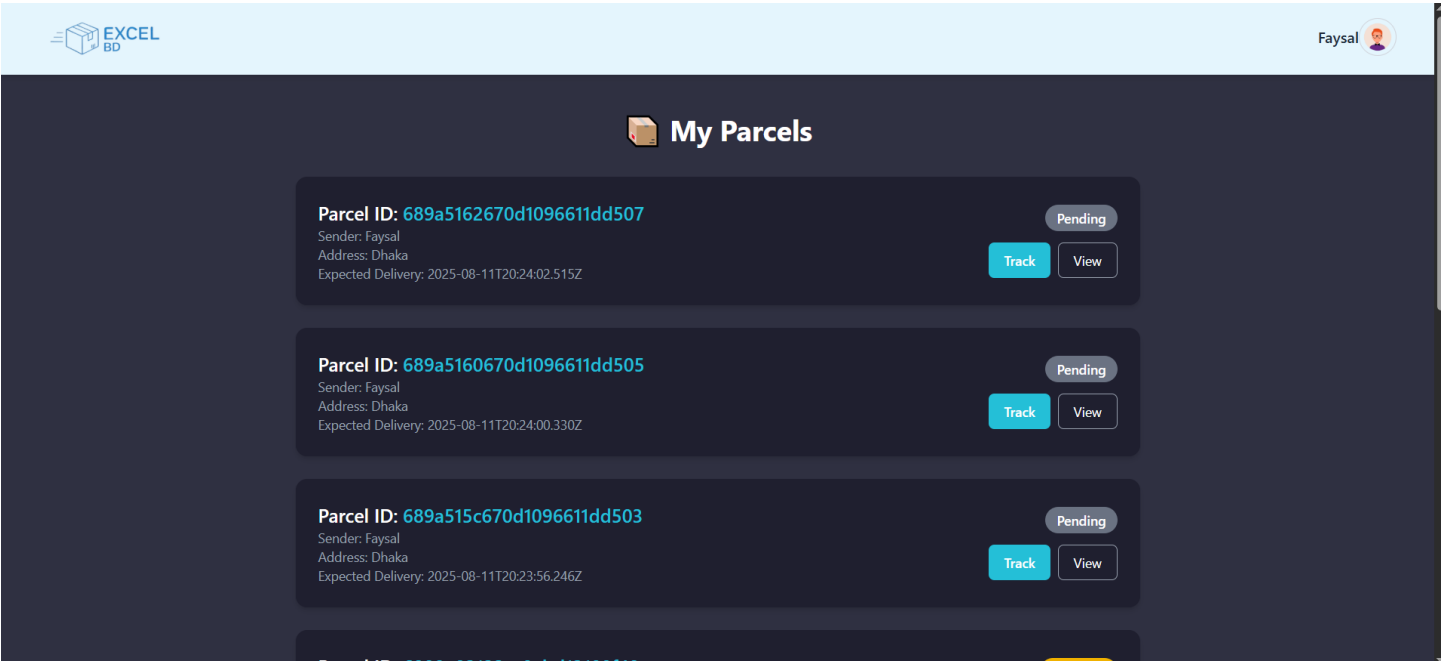# Client/User Side

Fig.11 Home

Fig.12 Login

Fig.13 Registration

Fig.14 My Parcels
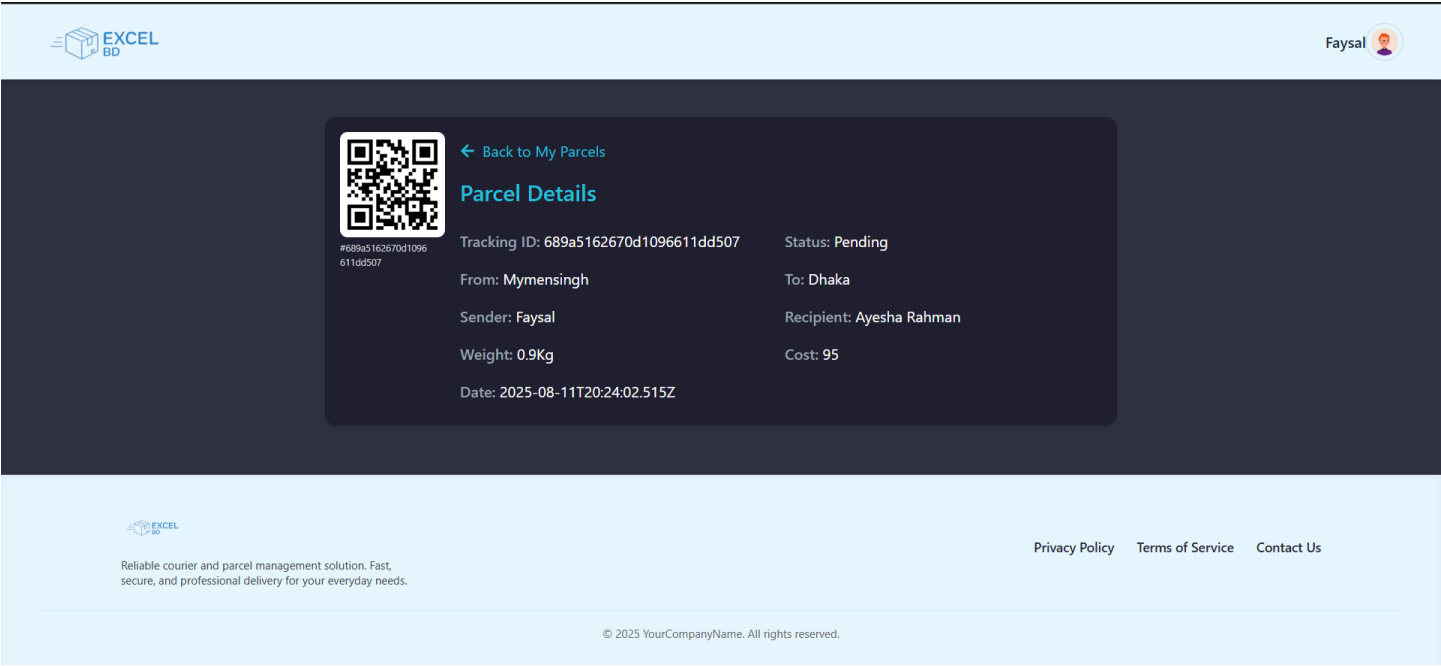

Fig.15 Parcel Details

Fig.16 Parcel Booking Page

Fi6.17 Profile