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03-134221-046 YASIR JAMIL

03-134221-008 ALI RAZA

DoseLogix: Pharmaceutical Distribution Management System

In partial fulfilment of the requirements for the degree of

Bachelor of Science in Computer Science

Supervisor: Dr Junaid Nasir Qureshi

Department of Computer Sciences

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C e r t i f i c a t e

We accept the work contained in the report titled

"DoseLogix: Pharmaceutical Distribution Management System"

written by

YASIR JAMIL

ALI RAZA

as a confirmation to the required standard for the partial fulfilment of the degree of Bachelor of Science in Computer Science.

Approved by:

Supervisor: Dr Junaid Nasir Qureshi

_____ (Signature)

January 05, 2026

DECLARATION

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted for any other degree or award at Bahria University or other institutions.

Enrolment	Name	Signature
03-134221-046	YASIR JAMIL	
03-134221-008	ALI RAZA	

Date : January 05, 2026

Specially dedicated to
my beloved grandmother, mother and father
(YASIR JAMIL)
my beloved grandmother, mother and father
(ALI RAZA)

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YASIR JAMIL
ALI RAZA

DoseLogix: Pharmaceutical Distribution Management System

ABSTRACT

The main objective of this venture is to overcome major constraints of the current Pharmaceutical Distribution Management Systems especially among the small and medium sized distributors. The existing software tends to be either old-fashioned in UI/UX, inconsistent data flow, expensive, or crippling with a deficit of certain industry-specific functional support. The key aim of DoseLogix is to develop a low-cost, contemporary, and powerful PDMS tool that can easily manage such vital functions as full inventory and detailed financial monitoring. This dedicated system is specifically designed to offer a secure authentication, the ability to support multi-tenancy, and built-in advanced analytics to support robust business expansion in the future.

The system architecture is a service-oriented system design with a modern Next.js front end and an asynchronous backend based on Express.js on the Node.js platform, and a dedicated Python micro-service to perform advanced computational functions. It uses JavaScript and TypeScript to develop the core applications, and uses Python libraries, including Scikit-learn and Pandas, to carry out the most important machine learning operations. The system uses MongoDB Atlas, a NoSQL document database that is a cloud-based system, to support data persistence across all the system modules with a high level of scalability and real-time data management of data.

The implementation successfully provided a powerful centralized application that included lean sales and purchase invoicing, real-time inventory controls with First Expiry First Out (FEFO) logic, and delivery logs. One of its major inventions is the inbuilt AI-based module, which makes correct predictions of up to seven days of future product sales based on the historical data interpreted by the best-performing models on our dataset. The system also includes a critical web scraping system to automatically gather the most recent health advices from recognized Pakistani health

advisories to help the distributors make proactive buying choices. The most important operational improvements are tracking the aging of receivables, automated stock notifications, and showing the previous three sales prices right in the sales invoice creating process.

As a concluding remark, DoseLogix is able to meet its major mandate, that is, providing an efficient, secure and modernized Pharmaceutical Distribution Management System, which is specifically designed to suit small and medium-sized enterprises. This is a specialized platform that directly addresses and overcomes key industry gaps posed by old, generalized or too expensive distribution software. The effective integration of advanced, user-centric features, including AI sales forecasting, latest health news from advisories and real-time financial tracking, significantly increases operational accuracy and supply chain responsiveness. DoseLogix is positioned as a highly reliable, scalable and industry-specific software that makes life easier and promotes sustainable growth of business among pharmaceutical vendors.

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LIST OF SYMBOLS / ABBREVIATIONS

DMS	Distribution Management System
PDMS	Pharmaceutical distribution management systems
SDLC	Agile Software Development Life Cycle
SSR	Server-Side Rendering
OTP	One Time Password
FEFO	FIRST EXPIRY FIRST OUT
UI	User Interface
UX	User Experience
JWT	JSON Web Token
LR	Linear Regression
RF	Random Forest
LSTM	Long Short Term Memory
SARIMA	Seasonal Auto-Regressive Integrated Moving Average
MAE	Mean Absolute Error
MSE	Mean Squared Error
RMSE	Root Mean Squared Error

CHAPTER 1

INTRODUCTION

1.1 Background

The pharmaceutical sector relies heavily on accurate inventory management, robust invoice management and reliable financial tracking. However, despite the critical nature of these tasks for running a business smoothly, many small or medium scale distributors, including us, have faced limitation in the capabilities of the available software.

Most of the available distribution management systems (DMS) fall into either of these three categories. One where we encounter outdated legacy applications, which offers poor data consistency, fragmented data flows and limited support. On the other hand we have full fledged DMS but they are generalized for all type of distribution systems i.e Dynamics 365. Dynamics 365, while being powerful and robust, it is not specifically tailored to cater the needs of a pharmaceutical DMS. Customizing such a generalized system is often time consuming, complex and expensive. And the last one are the applications that are updated and generalized but are so expensive for the smale to medium scaled distributors to afford.

Because of all these gaps, small and medium scale distributors tend to choose outdated legacy applications with inconsistent data flow and inefficient financial tracking with an application full of bugs and flaws. This eventually affects the financials of the distributors and highly impacts the growth of the distributors.

To address these challenges, this project proposes *DoseLogix*, a specialized and modern DMS tailored specifically for the pharmaceutical setup. DoseLogix is designed to cover the shortcomings of existing solutions, covering the cons of each, being developed on the latest technology with consistent data flow and an efficient financial tracking solution that aligns with the operational reality of small and medium scale pharmaceutical distributors.

1.2 Problem Statements

Small and medium scale pharmaceutical distributors lacks an efficient, robust, affordable and industry specific DMS that aligns with their workflows. Existing solutions are either outdated with inconsistent data flow, generalized systems that are costly and difficult to customize or modern applications that are financially out of reach. These limitations hinder business growth. Therefore, there is a need for a modern, robust, specifically tailored and cost-effective DMS.

1.3 Aims and Objectives

The goals of this project are shown as following:

i) To create a lean invoicing module to support purchase invoices and sales invoices to manage inventory quantities.

ii) To develop an effective financial tracking system that sustains the balances and the debit and credit histories.

iii) To incorporate AI based sales forecasting to assist distributors in making purchasing decisions.

iv) To incorporate web scraping to deliver up-to-date news on health in Pakistan.

v) To make it affordable and scalable, to enable it to be available to the small and medium scale distributors to facilitate future expansion.

vi) To provide authentication, authorization and multi-tenancy simultaneously.

1.4 Scope of Project

The scope of DoseLogix is to design and develop a spcialized DMS tailored exclusively for small and medium scale pharmaceutical distributors. The scope of this system is to design a centralized application handling all critical operational activities such as invoice management, inventory controlling and monitoring cash flows.

DoseLogix allows users to enlist new products, register new customers, employees and brands, and manage stock levels with their respective batch level entries.

On the purchase side, it allows user to generate purchase invoice of certain products respective to their brands and update stock at the inventory level. On the sales side, it allows the users to generate sales with the record of partial payments, credit sales and automation of stock updation in the inventory.

A complex yet critical component is integrated financial tracking mechanism that helps the distributors in maintaining the outstanding balances, debit an dcredit transactions, and payment histories of customers and brands. This comprehensive component help distributors in ensuring the clarity in deliverables and receivables. Delivery log is also critical as it takes care of the deliveries assigned to the employees linking their respective deliverable invoices for overall oversight of the sales invoices.

Our system incorporates AI-driven sales forecasting, which enables users to anlayze historical sales and predict the future demand of coming days sales. Furthermore, DoseLogix includes a web scraping module which is specifically

designed to bring the latest health related news to the distributors. This lets distributors to plan their stock needs effectively which will ultimately improve their business growth.

Where implementing all these features were a part of scope of this project but security is also a major concern here. To tackle that we have embedded the system with authentication, authorization and multi-tenancy, ensuring data transparency and each registered user can act independently accessing only their own data.

On the whole, DoseLogix is conceived as a secure, current, and convenient DMS, which enhances the effectiveness of its operations, increases the financial accuracy and enables the pharmaceutical distributors with the means that reflect the realities of their working processes. The scope of the project includes all the key features needed to develop a stable, scalable, and industry-specific platform that will be able to sustain both long-term operational and business development.

CHAPTER 2

LITERATURE REVIEW (and/or SRS)

2.1 Pharmaceutical Distribution Management Systems: Overview

Pharmaceutical distribution management systems (PDMS) are digital designed platforms to overview and manage the distribution of medicines from distributors to retailers. These systems manage inventories, invoice management and overview of cash flows. With the complexity of medicine inventories such as batch numbers, stock expiry, bonuses, discount etc., PDMS requires a software that handles the accurate stock management, financial tracking and maximized automation i.e. delivery logs, ledgers etc.

2.1.1 Exiting Solutions

Exiting solutions for PDMS such as Dynamic 365, Nizisolution pharma distribution software, Softronix pharma distribution software or offline pharmaceutical inventory management tools. These softwares are either outdated or not specifically tailored for fulfilling pharmacuetical needs.

2.1.2 Current Limitations

Despite availability, most existing solutions have significant gaps that make them less suitable for pharma industry's distributors. The limitations are listed below.

- **Complex and unfriendly UI:** Most of the users are not tech savy and using the system needs a lot of training to develop muscle memory.
- **Inconsistency in data flow:** Some of the offline available softwares have the inconsistency in data flow and aggregation.
- **No automated alerts:** Most of the locally available online apps do not have automated alerts for low stock or near expiry of medicine.
- **Latest health news:** None of the available solutions to our find updates the user with latest health related news of Pakistan.
- **Demand forecasting:** Most of the available solutions do not have the AI based forecasting that helps in predicting sales for upcoming days that affects the purchasing decision.

2.1.3 DoseLogix — Proposed Solution

DoseLogix is a PDMS which is modern and provides a user-friendly UI/UX experience covering operational in-efficiencies in current systems. DoseLogix address all the listed limitations in the available solutions.

- **User-friendly and clean interface:** The solution is designed by keeping it user-friendly and clean UI experience so that the users with minimal technical exposure can use it without extensive training.
- **Accurate inventory and batch management:** DoseLogix handles the inventory and batch management with bonuses and returns efficiently, ensuring no error or inaccuracy.

- **Automated alerts and reminders:** This system notifies the users with email notifications about low stock, near expiry, remaining balances of customers and OTPs for signup and forget password.
- **Integrated AI-based sales forecasting:** DoseLogix predicts upcoming 7 days sales helping in better purchasing decisions.
- **Latest health news integration:** This application scrapes health related news from recognized Pakistani health authorities(NIH, Chugtai Lab), and updates in our application so that distributors can stay informed about outbreaks and seasonal diseases.
- **Financial Overview:** Debit and credit payments to customers and brands are automatically reflected in the ledger and reports that gives an overview of cash flow.

2.2 Related Work

In researches, it's been documented that the external real world signals, social media trends and news from certified health advisories highly impacts the sales. These sources help distributors to being updated and be ready to meet the current need of market [1]. These external signals can help businesses to detect the requirement of market and proactively make a move, reducing the risk of stock shortage and improving supply chain responsiveness. DoseLogix's vision align with this approach and show latest news from health advisories to distributors to stock up for emerging needs.

Demand forecasting is also crucial for managing the pharmaceutical supply chain and distribution as mismatches between supply and demand can result in product spoilage, disturbing cash flows or even a bigger threat, endagering patients [2] [3]. Conventional techniques such as ARIMA and regression usually find it difficult to reflect the nonlinear nature, seasonal changes and other unforeseeable market factors in pharmaceutical sales data [2] [4].

In order to address these weaknesses, Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL) algorithms are widely utilized in research [3]. Prediction with the help of ML algorithms like the Random Forests (RF) and Support Vector Machines (SVM), whereas the more modern technologies of the DL (Long Short-Term Memory (LSTM) and Recurrent Neural Networks (RNNs)) are preferred due to the possibility of working with time-series data and long-term relationships [2] [4]. State-of-the-art models like such as Temporal Fusion Transformer (TFT) and TimeGPT also demonstrate high performance in capturing complex patterns [5].

The predictive model, no matter how sophisticated, has relied on the quality and integrity of the historical sales data in the time series as the fundamental basis of its sustained effectiveness. An important part of data quality is the treatment of the occurrence of outliers, set of values that are very different or inconsistent with the rest of the data. These unusual and non-repetitive events may affect historical data sets, but are either gross errors (related to processing errors that need correction when identified) or true outliers (related to particular events such as promotions or weather). When such anomalous values are incorporated in the forecast calculation, then they may compromise the model results heavily. If the presence of an outlier is detected, it should be replaced by a more appropriate and typical value, which generally improves prediction accuracy. Correction methods in outliers can involve the replacement of outliers by the mean of the directly neighbouring observations. The analytical tools and statistical techniques are also used to identify the outliers accurately. Box-plot technique is an effective statistical test and it has a rule according to which one can define outliers in terms of quartile ranges from 1.5 to 3.0 to differentiate between moderate and severe outliers. It is also noticed that for outliers detection, median should be used instead of mean. As a result, comprehensive data preprocessing is acknowledged as a crucial step towards successful time series forecasting [3].

In conclusion, the literature will indicate that the latest news highly influence the sales of coming days, so the distributors need to be readily updated so that they can fulfill their role in supply chain proactively. The current AI and ML models include incredible predictive power, thus can help distributors to predict their demand for coming days, ultimately improving the business growth and supply chain responsiveness.

2.2.1 Comparative Analysis of Existing Solutions

The Table 2.1 presents comparison between DoseLogix and some other famous existing solutions around the globe, including those available in Pakistan such as Softronix Pharma distribution software, Nizi Solution Pharma distribution software, Microsoft Dynamics 365 and locally available offline solutions.

Table 2.1: Comparative analysis of Existing Solutions

Feature	**DoseLogix**	**Offline Solutions**	**Softronix[6]**	**Nizi Solutions[7]**	**Dynamics 365[8]**
Accurate Data flow	✓	✓ (Partial)	✓	✓	✓
Alerts / notifications	✓		✓		✓
User-friendly UI/UX	✓		✓	✓	✓
Industry specific solution	✓	✓	✓	✓	
Demand Forecasting	✓				
Latest Health News	✓				

CHAPTER 3

DESIGN AND METHODOLOGY

3.1 Development Method

Agile Software Development Life Cycle (SDLC) has been utilized as the development method in developing DoseLogix. Agile was chosen here as it is specifically used when there is the chance that the requirements might evolve as the progress happens. As DoseLogix has so many integrated modules, each of the implemented modules needed to be developed, tested, and refined iteratively. By choosing the development method Agile, the team was able to build this system piece by piece, leveraging the continuous testing and refinement to improve the development process.

3.1.1 Why Agile Was Chosen?

Agile was chosen for DoseLogix due to its iterative nature, which allows the development to be evolved according to the evolving requirements. Unlike traditional methods like Waterfall, where the development method is rigid, sequential approach which essentially is not a suitable option for our project type. Agile allowed the team to re-prioritize the requirements after every step and update or refine the development structure accordingly.

3.2 Tools and Technologies

DoseLogix has been designed based on the latest web technologies, open-source frameworks and popular development tools to allow it to be performed, scaled, and reliable. The selected technology stack allows the seamless integration of frontend, backend, database, and AI components and the efficient development processes and the security of the data processing.

3.2.1 Programming Languages

DoseLogix was built using the following primary languages:

- JavaScript (ES6+)
- TypeScript
- Python

3.2.1.1 JavaScript and TypeScript

The main language of frontend and backend development is JavaScript. Other modules used TypeScript to support type safety, reduce runtime issue and improve the maintainability of code.

Collectively they are the key drivers of major aspects like user interfaces, API processing, authentication code and business processes.

3.2.1.2 Python

The tasks of AI-driven sales forecasting, web scraping and preprocessing of data were implemented using Python. It has vast machine learning packages, including scikit-

learn, pandas and NumPy, which allow it to be used to create valid predictive models that can be attached to the service behind the system. And the functionality of web scraping to scrape the latest news from Pakistani Health Advisories.

3.2.2 Frameworks and Libraries

The different frameworks and libraries are used in this project to develop a complete solution.

3.2.2.1 Frontend Framework

The following technology is used for the frontend development of the solution.

- **Next js:** The frontend interface was constructed with Next.js that supports server-side rendering (SSR), better performance, and optimization of search engine optimization. It has a component-based architecture that guarantees a clean and modular UI framework that can be used in scalable enterprise applications.

3.2.2.2 Backend Frameworks

The following technologies are used for the backend development.

- **Node js:** The basic node.js is a run time that has asynchronous functions.
- **Express js:** It provides a routing framework, middleware stack, which is required to handle API calls, authentication, invoice processing, and business logic.

- **Pyhton:** it provides a vast range of libraries like pandas, NumPy, pickle, BeautifulSoup etc for AI model training and web scraping techniques.

3.2.3 Development Tools

The development tools used in the development of DoseLogix are Visual Studio Code, Postman, GitHub and MongoDB compass.

3.2.3.1 Visual Studio Code

Visual studio code served as the main development tool that helped in writing and maintaining the code in their respective file structures in frontend, node js backend and pyhton scripts.

3.2.3.2 Postman

Postman has been used as a primary helper for testing the REST APIs, helping in validation requests and responses.

3.2.3.3 GitHub

GitHub was used for the version control, team collaboration and streamlining development workflow.

3.2.3.4 MongoDB Compass

MongoDB compass was used to visually interact and inspect data, schema verification and querying.

3.3 Architectural Design

DoseLogix is a service-based architecture, scalable, and modular ecosystem, which incorporates a modern Next.js frontend, a Node.js back-end, and an AI-driven python server. All user communications, such as form submissions, data visualizations and reporting processes are managed in the frontend (Next.js). These requests are handled by the backend (Node.js) with the business logic and API endpoints and is in charge of all communication between the user interface, database, and the AI server. Without any complex data structures, the backend stores and retrieves data in the form of structured data, including inventory, customers, users, and news insight, using MongoDB to provide an efficient and flexible data handling approach. Meanwhile, an autonomous Python server will do the AI-guided sales forecasting and retrieve the most recent certified news about health matters so that distributors learn in advance about the necessity in various medicine in the season. The Python service exposes its services to the backend, which in turn sends the processed insights to the frontend and communicates with the AI to get the results of the news trends and trends. The Figure 3.1 shows the architecture of DoseLogix.

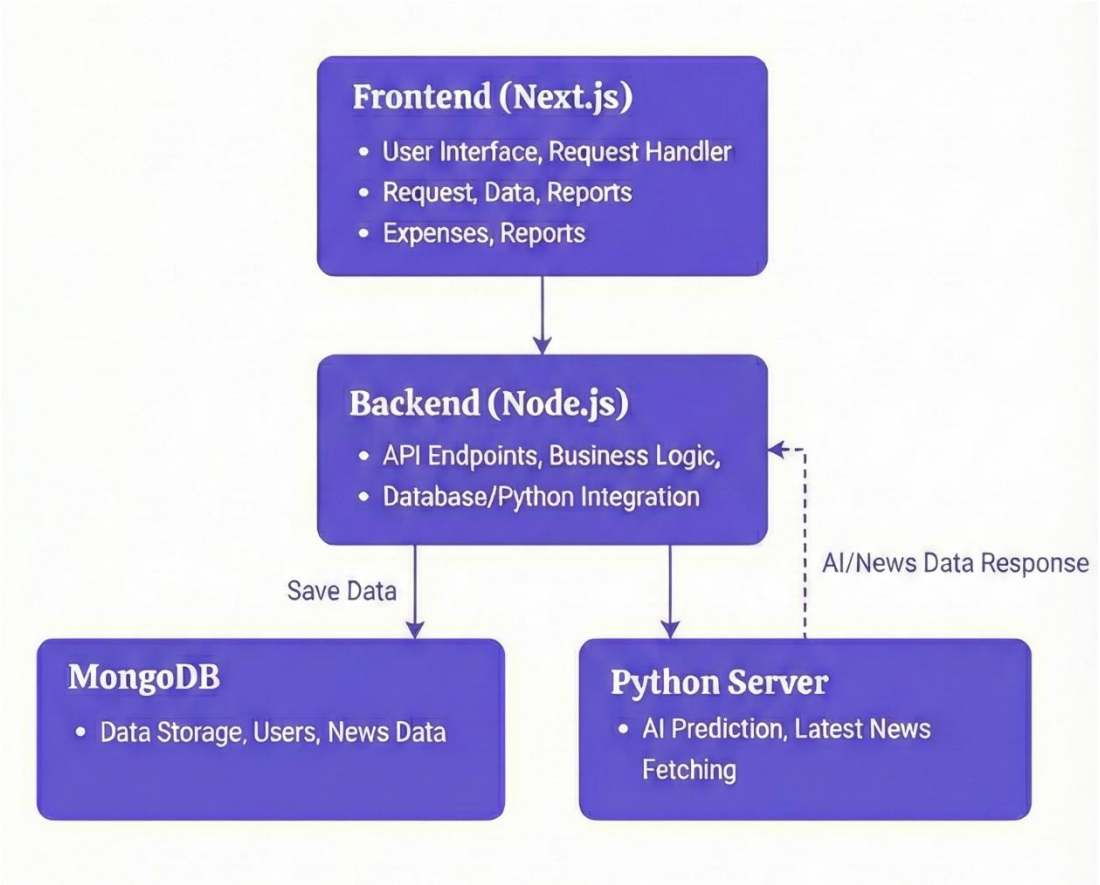


Figure 3.1: Architectural Design of DoseLogix

3.4 Database Technology

MongoDB was selected as the main database based on its flexibility, scalability and document architecture. It is an effective storage of all system modules. The modules are listed below.

- Brands
- Customers
- Employees
- Products
- Inventory
- Purchase invoices
- Sales invoices

- Ledger

3.4.1 MongoDB Atlas

MongoDb's database storage platform Atlas is utilized here for secure and encrypted cloud storage.

3.5 Use Case Diagrams

Use case diagrams is the general view of interactions between users and DoseLogix system. It indicates the actors and their interaction and accessibity within the application.

Users may use the application for managing customers, brands, employees, products, area/sub-area, group/sub-group, sales invoices, purchase invoices and profile information. The system will manage the dashboard, inventory, reports, delivery logs and ledger. These interactions are illustrated in the diagram to determine the functional requirements of the actors.

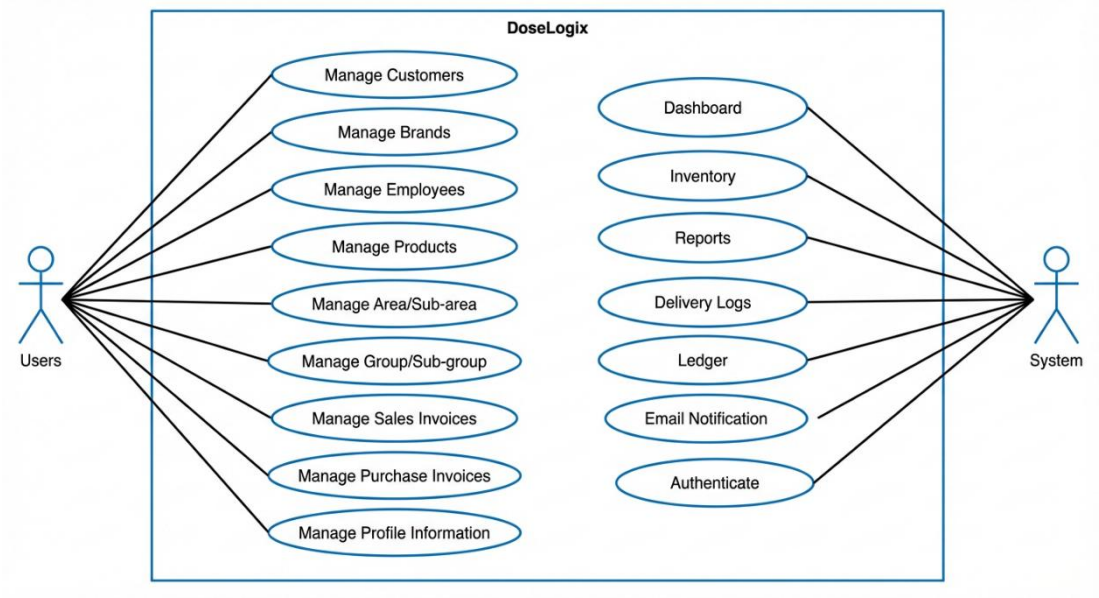


Figure 3.2: Use Case Diagram

3.5.1 Use Cases

Table 3.1: Use Case 1

USE CASE ID	**UC-01**
USE CASE NAME	**DASHBOARD**
Actors	User
Description	• Comprehensive insights for your pharmaceutical distribution. • Brand-Wise Sales Performance • Area-Wise Sales Distribution chart • Inventory Alerts • Latest News And Predictive Analytics
Trigger	User logins or navigates to “Dashboard” page.
Preconditions	User is logged in and authenticated.
Post conditions	The Dashboard page loads successfully and shows important summary data to the user.
Normal Flow	The user Successfully login and see the dashboard page.
Exceptions	N/A
Includes	Filters
Special Requirement	N/A
Assumptions	Core metrics, such as Total Sales, cash sales and credit sales.
Notes And Issues	N/A

Table 3.2: Use Case 2

USE CASE ID	**UC-02**
USE CASE NAME	**MANAGE CUSTOMERS**
Actors	User
Description	• Create new User • Search Customer • Edit customer Details • ON/OFF Customer Status
Trigger	User navigates to the "Customers" page.
Preconditions	User is logged in and authenticated.
Post conditions	Customer Records is successfully added, updated, or viewed with applied filters.
Normal Flow	• User navigates to customers page. • User Add or Update records.
Includes	Search/Filter Customers.

Table 3.3: Use Case 3

USE CASE ID	**UC-03**
USE CASE NAME	**MANAGE BRANDS**
Actors	User
Description	• Add new Brands • Search Brands • Edit/Manage Brands Details • ON/OFF Brands Status
Trigger	User navigates to the "Brands" page.
Preconditions	User is logged in and authenticated.
Post conditions	Brands Records is successfully added, updated, or viewed with applied filters.
Normal Flow	• User navigates to Brands page. • User Add or Update records.
Exceptions	User attempts to add a brand with a name that already exists, the System blocks the creation and displays an error.
Includes	Search/Filter Brands.
Assumptions	N/A
Notes and Issues	N/A

Table 3.4: Use Case 4

USE CASE ID	**UC-04**
USE CASE NAME	**MANAGE EMPLOYEES**
Actors	User
Description	• User Add New Employee • User Assign Designation To the Employee • Search Employee Details • Edit/Manage Employee Details • ON/OFF Brands Status
Trigger	User navigates to the "Employees" page.
Preconditions	User is logged in and authenticated.
Post conditions	An Employee record is successfully created, updated, or its status is modified.
Normal Flow	• User navigates to Employee page. • User Add or Update records.
Alternative Flow	N/A
Assumptions	N/A
Notes and Issues	N/A

Table 3.5: Use Case 5

USE CASE ID	**UC-05**
USE CASE NAME	**MANAGE PRODUCTS**
Actors	User
Description	• User Add New Product • Search Product Details • Edit/Manage Product Details • ON/OFF Brands Status
Trigger	User navigates to the "Products" page.
Preconditions	User is logged in and authenticated.
Post conditions	A Product record is successfully created, updated, or its status is modified in the database.
Normal Flow	• User navigates to Products page. • User Add or Update records.
Assumptions	N/A
Notes and Issues	N/A

Table 3.6: Use Case 6

USE CASE ID	**UC-06**
USE CASE NAME	**MANAGE SALES INVOICES**
Actors	User
Description	• User Generates New Sales Invoice • Search Sales Invoice Details • Track payment • View Details of sales Invoice
Trigger	User navigates to the "Sales Invoices" page.
Preconditions	User is logged in and authenticated.
Post conditions	A new Sales Invoice is successfully created and recorded, Inventory is reduced, delivery log is created and the Ledger is updated.
Normal Flow	• User navigates to Sales Invoices page. • User Add or Update records.
Alternative Flow	N/A
Special Requirement	Inventory must be updated immediately upon invoice finalization (deduction of stock).
Assumptions	N/A
Notes and Issues	N/A

Table 3.7: Use Case 7

USE CASE ID	**UC-07**
USE CASE NAME	**MANAGE PURCHASE INVOICES**
Actors	User
Description	• User Generates New Purchase Invoice • Search Purchase Invoice Details • Track Purchase History • View Details of Purchase Invoice
Trigger	User navigates to the "Purchase Invoices" page.
Preconditions	User is logged in and authenticated.
Post conditions	A new Purchase Entry is successfully recorded, and Inventory stock levels are increased.
Normal Flow	• User navigates to Purchase Invoices page. • User Add or Update records.
Special Requirement	Inventory must be increased immediately upon purchase entry finalization.
Assumptions	N/A
Notes and Issues	N/A

Table 3.8: Use Case 8

USE CASE ID	**UC-08**
USE CASE NAME	**INVENTORY**
Actors	**User**, **System**
Description	• User to monitor current stock levels • Search for Inventory Details • System Update Level • View Details of batch Information • Stock Status
Trigger	User navigates to the "Inventory" page or a stock level changes (System).
Preconditions	User is logged in and authenticated.
Post conditions	N/A
Normal Flow	• User requests the Inventory page. • System retrieves real-time stock levels, batch details, and calculated inventory value. Data is displayed to the User.
Alternative Flow	N/A
Includes	N/A
Special Requirement	Inventory updates must be real-time as they are linked to core UC-06 (Sales) and UC-07 (Purchase).
Assumptions	N/A
Notes and Issues	N/A

Table 3.9: Use Case 9

USE CASE ID	**UC-09**
USE CASE NAME	**LEDGER**
Actors	User, System
Description	• User to review all historical financial transactions (sales, purchases, expenses) • System maintains the ledger • System stores daily snapshots • Provides filtering • Export capabilities for analysis
Trigger	• User navigates to the "Ledger" page. • A new/update record happened in sales, purchases and expenses.
Preconditions	User is logged in and authenticated.
Post conditions	Ledger data and summaries, filtered by user criteria, are successfully displayed OR the data is exported.
Normal Flow	• User navigates the Ledger page. • System aggregates and retrieves the requested financial transactions from the database. System renders the transaction list and calculates financial summaries (e.g., total income, total expenses). User reviews the data.
Alternative Flow	N/A
Includes	N/A
Special Requirement	• Ledger must be tamper-proof, with automated daily snapshots managed by the System.

	• A Sync button to sync records in case something is missing.

Table 3.10: Use Case 10

USE CASE ID	**UC-010**
USE CASE NAME	**REPORTS**
Actors	User, System
Description	• User to access and analyze various detailed business reports (such as Sales by Customer, Product and Brands). • System aggregates data, generates the reports, displays them
Trigger	User navigates to the "Reports" section.
Preconditions	User is logged in and authenticated.
Post conditions	N/A
Normal Flow	• User navigates to Reports page. • User Add or Update records.
Alternative Flow	User selects the "Export" button; the System compiles the displayed data into a file (e.g., Excel/PDF) for download.
Exceptions	N/A
Includes	N/A
Special Requirement	Reports must be secure and strictly adhere to the User's multi-tenancy access rules.
Assumptions	N/A
Notes and Issues	N/A

Table 3.11: Use Case 11

USE CASE ID	**UC-11**
USE CASE NAME	**MANAGE EXPENSES**
Actors	User
Description	1. Add new Expenses 2. Search Expenses 3. Edit/Manage Expense Details 4. ON/OFF Expense Status
Trigger	User navigates to the "Expenses" page.
Preconditions	User is logged in and authenticated.
Post conditions	A new Expense record is successfully created, the Ledger is updated, and the expense is available for reporting.
Normal Flow	• User navigates to Expenses page. • User Add or Update records.
Alternative Flow	N/A
Exceptions	N/A
Includes	N/A
Special Requirement	N/A
Assumptions	N/A
Notes and Issues	N/A

CHAPTER 4

DATA AND EXPERIMENTS (and/or IMPLMENTATION)

4.1 Frontend

The frontend of DoseLogix is developed using Next.js [9], a modern framework of React. The primary software used for development is visual studio code [10].

The general aim of DoseLogix frontend to provide a user friendly, responsive experience and majorly for distributors who are not tech anthusiast. All the screens are carefully designed, keeping in mind about the targeted audience. The interface is designed using professional UI principles, using modular structures and dialog based forms. Toast is used to update users about the completion or failure of task.

The application on start opens a login page, asking the user to log in as shown in Figure 4.1. This system only allow authenticated users to enter their dedicated profile and access their data.

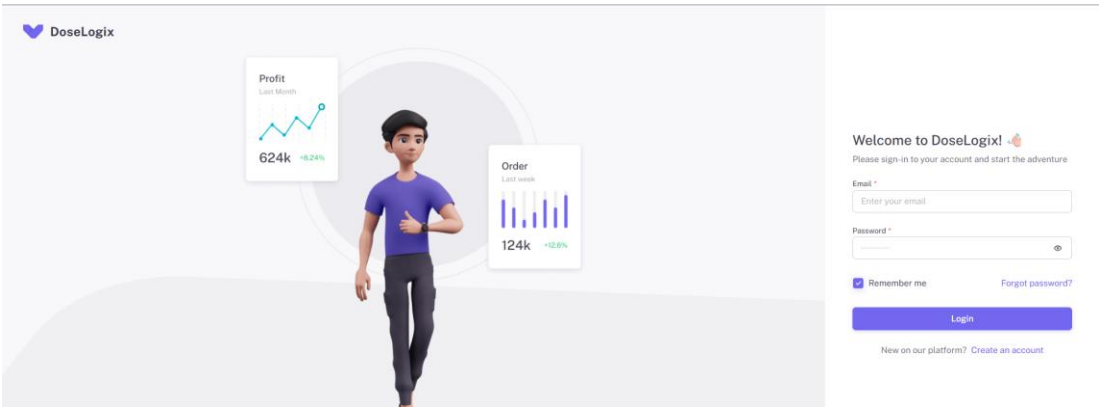


Figure 4.1: Login Screen

Once logged in, the users are presented with dashboard and quick vertical side bar menu for navigation as shown in Figure 4.2.

The side bar menu is consisted of multiple modules listed in the following bullets.

- Customer management
- Brands management
- Employees management
- Products management
- Purchase invoices
- Sales invoices
- Inventory tracking
- Reports
- Delivery logs
- Expenses management
- Ledger and basic finance tracking

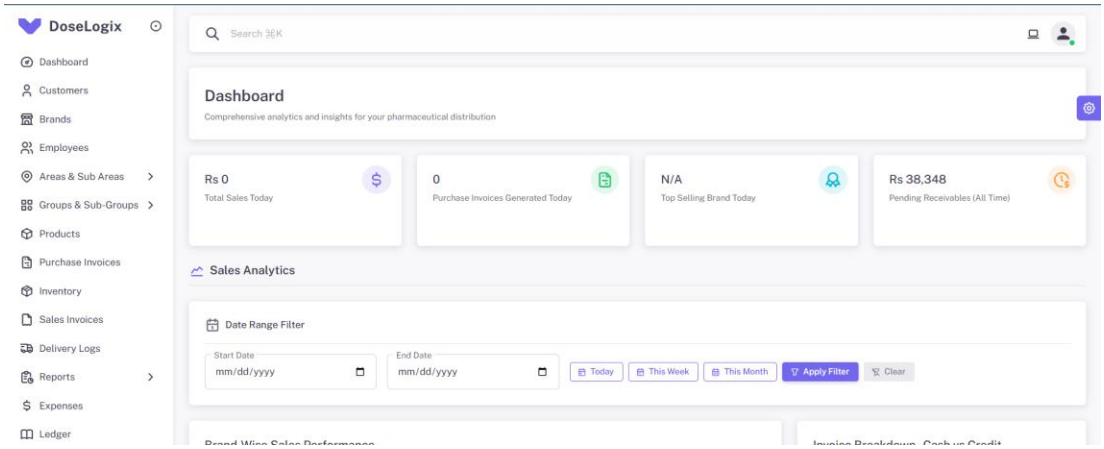


Figure 4.2: Dashboard and Navigation

The side bar menu ensures that the user can navigate anywhere quickly.

The records listing of components like registered customer, brands, employees, products, inventory and invoices, all of these are implemented in a tabular layouts with

filters and consistency throughout the application. There is a notification through e-mail system that notifies users with low stock, expiry of medicines and OTPs for account registration and forgot password.

The invoice generation screens are designed in a way, its easy for use and provides a reactive response experience. It has seamless creation, editing and viewing of invoices. The sales invoice screen is shown in Figure 4.3.

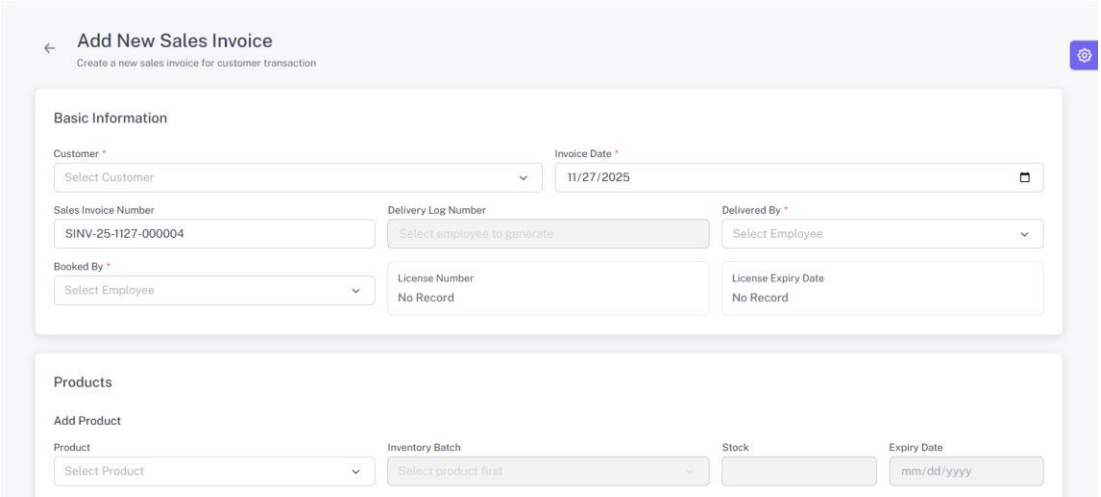


Figure 4.3: Sales Invoice Screen

Key UI features include:

- Searchable product dropdowns
- Automatic and intelligent batch selection
- Last three sales of the selected products
- Auto-calculation of bonuses, discounts
- Dynamic invoice rows
- Running totals and grand totals
- Customer credit display

Once saved, invoices can be previewed or printed.

The system automatically aggregates data into certain pages and show to distrbutors, such as Ledger, Inventory, Reports and Delivery Logs. Ledger show all

the in-out cash flows. Inventory is to track the stock of each medicine respective to their batches. Reports are to check the sales of products, customers remaining balances and brands remaining balances. Delivery logs are to track deliveries that are assigned against employees, shows all invoices and their respective data in delivery logs.

4.1.1 Highlighting Features

The key highlighting features that make our project more user-friendly and shine from the rest of other solutions are Latest Health news, Demand forecasting, old prices of medicines, Last invoice details, a below minimum sale price check, intelligent batch slection, User-interactive UI of dashboard analytics and export options.

4.1.1.1 Latest Health Related News

The project has introduced novelty in PDMS industry with incorporating latest health related news in DoseLogix. The reason for this is keeping distributors updated from our end, so that they might keep up with their stock requirements on emerging needs of specific medicines. For example, usually in December and January flu might spread exponentially. The Latest health news representation is shown in Figure 4.4.

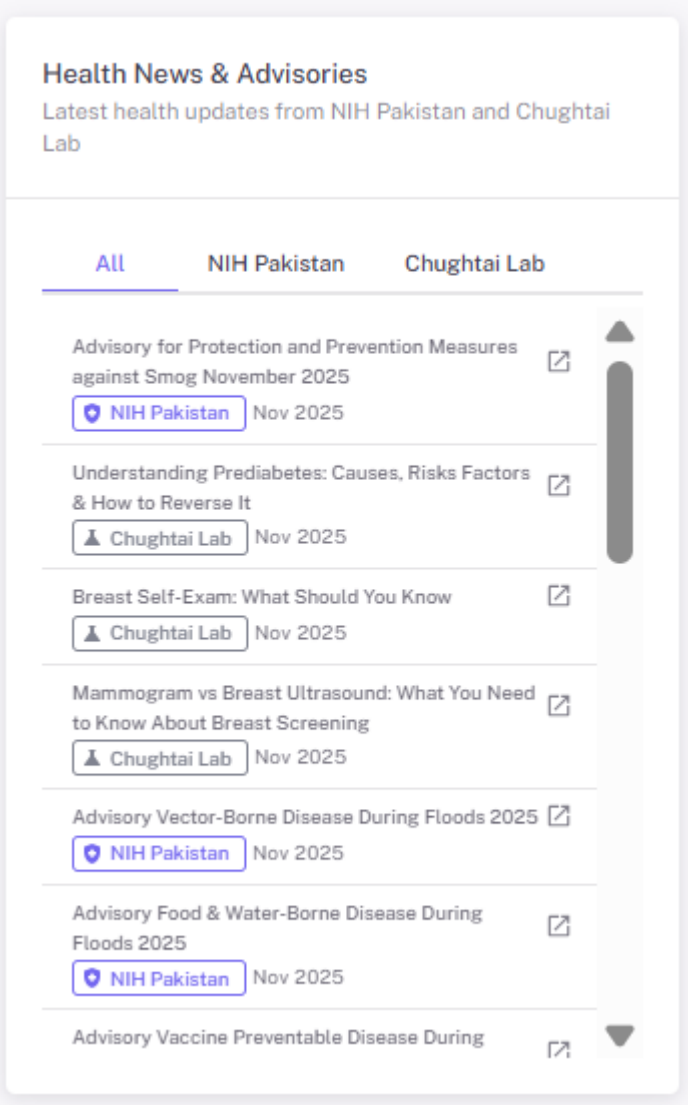


Figure 4.4: Latest Health News for emerging needs

4.1.1.2 Demand Forecasting

Another novelty of our project is Demand Forecasting. Most of the existing solutions have AI integrated but for tasks like customers or brands insights and Microsoft's Copilot integration. But none of the softwares to our knowledge has demand forecasting implemented in it. Our solution provides AI based predictive analysis for Demand forecasting. The prediction for demand forecasting can be seen in Figure 4.5.

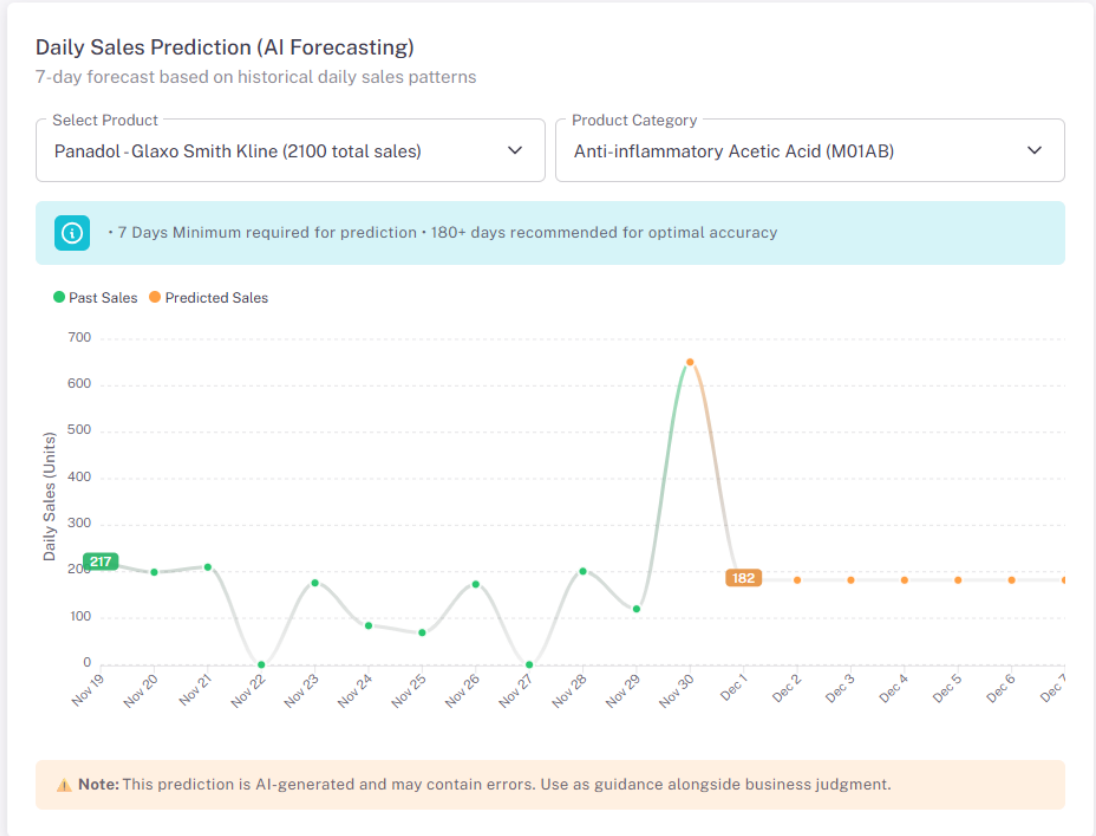


Figure 4.5: Next 7 Days Sales Prediction of selected medicines

4.1.1.3 Last Invoice Details

Another highlighting feature of DoseLogix, we show the distributors the last invoice number and last invoice price, so that the distributor can see the loyalty of customers according to their last order. The last invoice number and last invoice price are shown in Figure 4.6.

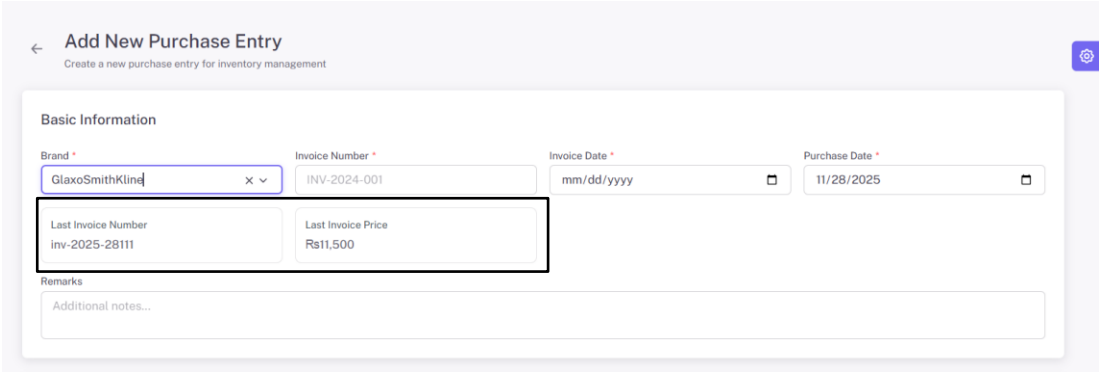


Figure 4.6: Last Invoice Details

4.1.1.4 Old Prices of Medicines

While creating sales invoices, when selecting a product, the distributors faced an issue where they need to open another extra tab to overlook the last prices of selected medicines to this specific customers, so that they can offer selective prices to the customers. We have addresses this issue and highlights the last three prices of selected medicines to this specific customer. We can see that in Figure 4.7.

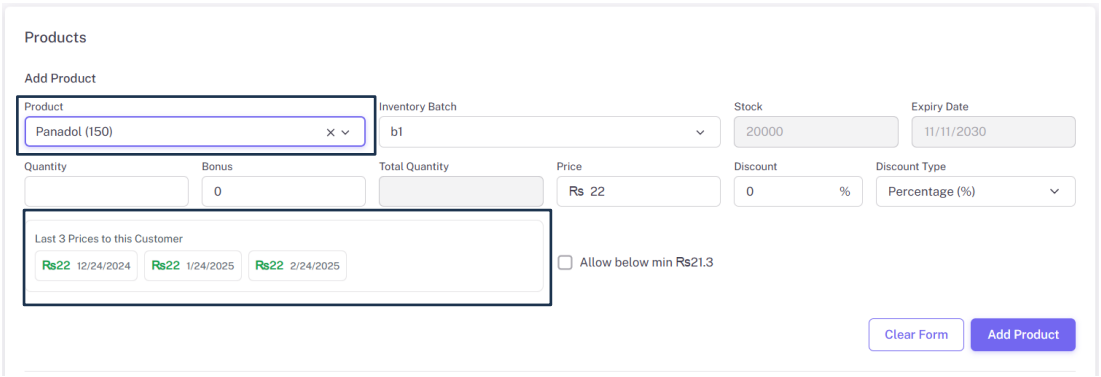


Figure 4.7: Old Prices of Selected Medicines

4.1.1.5 Below Minimum Sale Price

Another highlight feature is that our project allow users to set a Minimum Sale Price threshold while saving purchase invoice. This threshold is set on run time by distributors to keep a safe profit or sale at no profit to customers. Distributors sale products below minimum price on some internal factors such as the product has been in inventory for a long time and the distributor wants to sell it to clear up inventory and storage area. The functionality of the sale below minimum price is shown in Figure 4.8 and 4.9.

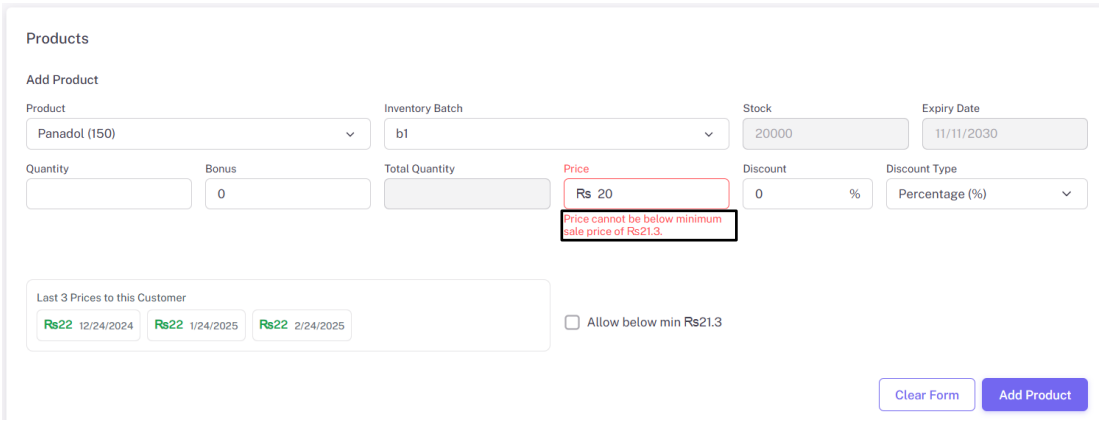


Figure 4.8: Sale price below Min Sale Price UnChecked

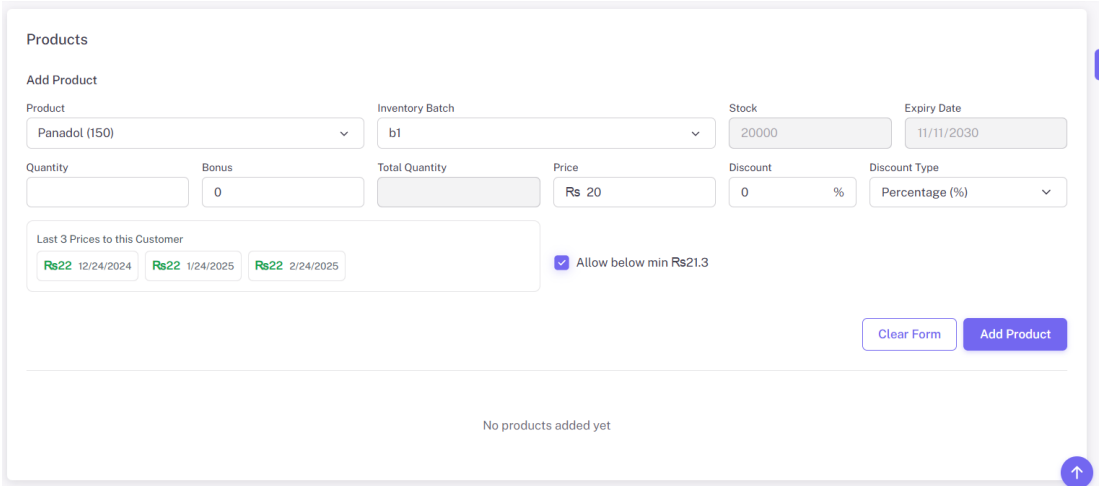


Figure 4.9: Sale price below Min Sale Price Checked

4.1.1.6 Intelligent Batch selection

In sales invoices, the inventory batches are selected automatically. The intelligent workflow of project allows the auto batch selection in FIRST EXPIRY FIRST OUT (FEFO) order. So the batch with first expiry of selected medicine is automatically selected. However, the user can override this functionality for obvious reasons, by changing the selected batch.

4.1.1.7 Dashboard Analytics

The dashboard of DoseLogix is specially designed with a user interactive and user friendly UI/UX experience which gives the user quick access to features such as Brands-wise Sales Performance, Invoice Breakdown - Cash vs Credit, Top Selling Products, Area-wise Sales Distribution, Recievables Aging Analysis, Inventory Alerts, Sales Prediction and Health Related News.

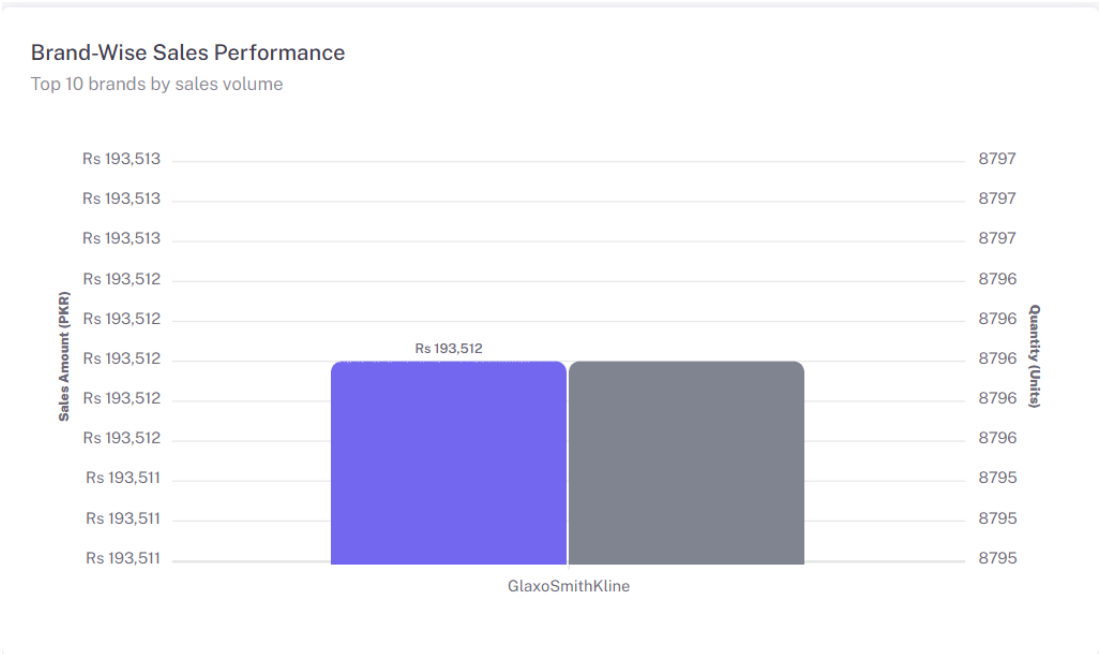


Figure 4.10: Brand-wise Sales performances of Distributors

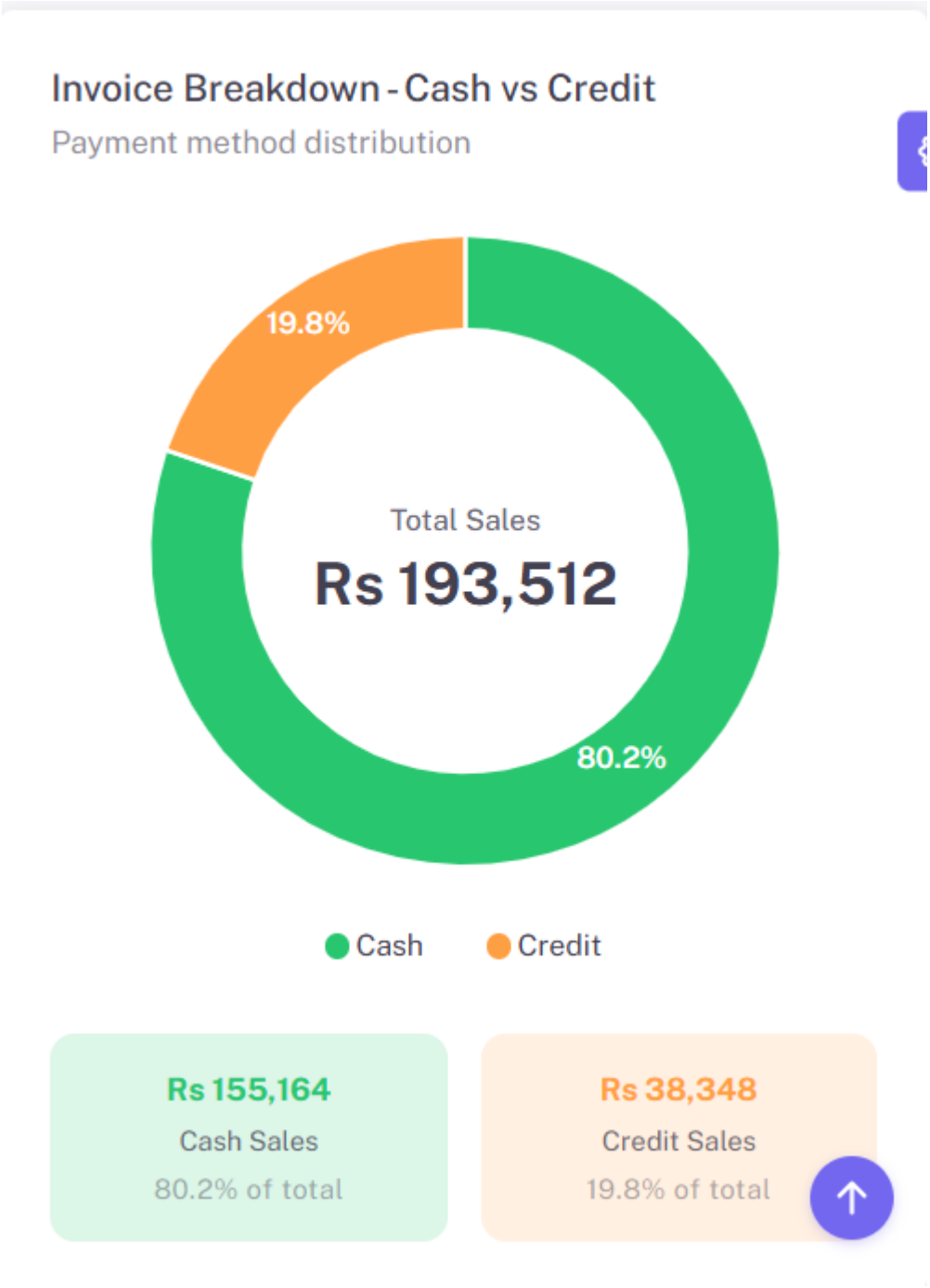


Figure 4.11: Cash vs Credit Invoice Breakdown

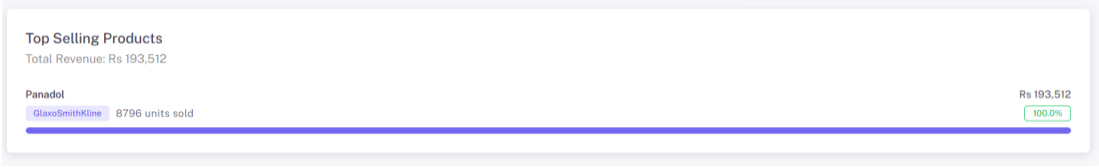


Figure 4.12: Top Selling Products

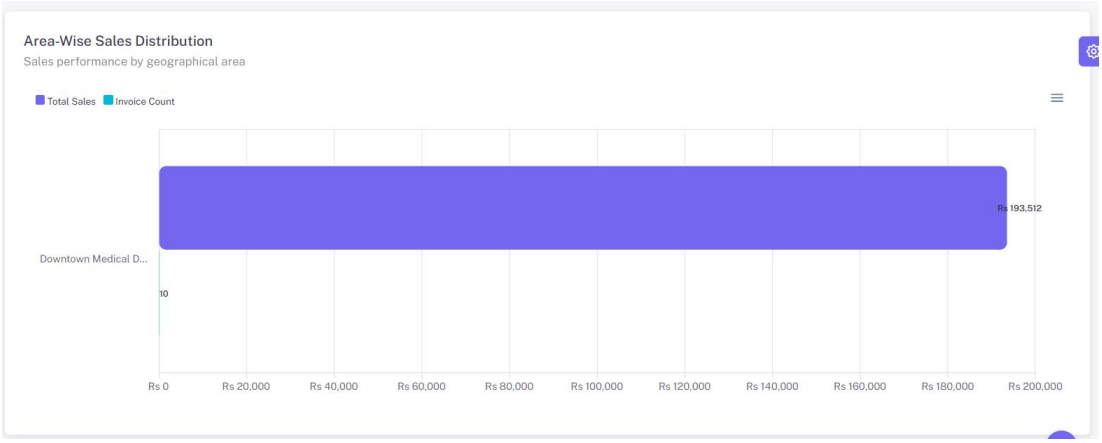


Figure 4.13: Area wise Sales of Distributors

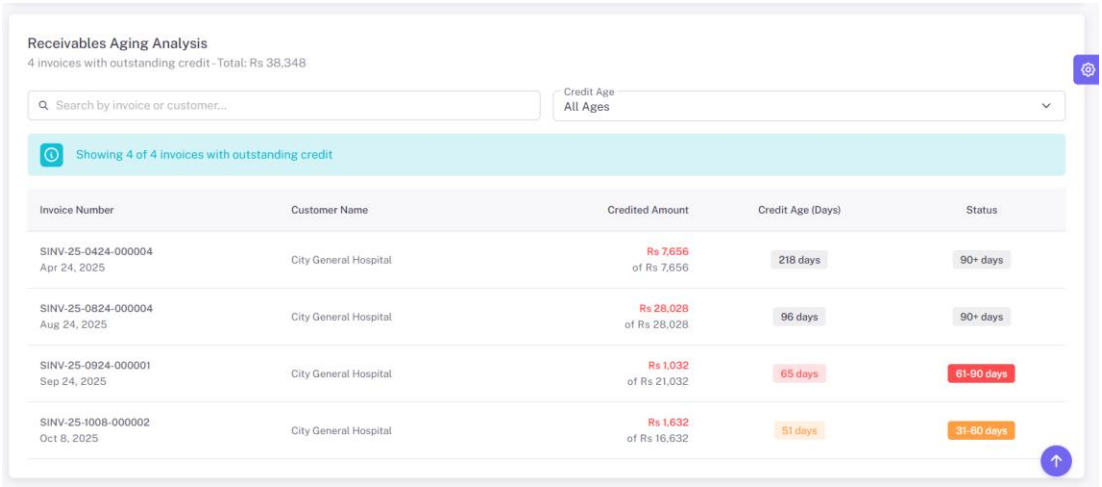


Figure 4.14: Age of Recievables Analysis

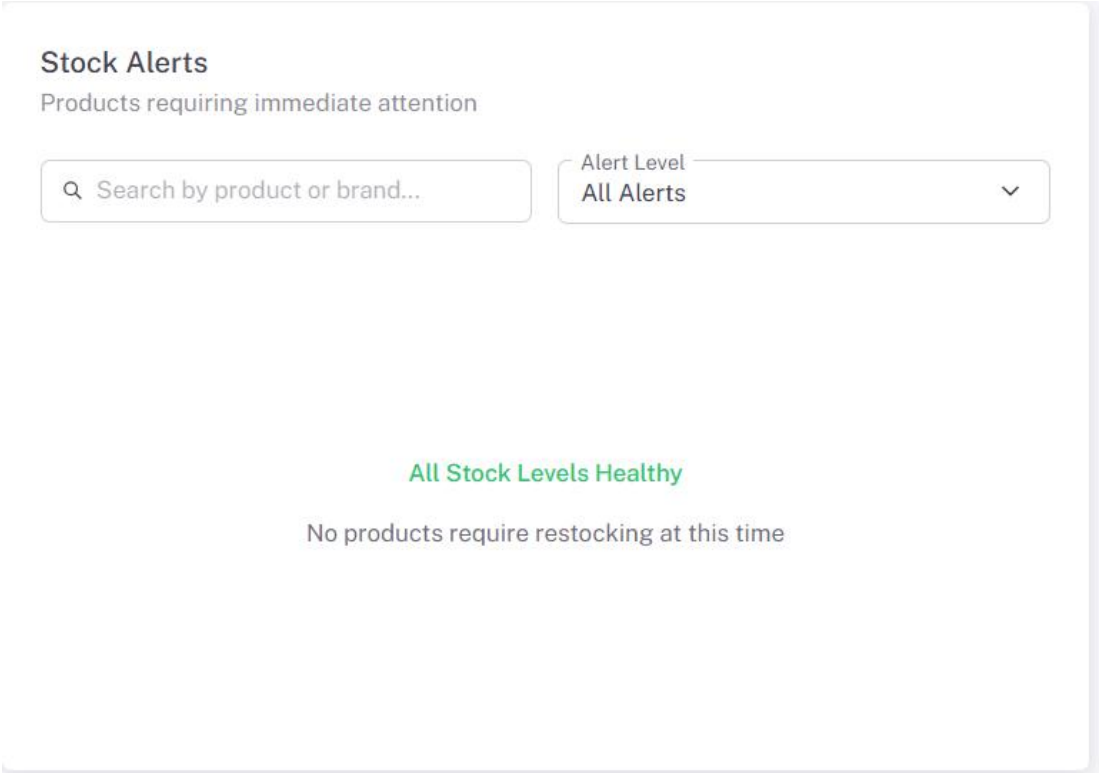


Figure 4.15: Stock Alerts of medicines

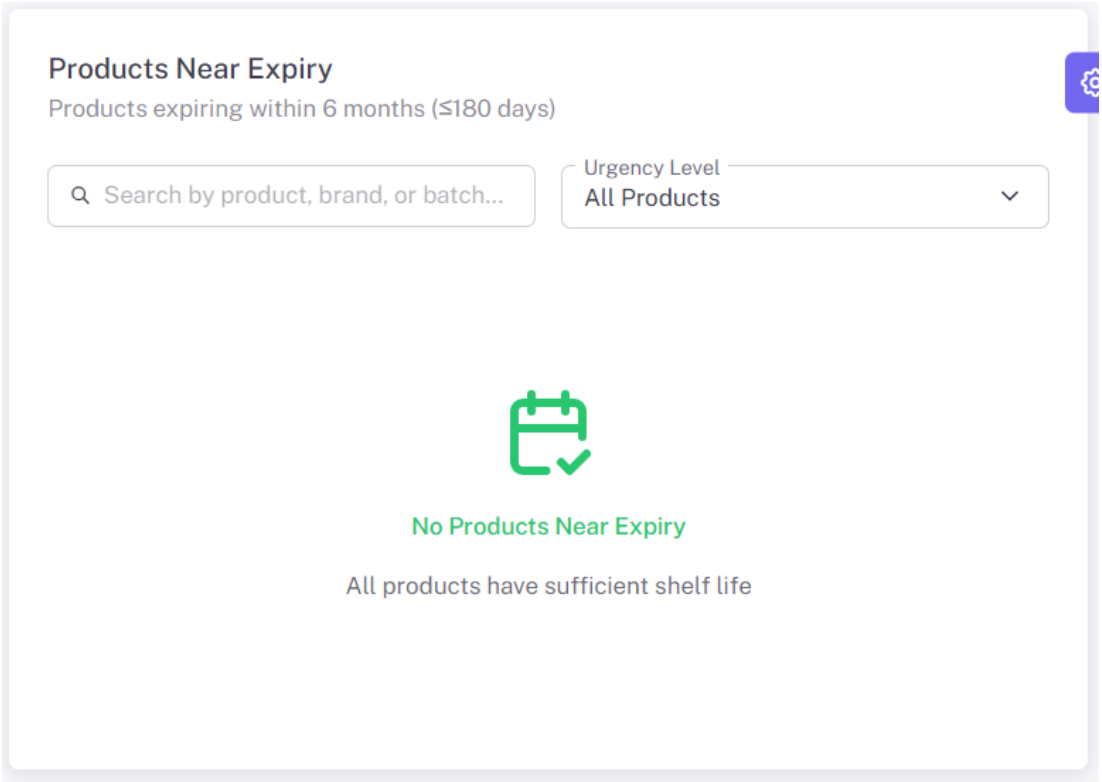


Figure 4.16: Expiry status of medicines

4.2 Backend

The backend has two parts. One is where we have the backend for Node js server and the other is where we have python backend server.

4.2.1 NodeJs Server

The backend server for the business logic is designed in NodeJs [11] with ExpressJs [12] framework. MongoDB [13] is used for the database management. MongoDB Atlas [14] is used as a primary cloud database storage. The backend is responsible for authentication/authorization, API endpoints, data consistency and pathway to connect Pyhton server.

4.2.1.1 Project Structure

The NodeJs server is developed by following market structure for a modular and scalable approach. This approach can help to maintain and scale the application for future advancements. The directory structure can be seen in the Figure 4.17.

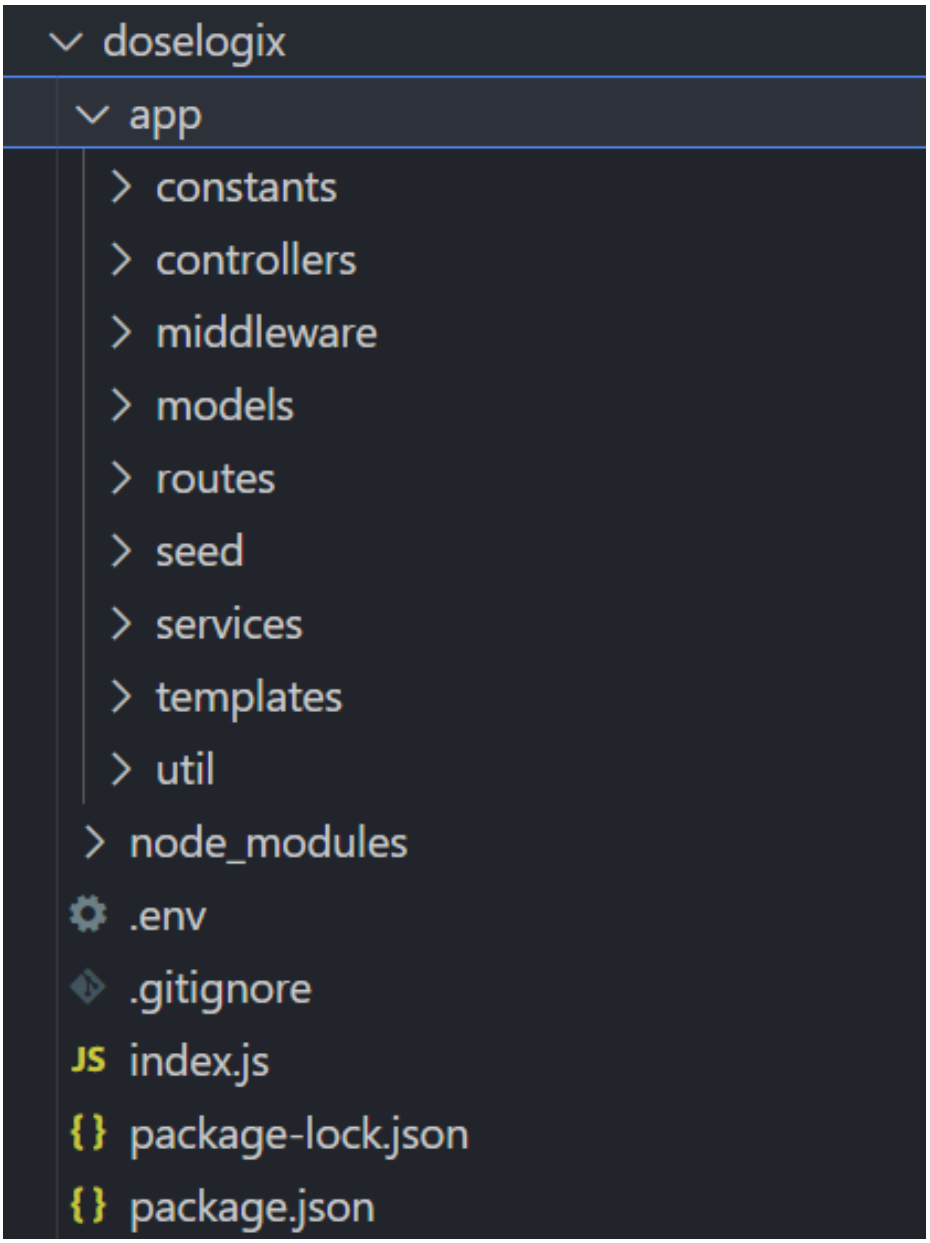
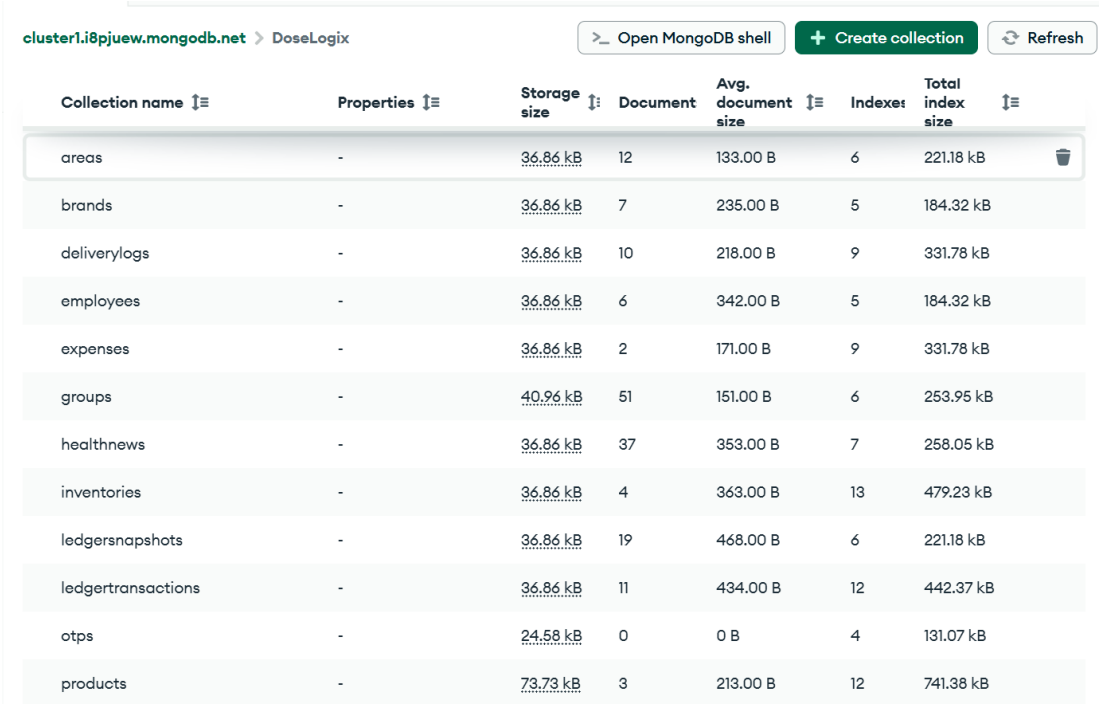


Figure 4.17: Node.js Project Structure

Here each folder follows their respective tasks and functionalities. This separation enables the unit testing easy and clear ownership of functionality. This makes the debugging and bugs resolving much easier.

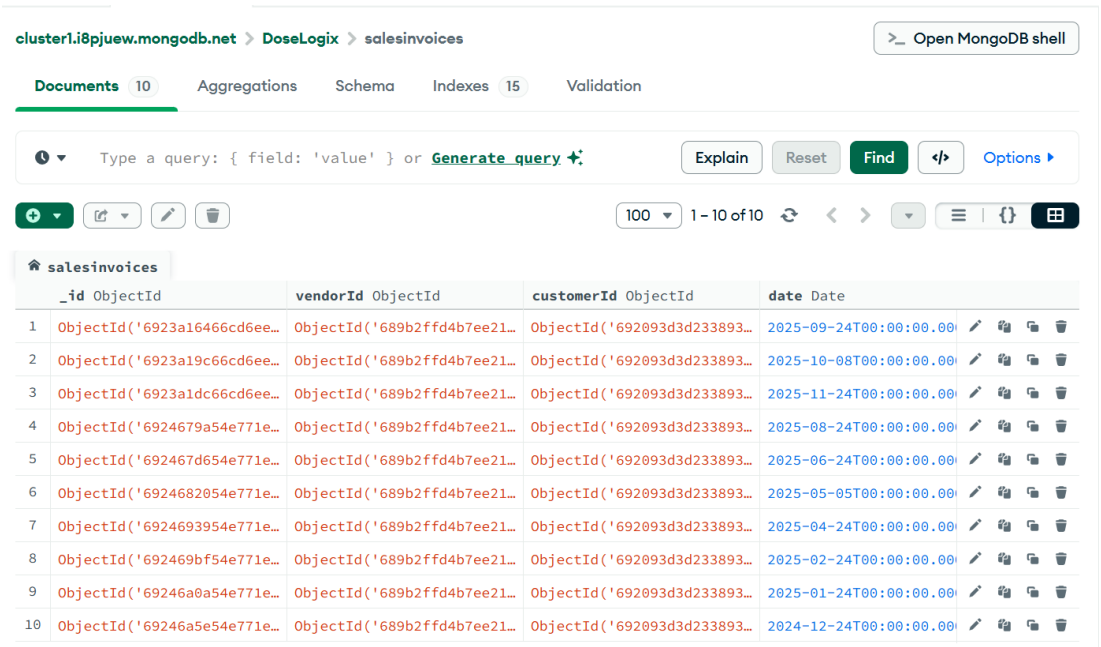
4.2.1.2 MongoDB Atlas

The data is stored in JSON format in MongoDB Atlas. Indexing has also been implemented to fasten up the query results.



Collection name	Properties	Storage size	Document	Avg. document size	Indexes	Total index size
areas	-	36.86 kB	12	133.00 B	6	221.18 kB
brands	-	36.86 kB	7	235.00 B	5	184.32 kB
deliverylogs	-	36.86 kB	10	218.00 B	9	331.78 kB
employees	-	36.86 kB	6	342.00 B	5	184.32 kB
expenses	-	36.86 kB	2	171.00 B	9	331.78 kB
groups	-	40.96 kB	51	151.00 B	6	253.95 kB
healthnews	-	36.86 kB	37	353.00 B	7	258.05 kB
inventories	-	36.86 kB	4	363.00 B	13	479.23 kB
ledgersnapshots	-	36.86 kB	19	468.00 B	6	221.18 kB
ledgertransactions	-	36.86 kB	11	434.00 B	12	442.37 kB
otps	-	24.58 kB	0	0 B	4	131.07 kB
products	-	73.73 kB	3	213.00 B	12	741.38 kB

Figure 4.18: Collections in Database



	_id ObjectId	vendorId ObjectId	customerId ObjectId	date Date
1	ObjectId('6923a16466cd6ee…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-09-24T00:00:00.00
2	ObjectId('6923a19c66cd6ee…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-10-08T00:00:00.00
3	ObjectId('6923a1dc66cd6ee…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-11-24T00:00:00.00
4	ObjectId('6924679a54e771e…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-08-24T00:00:00.00
5	ObjectId('692467d654e771e…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-06-24T00:00:00.00
6	ObjectId('6924682054e771e…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-05-05T00:00:00.00
7	ObjectId('6924693954e771e…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-04-24T00:00:00.00
8	ObjectId('692469bf54e771e…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-02-24T00:00:00.00
9	ObjectId('69246a0a54e771e…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2025-01-24T00:00:00.00
10	ObjectId('69246a5e54e771e…	ObjectId('689b2ffd4b7ee21…	ObjectId('692093d3d233893…	2024-12-24T00:00:00.00

Figure 4.19: Records of Sales Invoices

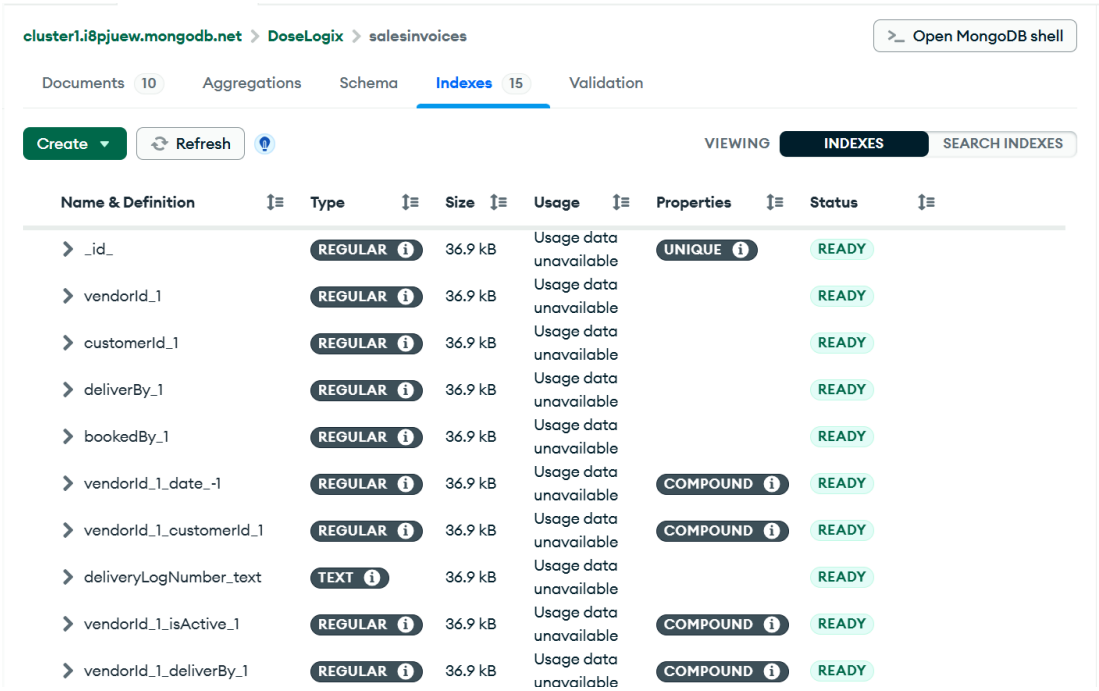


Figure 4.20: Indexes of Sales Invoices

4.2.1.3 Authorization and Authentication

The login/signup is secured by bycrypt [15] for hashing the password. And JWT [16] is used for session tokens. The middleware ensures multi-tenancy that only authenticated users can access tenant-specific data.

4.2.1.4 Background Jobs & Scheduling

The backend hold scheduled job that ensures the backup of reccurent tasks. In backend we have created a cron jobs using node-cron [17] to run a scheduled job that calls an external Python service to fetch health news and upserts it into MongoDB and to create daily snapshots for vendors to overview their ledger.

4.2.1.5 Testing & API Verification

Postman known for API testing has been used while creating and tracking API requests and responses. These tests helped ensuring the consistency of data flow between REST APIs. The flowchart is shown in Figure 4.21.

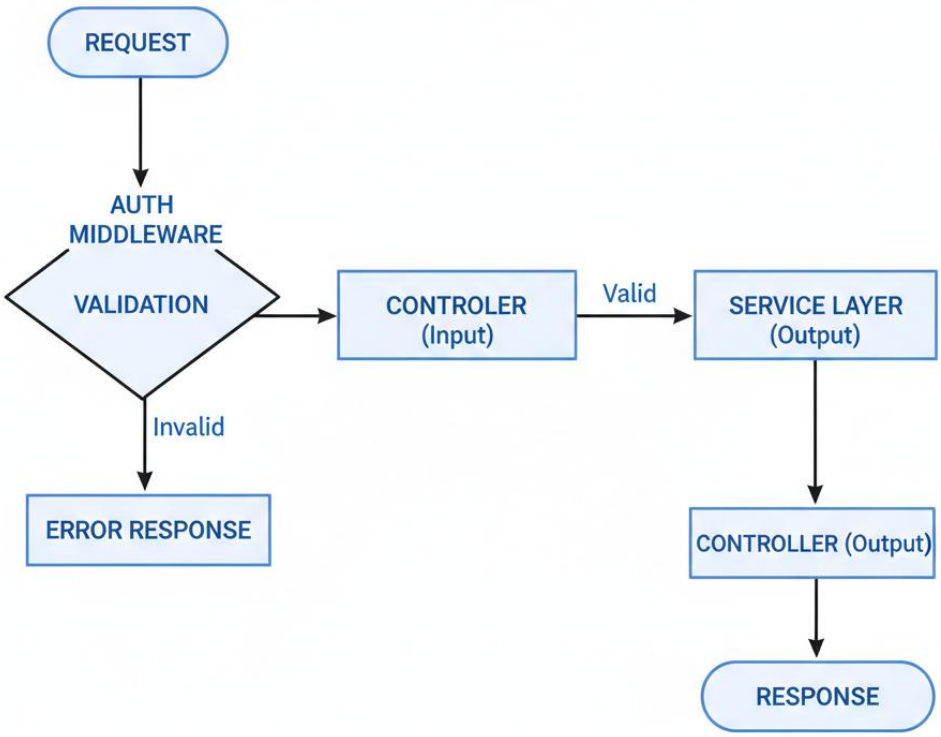


Figure 4.21: Flow Chart of Backend

4.2.2 Python Server

The pyhton micro-service in this projectis used for two purposes. One is the web scraper that scrape latest new from NIH Pakistan and Chugtai Lab's official website. The other is forecasting of coming days sales data.

4.2.2.1 Demand Forecasting

The pyhton micro-service is also responsible for predicting values on past daily sales. If the data for prediction is less than 30 days. It would predict moving average of the available data. If the data records are more than 30 than we will have the pickle file to predict upcoming sales for 7 days.

As the dataset we have used is contains 8 categories of medicines. Each category describes their fundamentals. The categories are listed below.

- M01AB - Anti-inflammatory and antirheumatic products, non-steroids, Acetic acid derivatives and related substances
- M01AE - Anti-inflammatory and antirheumatic products, non-steroids, Propionic acid derivatives
- N02BA - Other analgesics and antipyretics, Salicylic acid and derivatives
- N02BE/B - Other analgesics and antipyretics, Pyrazolones and Anilides
- N05B - Psycholeptics drugs, Anxiolytic drugs
- N05C - Psycholeptics drugs, Hypnotics and sedatives drugs
- R03 - Drugs for obstructive airway diseases
- R06 - Antihistamines for systemic use

We have separated each category and trained models on each of them separately.

4.2.2.1.1 Models Selection

For the training of demand forecasting for upcoming sales, we used different models to train on our dataset and evaluated their performance. The models we used are Linear Regression (LR), Random Forest (RF), XGBoost, LSTM, Prophet and SARIMA. The evaluation metrices used are MAE, MSE and RMSE.

We ran the all the models and evaluated their performance, and came to an ultimatum picking best performing models on each category and discarding others. The best performing models on each category are listed in the Table 4.1.

Table 4.1: Best Performing Models in Each Category

Category	Model Type	MAE	MSE	RMSE
M01AB	LR	1.922236	5.974565	2.444292
M01AE	LR	1.382081	3.138336	1.771535
N02BA	LR	1.385464	3.207793	1.791031
N02BE	RF	8.155147	115.626387	10.752971
N05B	XGBoost	2.871582	13.168474	3.628839
N05C	LR	0.752474	0.991992	0.995988
R03	LR	5.200283	49.284202	7.020271
R06	LR	1.411158	3.522264	1.876770

4.2.2.2 Latest Health News Scraper

Both of these mentioned websites are scraped through custom scripts. When the python server runs, it automatically run the custom scritps to fetch latest news and details.

The Chugtai Lab's script scrape the available latest news. The scraped data is source, dates, titles and links [18]. The NIH Pakistan's script also scrapes the available latest news. The scraped data here is also source, dates, titles and links [19].

The scraped data from both of these websites are standardized in one generalized structure and then is sent to NodeJs backend, where we save the data in the database. When the python server runs for the first time, it scrapes the data from these sites. But NodeJs server also has a cron job that hits an HTTP request to the python server. The python server runs the script and scrapes the data. The scraped data is then sent to the NodeJs server.

CHAPTER 5

User Manual

5.1 Login Page

Allows users to sign in using their email and password. Integrates with backend authentication and displays error messages for invalid credentials.

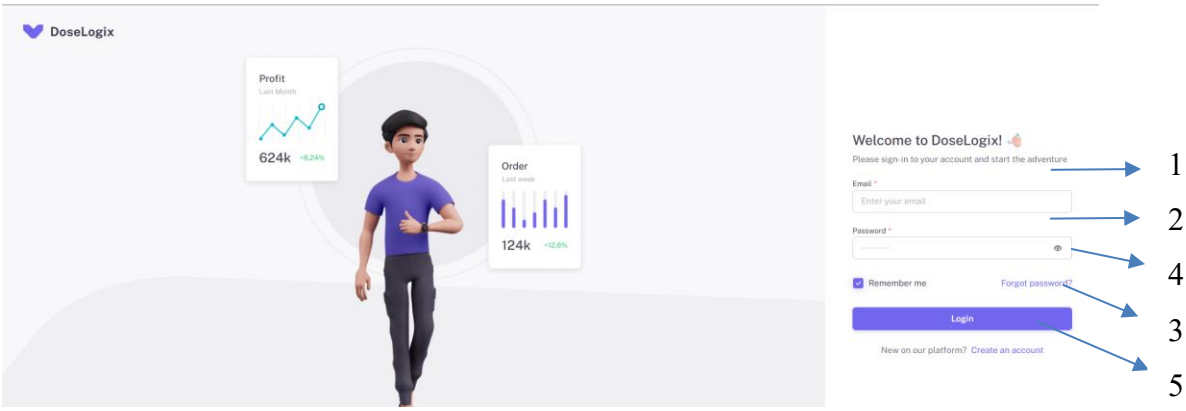


Figure 5.1: Login Page

1. Enter Email
2. Enter Password
3. Sign-in Button To Login
4. Click If You Forgot Password
5. Click If You Are a New User

5.2 Signup Page

Enables new users (vendors) to create an account by providing business and contact details. Validates required fields and password strength

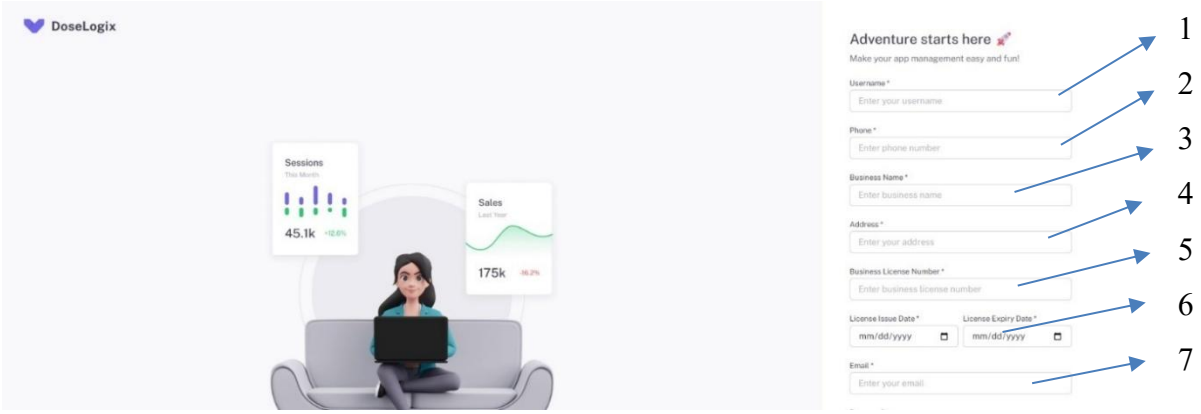


Figure 5.2: Signup Page

1. Enter Your Username
2. Enter You Valid Phone
3. Enter a Bussiness Name
4. Enter Adress
5. Enter Licence Name
6. Select Date
7. Enter valid Email

5.3 Forget Password Page

Lets users request a password reset link by entering their registered email. Sends instructions to email if the account exists.

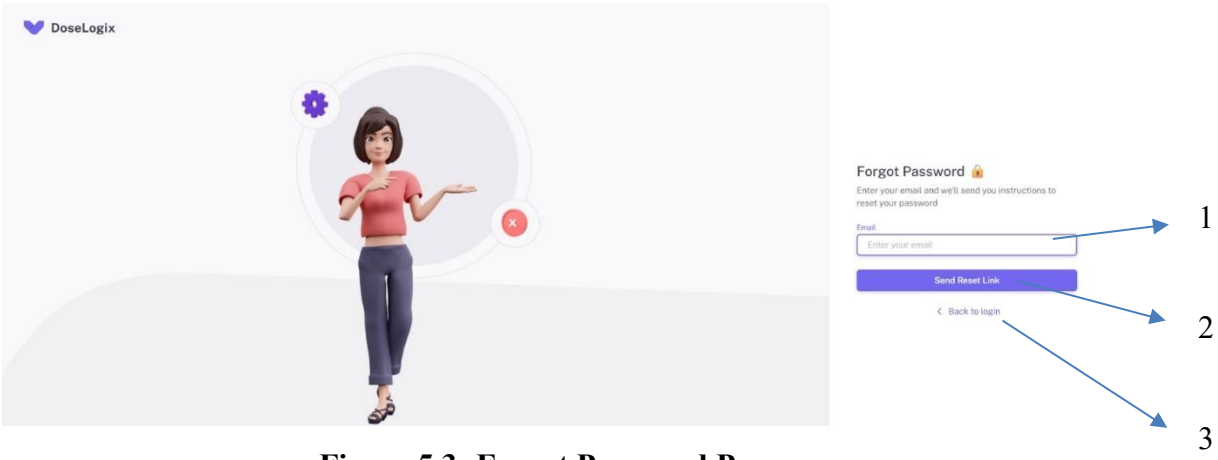


Figure 5.3: Forgot Password Page

1. Enter your Email
2. Submit Button
3. Return to Login Page

5.4 Dashboard Page

Main landing page after login. Shows business KPIs, summary cards, charts, and quick links to key modules.

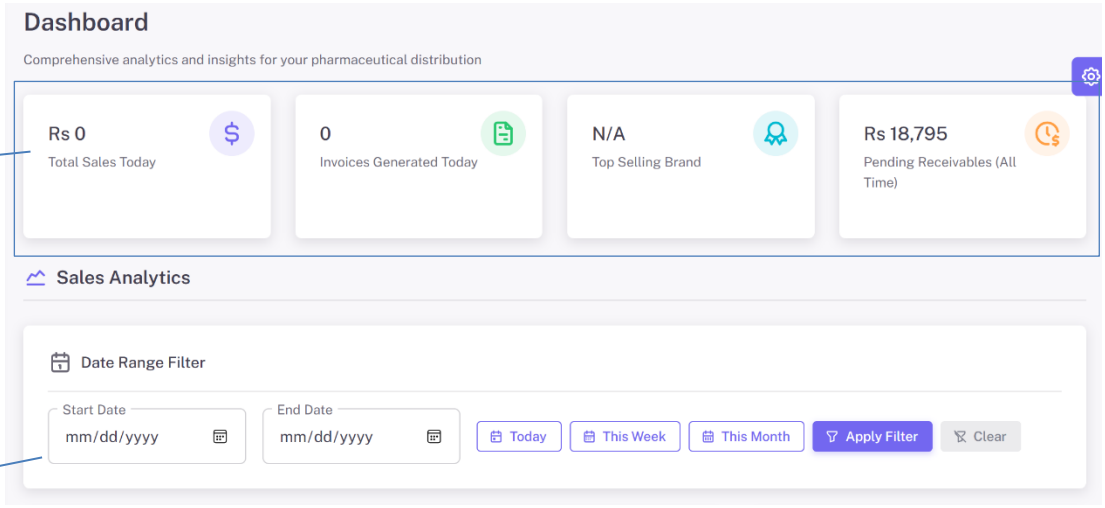


Figure 5.4: Dashboard Page 1

1. Summary Cards
2. Date Range Filter

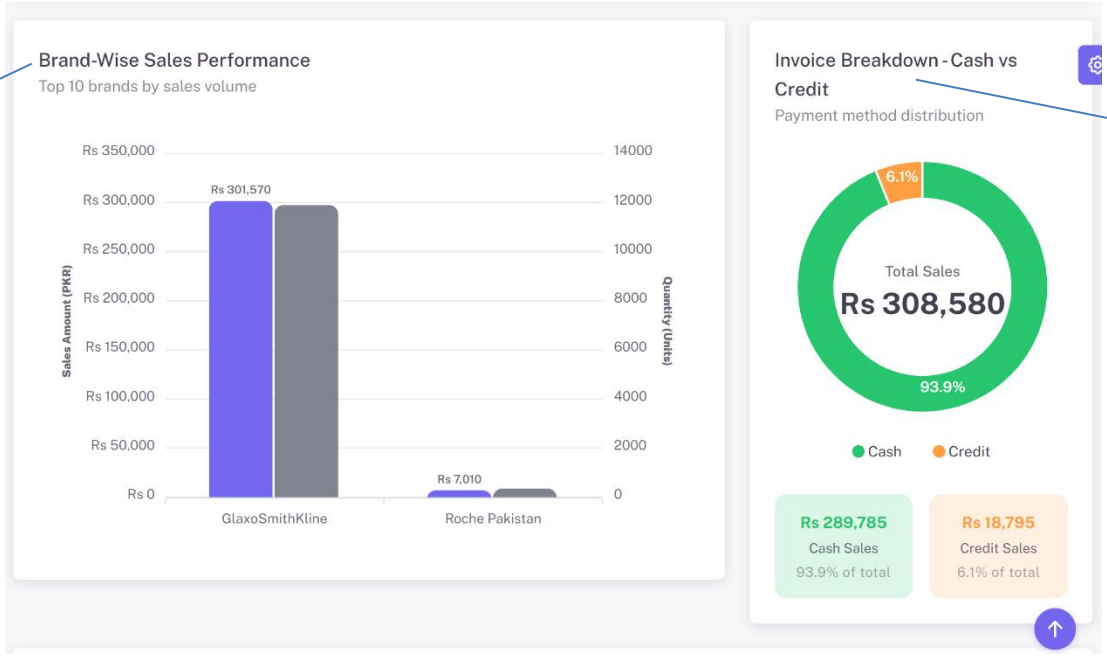


Figure 5.5: Dashboard Page 2

3. Brand Wise Perfomance
4. Invoice Breakdown Cash VS Credit

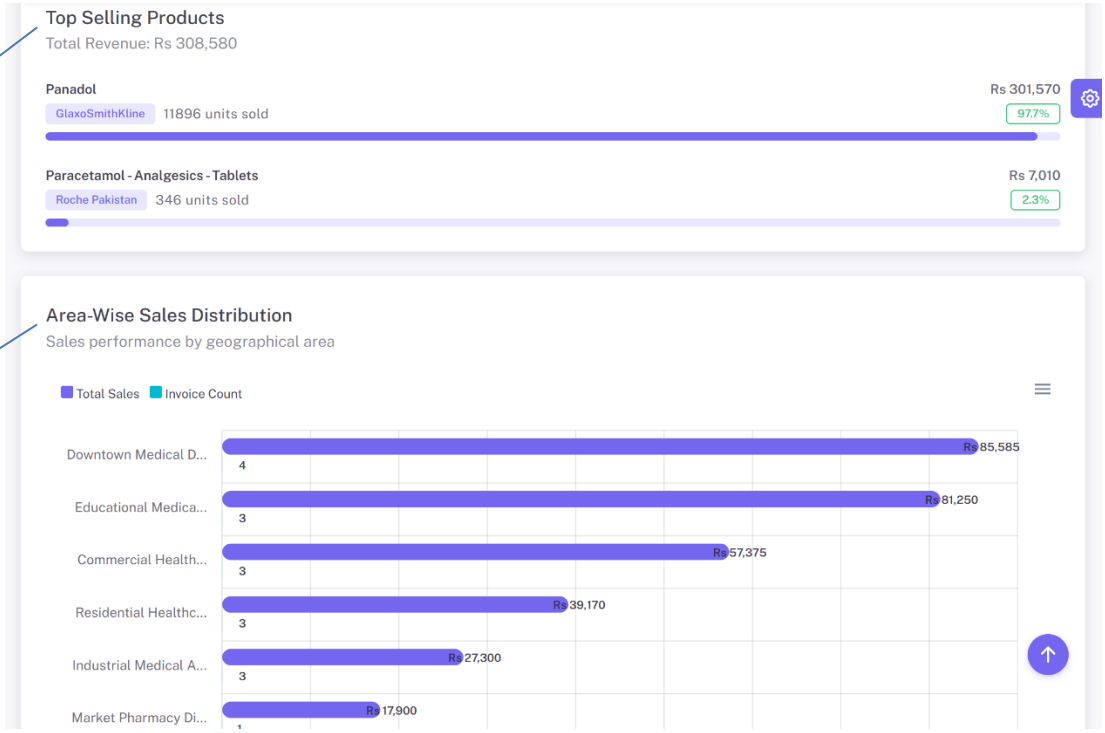


Figure 5.6: Dashboard Page 3

5. Top Selling Product
6. Area Wise Sales Distribution

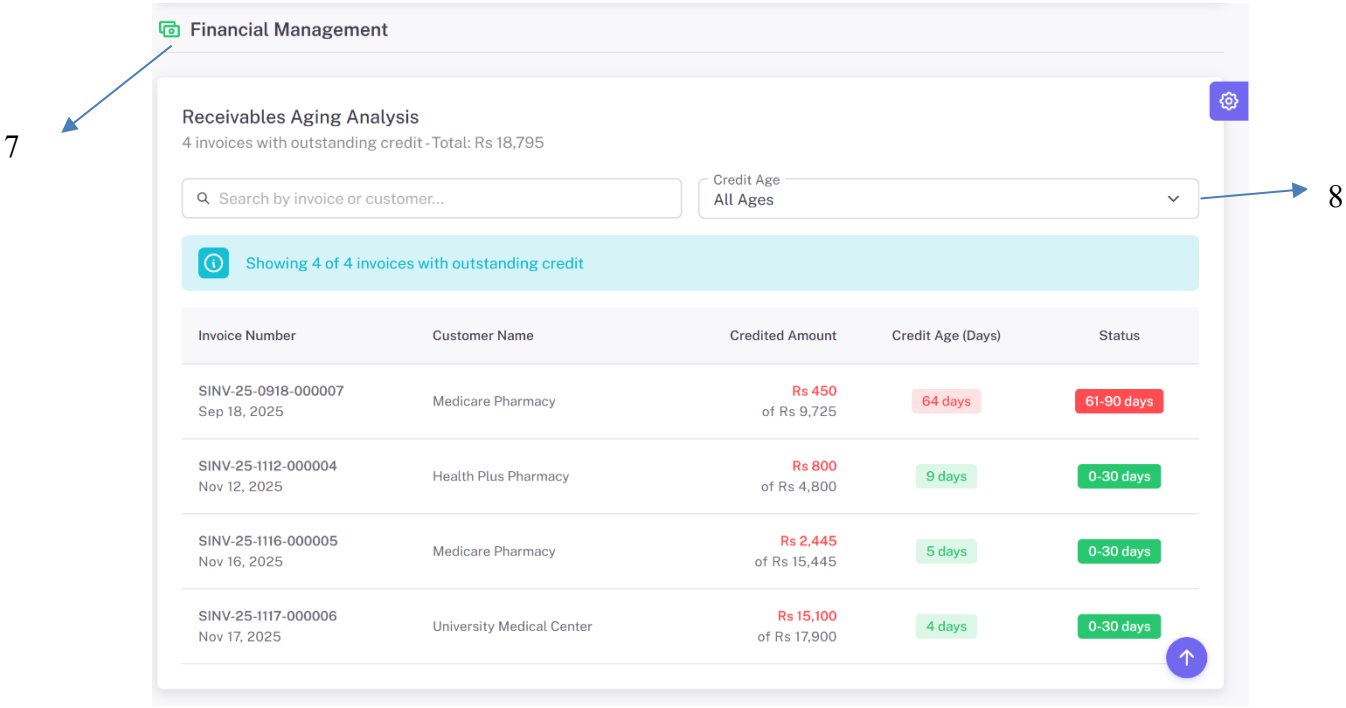


Figure 5.7: Dashboard Page 3

7. Finanacial Management
8. Credit Age Filter (Days)

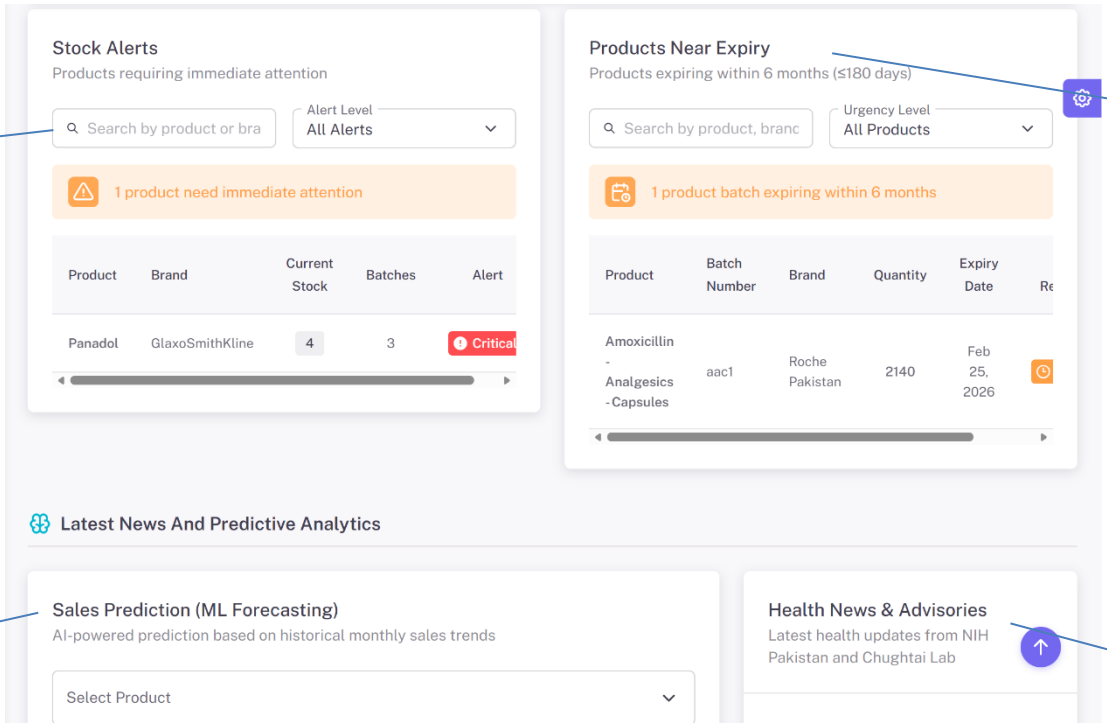


Figure 5.8: Dashboard Page 4

9. Stock Alerts
10. Products Near Expiry
11. Sales Prediction (ML Forecasting)
12. Health News & Advisories

5.5 Theme Customizer

Change Accent color, theme of application, skin and layouts.

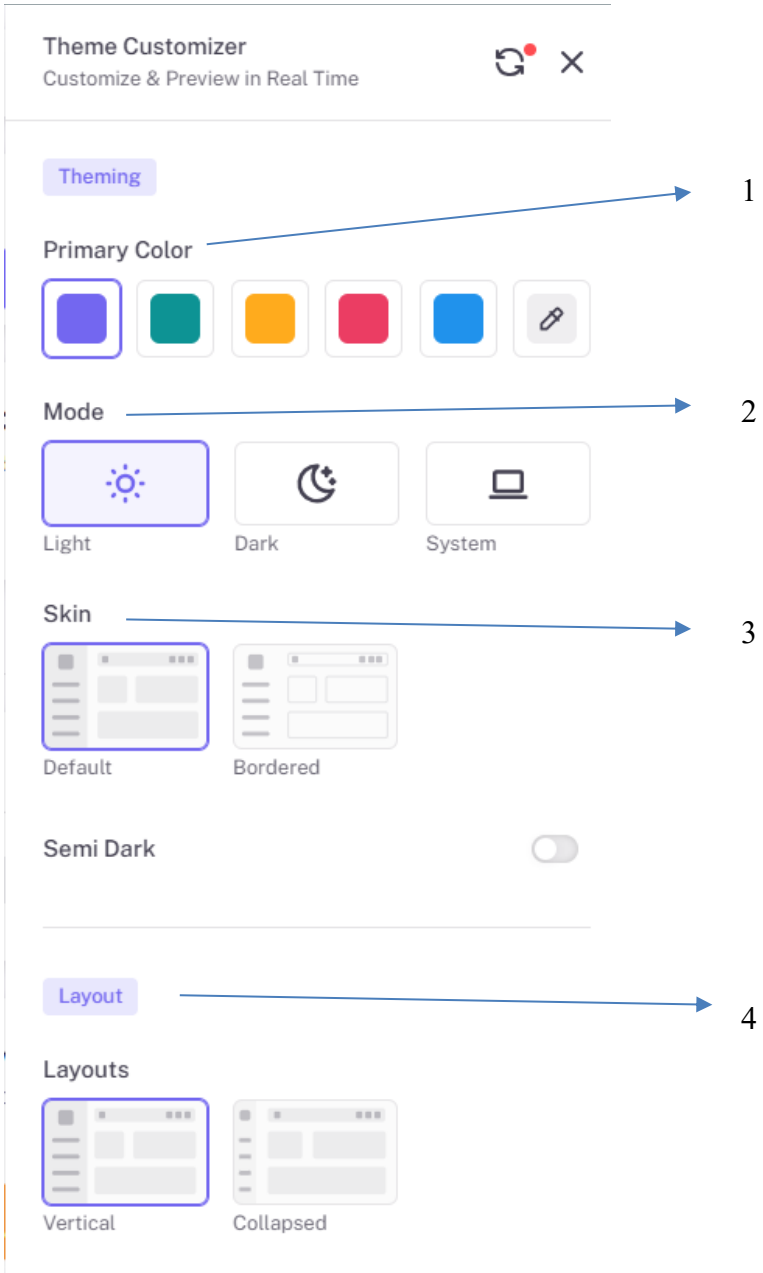


Figure 5.9: Theme Customization

1) Primary color for app
2) Mode
3) Skin
4) Layout

5.6 Profile Information

User can view and edit their profile information from here.

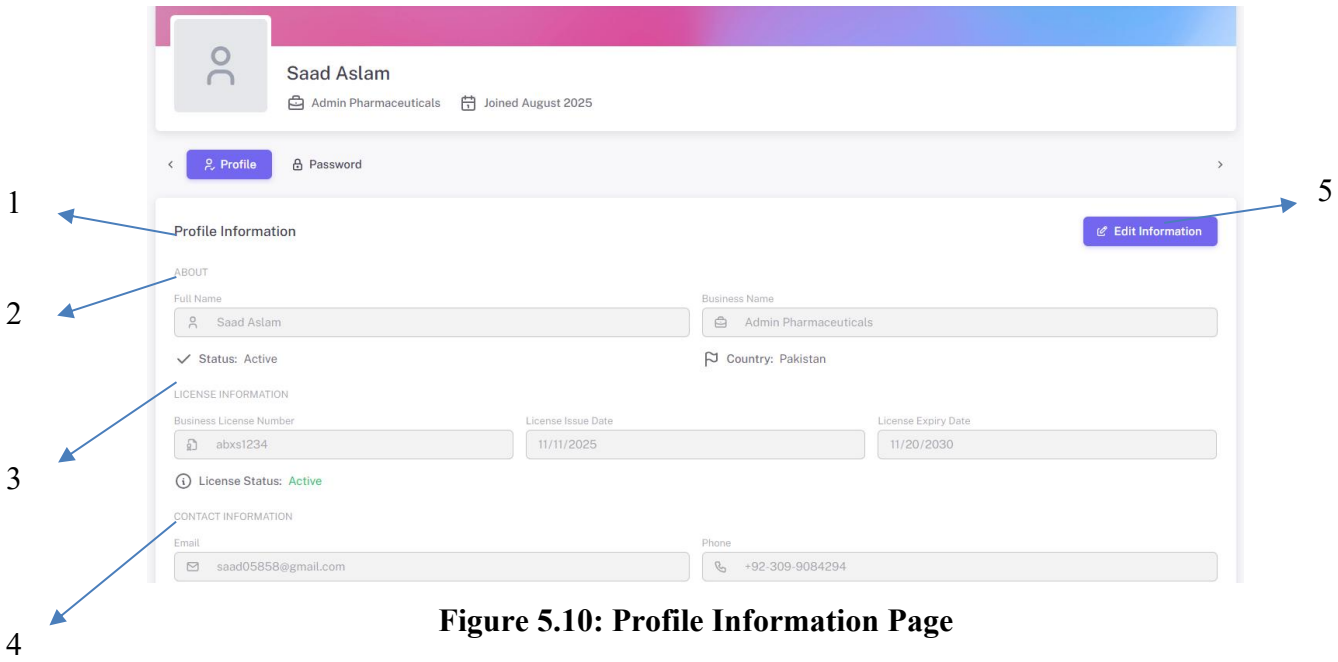


Figure 5.10: Profile Information Page

1) Profile information fields
2) About section
3) License Information section
4) Contact information section
5) Edit information button

5.7 Change Password

User can change their password from here.

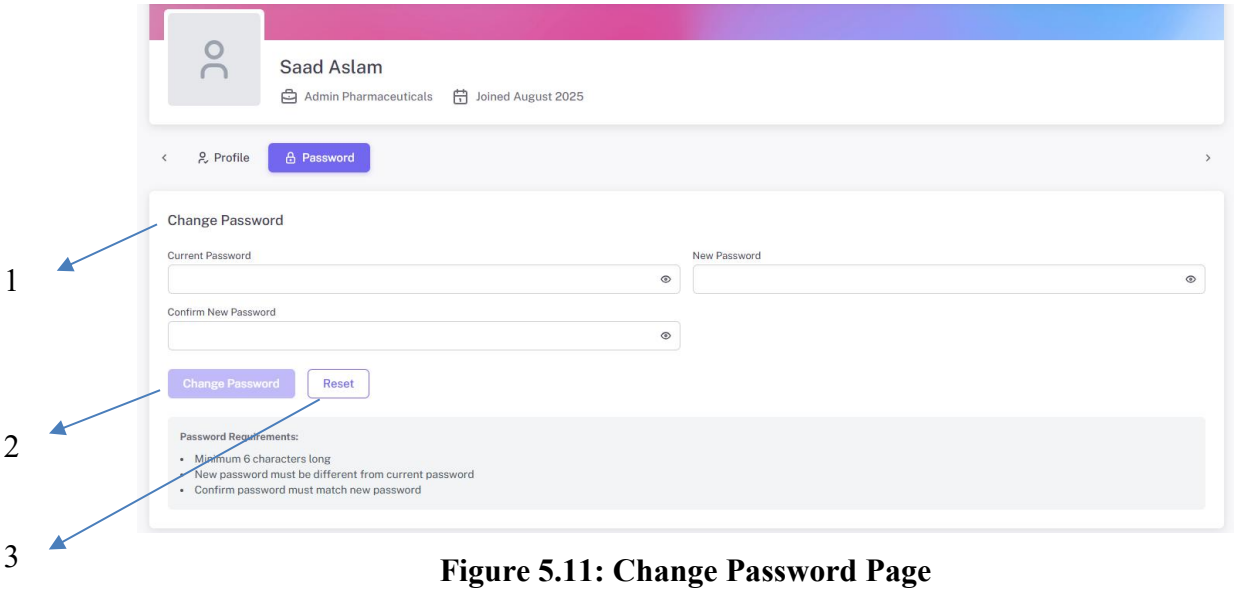


Figure 5.11: Change Password Page

1) Password Changing Fields
2) Change password button
3) Reset button

5.8 Customer Page

Manage customer records: add, edit, view details, filter by category/location, and toggle active status.

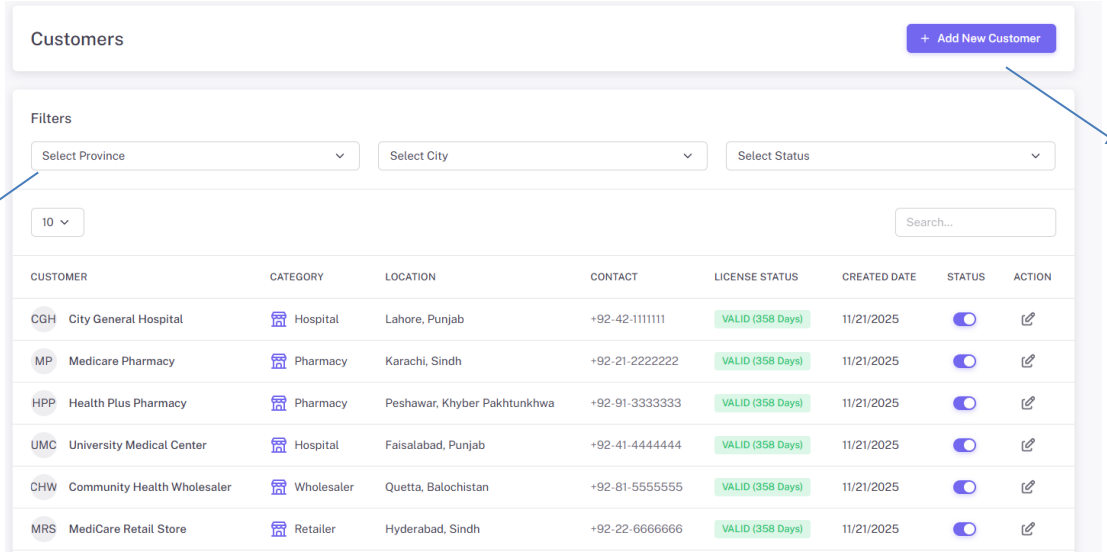


Figure 5.12: Customer Page

1. Add New Customer
2. Filter

5.9 Brands Page

List and manage product brands. Add new brands, edit details, and toggle brand status.

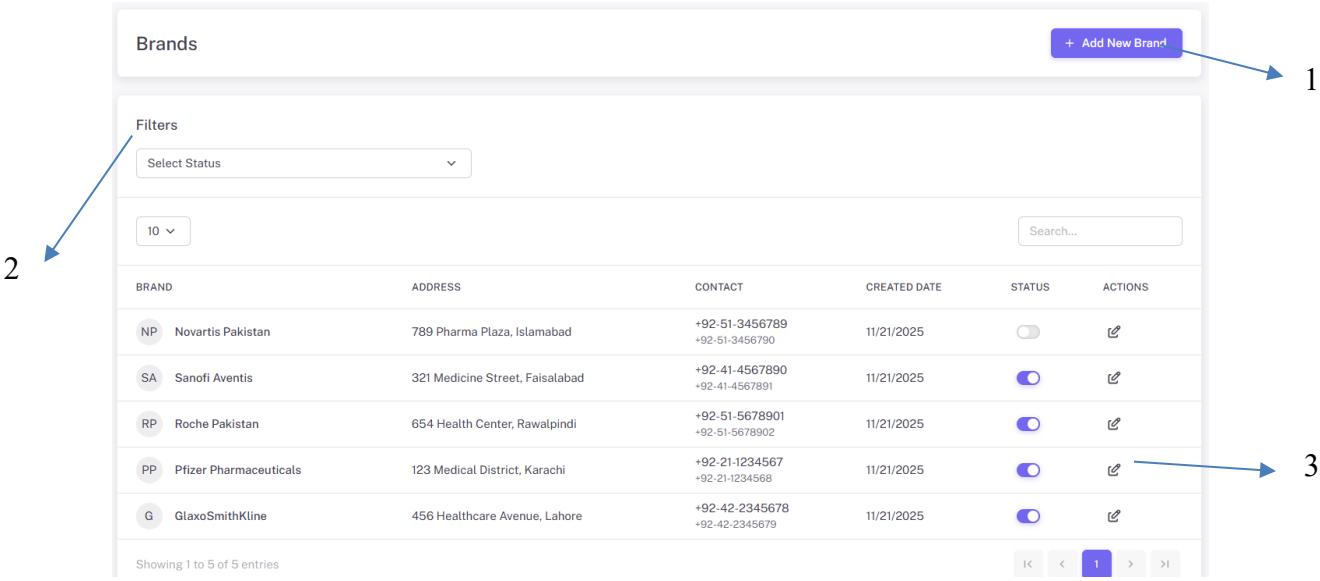


Figure 5.13: Brands Page

1. Add New Brand
2. Filter
3. Edit Brands

5.10 Edit Brands Page

View, add, and edit products. Includes filters by brand/group/subgroup, and product status toggling.

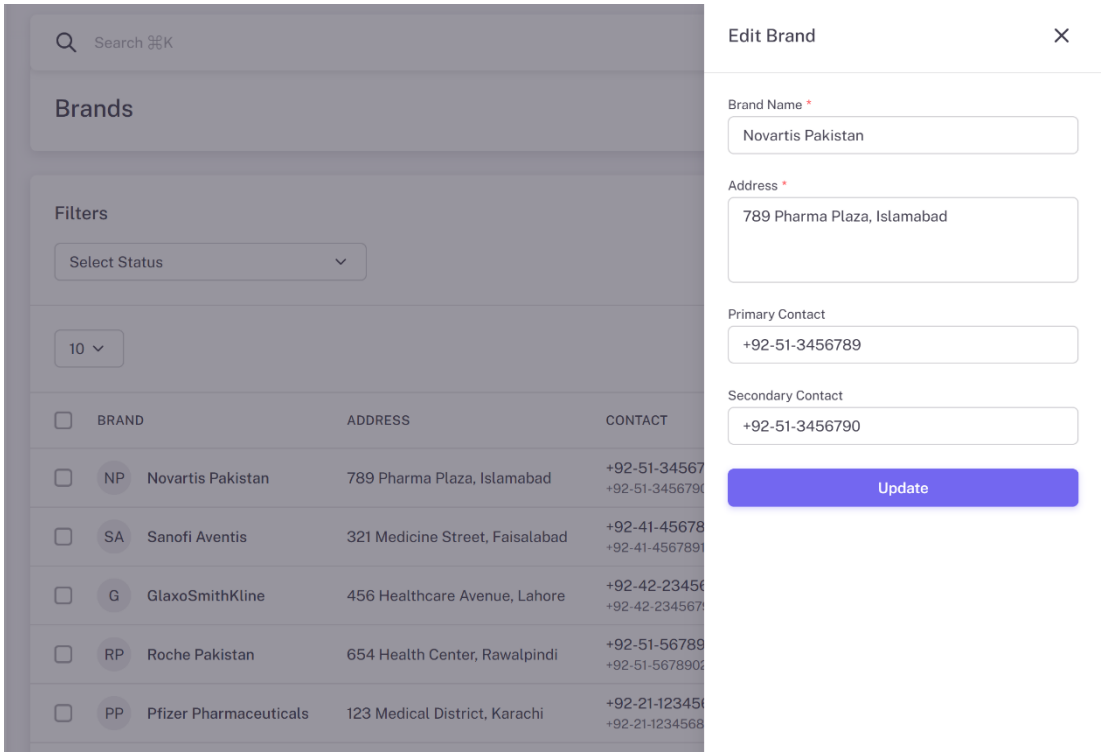


Figure 5.14: Edit Brands Page

1. Edit Brand Details

5.11 Employee Page

Add and manage employee records, assign roles, and track activity.

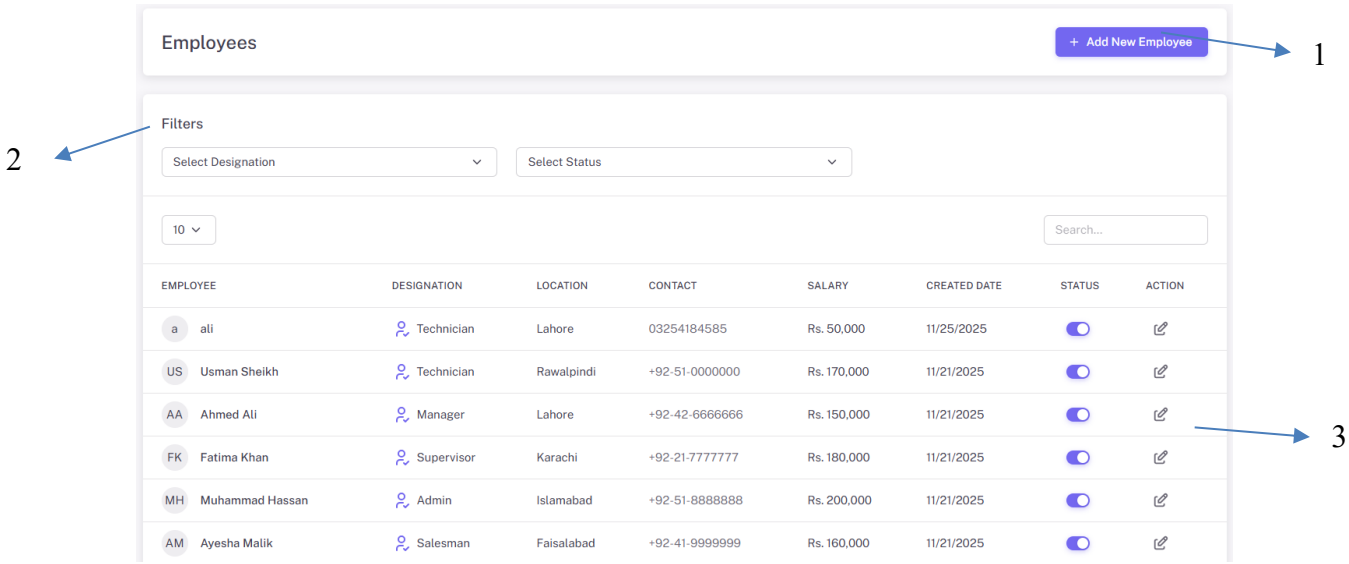


Figure 5.15: Employees Page

1. Add New Employee
2. Filter
3. Edit Employees

5.12 Edit Employee Page

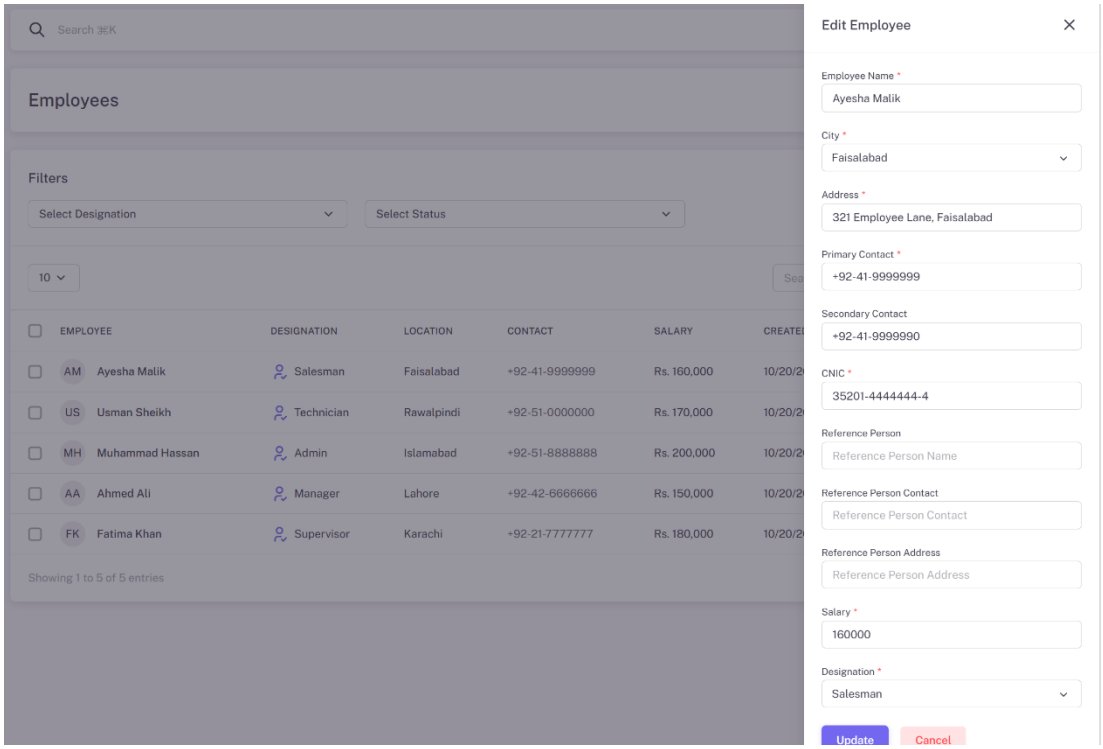


Figure 5.16: Edit Employees Page

1. Edit Employee Details

5.13 Areas Page

Define and manage geographic areas and subareas for customer and sales segmentation.

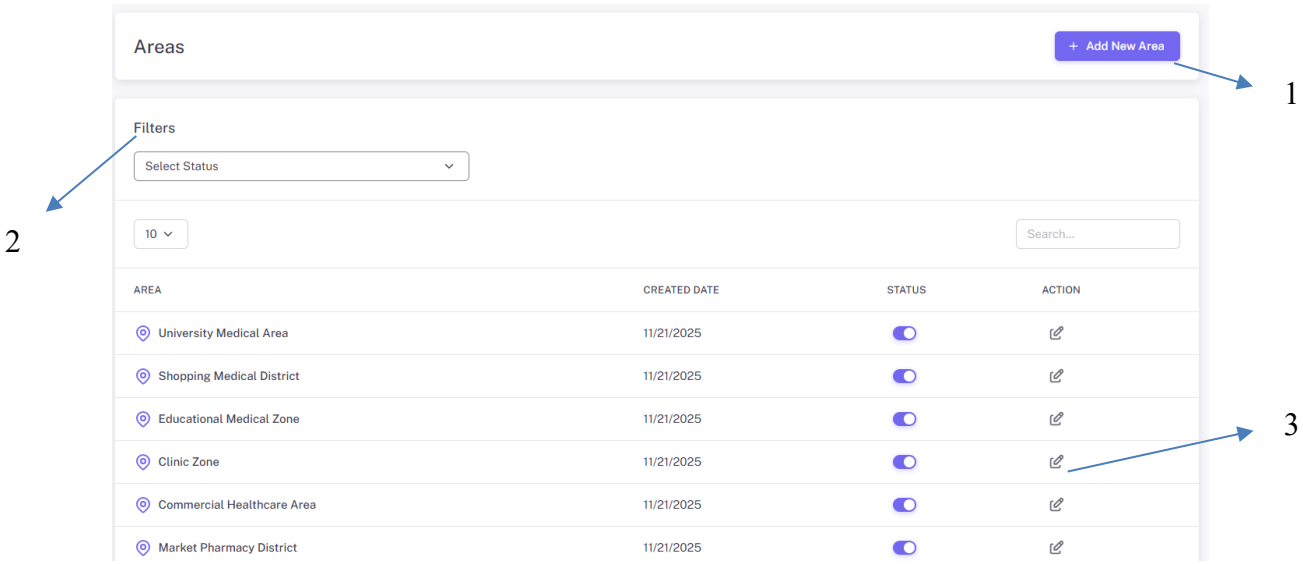


Figure 5.17: Areas Page

1. Add New Area
2. Filter
3. Edit Areas

5.14 Sub-Area Page

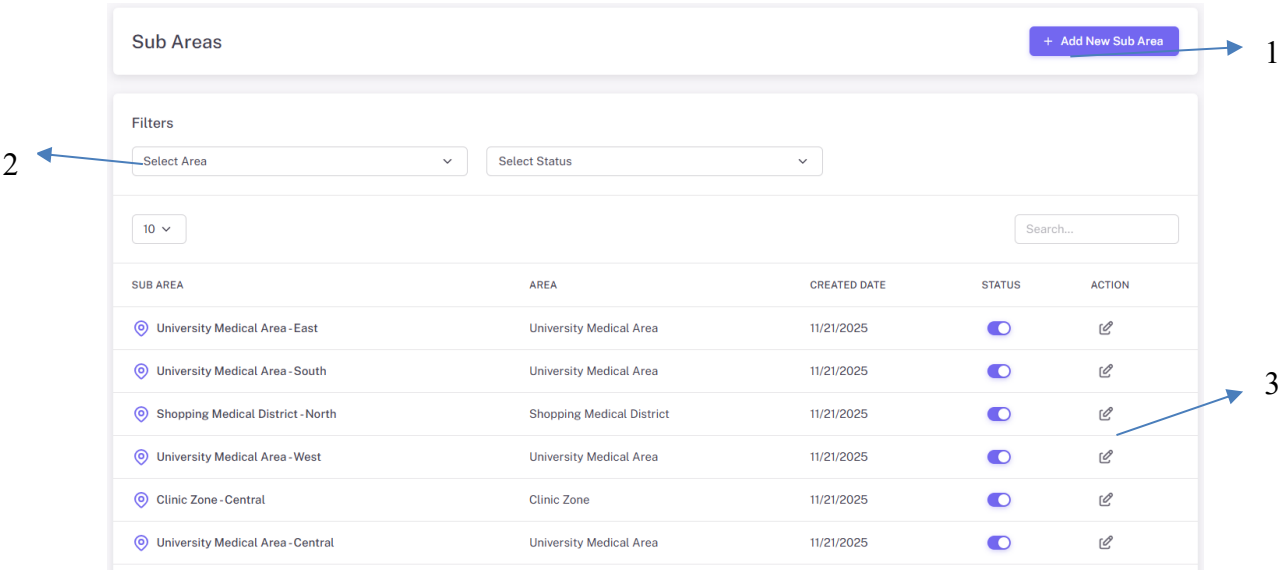


Figure 5.18: Sub-Area Page

1. Add New Sub-Area
2. Filter
3. Edit Sub-Areas

5.15 Edit Sub-Area Page

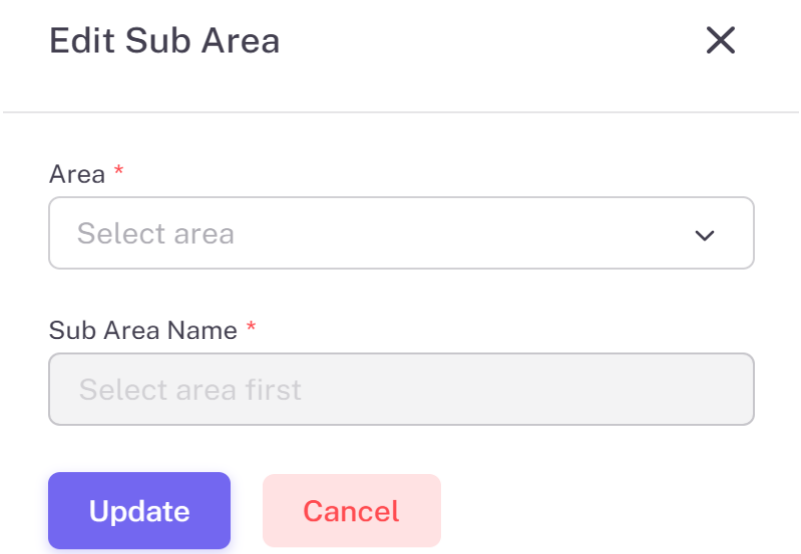


Figure 5.19: Edit Sub-Area Page

1. Edit Sub-Area Details

5.16 Group Page

Organize products into groups and subgroups for easier management and reporting

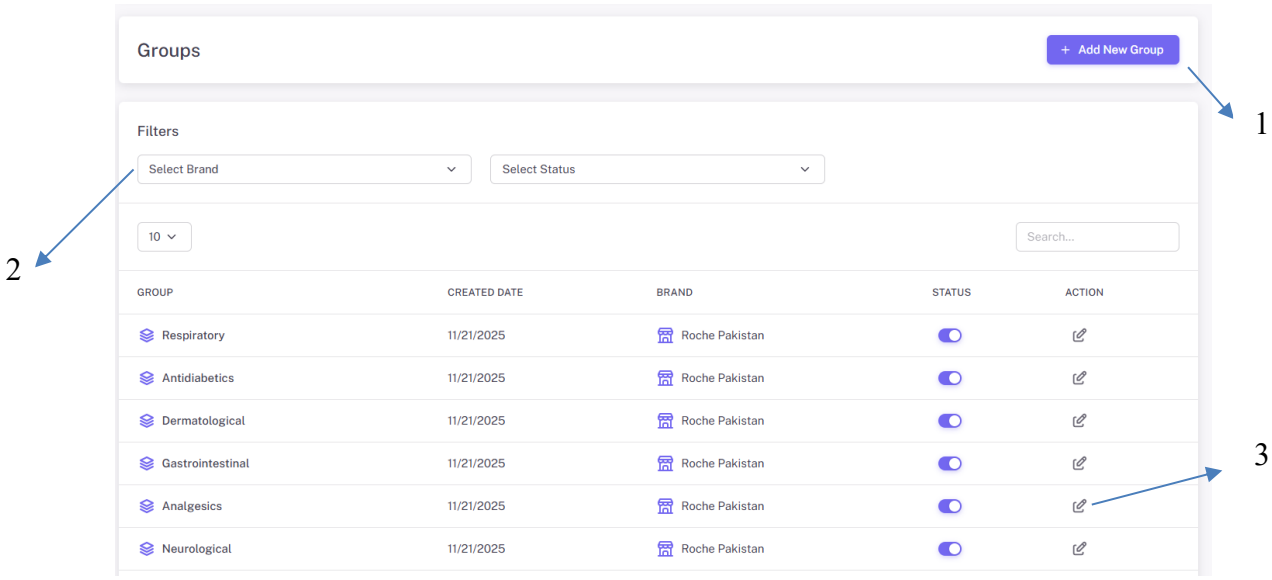


Figure 5.20: Groups Page

1. Add New Group
2. Filter
3. Edit Group Details

5.17 Edit Group Page

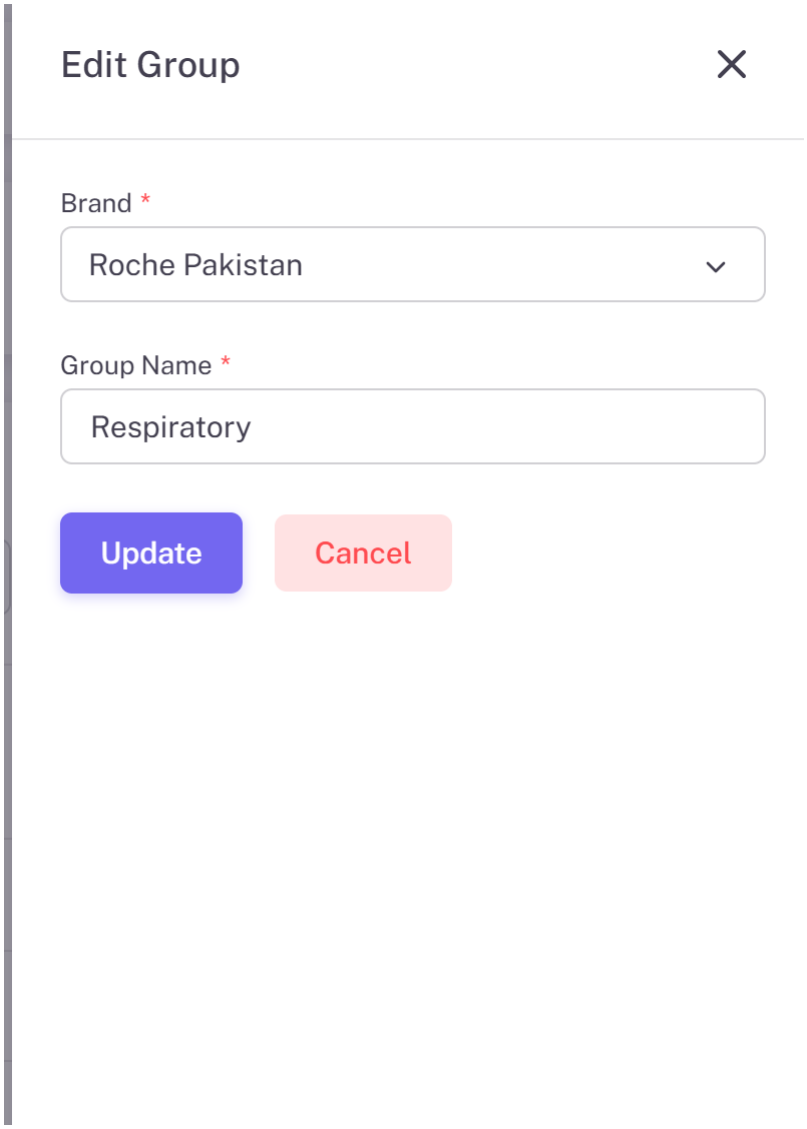


Figure 5.21: Edit Group Page

1. Edit Group Details

5.18 Sub Group Page

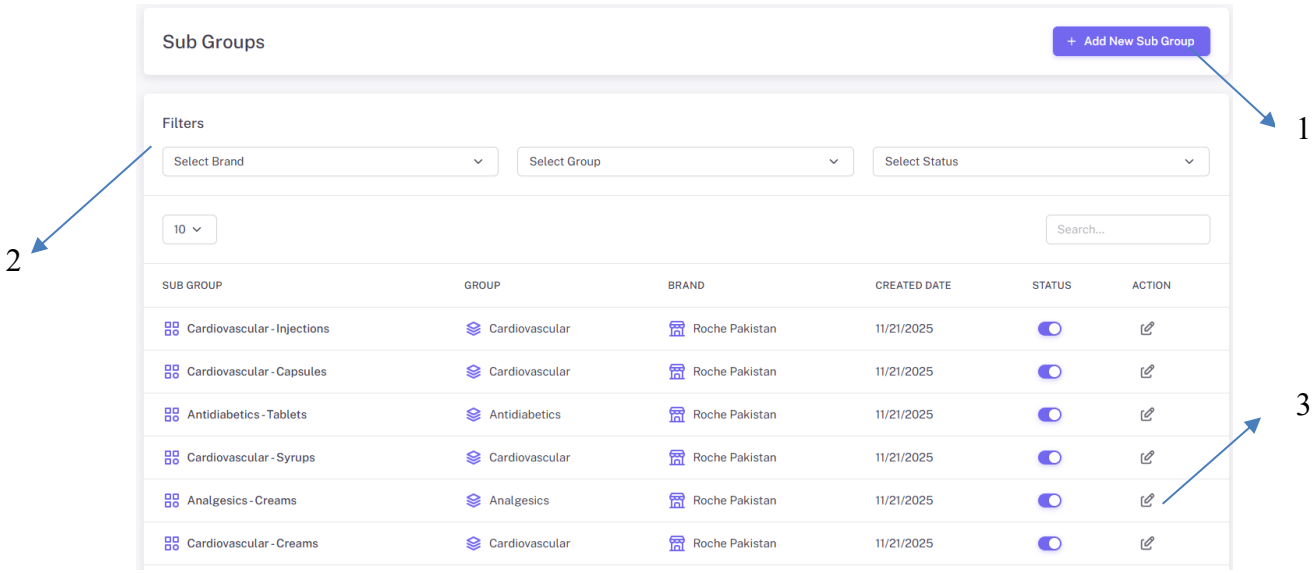


Figure 5.22: Sub-Group Page

1. Add New Sub Group
2. Filter
3. Edit Sub Group Details

5.19 Edit Sub Group Page

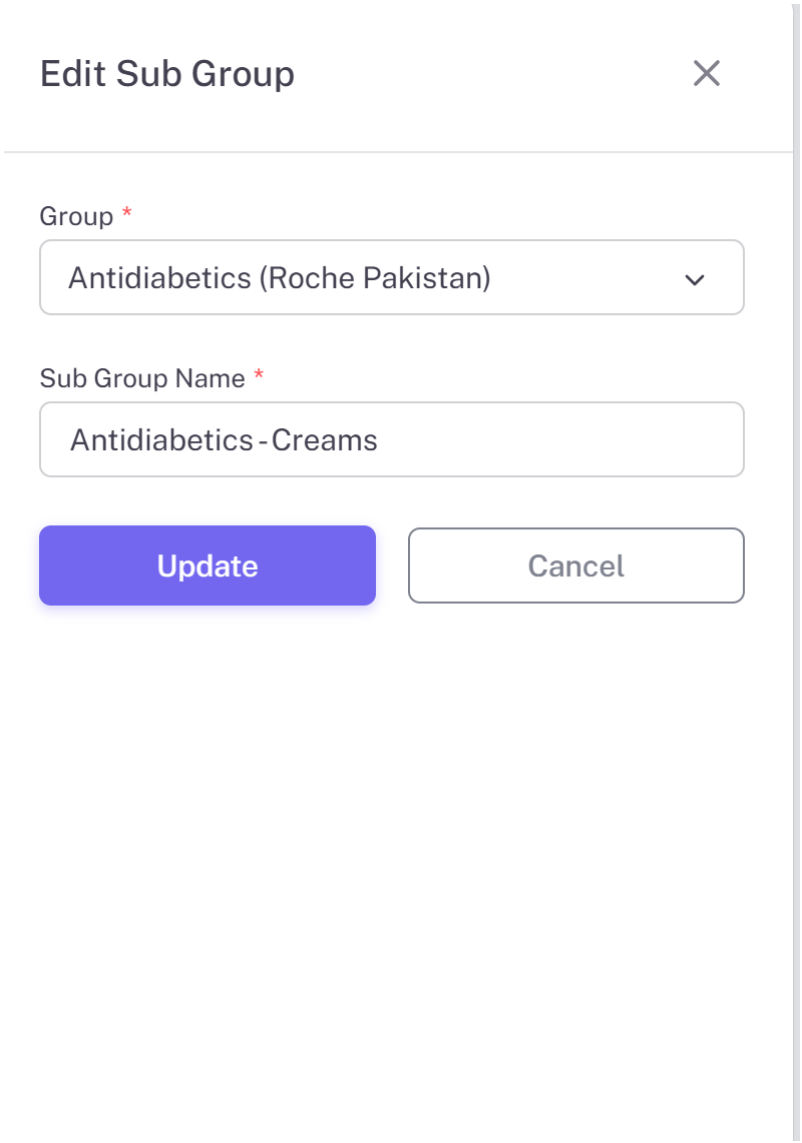


Figure 5.23: Edit Sub-Group Page

1) Edit Sub Group Details

5.20 Product Page

View, add, and edit products. Includes filters by brand/group/subgroup, and product status toggling

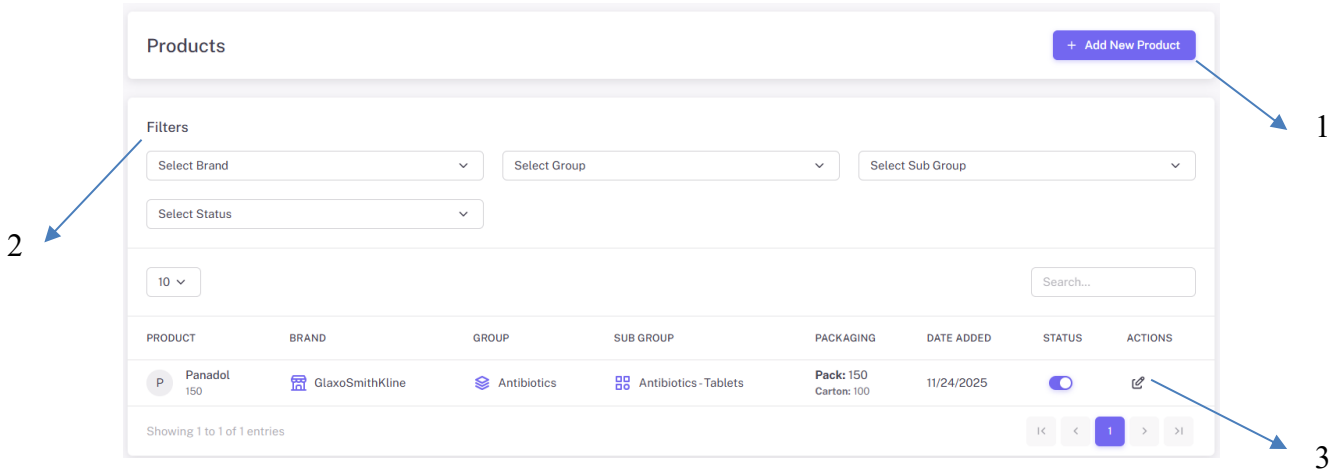


Figure 5.24: Product Page

1) Add New Product
2) Filters
3) Edit Product

5.21 Edit Product Page

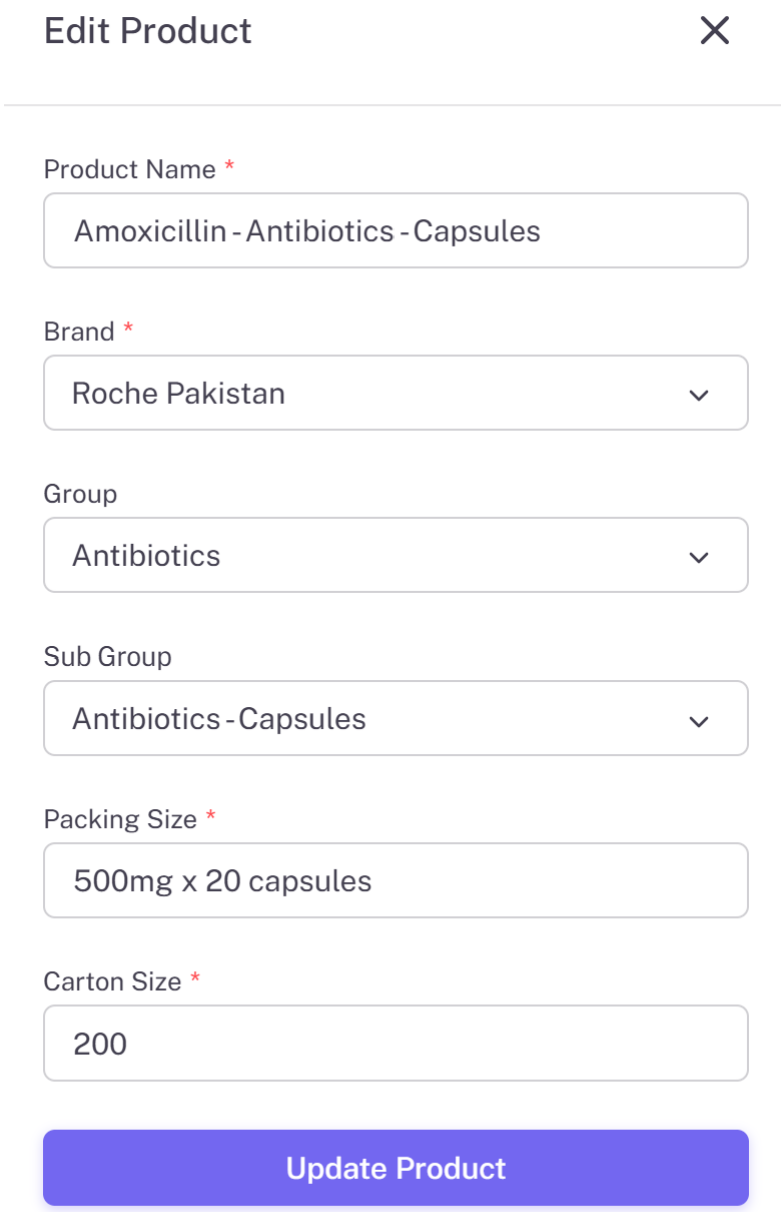


Figure 5.25: Edit Product Page

1. Edit Product Details

5.22 Purchase Invoice Page

Manage purchase records, supplier invoices, and track incoming stock.

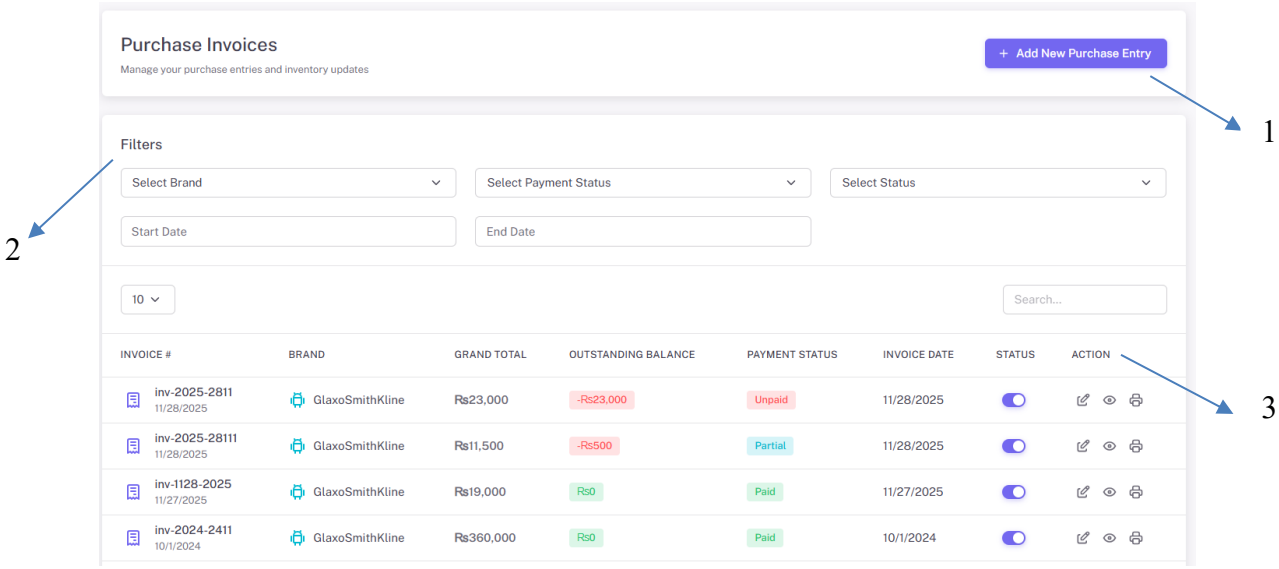


Figure 5.26: Purchase Invoice Page

1. Add New Purchase Invoice
2. Filter
3. Multiple Actions on Invoice Details

5.23 Edit Purchase Invoice Page

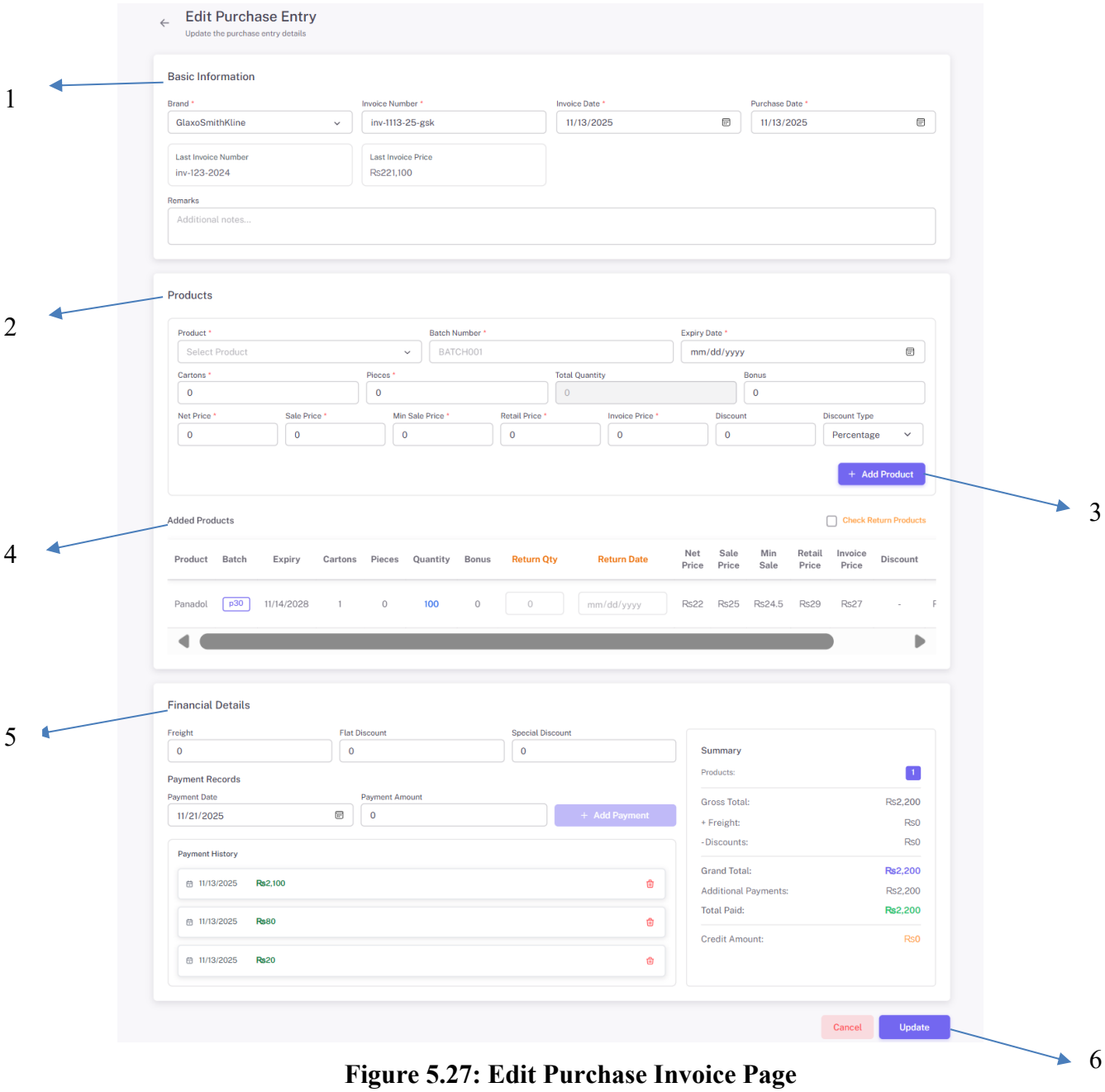


Figure 5.27: Edit Purchase Invoice Page

1. Edit Basic Information
2. Add/Edit Product
3. Add/Update Product button
4. Added Products
5. Edit Financial Details with Payment history
6. Update Button

5.24 Inventory Management Per Batch Details Page

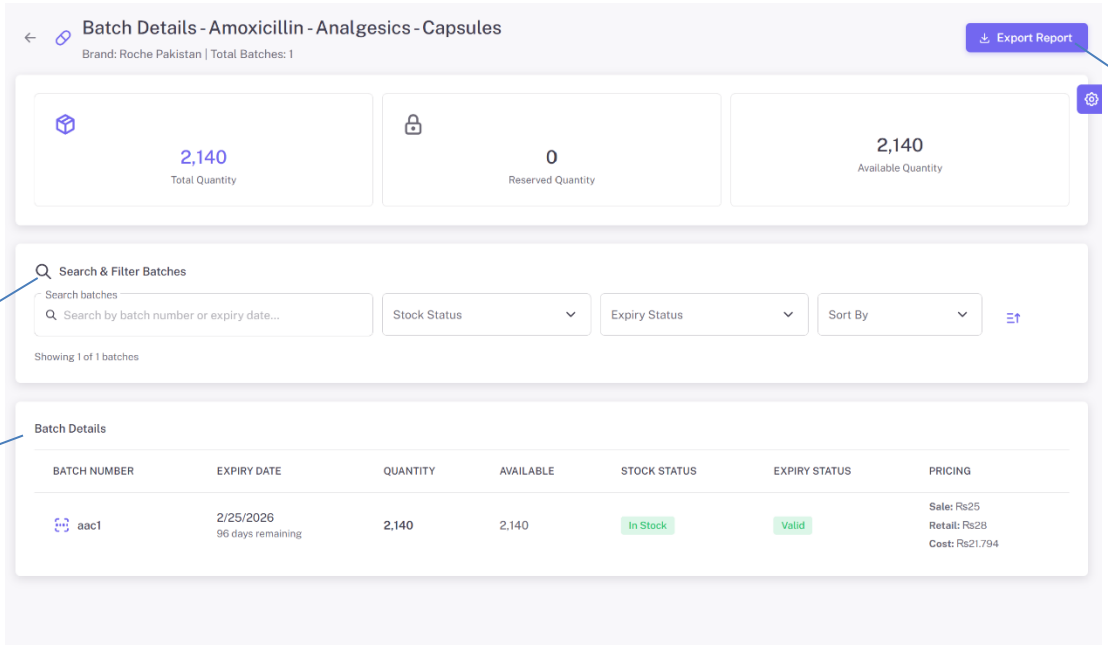


Figure 5.28: Per Batch Details of Inventory

1. Export Report
2. Filters
3. Batch details

5.25 Sales Invoice Page

Create, view, and manage sales invoices. Includes payment tracking, analytics, and customer history.

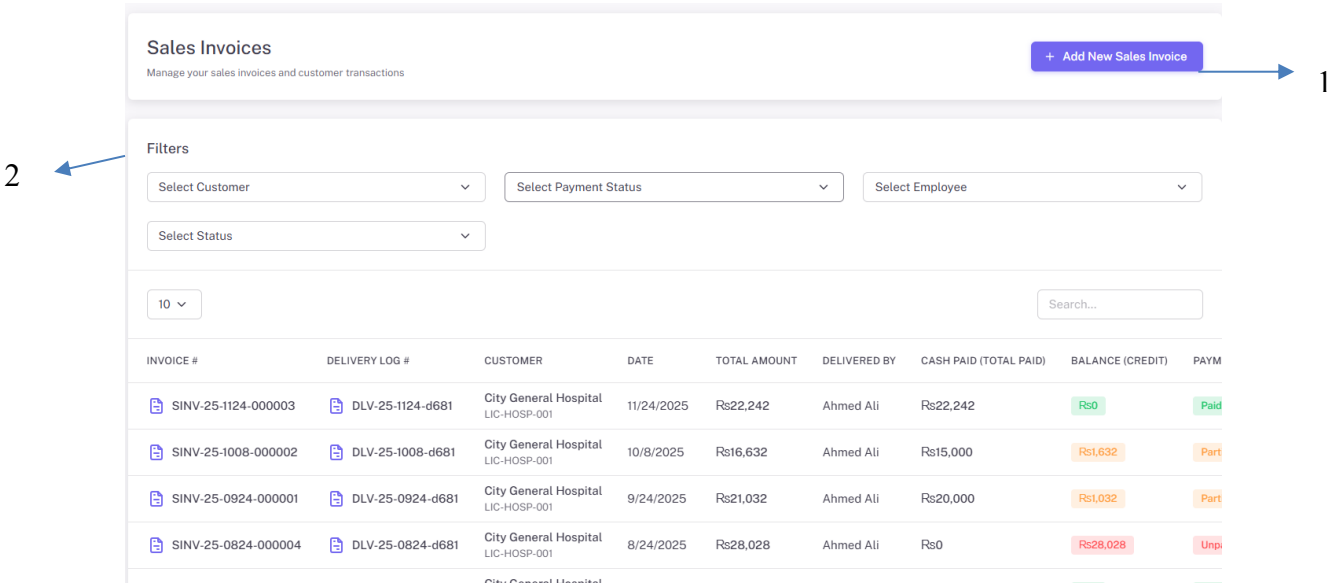


Figure 5.29: Sales Invoice Page

1. Add New Sales Invoice
2. Filter

5.26 Edit Sales InvoicePage

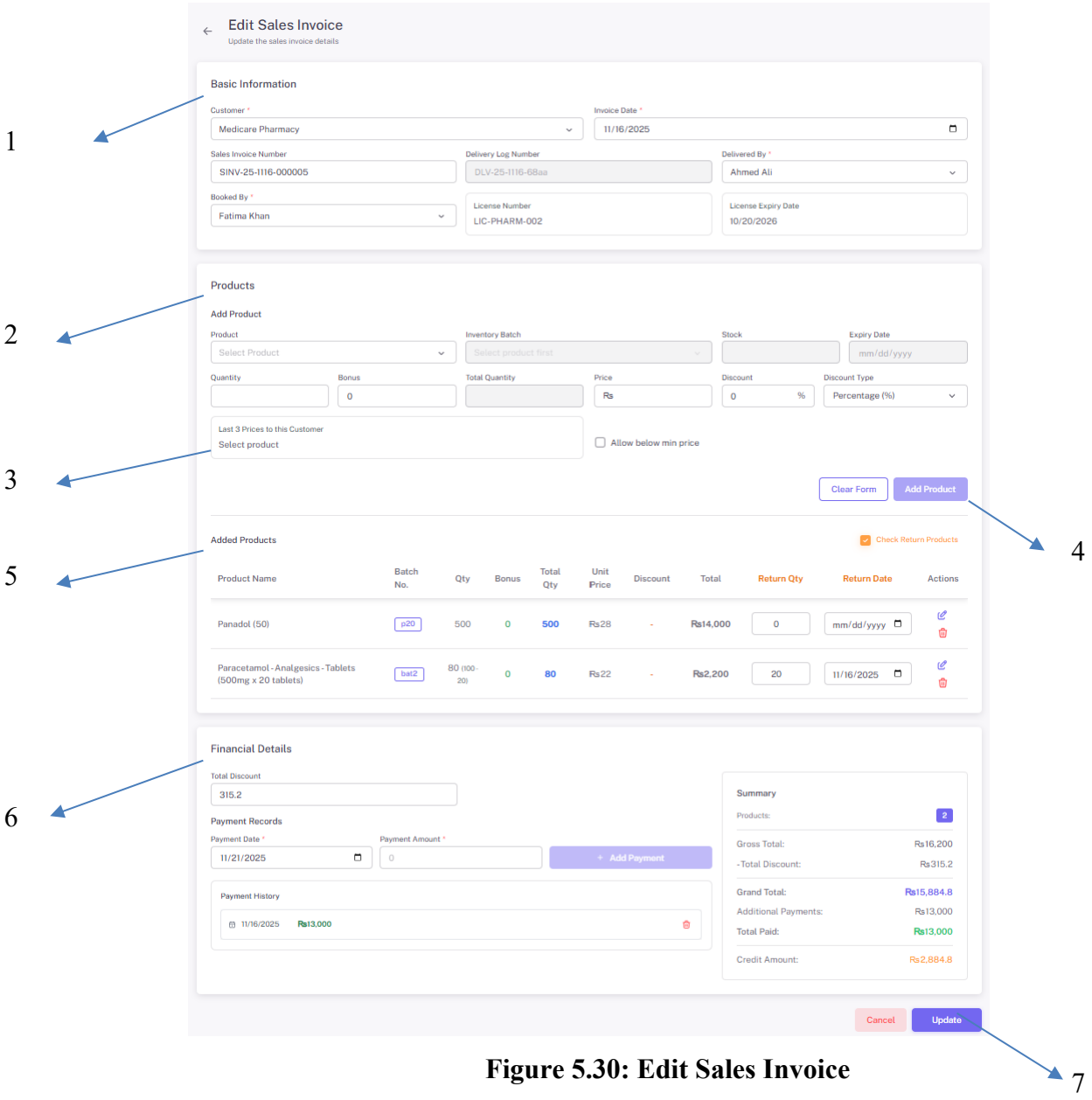


Figure 5.30: Edit Sales Invoice

1. Edit Basic Information
2. Add/Edit Product
3. Last 3 times Prices of same medicine to same customer
4. Add/Update Product Button
5. Added Products List
6. Edit Financial Details with financial history
7. Update Button

5.27 Delivery Logs Page

Log and track product deliveries, shipments, and sync with invoices.

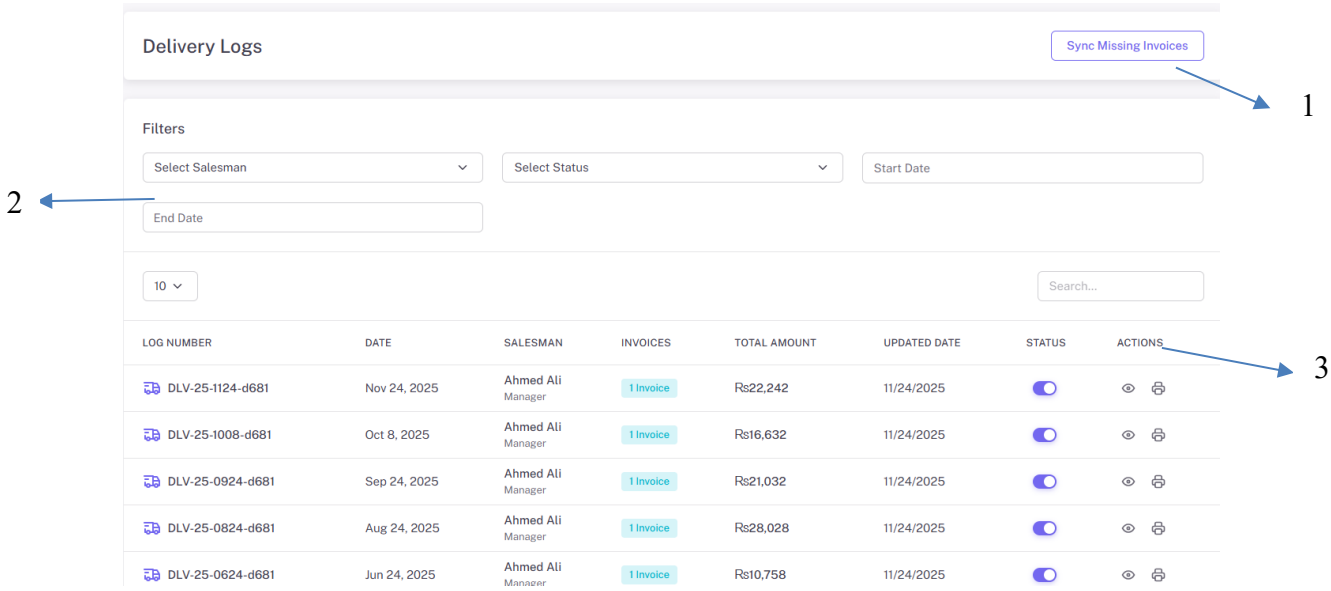


Figure 5.31: Delivery Log Page

1. Sync Missing Invoice Button
2. Filters
3. Multiple Actions

5.28 Delivery Logs Details Page

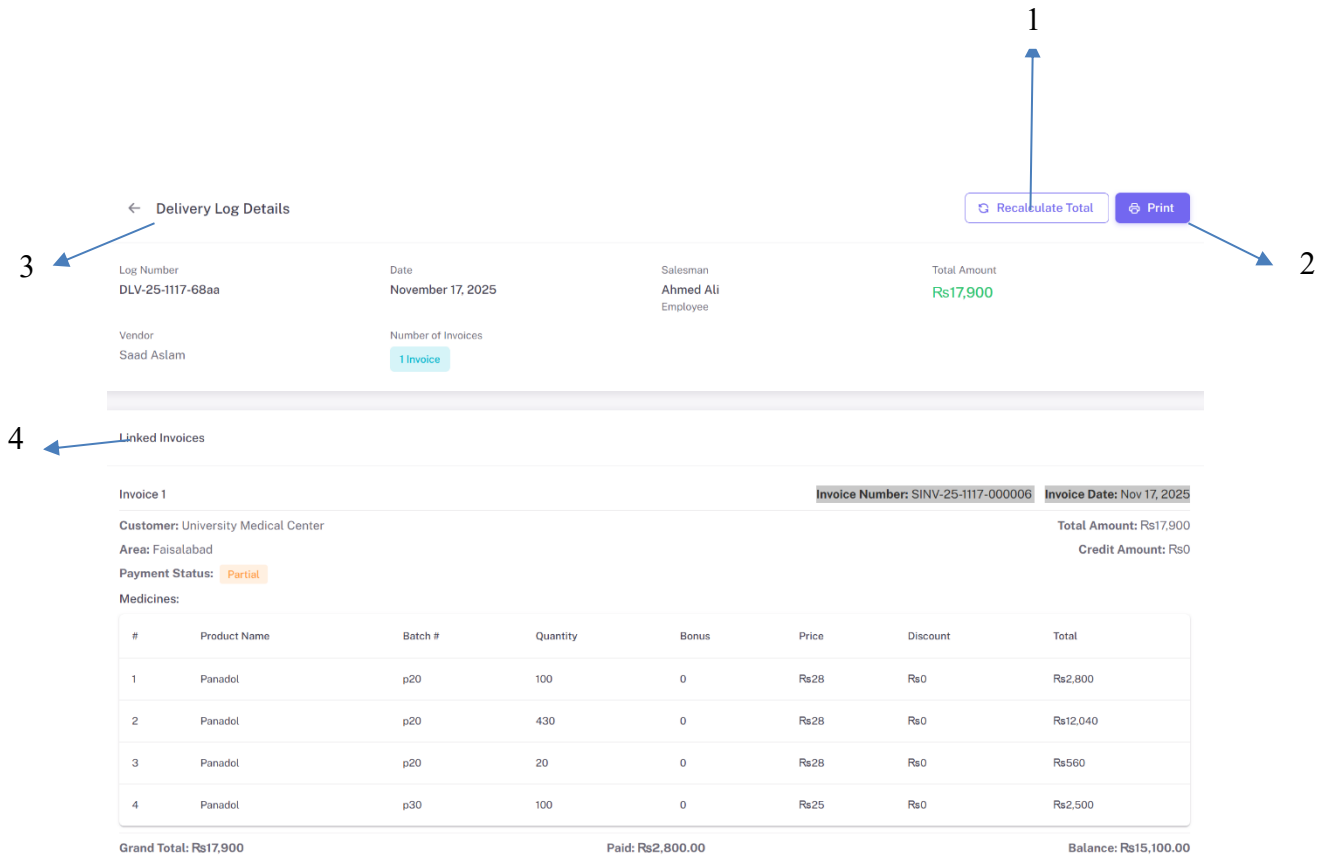


Figure 5.32: Delivery Log's Detail Page

1. Recalculate Total Button syncing it with Sales Invoices DB
2. Print Button
3. Delivery Log Details
4. Linked Invoices

5.29 Product Reports Page

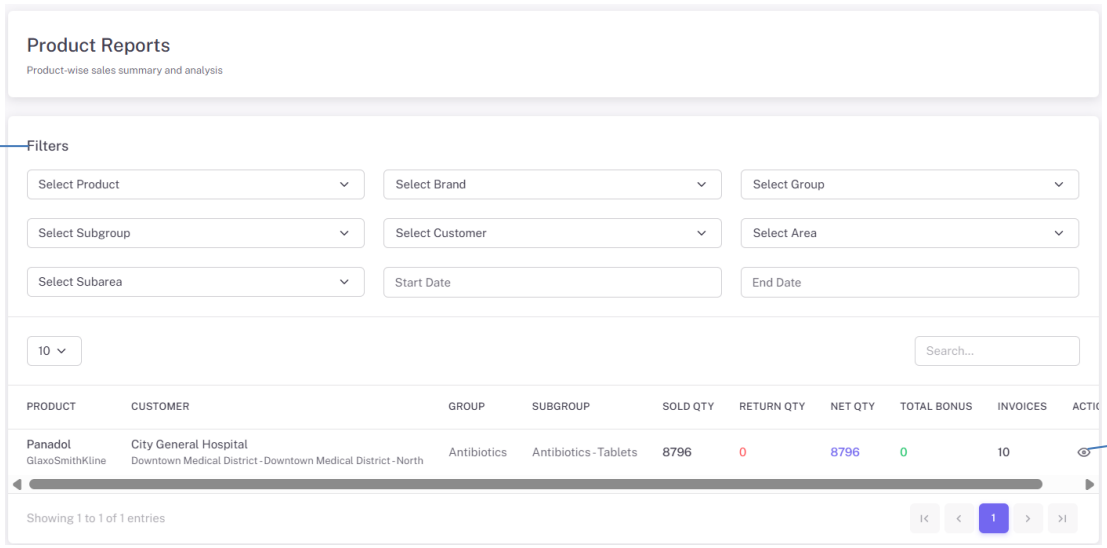


Figure 5.33: Product Report Page

1. Filters
2. View Product report

5.30 Brand Report Page

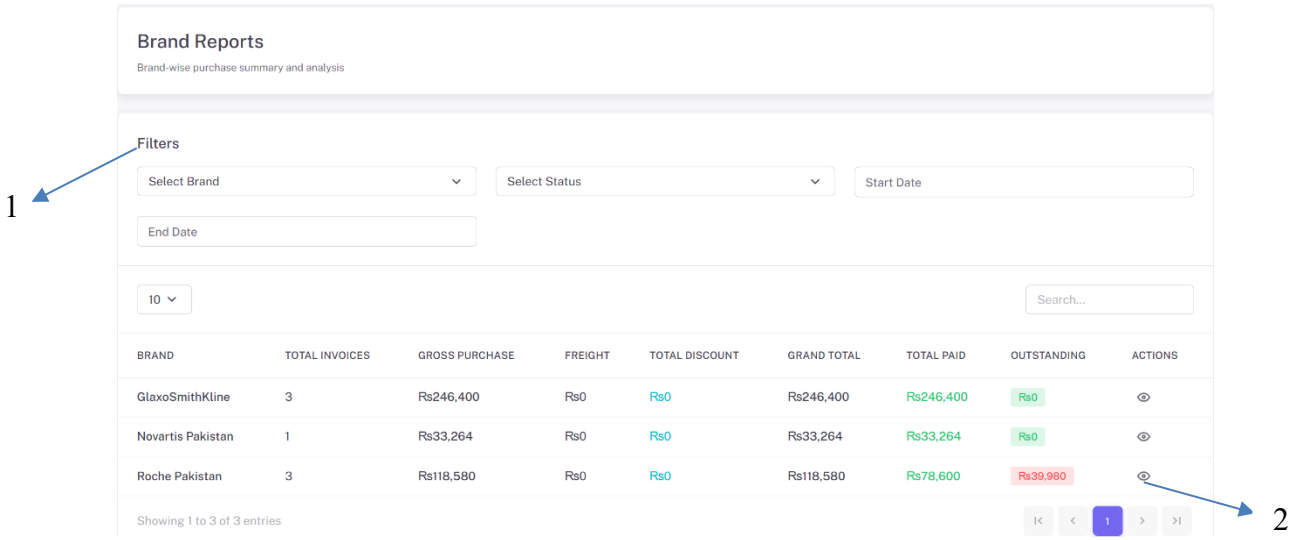


Figure 5.34: Brand Report Page

1. Filter
2. View brand report

5.31 Brand Report Detail Page

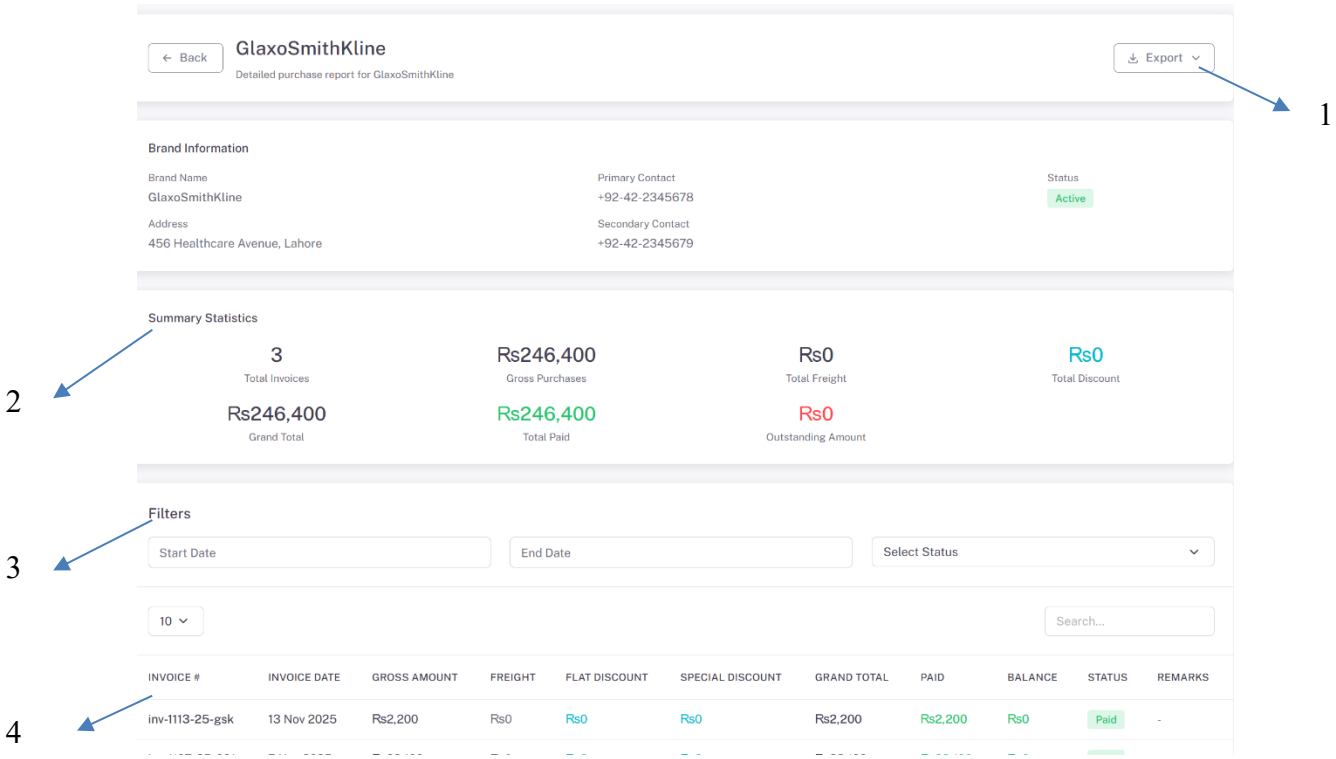


Figure 5.35: Brand Report's Detail Page

1. Export Button
2. Summary Stactics
3. Filters
4. List of brand’s Cash/Credit records against invoices

5.32 Customer Report Page

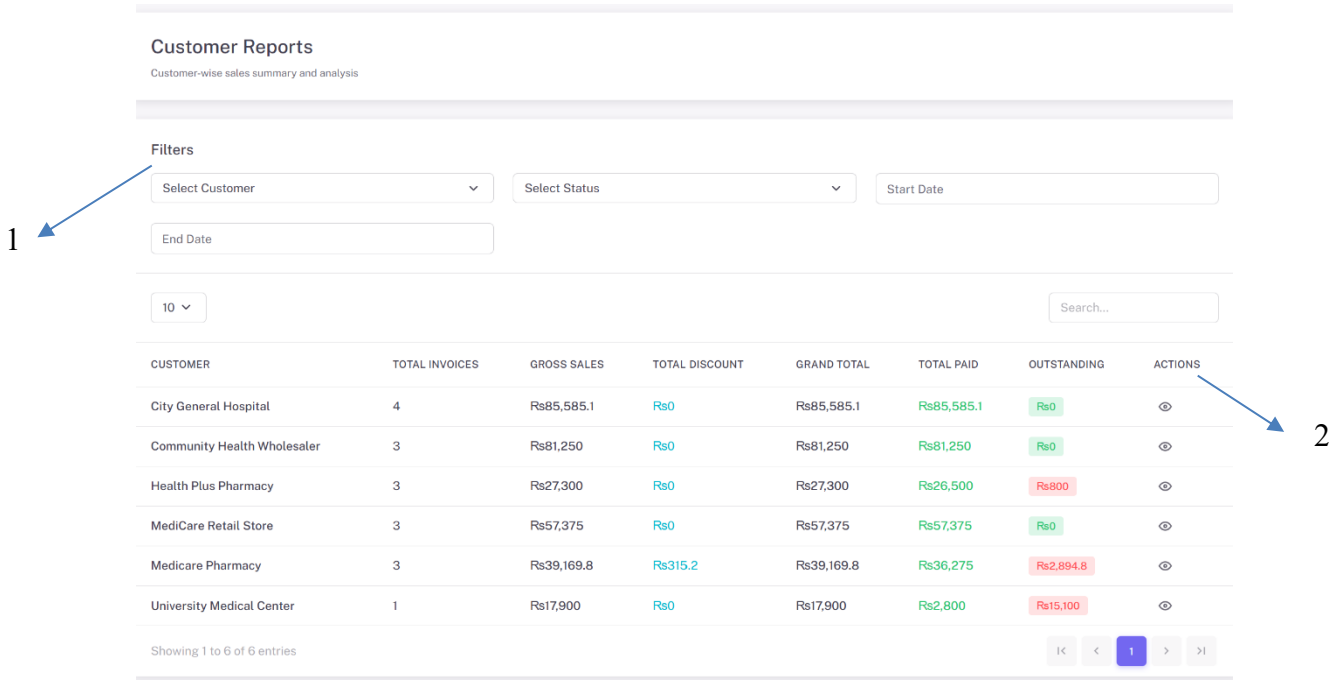


Figure 5.36: Customer Report Page

1. Filter
2. Actions

5.33 Customer Report Detail Page

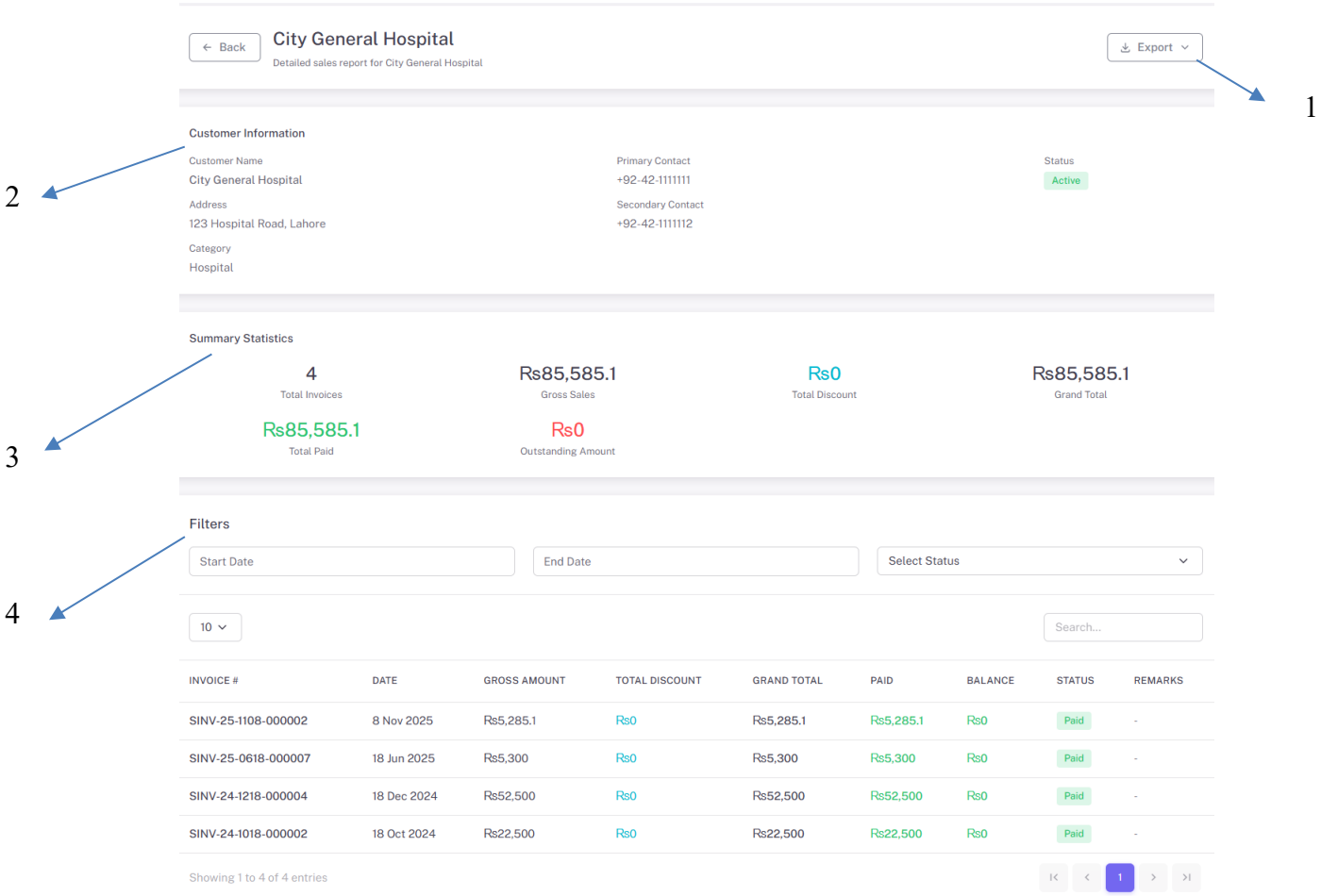


Figure 5.37: Customer Report's Details Page

1. Export Button
2. Customer Information
3. Summary Stactics
4. Filters
5. List of customer’s cash/credit record against invoices

5.34 Expenses Page

Record and categorize business expenses. View expense history, filter by category/date, and generate reports.

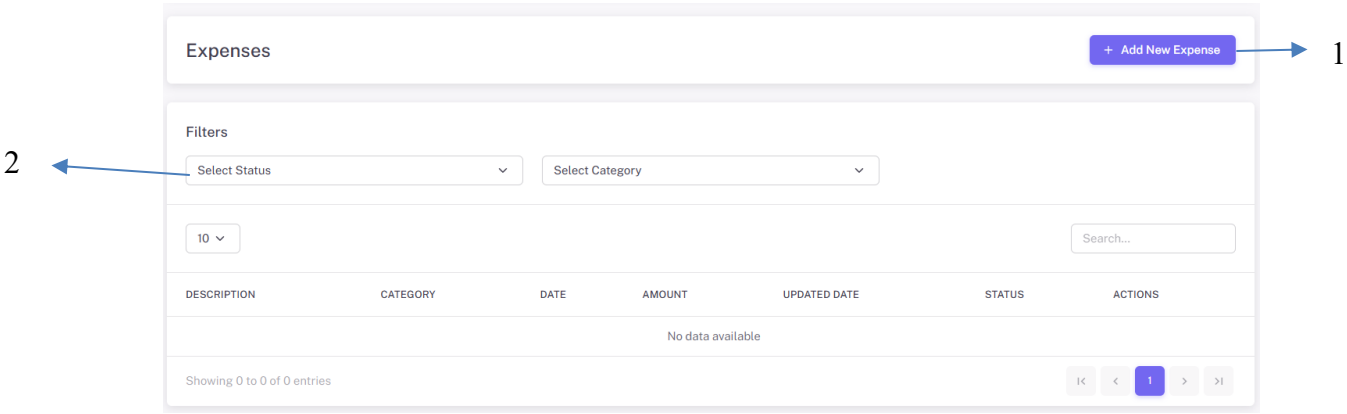


Figure 5.38: Expenses Page

1. Add New Expense Button
2. Filter

5.35 Ledger Page

The Ledger page provides a comprehensive view of all financial transactions and balances for the business. It aggregates data from sales, purchases, expenses, and other sources to present a unified financial record

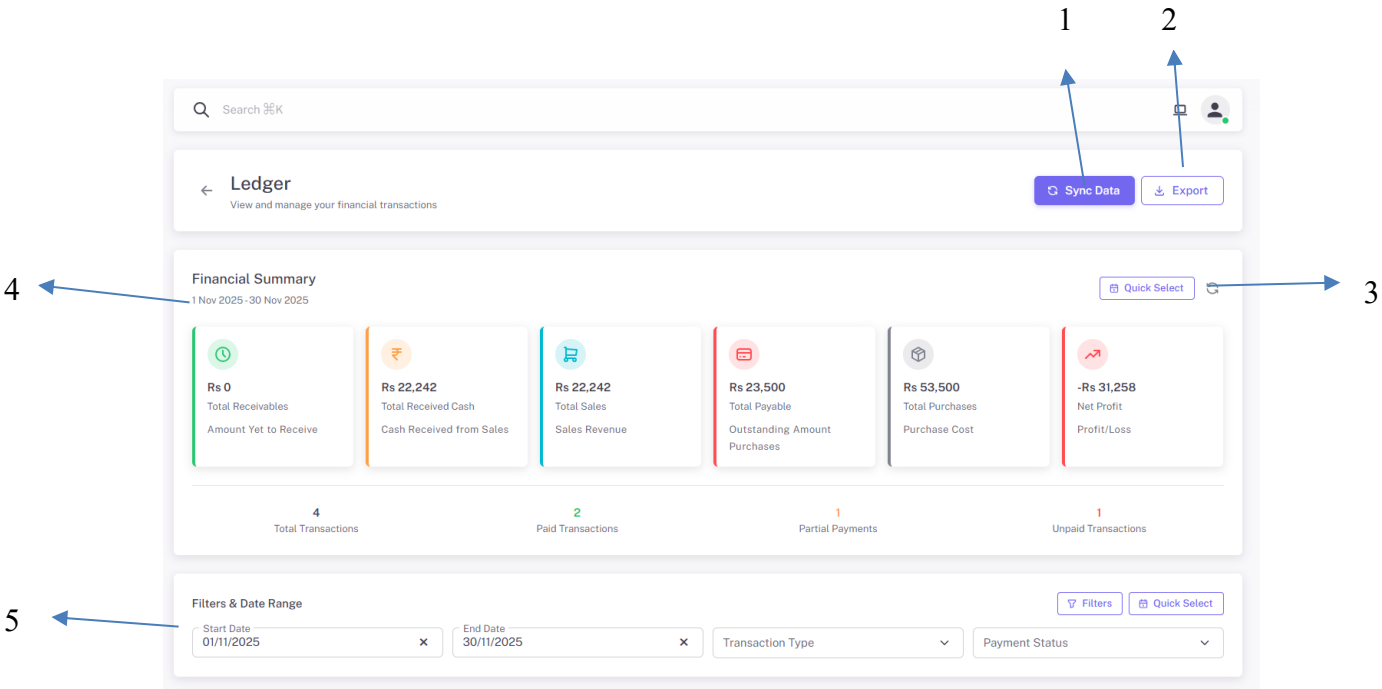


Figure 5.39: Ledger Page

1. Sync Button
2. Export Button
3. Qick select (Date)
4. Finanacial Summary
5. Filter & Date Range

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The development of DoseLogix successfully addressed the dire need of an efficient, robust and low cost and industry specific Pharmaceutical Distribution Management System (PDMS) designed to meet the needs of small and medium scale distributors.

This project was designed in such a manner that it fills the gaps that exist in the current solutions, which are in most cases either out of date, provide inconsistent data flow, or are costly and generalized systems that cannot be customized. DoseLogix meets its main objective of offering a secure, modern, and convenient platform that is meant to conform to the operational conditions of pharmaceutical distribution.

The developed system has a centralized application that controls the necessary operations which include a lean invoicing module to deal with both purchase and sales records, full inventory control and cash flow monitoring. It has successfully made a critical financial tracking system to sustain outstanding balances, debit/ credit transactions and payment history of customers and brands and thus the receivables and deliverables are clear. DoseLogix is a majorly differentiated product with its novel, integrated capabilities: AI-powered sales forecasting, which relies on past data to forecast upcoming demand, helping distributors make well-informed buying choices. More so, the service is further equipped with an exclusive web scraping system to provide the most recent news in health-related matters of the acknowledged Pakistani

health authorities (NIH and Chugtai Lab) so that distributors could anticipate in advance in meeting new market demands.

DoseLogix has been developed on the basis of a solid architecture with Next.js, Node.js, Python, and MongoDB that guarantee user-friendly interface/user experience (UI/UX), as well as the essential functions such as authentication, authorization, multi-tenancy, and alerts on low stocks or medicine expiry date. Through these goals, DoseLogix will have the ability to offer a scalable and faithful industry-specific platform that will increase the efficiency of operations and improve business expansion in the pharmaceutical industry.

6.2 Future Prospects

Although at its present capacity, DoseLogix offers a thorough and efficient DMS to small and medium-scale enterprises, there are future developments that are to be enhanced to give it an improved capacity and market presence. The main areas of future development and recommendations involve such features as multi brand support, e pharmacy integration with POS Systems.

6.2.1 Multi-branch support for large distributors and chain networks

This expansion aims to scale the DoseLogix infrastructure to successfully accommodate the more complex organizational structures and geographical distribution requirements of larger distributors and chain networks.

6.2.2 Automated billing and reporting

Future development will focus on incorporating enhanced administrative automation features, specifically automating billing processes, calculating taxes, and generating compliance reports. This will streamline financial operations and ensure adherence to evolving regulatory standards.

6.2.3 Integration with e-pharmacy platforms and POS systems

To increase the system's utility within the wider pharmaceutical ecosystem, a key prospect is the integration of DoseLogix with external retail environments, including various e-pharmacy platforms and Point of Sale (POS) systems.

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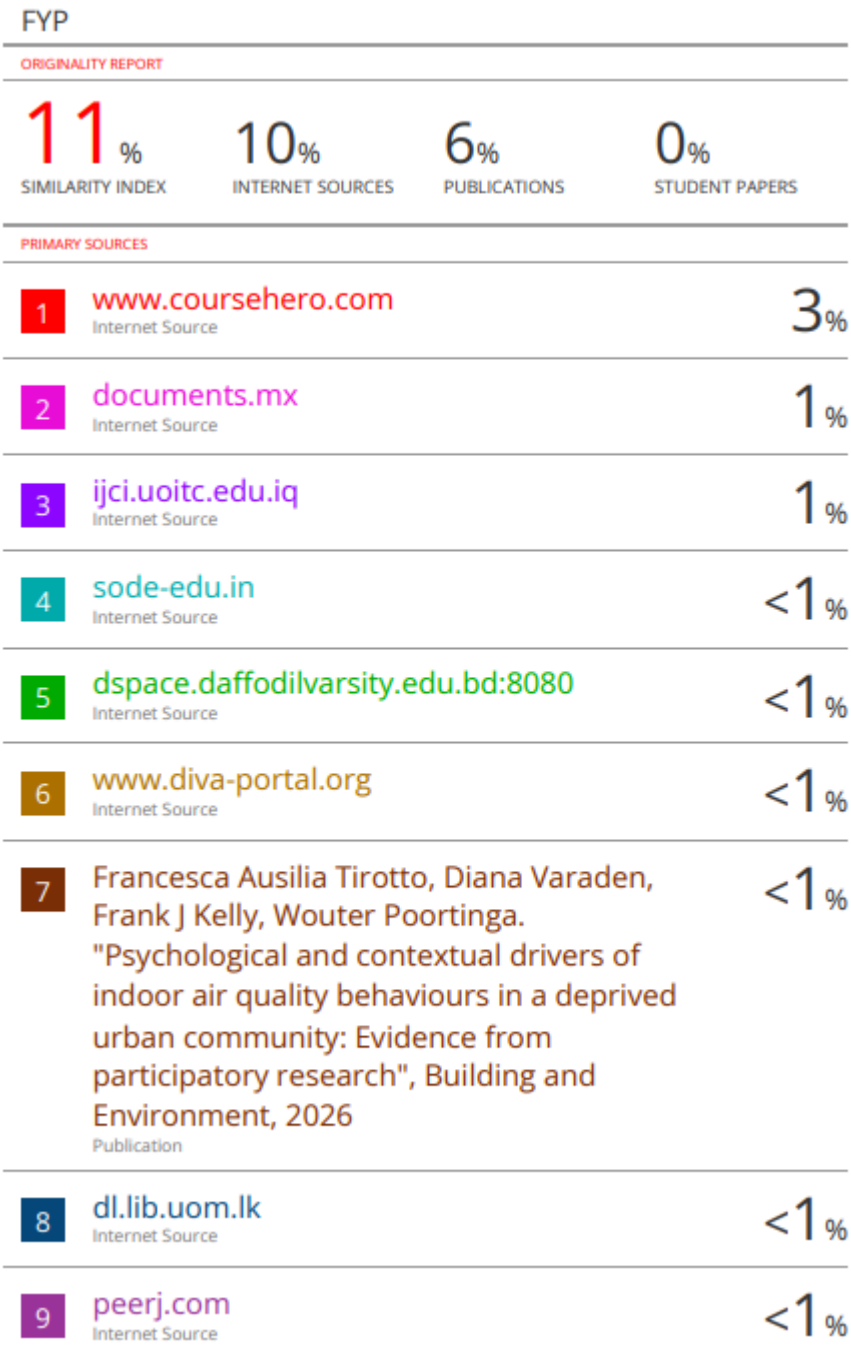
APPENDICES



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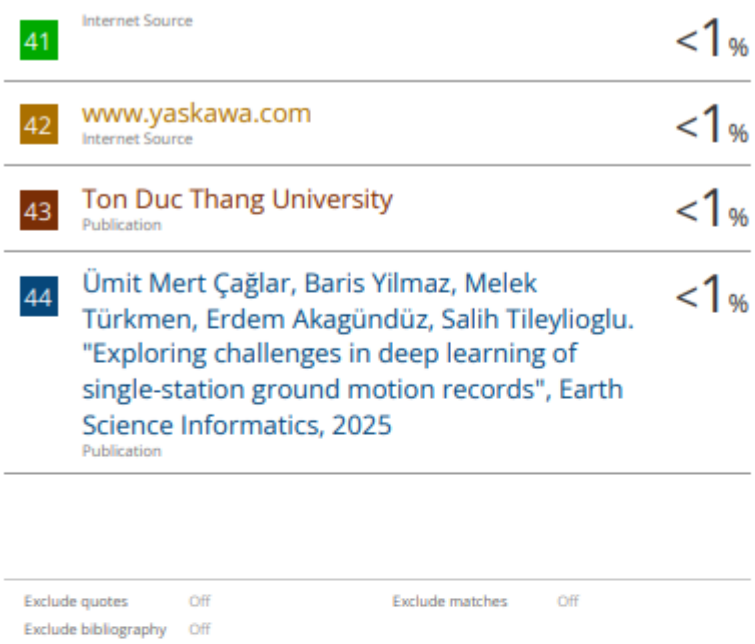

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