
Software Requirements Specification

for
StockSight

Version 1.3 approved

Prepared by
Gong Yuelong (U2320259D)
Lim Jun Shawn (U2320477A)
Tee Jia Hong (U2420150G)
Garv Sachdev (U2323262H)

SCEA_Group 3

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Revision History

Name	Date	Reason For Changes	Version
Tee Jia Hong	4/4/2025	Creation of SRS and writeup for introduction and overall description	1.0
Lim Jun, Shawn	7/4/2025	Refine	1.1
Garv Sachdev	7/4/2025	Include machine learning model description	1.2
Gong Yuelong	7/4/2025	Refine	1.3

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1.Introduction

1.1.Purpose

The purpose of this Software Requirements Specification (SRS) document is to provide a comprehensive and extensive coverage on the software requirements and specifications for StockSight, a centralized platform designed to assist businesses in managing their inventory, thus improving the efficiency and minimising the loss. This SRS will serve as the basis for the architecture, development, testing and implementation of StockSight.

The primary objectives of the StockSight software are:

1. Dashboard: Summary of sales activities and sales overview over a fixed period of time
2. Forecast: A prediction forecast of sales volume and the total profits over a fixed period of time, inclusive of weekly sales per inventory item
3. Inventory: Allows users to add inventory items and various attributes such as SKU and quantity
4. Sales Transactions: Allows users to view transaction records, add new records with various attributes, and edit the status of the transactions accordingly
5. Purchase Orders: Allows users to add new purchase orders and its various attributes, and allows managers to approve such orders

This document will cover the overall description of the StockSight system, which includes the features, interfaces, user classes descriptions, and other function or non-functional requirements of Stocksight. This document will also explain how external APIs are used and how they interact with Stocksight. The information contained in this document will ensure that all involved personnel have a comprehensive understanding of the system's intended capabilities, architecture and design.

The intended audience for this SRS includes the project sponsor, project and product managers, software developers, quality assurance team, and any other key stakeholders involved in the StockSight project.

1.2.Document Conventions

This Software Requirements Specification (SRS) document follows standard typographical conventions to ensure clarity and uniformity. Text in bold represents GUI elements, user inputs, or other emphasis. Text in italics denote newly introduced terms, important notes or areas requiring special attention. Source code, API endpoints, and database queries are presented in monospace font. Priorities for high-level requirements are inherited by detailed requirements unless explicitly stated otherwise.

Software Requirement Specification Standard: IEEE 830-1998. Priorities of higher level requirements are inherited by detailed level requirements.

Font: Times New Roman

Heading 1: Size 18, Bold

Heading 2: Size 16, Bold

Heading 3: Size 14, Bold

Content: Size 12

Line Spacing: Single

Further conventions on special terms used throughout this document are described in Appendix A: Data Dictionary

1.3. Intended Audience and Reading Suggestions

Based on the selected project idea, the following characteristics shall define the intended audience:

1. Retail Businesses
 - 1.1. Businesses looking for an automated system to manage product demand and optimize supply chain operations.
2. Warehouses and Distribution Centers
 - 2.1. Logistics firms and warehouses that handle large inventories and require precise stock management and timely replenishment alerts.
 - 2.2. Companies seeking to improve inventory turnover rates and reduce storage costs.
3. E-commerce Platforms
 - 3.1. Online marketplaces and direct-to-consumer brands that manage digital sales and fulfillment.
4. Product Managers
 - 4.1. Product managers spearheading the development and the maintenance of the StockSight software. This document also contains other useful information that can help Software Engineers in application development.

Reading suggestion:

1. Introduction
 - 1.1. This section provides an overview of the StockSight project through elaborating on the scope and mission of the project.
2. Overall Description:
 - 2.1. This section covers the details of the StockSight project, including the architecture design, user case descriptions, boundary definition, user classes descriptions as well as constraints.
3. External Interface Requirements

- 3.1. This section covers the screenshots of User Interface (UI), which helps the users to have a better idea of how StockSight will look like.
 - 3.2. This section also covers the external API and external libraries that StockSight utilized.
4. System Features
 - 4.1. This section covers the detailed description of the functional requirements of StockSight.
 5. Other Non-Functional Requirements
 - 5.1. This section covers the descriptions of the non-functional requirements of StockSight
 6. Other Requirements
 - 6.1. This section includes a data dictionary, pertinent analysis models, a list of test cases, testing and expected output, and other relevant information.
 7. Appendix
 - 7.1. This section includes information that are good to know for the users

1.4. Product Scope

Poor inventory management has been a huge issue for businesses, with many requiring help with overstocked items, and having trouble maintaining their stock levels.

Many companies have attempted to solve this issue by creating similar inventory management software that can help to track their stock levels. However, most of the existing software have bugs and data errors, and most inventory management software provide limited predictive analytics capabilities for businesses. The process requires a high customisation process, especially for large scale businesses. Even then, existing solutions do not provide predictive analytics and stock level tracking, resulting in an inefficient and inaccurate inventory management software.

Therefore, we arrived at our problem statement. How can we help local businesses manage their inventory efficiently by integrating stock level tracking, demand forecasting, and more, to create an all-in-one management software for businesses?

With all these issues in mind, we wanted to create an all-in-one software to integrate and support inventory management services for businesses. Our application, Stocksight is a web-based inventory management system designed to empower businesses with real-time stock tracking, demand forecasting, and automated inventory optimization. By leveraging data analytics and machine learning, StockSight enables companies to minimize stock outs, reduce excess inventory, and streamline supply chain operations. The system provides actionable insights through sales trend analysis and low-stock alerts, helping businesses cut costs, improve efficiency, and enhance decision-making. Stocksight offers an intuitive interface for managers and employees to monitor inventory levels, process sales transactions, and generate purchase orders seamlessly. Our mission is to eliminate manual inventory errors and support scalable growth by delivering a solution that

adapts to dynamic market demands. Ultimately, Stocksight aims to become an all-in-one inventory intelligence platform, driving profitability through smarter inventory management.

1.5. References

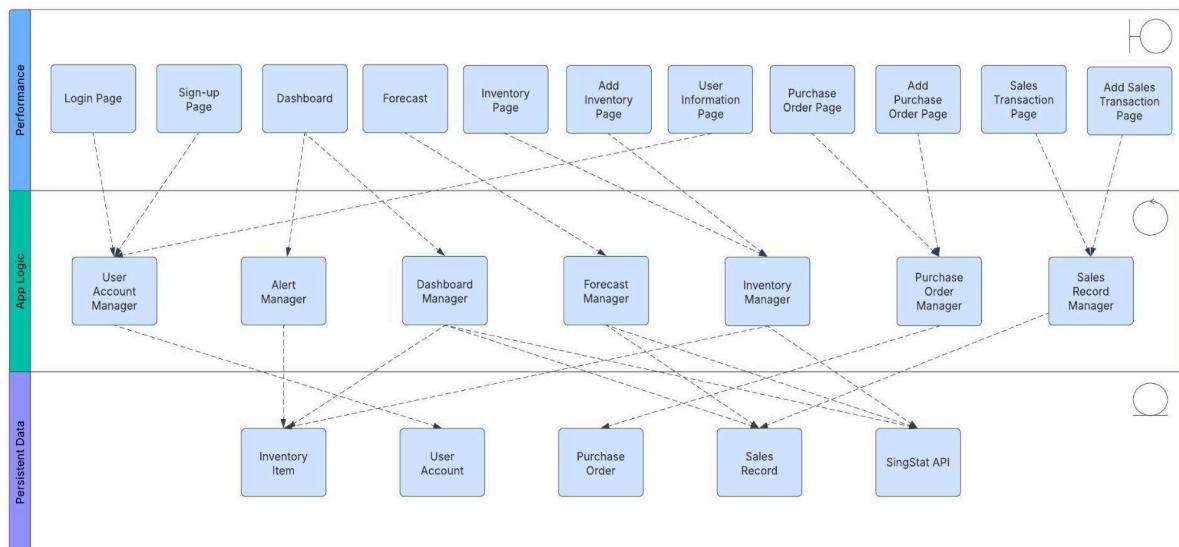
1. MongoDB documentation. MongoDB, Inc (2023). Retrieved 4th April from <https://www.mongodb.com/docs/>.
2. Singstat link

2. Overall Description

2.1. Product Perspective

StockSight is a new, self-contained product designed for e-commerce inventory management. It is not a follow-on member of a product family. However, we aim to eliminate spreadsheets and legacy systems with an automated, data-driven solution for business to adapt.

The architecture design diagram of Stocksight is shown below for a brief overview of how StockSight operates.



2.2. Product Functions

The StockSight software is designed to provide businesses with a seamless inventory tracking experience by integrating real time industry data, forecasting abilities, and order tracking capabilities. StockSight consist of 5 major categories - User Account Management, Inventory Management, Purchase Order Management, Sales Transaction Management, Data Management

2.2.1. User Account Management

1. User Registration
2. User Login
3. User Profile Edit

2.2.2. Inventory Management

1. Add Inventory Item
2. Delete Inventory Item
3. Display Inventory Item Details and Sales Prediction

2.2.3. Purchase Order Management

1. Add Purchase Order
2. Delete Purchase Order
3. Filter Purchase Order
4. Search Purchase Order
5. Approve Purchase Order

2.2.4. Sales Transaction Management

1. Add Sales Transaction
2. View Sales Transaction
3. Update Sales Transaction
4. Filter Sales Transaction
5. Search Sales Transaction
6. Delete Sales Transaction

2.2.5. Data Management

1. View Dashboard
2. View Forecast
3. Send Below Reorder Point Notification

2.3. User Classes and Characteristics

2.3.1. Inventory Manager

Aspect	Description
Frequency of Use	High

Subset of Product Function Used	<ul style="list-style-type: none"> • Inventory Management • Reorder Point Management • Purchase Order Management • Sales Transaction Management • Dashboard Analytics
Technical Expertise	<ul style="list-style-type: none"> • Understand data trends • Familiar with browser-based inventory management systems • Uses data-driven decision making
Characteristic	<ul style="list-style-type: none"> • Decision-maker; relies on accurate stock/sales data. • Needs granular control over inventory thresholds. • Prioritizes time-saving automation (e.g., auto-PO generation).

2.3.2. Sales Employees

Aspect	Description
Frequency of Use	Very High
Subset of Product Function Used	<ul style="list-style-type: none"> • Recording sales transactions • Updating sales transactions statuses • Managing customer information
Technical Expertise	<ul style="list-style-type: none"> • Familiar with simple data entry tasks • Familiar with standard web interfaces
Characteristic	<ul style="list-style-type: none"> • Task-oriented and accuracy-focused • Comfortable with repetitive data entry tasks, • Responsive to customer interactions and quick updates

2.3.3. Purchasing Employees

Aspect	Description
Frequency of Use	High
Subset of Product Function Used	<ul style="list-style-type: none"> • Creating purchase orders

	<ul style="list-style-type: none"> • Tracking order statuses • Managing vendor details
Technical Expertise	<ul style="list-style-type: none"> • Comfortable using structured interfaces for managing purchase orders
Characteristic	<ul style="list-style-type: none"> • Methodical, systematic in tracking purchase order statuses • Vendor relationship management, and procurement tasks.

2.3.4. Business Analysts / Managers

Aspect	Description
Frequency of Use	Moderate to High
Subset of Product Function Used	<ul style="list-style-type: none"> • Inventory Management • User Account Management • Sales Transaction Management • Viewing dashboards • Approving purchase orders • Reviewing industry trends • Generating reports
Technical Expertise	<ul style="list-style-type: none"> • Analytical skills and data science • Proficient with business analytics dashboards and forecasting tools
Characteristic	<ul style="list-style-type: none"> • Analytical, strategic thinkers • Data-driven decision-makers who rely heavily on accurate insights and forecasts • Leadership-oriented <p><i>** Refer to Appendix C for more details on machine learning models</i></p>

2.3.5. System Administrators

Aspect	Description
Frequency of Use	Low to moderate

Subset of Product Function Used	<ul style="list-style-type: none"> User account management Role-based access control Security management, troubleshooting.
Technical Expertise	<ul style="list-style-type: none"> Expert in software administration Role management, security practices.
Characteristic	<ul style="list-style-type: none"> Highly technical, problem-solvers Concerned with system integrity Security-oriented Quick responders to technical issues and system maintenance tasks.

2.4. Operating Environment

The production and development environment of StockSight Web application will be covered under this section.

2.4.1. User Device Permissions

1. Internet Connection: Enables real-time fetching of SingStat API data and backend communication
2. Browser storage: Required to store user authentication tokens and session information.
3. Email Sending / Receiving: Used for sending verification codes for new account registrations.

2.4.2. External API Permissions

The following permissions are required for integration with external services.

1. SingStat API: Authorization to fetch real-time industry-specific data for sales prediction, industry health analysis, and business forecasting.

2.4.3. Local Environment

The StockSight Application operates entirely in a local environment, requiring the following system setup:

1. Frontend: Developed using React with TypeScript. The frontend utilizes React Router for navigation, React Bootstrap for UI components, and Recharts/Chart.js libraries for data visualization.
2. Backend: Built with Python Flask framework, leveraging libraries such as Pandas, NumPy, scikit-learn, statsmodels (for SARIMAX forecasting), and sentence-transformers (for product categorization via NLP embedding).

3. Database: MongoDB stores user authentication details, inventory management data, sales transactions, and purchase orders.
4. Compatibility: The application is fully compatible with modern browsers (Chrome, Firefox, Safari, Edge) across Windows, macOS, Android, and iOS.

2.4.4. Development Environment

The development of StockSight is carried out in the following local setup:

System Requirements:

- Operating System: Windows 10+, macOS, Linux
- Processor: Intel Core i5 or equivalent (recommended Core i7 or higher)
- Memory: Minimum 8 GB RAM (16 GB recommended for optimal performance)
- Disk Space: At least 10 GB available space
- Internet Connection: Stable internet access required for API usage and dependency management

Development Environment	Description
Version Control: Git, GitHub	Git manages source code versioning. GitHub hosts the repository for collaborative development and code management.
Frontend Framework (React, TypeScript)	<p>React is a powerful, open-source JavaScript library developed by Facebook, tailored for building dynamic, responsive user interfaces, especially in single-page applications. It empowers developers to build reusable UI components that efficiently handle real-time data, simplifying the creation of interactive and complex front-end experiences. React employs a component-based architecture, where each component manages its own state, resulting in structured, maintainable, and scalable code.</p> <p>A standout feature of React is its virtual DOM, which boosts performance by updating only specific elements of the UI rather than re-rendering the entire page. This approach ensures quicker, smoother interactions. Additionally, React's versatility and seamless integration with other libraries and frameworks make it an ideal choice for developing scalable applications with efficient rendering and</p>

	responsive user interactions.
Backend Framework (Flask)	<p>Flask is a lightweight, open-source web framework for Python, designed to build robust, dynamic web applications and APIs. Known for its simplicity and flexibility, Flask allows developers to create customized backend systems tailored specifically to their application's requirements. Its minimalist structure is highly effective for handling RESTful APIs, server-side logic, and database operations, providing a streamlined backend development experience.</p> <p>The modular design of Flask lets developers include only the essential components, keeping it efficient and focused. Core functionalities such as URL routing, request handling, and session management come built-in, while integration with external libraries easily supports advanced features like database connections (e.g., MongoDB, SQLite) and external API interactions.</p> <p>A key strength of Flask is its simplicity, significantly reducing development time and enabling developers to concentrate on core application logic. Leveraging Python's extensive ecosystem of libraries, Flask enhances flexibility, supporting tasks like data processing, caching, and real-time updates. Its adaptability ensures scalable, maintainable backend architectures, making Flask a preferred framework for dynamic applications like StockSight.</p>
Database (MongoDB)	MongoDB is an open-source, NoSQL database designed for efficient storage, retrieval, and management of flexible, semi-structured data. Its document-oriented architecture stores information as JSON-like documents, providing a natural and intuitive data representation ideal for dynamic applications. MongoDB's schema-less structure allows for

	<p>rapid iteration and easy scalability, enabling developers to adapt quickly to evolving data requirements.</p> <p>Key advantages of MongoDB include its high performance, horizontal scalability through sharding, and robust querying capabilities. It efficiently handles large volumes of data, supporting real-time analytics, indexing, and aggregation. This combination of flexibility, scalability, and performance makes MongoDB especially suitable for modern applications requiring responsive data management, such as StockSight.</p>
Data & ML Libraries (Pandas, NumPy, scikit-learn, statsmodels, sentence-transformers)	<p>StockSight utilizes several powerful Python data and machine learning libraries, providing comprehensive analytical capabilities and predictive functionality:</p> <p>Pandas: A data manipulation and analysis library offering intuitive structures such as DataFrames, ideal for handling structured datasets, preprocessing tasks, and feature engineering.</p> <p>NumPy: A foundational numerical computing library in Python, essential for efficient numerical operations, matrix manipulations, and mathematical computations required by analytics workflows.</p> <p>scikit-learn: A widely-used machine learning library providing robust tools for predictive modeling, classification, clustering, and model evaluation, simplifying the deployment of advanced analytics solutions.</p> <p>statsmodels: Specializes in statistical modeling and time-series forecasting (e.g., SARIMAX models), enabling accurate predictive insights and trend analysis for business forecasting.</p> <p>sentence-transformers: An NLP library producing advanced embeddings from textual data, allowing accurate categorization and</p>

	<p>semantic analysis of product names and descriptions, enhancing StockSight's capability in predictive analytics and industry-specific categorization tasks.</p> <p><i>** Refer to Appendix C for more details on machine learning models</i></p>
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2.5.Design and Implementation Constraints

This section outlines the constraints and limitations within which StockSight was designed and implemented:

1. Limited development budget hinders the usage of more advanced and reliable APIs.
2. Technology stack and usage of a specific framework determined by the development team. Front-end development limited to React.js with TypeScript. Backend restricted to Python using Flask, MongoDB as the primary database.
3. Reliance on real-time data from external APIs may lead to performance degradation due to the dependency on SingStat API availability and response time, subject to API provider constraints and potential downtimes.
4. Machine learning accuracy and performance dependent on the availability and quality of historical data, particularly from SingStat API datasets.
5. The application is locally hosted, requiring users to set up their environment (e.g., installing dependencies, configuring servers) rather than using centralised hosting or cloud services.

2.6.User Documentation

User documentation will include:

- README.md (For users and developers)
 - The README document provides the overview of all the functions and the logic behind the analysis. It can be accessed at:
 - <https://github.com/softwarelab3/2006-SCEA-I3/blob/main/README.md>

2.7.Assumptions and Dependencies

<List any assumed factors (as opposed to known facts) that could affect the requirements stated in the SRS. These could include third-party or commercial components that you plan to use, issues around the development or operating environment, or constraints. The project could be affected if these assumptions are incorrect, are not shared, or change. Also identify any dependencies the project has on external factors, such

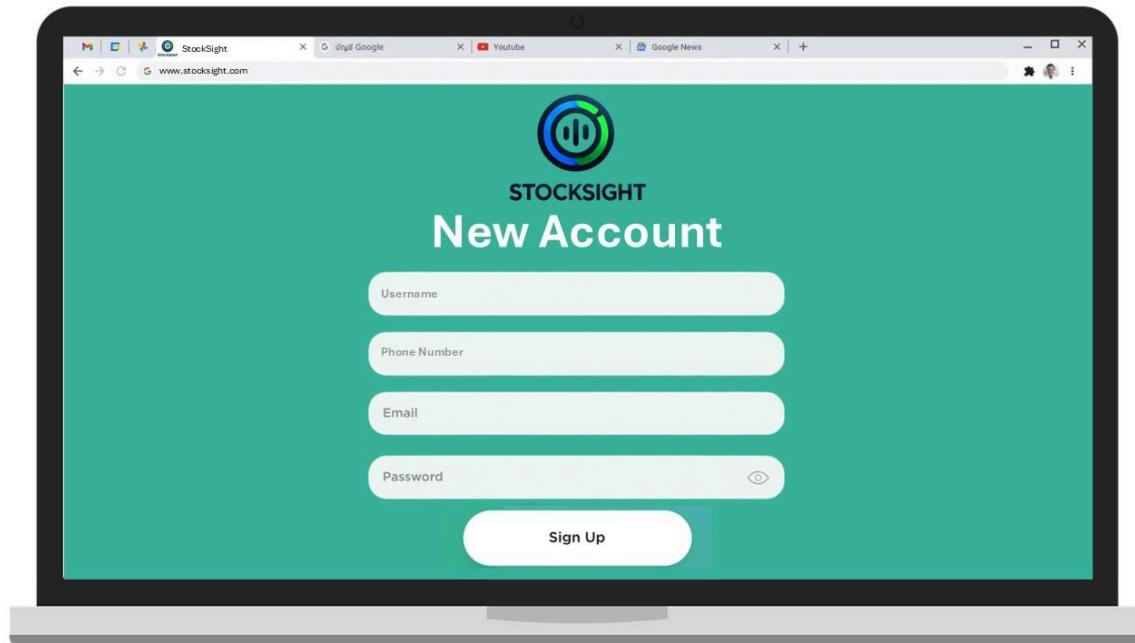
as software components that you intend to reuse from another project, unless they are already documented elsewhere (for example, in the vision and scope document or the project plan).>

- Assumptions:
 - Users will maintain stable internet connectivity for real time data synchronisation.
 - The SingStat API used is reliably accessible and returns timely, accurate data.
 - Historical sales data of more than 3 months exists for forecasting.
- Dependencies:
 - Cloud provider uptime will affect Stocklight performance
 - Third-party API such as MongoDB and SingStat will allow StockSight to be developed smoothly

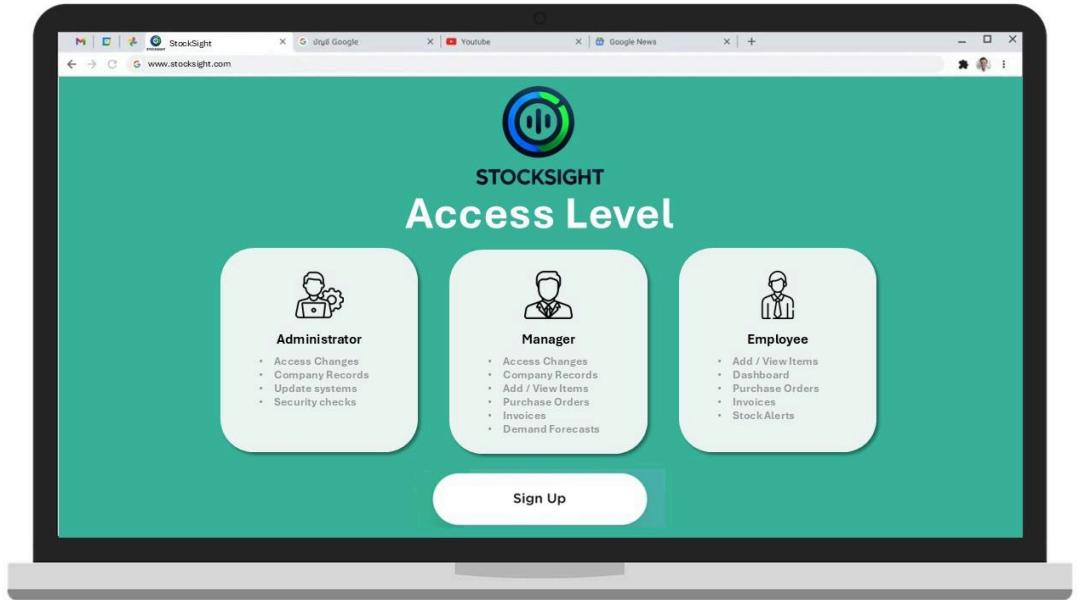
3.External Interface Requirements

3.1.User Mockups

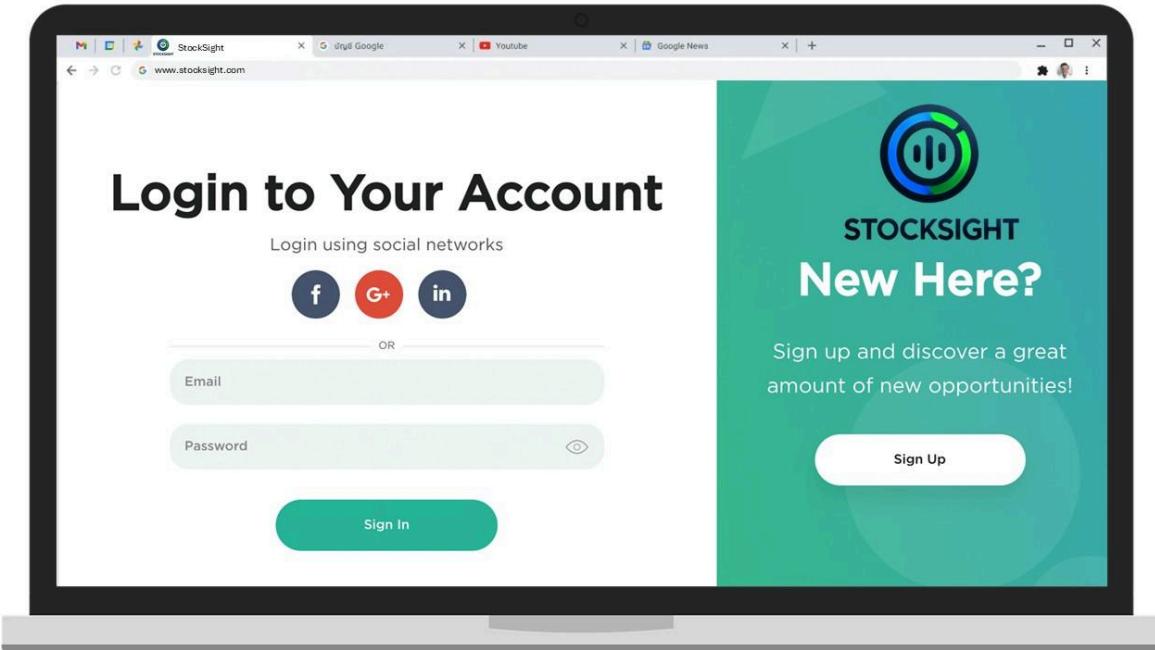
3.1.1 Create Account



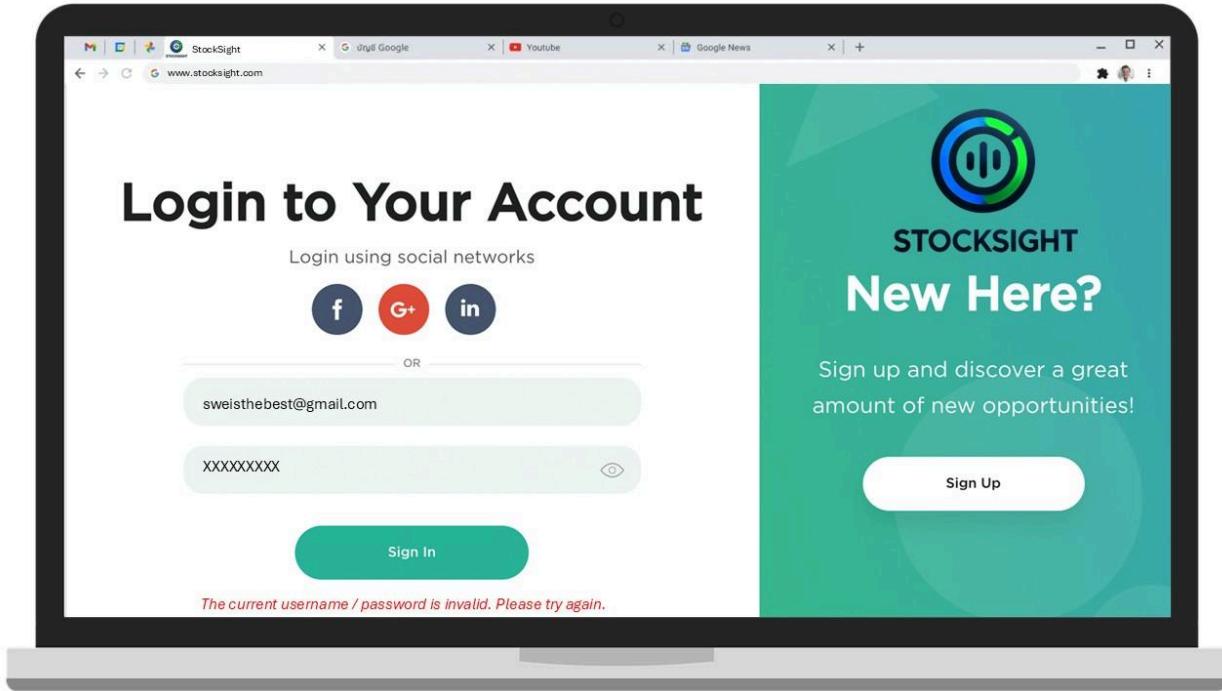
3.1.2 Access Level for new account



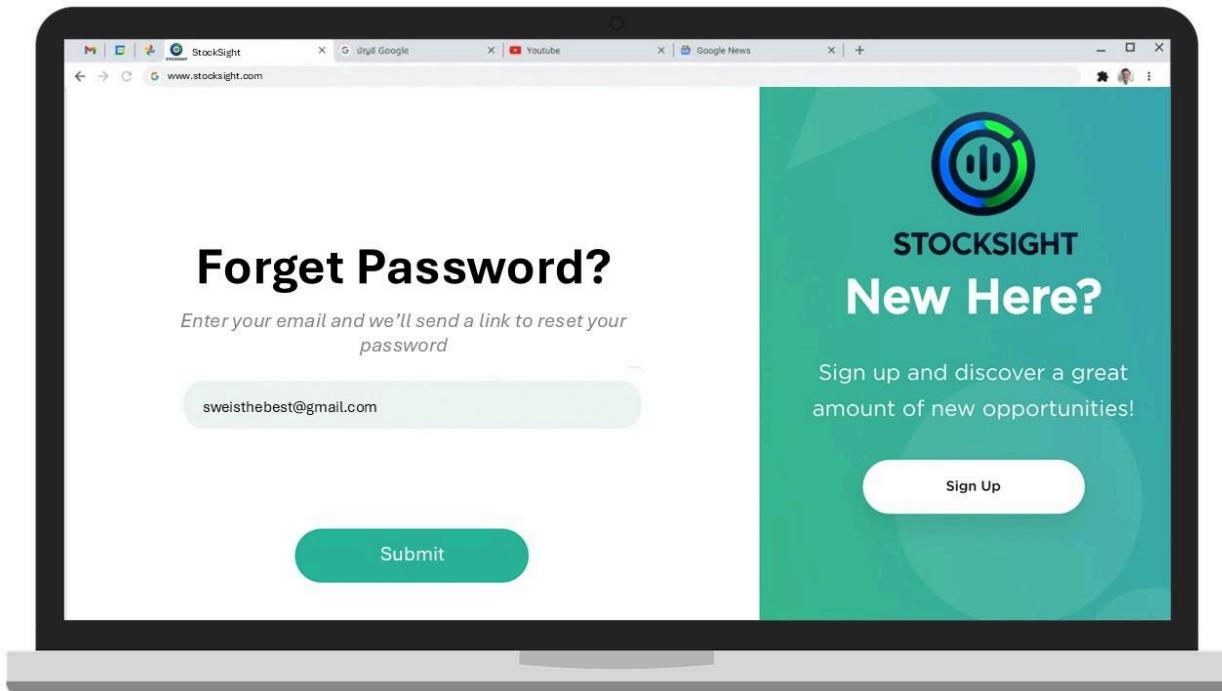
3.1.3 Login Page



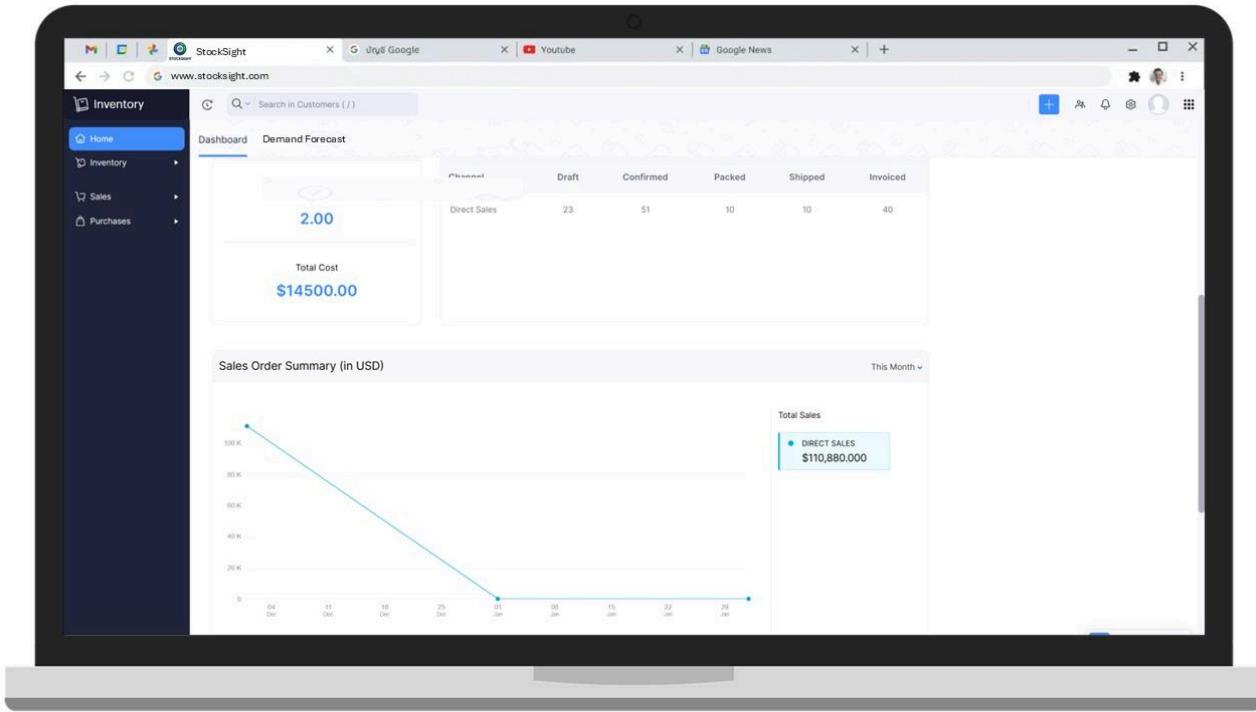
3.1.4 Login Page (Invalid Credentials)



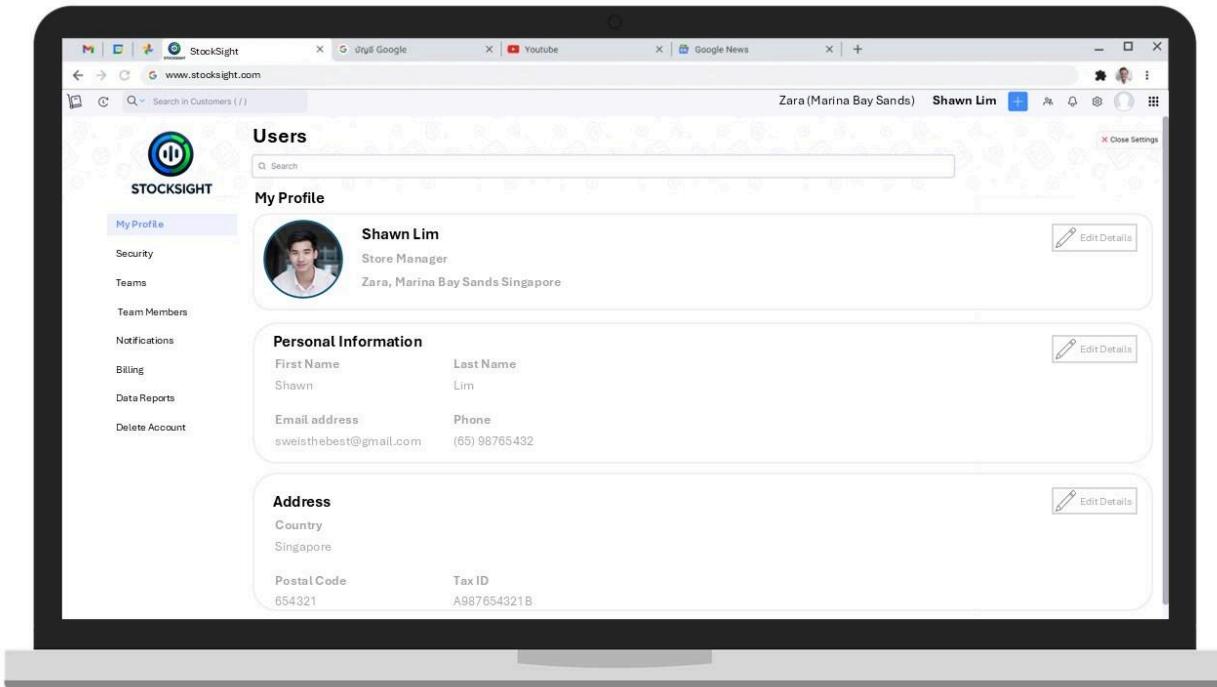
3.1.5 Login Page (Forgotten Password Reset)



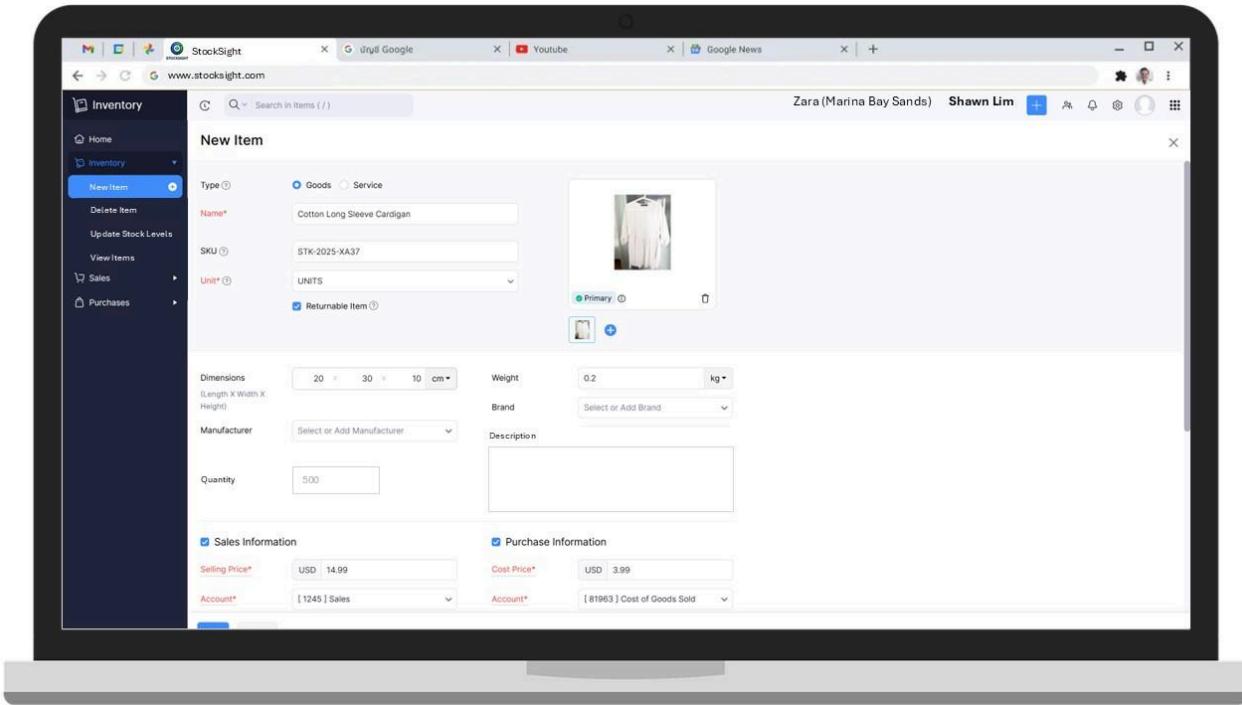
3.1.6 Dashboard



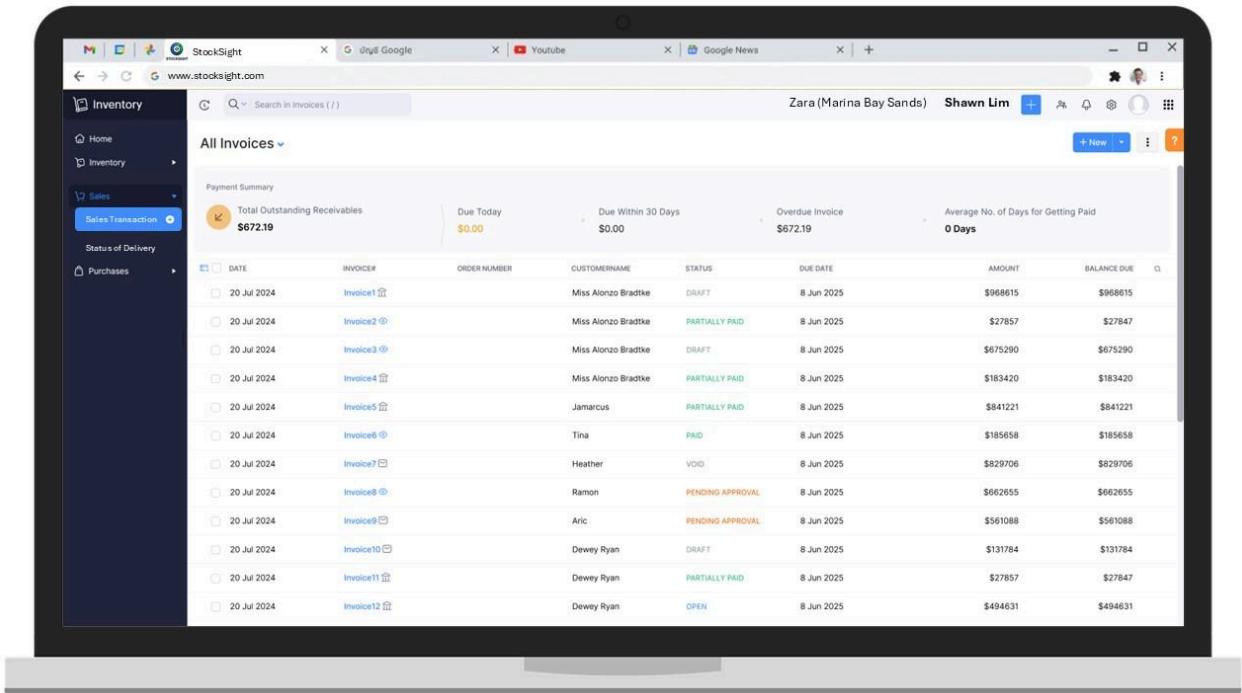
3.1.7 Profile



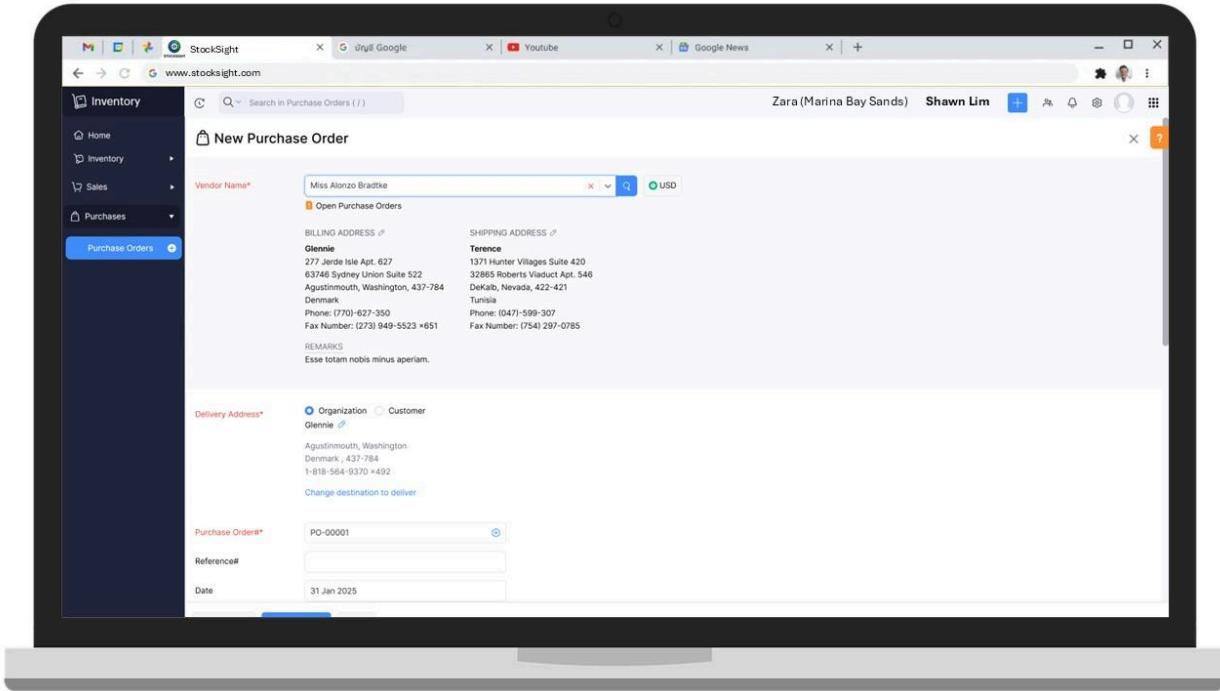
3.1.8 Adding Items



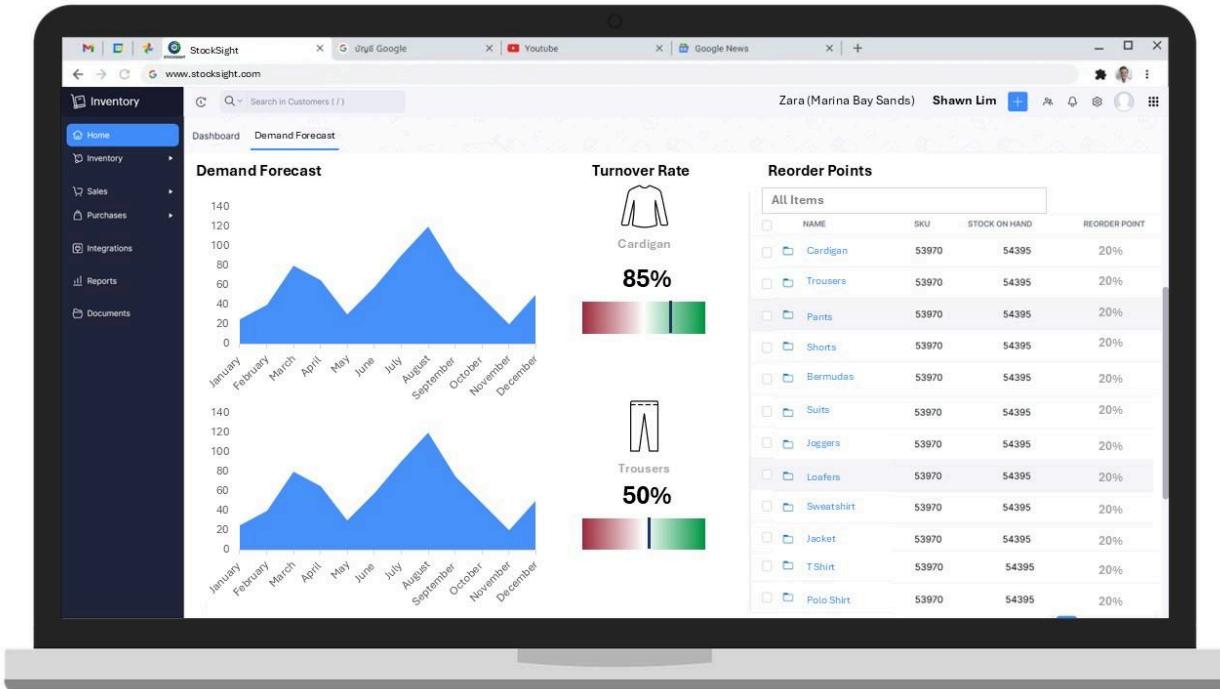
3.1.9 Sale Transaction Page



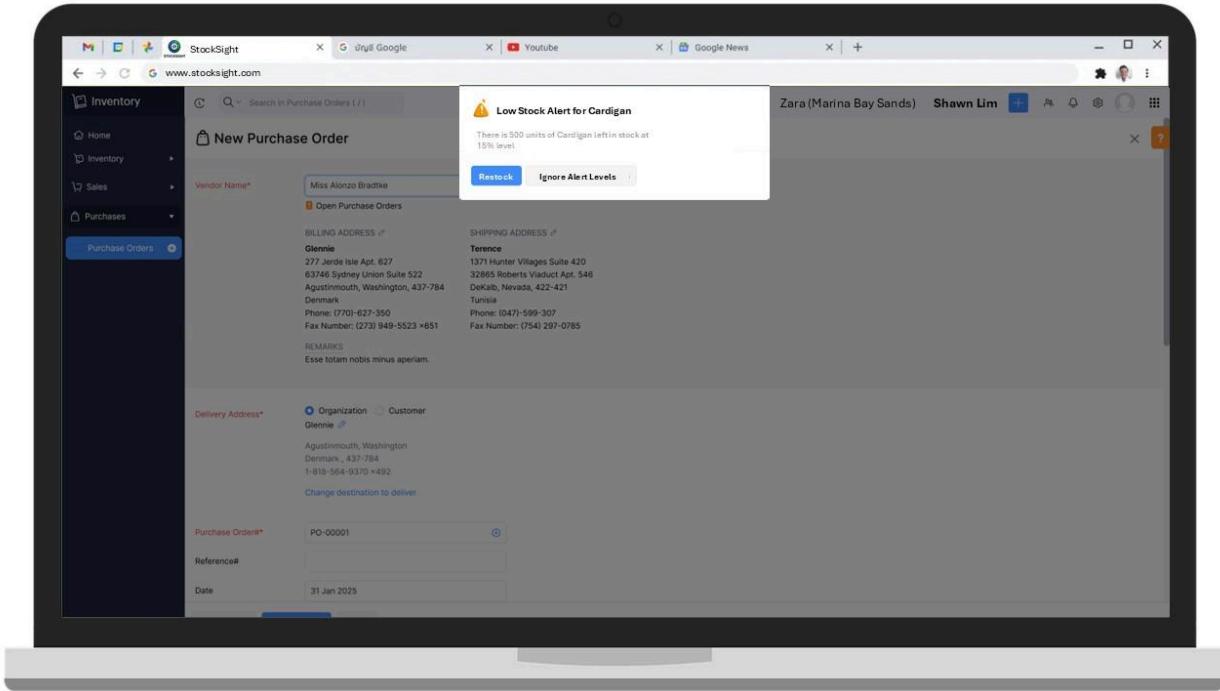
3.1.10 Purchase Order Page



3.1.11 Demand Forecasting Page

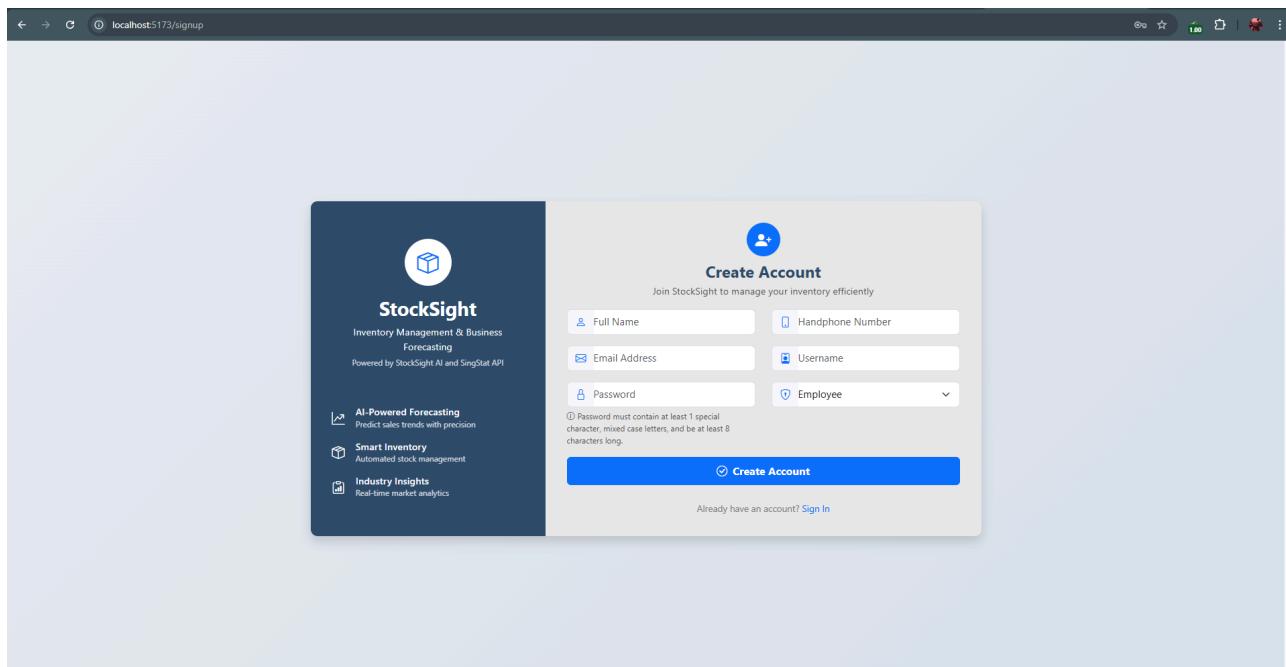


3.1.12 Low Stock Alert

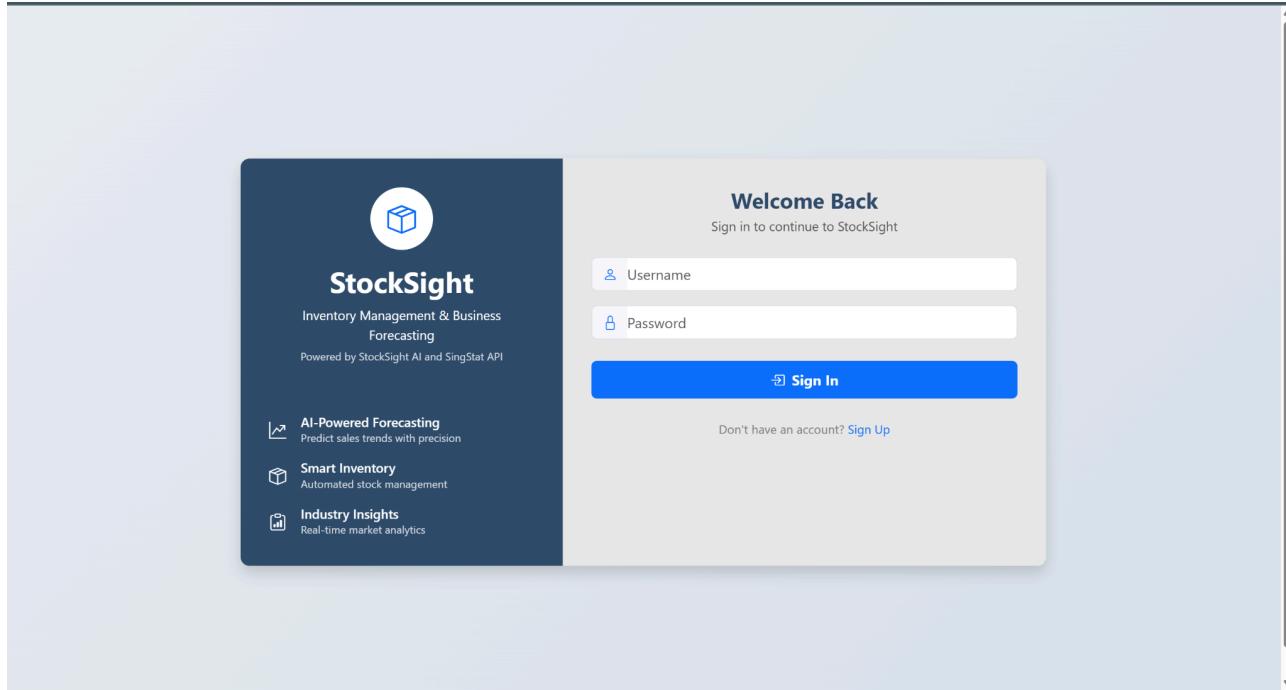


3.2. User Interface

3.2.1 Create New Account



3.2.2 Login



3.2.3 Introduction Page

Welcome to StockSight

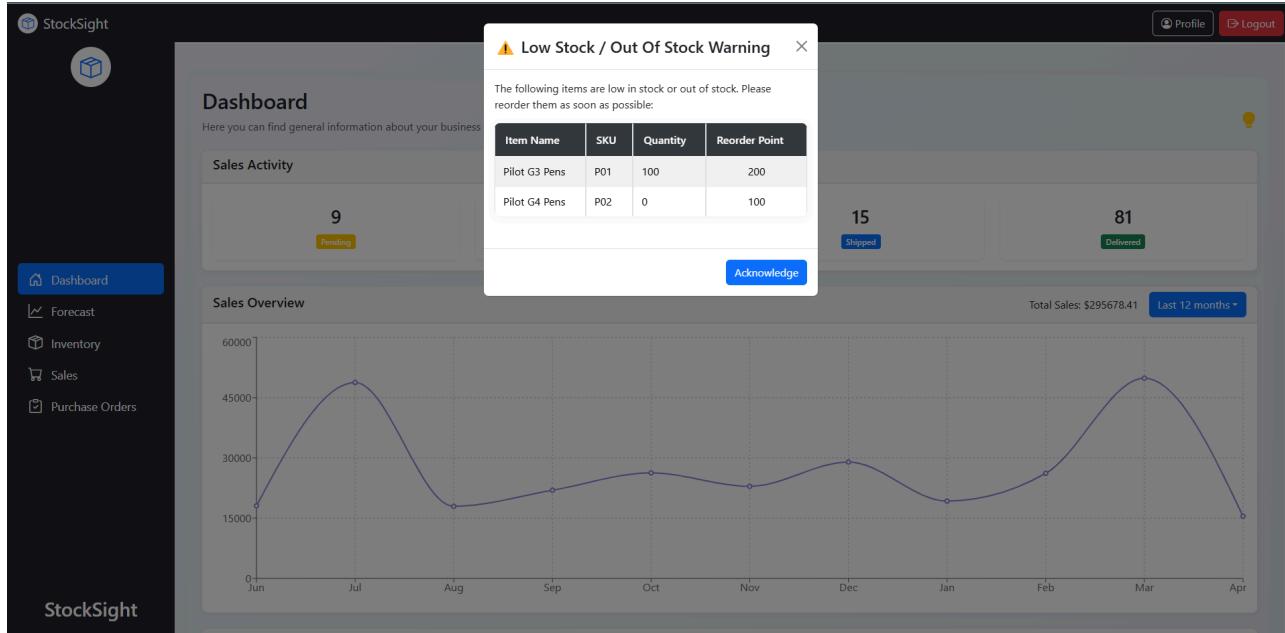
Your intelligent inventory management and business forecasting solution
Powered by StockSight AI and SingStat API

Discover what StockSight can do for you

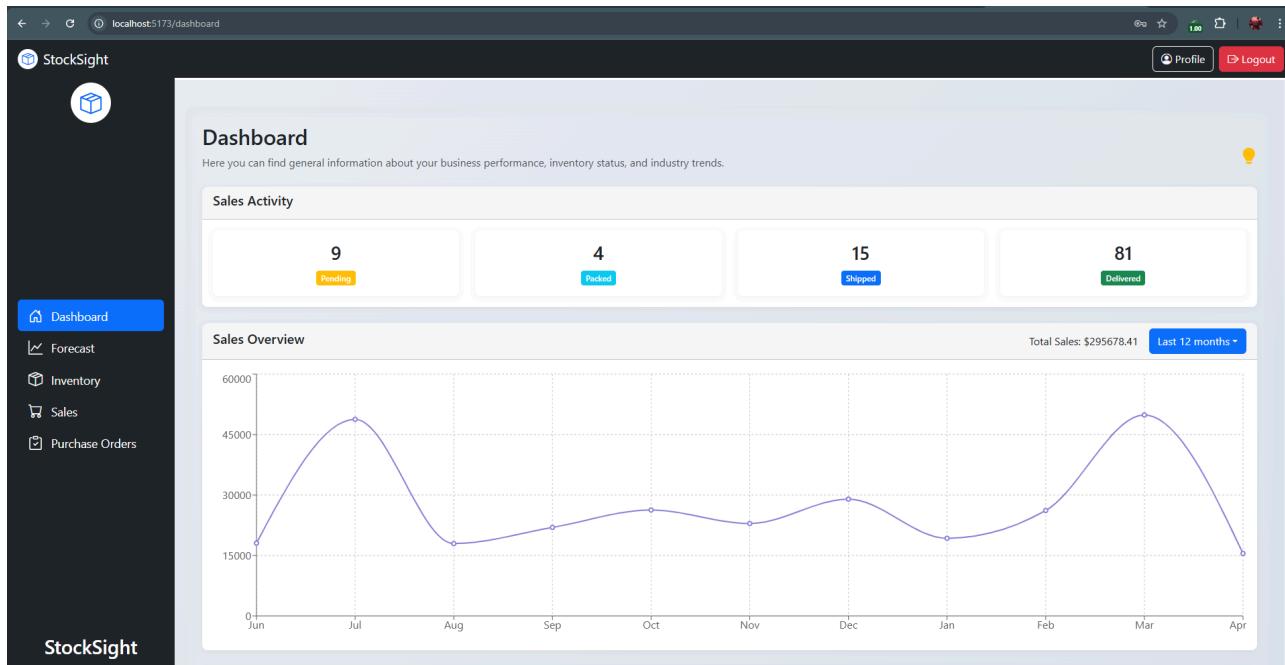
- Dashboard**: Get a comprehensive overview of your business with real-time metrics, sales activity tracking, and industry health indicators.
- Forecast**: Leverage AI-powered predictions to anticipate sales trends, optimize inventory, and make data-driven business decisions.
- Inventory**: Efficiently manage your stock with automated low-stock alerts, detailed item tracking, and streamlined inventory operations.
- Sales**: Track all your transactions, monitor customer purchases, and analyze sales performance across different time periods.
- Purchase Orders**: Create and manage purchase orders with vendors, track order status, and automatically update inventory upon approval.
- User Profile**: Manage your account settings, update personal information, and customize your StockSight experience.

StockSight combines powerful analytics with industry data to provide you with actionable insights for your business.

3.2.4 Low Stock Alert



3.2.5 Dashboard Page



3.2.6 Manufacturing Sector Statistics Page

The screenshot shows the StockSight dashboard with a dark theme. At the top, there's a header bar with a profile icon, a logout button, and a search bar. Below the header is a navigation sidebar with links for Dashboard, Forecast, Inventory, Sales, and Purchase Orders. The main content area has two large sections: "Top 5 Services Sectors" and "Top 5 Manufacturing Sectors". Each section contains a line chart showing cumulative average net weighted balance over time from Q1 '22 to Q4 '24. The "Services Sectors" chart includes Accommodation, Other Financial Services, Accommodation & Food Services, Insurance Companies, and Recreation, Community & Personal Services. The "Manufacturing Sectors" chart includes Aerospace, Transport Engineering, Marine & Offshore Engineering, Semiconductors, and Others. Below each chart is a "Ranked List of Top 5 Service/Mfg Sectors in Singapore" section with a note about using cumulative averages for long-term trends.

3.2.7 Forecasting Page

The screenshot shows the StockSight forecasting page with a dark theme. The header and sidebar are identical to the dashboard. The main content area features two large boxes: "Sales Metrics" and "Profit Metrics". The "Sales Metrics" box displays Predicted Sales (\$10,400), Sales Growth (+8566.6%), and Forecast Confidence (37%). The "Profit Metrics" box displays Predicted Profit (\$2,833), Profit Margin Trend (+4622.2%), and Top Growth Product (Air Wrap). Below these boxes is a chart titled "Total Sales (Past 2-3 Weeks + Prediction)" showing a downward trend from approximately 16,000 to 12,000 over time, with a legend indicating "Total Sales".

3.2.8 Profile Page

The screenshot shows the StockSight profile page at localhost:5173/profile. The top navigation bar includes links for Profile and Logout. The main content area displays a "Profile" section with the following details:

- Full Name:** Lim Jun Shawn
- Access level:** Manager
- Email:** shawnlim202@gmail.com [Edit](#)
- Username:** Shawn_1m [Edit](#)

The left sidebar contains navigation links: Dashboard, Forecast, Inventory (which is highlighted in blue), Sales, and Purchase Orders. The bottom of the sidebar features the StockSight logo.

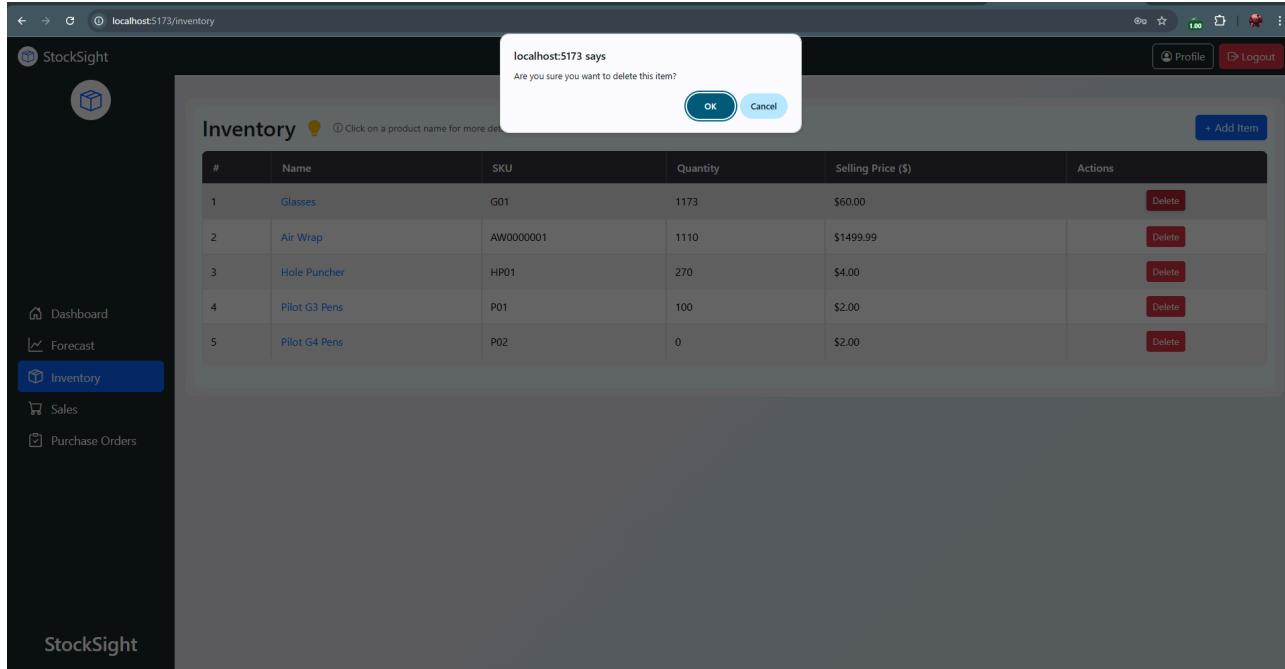
3.2.9 Inventory Page

The screenshot shows the StockSight inventory page at localhost:5173/inventory. The top navigation bar includes links for Profile and Logout. The main content area displays an "Inventory" table with the following data:

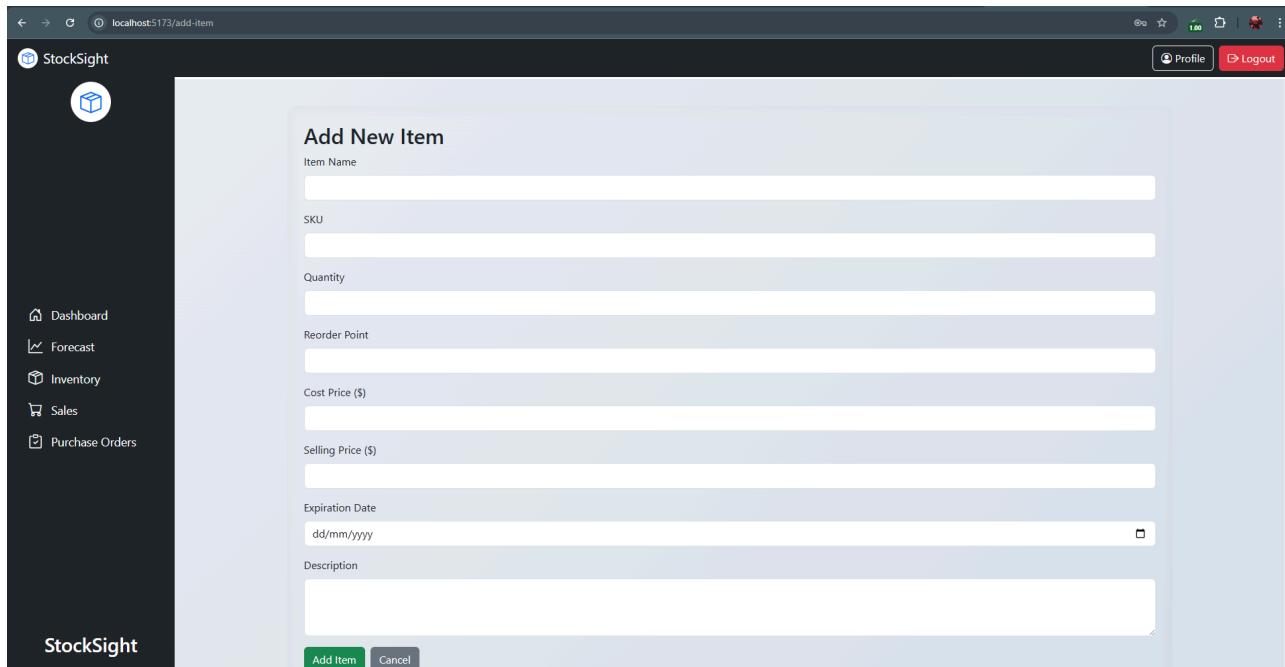
#	Name	SKU	Quantity	Selling Price (\$)	Actions
1	Glasses	G01	1173	\$60.00	Delete
2	Air Wrap	AW0000001	1110	\$1499.99	Delete
3	Hole Puncher	HP01	270	\$4.00	Delete
4	Pilot G3 Pens	P01	100	\$2.00	Delete
5	Pilot G4 Pens	P02	0	\$2.00	Delete

The left sidebar contains navigation links: Dashboard, Forecast, Inventory (which is highlighted in blue), Sales, and Purchase Orders. The bottom of the sidebar features the StockSight logo.

3.2.10 Delete Inventory Confirmation



3.2.11 Add Inventory Item



3.2.12 Sale Transaction Page

The screenshot shows the StockSight Sales Transactions page. On the left is a dark sidebar with icons for Dashboard, Forecast, Inventory, Sales (which is selected), and Purchase Orders. The main area has a header "Sales Transactions" with a search bar, status dropdown, and date input. Below is a table with columns: Transaction ID, Item, Quantity, Customer, Date, Status, Total Price, and Actions. The table lists various sales entries, each with a unique ID, item name like "Glasses" or "Deodorant", quantity, customer name like "Wendy" or "GAV", purchase date, status (e.g., Shipped, Delivered, Pending), total price, and a set of edit and delete icons.

Transaction ID	Item	Quantity	Customer	Date	Status	Total Price	Actions
3d10c624-42ee-4e2b-8988-c922ee907993	Glasses	20	Wendy	2025-03-27	Shipped	\$1200.00	
113630f7-aa73-42d5-bb89-d545d8e83d	Deodorant	10	GAV	2025-03-30	Shipped	\$12000.00	
a686e3dd-4f70-4425-b567-d48d9fe5c7e	Deodorant	1	GAV	2025-03-27	Delivered	\$1200.00	
fde55ff0-ce01-4217-876a-f395fcf399b4	Glasses	2	gav	2025-03-27	Delivered	\$120.00	
64347817-5ad0-4ba1-986e-fb7becdbb55	Glasses	5	gav	2025-04-01	Shipped	\$300.00	
e42ca0ab-ecd0-404a-a682-22dea9a5e0dc	Glasses	20	gav	2025-03-27	Delivered	\$1200.00	
b158c096-a849-4c78-b2a8-5f1650b98a1f	Glasses	1		2025-04-05	Shipped	\$60.00	
a2793517-ffaa-4995-9e53-bf325a70dd81	Air Wrap	10	kjnkjn	2025-04-01	Pending	\$14999.90	
4a450599-0dad-4cd7-a518-d9800ffcd71	Air Wrap	2	Wendy	2024-06-12	Delivered	\$2999.98	
4702538d-196a-4ae4-951a-b699b6b76357	Glasses	1	Wendy	2024-06-16	Delivered	\$60.00	
dde24717-c18d-4022-8966-c5be8fc997ed	Air Wrap	1	Priya	2024-06-16	Delivered	\$1499.99	
519713bc-d0ac-42a1-ba81-25e1dd9f3ed9	Glasses	18	Marcus	2024-06-20	Delivered	\$1080.00	
b5a55631-5187-49c2-9eac-2b32a2cec8db	Air Wrap	1	John	2024-06-20	Delivered	\$1499.99	

3.2.13 Sale Transaction Details

The screenshot shows the StockSight Sales Transactions page with a modal dialog titled "Transaction Details". The modal displays the following information for the transaction with ID 3d10c624-42ee-4e2b-8988-c922ee907993: SKU: G01, Item Name: Glasses, Quantity: 20, Customer Name: Wendy, Payment Method: cash, Transaction Date: 2025-03-27, Status: Shipped, and Total Price: \$1200.00. The background table and sidebar are visible.

Date	Status	Total Price	Actions
2025-03-27	Shipped	\$1200.00	
2025-03-30	Shipped	\$12000.00	
2025-03-27	Delivered	\$1200.00	
2025-03-27	Delivered	\$120.00	
2025-04-01	Shipped	\$300.00	
2025-03-27	Delivered	\$1200.00	
2025-04-05	Shipped	\$60.00	
2025-04-01	Pending	\$14999.90	
2024-06-12	Delivered	\$2999.98	
2024-06-16	Delivered	\$60.00	
2024-06-16	Delivered	\$1499.99	
2024-06-20	Delivered	\$1080.00	
2024-06-20	Delivered	\$1499.99	

3.2.14 Update Transaction Status

The screenshot shows the StockSight Sales Transactions page. A modal window titled "Update Transaction Status" is open, prompting the user to change the status of a transaction. The current status is "Shipped". The new status dropdown menu includes "Pending", "Packed", "Shipped" (which is selected), and "Delivered". The main table lists various sales transactions with columns for Date, Status, Total Price, and Actions.

Date	Status	Total Price	Actions
2025-03-27	Shipped	\$1200.00	
2025-03-30	Shipped	\$12000.00	
2025-03-27	Delivered	\$1200.00	
2025-04-01	Shipped	\$300.00	
2025-03-27	Delivered	\$1200.00	
2025-04-05	Shipped	\$60.00	
2025-04-01	Pending	\$14999.90	
2024-06-12	Delivered	\$2999.98	
2024-06-16	Delivered	\$60.00	
2024-06-16	Delivered	\$1499.99	
2024-06-20	Delivered	\$1080.00	
2024-06-20	Delivered	\$1499.99	

3.2.15 Add Sale Transaction

The screenshot shows the StockSight Sales Transactions page with an open "Add Sales Transaction" modal. The modal form contains fields for Item (a dropdown menu), Quantity (set to 1), Customer Name (Wendy), Payment Method (Cash), Transaction Date (12/04/2025), and Total Price (\$0.00). The main table on the right lists existing sales transactions with columns for Status, Total Price, and Actions.

Status	Total Price	Actions
Shipped	\$1200.00	
Shipped	\$12000.00	
Delivered	\$1200.00	
Delivered	\$120.00	
Shipped	\$300.00	
Delivered	\$1200.00	
Shipped	\$60.00	
Pending	\$14999.90	
Delivered	\$2999.98	
Delivered	\$60.00	
Delivered	\$1499.99	
Delivered	\$1080.00	
Delivered	\$1499.99	

3.2.16 Purchase Order Page

The screenshot shows the StockSight application interface for managing purchase orders. On the left, there is a sidebar with icons for Dashboard, Forecast, Inventory, Sales, and Purchase Orders. The Purchase Orders icon is highlighted with a blue box. The main content area has a header "Purchase Orders" with a search bar and a status dropdown set to "All Statuses". Below is a table with the following data:

Reference #	Item Name	SKU	Vendor	Quantity	Status	Actions
PO-79FB8F32	Iphone4	IP4	apple	2	approved	<button>Delete</button>
PO-A187DD9F	Glasses	G01	Nanyang Optical	10	approved	<button>Delete</button>
PO-66029E2B	Chocolate	CHO1100111	Hersheys	10	pending	<button>Approve</button> <button>Delete</button>
PO-C9C7135F	Chocolate	CHO1100111	skibidi	67	pending	<button>Approve</button> <button>Delete</button>
PO-E16AD502	Chocolate	CHO1100111	yuwgfw	6	approved	<button>Delete</button>
PO-552EF327	Bottle	B01	hiuehf	10	pending	<button>Approve</button> <button>Delete</button>
PO-EA46A4D9	Air Wrap	AW0000001	wef	10	approved	<button>Delete</button>
PO-2B7A5E06	Glasses	G01	Optic	13	approved	<button>Delete</button>
PO-F6C53466	Hole Puncher	HP01	Popular	100	approved	<button>Delete</button>
PO-88956C65	Hole Puncher	HP01	Popular	100	approved	<button>Delete</button>

3.2.17 Delete Purchase Order Confirmation

The screenshot shows the same StockSight Purchase Orders page as above, but with a modal dialog box in the center. The dialog box has a title "localhost:5173 says" and the message "Are you sure you want to delete this purchase order?". It contains two buttons: "OK" and "Cancel".

3.2.18 Add Purchase Order

The screenshot shows a web browser window for 'localhost:5173/create-purchase-order'. The page title is 'StockSight'. On the left, there's a sidebar with icons for Dashboard, Forecast, Inventory, Sales, and Purchase Orders. The main content area has a heading 'Create New Purchase Order'. It contains four input fields: 'Item Name' (with a note 'Will auto-fill from SKU'), 'SKU' (with a note 'Type or select a valid SKU from inventory'), 'Vendor' (with a note 'Enter vendor name'), and 'Quantity' (with a value '1'). At the bottom are two buttons: 'Create Purchase Order' (blue) and 'Cancel' (grey).

3.3.Hardware Interfaces

This section describes the hardware interfaces required for the StockSight web application to perform effectively and reliably.

Requirements	Description
Operating System	<ul style="list-style-type: none"> - For Windows: Windows 10 and later versions - For macOS: macOS 10.15 and later versions - For Linux: Ubuntu, Debian, Fedora
Network Infrastructure	Wireless Network Interface Card (WNIC) on a modern chip with a cellular modem, with a standard TCP / IP based network supporting HTTP / HTTPS protocol.
Database Server	Host server with adequate CPU, RAM, storage for MongoDB operations.
Interaction	A functional touchpad or mouse to navigate through the website.

3.4.Software Interfaces

Operating Systems:

1. Windows 10 or later

2. macOS 10.15 or later
3. Linux (Ubuntu 20.04 recommended)

Tools:

1. Visual Studio Code (IDE)
2. Git and GitHub (version control)
3. npm (frontend package management)
4. pip (Python package management)

Third-Party Libraries

1. Frontend: React.js (v18.2.0), TypeScript, React Router, React Bootstrap, Recharts, Chart.js, Vite
2. Backend: Flask, Pandas, NumPy, scikit-learn, statsmodels, sentence-transformers

APIs:

1. SingStat API (Singapore Department of Statistics)

3.5 Communications Interfaces

StockSight requires communication mechanisms and standards as described below:

1. Client-Server Communication: HTTP/HTTPS protocol used for communication between React frontend and Flask backend APIs, secured via SSL/TLS encryption.
2. External API Communication: HTTPS requests to SingStat API, JSON-formatted data exchange.
3. Email Communication: SMTP protocol for sending emails (account verification, password recovery). Standard email formatting using HTML/plain text.
4. Security and Encryption: SSL/TLS encryption required for all external communications. Authentication tokens (JWT) used to securely manage user sessions.
5. Data Transfer Rates: Optimal performance achieved with broadband or equivalent network speeds; recommended minimum data transfer rate: 10 Mbps.
6. Synchronization: Real-time data fetching, synchronization handled via asynchronous HTTP requests (RESTful APIs).

4. System Features

4.1. User Account Creation

4.1.1 Description and Priority

StockSight allows new users to create secure accounts to access system functionalities

Overall Priority	Description
High	Create Account allows new users to create an account in our system database. To create an account, users must input Name, Username, Email, Phone Number, Password.

4.1.2 Stimulus/Response Sequences

Use Case ID	USER_UC_1		
Use Case Name	User Account Creation		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers / Employees
Description	Create Account allows new users to create an account in our system database. To create an account, users must input Name, Username, Email, Phone Number, Password.
Preconditions	<ol style="list-style-type: none"> 1. The provided Username must be unique (not already in use). 2. The Password must meet the following requirements: <ol style="list-style-type: none"> 2.1. At least 1 special character 2.2. Mixed case (upper and lower case letters) 2.3. A minimum of 8 characters 3. The provided Phone Number must not be associated with an existing account. 4. The provided Email must not be associated with an existing account.
Postconditions	<ol style="list-style-type: none"> 1. System creates an account.

	<ol style="list-style-type: none"> 2. User account information is updated into the system. 3. System displays the login page.
Priority	High
Frequency of use	5
Flow of events	<ol style="list-style-type: none"> 1. User inputs required information: Name, Username, Email, Phone Number, Password, and Access Level. 2. System sends a confirmation email to the user's email account with a unique 6 digit code. 3. User enter a unique 6 digit code 4. System check the code 5. System validates the information.
Alternative flows	<p>AF-S1-a. User account already exists: Phone number/ email taken.</p> <ol style="list-style-type: none"> 1. System displays “User account already exists” 2. System prompts users to create an account or log in. 3. After creating an account, the system then continues from main flow step 1. 4. If log in, then system directs to log in page to continue from Login (USER_UC_2) <p>AF-S1-b. Username already taken</p> <ol style="list-style-type: none"> 1. System displays “Username already taken” 2. System prompts users to input a different username. 3. Continue from main flow step 1. <p>AF-S1-c. Passwords do not meet requirements.</p> <ol style="list-style-type: none"> 1. System displays “Please input a password of at least 1 special character, mixed case and at least 8 characters long” message. 2. Continue from main flow step 1.
Exceptions	
Includes	Update Account Information (USER_UC_3)
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.1.3 Functional Requirements

REQ-1: Allow users to create accounts

REQ-2: Prevent duplicate accounts.

REQ-3: Verify email addresses, phone number and password upon registration.

4.2. User Login

4.2.1 Description and Priority

StockSight allows new users to login into the system.

Overall Priority	Description
High	Login allows users to enter the app to use features catered for registered users of the app. To login to the system, the user must input a unique username and the corresponding password. There will be a maximum of 5 attempts, after which, the user will have to wait for 30 minutes before another attempt.

4.2.2 Stimulus/Response Sequences

Use Case ID	USER_UC_2		
Use Case Name	User Login		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	Login allows users to enter the app to use features catered for registered users of the app. To login to the system, the user must input a unique username and the corresponding password. There will be a maximum of 5 attempts, after which, the user will have to wait for 30 minutes before another attempt.
Preconditions	User must have an existing account in the application database

Postconditions	System displays the dashboard
Priority	
Frequency of use	5
Flow of events	<ol style="list-style-type: none"> 1. User enters username and password on login form. 2. User submits details. 3. System validates the user's username and password.
Alternative flows	<p>AF-S2-a. Invalid Username</p> <ol style="list-style-type: none"> 1. System cannot find the username in the database. 2. System displays an error message. 3. System prompts user to input username and password or Create Account. 4. If the "Create Account" prompt is ignored, use case resumes at main flow step 1. 5. If the user wants to "Create Account", then System resumes from Create Account step 1. <p>AF-S2-b. Invalid Password</p> <ol style="list-style-type: none"> 1. Password does not match for unique username. 2. System displays an error message. 3. System prompts user to input username and password. 4. Use case resumes at main flow step 1. <p>AF-S2-c. Missing Username/ Password</p> <ol style="list-style-type: none"> 1. System displays an error message. 2. System prompts user to input username and password. 3. Use case resumes at main flow step 1. <p>AF-S2-d. Maximum 5 attempts exceeded</p> <ol style="list-style-type: none"> 1. System displays "maximum attempts exceeded, try again in 30 minutes" message. 2. System locks the user account for 30 minutes.
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.2.3 Functional Requirements

REQ-1: Verify username and password upon user login

4.3. User Profile Management

4.3.1 Description and Priority

StockSight allows new users to make changes to their profiles.

Overall Priority	Description
High	Update Account Information allows user to edit account information such as username and email

4.3.2 Stimulus/Response Sequences

Use Case ID	USER_UC_3		
Use Case Name	Update Account Information		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	Update Account Information allows user to edit account information such as username and email
Preconditions	<ol style="list-style-type: none"> Users must have an existing account. Users must have already logged into their account.
Postconditions	Users will have updated account information.
Priority	
Frequency of use	1
Flow of events	<ol style="list-style-type: none"> User access their information through the profile tab. User selects the field to update. User inputs new desired update. System updates information in the database.

Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.3.3 Functional Requirements

REQ-1: Prompt user to re-enter the input if empty input is detected.

4.4.Add Inventory Item

4.4.1 Description and Priority

StockSight allows new users to add items into the inventory.

Overall Priority	Description
High	The user adds a new product to the inventory with relevant details such as name, SKU, quantity, supplier, and category.

4.4.2 Stimulus/Response Sequences

Use Case ID	UC-INV-001		
Use Case Name	Add new Inventory Item		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees

Description	The user adds a new product to the inventory with relevant details such as name, SKU, quantity, supplier, and category.
Preconditions	The required fields (name, SKU, price, quantity, supplier, category) must be known.
Postconditions	The new product is successfully saved in the system and available for tracking.
Priority	
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the “Add Inventory Item” page. 2. User enters product details (name, SKU, price, quantity, supplier, etc.). 3. User clicks “Save.” 4. System validates and stores the information. 5. Confirmation message is displayed.
Alternative flows	<p>AF-1: Required field is missing</p> <ol style="list-style-type: none"> 1. The system prompts the user to complete all required fields. 2. System resumes from main flow step 2. <p>AF-2: SKU already exists</p> <ol style="list-style-type: none"> 1. The system alerts the user and asks if they want to update instead. 2. System resumes from main flow step 2.
Exceptions	
Includes	
Special requirements	Stable Internet Connection
Assumptions	NA
Notes and Issues	User has permission to add new inventory.

4.4.3 Functional Requirements

REQ-1: System allows users to update the inventory only if all the required details are filled.

4.5. Delete Inventory Item

4.5.1 Description and Priority

StockSight allows new users to delete inventory items.

Overall Priority	Description
Medium	The user removes an item from the inventory system.

4.5.2 Stimulus/Response Sequences

Use Case ID	UC-INV-002		
Use Case Name	Delete Inventory Item		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	The user removes an item from the inventory system.
Preconditions	Items must exist in inventory.
Postconditions	Item is removed and no longer available in stock.
Priority	Medium
Frequency of use	2
Flow of events	<ol style="list-style-type: none"> 1. User searches for an item. 2. User selects the item. 3. User clicks “Delete.” 4. System asks for confirmation. 5. User confirms, and the system removes the item. 6. System updates stock records.
Alternative flows	AF-1: Item has pending sales or purchase orders

	1. The system prevents deletion. 2. System resumes from main flow step 1.
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.5.3 Functional Requirements

REQ-1: Allow users to click the delete button.

4.6 Item Details and Sales Prediction

4.6.1 Description and Priority

StockSight allows new users to view item information and sales prediction.

Overall Priority	Description
Medium	The system displays item information and its sales prediction

4.6.2 Stimulus/Response Sequences

Use Case ID	UC-INV-003		
Use Case Name	Display Item Details and Sales Prediction		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	The system displays item information and its sales prediction

Preconditions	1. The user must be logged into the system. 2. The item must exist in the inventory database.
Postconditions	The requested item details and sales prediction graph are displayed on the screen.
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. The user navigates to the inventory items. 2. The user searches for an item using its name, SKU, or other attributes. 3. User click on the item 4. The system retrieves the item details from the database. 5. The system displays the item details on new page
Alternative flows	<p>AF-1: Item not found</p> <ol style="list-style-type: none"> 1. The system displays an error message: "Item not found. Please check the SKU or item name and try again." 2. The user may retry the search with a different query.
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.6.3 Functional Requirements

REQ-1: Allow users to click the item to see the details and sales prediction.

4.7.Inventory List Display

4.7.1 Description and Priority

StockSight allows new users to view the inventory list.

Overall Priority	Description
High	The user retrieves and views a list of inventory items with relevant details.

4.7.2 Stimulus/Response Sequences

Use Case ID	UC-INV-004		
Use Case Name	Inventory List Display		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	The user retrieves and views a list of inventory items with relevant details.
Preconditions	1. Users must be logged in.
Postconditions	1. Inventory list is displayed on-screen.
Priority	High
Frequency of use	5
Flow of events	1. User navigates to the inventory page. 2. System retrieves and displays the inventory list.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.7.3 Functional Requirements

REQ-1: Allow users to see the inventory list once clicked into the inventory tab.

4.8. Alert Notification

4.8.1 Description and Priority

StockSight allows new users to see notification once detected item below reorder point.

Overall Priority	Description
Medium	System notifies users when stock to or below a predefined reorder-point

4.8.2 Stimulus/Response Sequences

Use Case ID	UC-ALT-001		
Use Case Name	Alert Notification		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	System notifies users when stock to or below a predefined reorder-point
Preconditions	<ol style="list-style-type: none"> Low-stock threshold must be set. Items must be tracked in the system.
Postconditions	Alerts are generated for items below or equals to reorder-point
Priority	Medium
Frequency of use	2
Flow of events	<ol style="list-style-type: none"> System checks stock levels. System identifies items below the reorder point. System will push alert notifications when user next login Users can view alerts.

Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.8.3 Functional Requirements

REQ-1: Allow users to see the alert once they login into the account.

4.9.Add Purchase Order

4.9.1 Description and Priority

StockSight allows new users to add purchase order.

Overall Priority	Description
Medium	User generates a new purchase order for restocking inventory.

4.9.2 Stimulus/Response Sequences

Use Case ID	UC-PO-001		
Use Case Name	Create Purchase Order		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	User generates a new purchase order for restocking inventory.

Preconditions	The necessary information (Item Name, SKU, Vendor and Quantity) must be known
Postconditions	New Purchase Order added under Purchase Order tab
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the purchase order section. 2. User selects items to reorder. 3. User enters quantity and supplier details. 4. System generates a PO. 5. User submits PO for approval.
Alternative flows	<p>AF-1: If supplier details are missing System alert user to fill in all details</p> <ol style="list-style-type: none"> 1. User must update them <p>AF-2: If Purchase Order number not unique</p> <ol style="list-style-type: none"> 1. System alert user that PO number exists
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.9.3 Functional Requirements

REQ-1: Allow users to click the add purchase order button.

4.10. Delete Purchase Order

4.10.1 Description and Priority

StockSight allows users with manager roles to delete purchase orders.

Overall Priority	Description
Medium	Manager removes a purchase order from the Purchase Order tab

4.10.2 Stimulus/Response Sequences

Use Case ID	UC-PO-002		
Use Case Name	Delete Purchase Order		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers
Description	Manager removes a purchase order from the Purchase Order tab
Preconditions	The Purchase Order to be removed must exist
Postconditions	Purchase Order removed from the Purchase Order tab
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the "Purchase Order" tab. 2. User selects PO. 3. User selects “delete” under the “Action” section. 4. System updates purchase order list.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.10.3 Functional Requirements

REQ-1: Allow users to click the delete button if they are managers.

4.11.Approve Purchase Order

4.101.1 Description and Priority

StockSight allows users with manager roles to approve purchase orders.

Overall Priority	Description
Medium	Managers approve purchase order for shipment

4.11.2 Stimulus/Response Sequences

Use Case ID	UC-PO-003		
Use Case Name	Approve Purchase Order		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers
Description	Managers approve purchase order for shipment
Preconditions	A PO must be recorded
Postconditions	<ol style="list-style-type: none"> 1. Status of purchase order will be changed to “approved” 2. Inventory stock number of related item will be updated
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the "Purchase" section. 2. User selects received PO. 3. User verifies the quantity and condition. 4. Click to approve. 5. System update status to be approved
Alternative flows	
Exceptions	

Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.11.3 Functional Requirements

REQ-1: Allow users to click the approve button only if they are manager.

4.12. Filter Purchase Order

4.12.1 Description and Priority

StockSight allows users to filter purchase orders.

Overall Priority	Description
Medium	User filters the purchase order list based on status

4.12.2 Stimulus/Response Sequences

Use Case ID	UC-PO-004		
Use Case Name	Filter Purchase Order		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	User filters the purchase order list based on status
Preconditions	Purchase order list exist
Postconditions	Purchase order list is filtered based on status

Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the purchase order section. 2. User selects the filter. 3. User selects the status to filter.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.12.3 Functional Requirements

REQ-1: Allow users to click the filter button.

4.13. Search Purchase Order

4.13.1 Description and Priority

StockSight allows users to search purchase orders.

Overall Priority	Description
Medium	User search a purchase order based on information given (SKU, Reference number or Item Name)

4.13.2 Stimulus/Response Sequences

Use Case ID	UC-PO-005		
Use Case Name	Search Purchase Order		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	User search a purchase order based on information given (SKU, Reference number or Item Name)
Preconditions	Purchase order that is being searched exist
Postconditions	Purchase order that is being searched is presented to the user
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the purchase order section. 2. User selects the search function. 3. User enter the details of the required purchase order.
Alternative flows	<p>AF-1: If purchase order being searched does not exist</p> <ol style="list-style-type: none"> 1. System alert user that the purchase order does not exist 1. System resumes from main flow step 3
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.13.3 Functional Requirements

REQ-1: Allow users to click the search button.

4.14. Record Sales Transaction

4.14.1 Description and Priority

StockSight allows users to record sales transactions.

Overall Priority	Description
Medium	Users log a completed sale, updating stock levels accordingly.

4.14.2 Stimulus/Response Sequences

Use Case ID	UC-SAL-001		
Use Case Name	Record Sales Transaction		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	Users log a completed sale, updating stock levels accordingly.
Preconditions	Product must exist in inventory.
Postconditions	<ol style="list-style-type: none"> 1. Sales record is created 2. Stock is updated.
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User selects Add Sales Orders 2. User records relevant information 3. User confirms sale. 4. System updates inventory quantity and sales records.
Alternative flows	<p>AF-1: User enters a product that does not exist in the inventory.</p> <ol style="list-style-type: none"> 1. System displays: "Error: Product not found. Please check the product list or add the product before recording the sale." 2. System resumes from main flow step 1 <p>AF-2: User attempts to record a sale for an out-of-stock product.</p> <ol style="list-style-type: none"> 1. System displays: "Insufficient stock. Please update stock levels before completing the sale." <p>AF-3: Sale is canceled before confirmation.</p> <ol style="list-style-type: none"> 1. System discards the transaction and does not update inventory.

Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.14.3 Functional Requirements

REQ-1: Allow users to click the add sales transaction button.

4.15. View Sales Transaction Details

4.15.1 Description and Priority

StockSight allows users to view sales transaction details.

Overall Priority	Description
Medium	Users can view sales transaction details.

4.15.2 Stimulus/Response Sequences

Use Case ID	UC-SAL-002		
Use Case Name	View Sales Transaction Details		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	Users can view sales transaction details.
Preconditions	Sales transactions must exist in the database.

Postconditions	Sales transaction details displayed to users.
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User selects Sales Transaction tab 2. System retrieves and displays sales records.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.15.3 Functional Requirements

REQ-1: Allow users to click the sales transaction tab.

4.16. Update Sales Transaction Status

4.16.1 Description and Priority

StockSight allows users to update sales transaction status.

Overall Priority	Description
Medium	Users can update the sales order status from "Pending" to "Packed", "Shipped", or "Delivered" to reflect the current state of an order.

4.16.2 Stimulus/Response Sequences

Use Case ID	UC-SAL-003		
Use Case Name	Update Sales Transaction Status		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong

Date Created	18.02.2025	Date Last Updated	18.02.2025
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Aspect	Details
Actor	Managers/ Employees
Description	Users can update the sales order status from "Pending" to "Packed", "Shipped", or "Delivered" to reflect the current state of an order.
Preconditions	Sales Order must exist in the system
Postconditions	The order status is updated in the system.
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the Sales Orders section. 2. User selects an existing order. 3. User updates the order status to Pending, Packed, Shipped, or Delivered. 1. System validates the new status. 2. System updates the order status in the database.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.16.3 Functional Requirements

REQ-1: Allow users to click the status button.

4.17.Filter Sales Transaction

4.17.1 Description and Priority

StockSight allows users to filter sales transactions.

Overall Priority	Description
Medium	User filters the sales transaction list based on status

4.17.2 Stimulus/Response Sequences

Use Case ID	UC-SAL-004		
Use Case Name	Filter Sales Transaction		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	User filters the sales transaction list based on status
Preconditions	Sales transaction list exist
Postconditions	Sales transaction list is filtered based on status
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the sales transaction section. 2. User selects the filter. 3. User selects the status to filter.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA

Notes and Issues	NA
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4.17.3 Functional Requirements

REQ-1: Allow users to click the filter button.

4.18. Search Sales Transaction

4.18.1 Description and Priority

StockSight allows users to create secure accounts to access system functionalities

Overall Priority	Description
Medium	User search a sales transaction based on information given (ID, item name, customer)

4.18.2 Stimulus/Response Sequences

Use Case ID	UC-SAL-005		
Use Case Name	Search Sales Transaction		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	User search a sales transaction based on information given (ID, item name, customer)
Preconditions	Sales transaction that is being searched exist
Postconditions	Sales transaction that is being searched is presented to the user
Priority	Medium
Frequency of use	3

Flow of events	1. User navigates to the sales transaction section. 2. User selects the search function. 3. User enters the details of the required sales transaction.
Alternative flows	AF-1: If sales transaction being searched does not exist 1. System alerts user that the sales transaction does not exist 2. System resumes from main flow step 3
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.18.3 Functional Requirements

REQ-1: Allow users to click the search button.

4.19. Delete Sales Transaction

4.19.1 Description and Priority

StockSight allows users to delete sales transactions.

Overall Priority	Description
Medium	User removes sales transaction from the Sales Transaction tab

4.19.2 Stimulus/Response Sequences

Use Case ID	UC-SAL-006		
Use Case Name	Delete Sales Transaction		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/Employees
Description	User removes sales transaction from the Sales Transaction tab
Preconditions	The sales transaction to be removed must exist
Postconditions	Sales transaction removed from the sales transaction tab
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the "Sales Transaction" tab. 2. User selects the sales transaction. 3. User selects “delete” under the “Action” section. 4. System updates sales transaction list.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.19.3 Functional Requirements

REQ-1: Allow users to click the delete button.

4.20.Dashboard Display

4.20.1 Description and Priority

StockSight allows users to view the dashboard through the dashboard tab.

Overall Priority	Description
Medium	Users view a comprehensive dashboard displaying various key metrics and graphical insights.

4.20.2 Stimulus/Response Sequences

Use Case ID	SYSTEM_UC_1		
Use Case Name	Dashboard Display		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	Users view a comprehensive dashboard displaying various key metrics and graphical insights.
Preconditions	Sales and inventory data must exist in the system.
Postconditions	Dashboard is displayed with updated metrics and graphical reports.
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to the dashboard. 2. System retrieves relevant data. 3. System displays graphs and insights.
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.20.3 Functional Requirements

REQ-1: Allow users to click the dashboard tab.

4.21. Forecast Display

4.21.1 Description and Priority

StockSight allows users to view forecasts under the forecast tab.

Overall Priority	Description
Medium	Users view predictive analytics and forecasting for sales and inventory trends.

4.21.2 Stimulus/Response Sequences

Use Case ID	SYSTEM_UC_2		
Use Case Name	Forecast Display		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	Users view predictive analytics and forecasting for sales and inventory trends.
Preconditions	At least 3 months of historical data must be available
Postconditions	System displays forecasted sales and inventory levels on the forecast dashboard
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User selects the forecast tab. 2. System analyzes historical data. 3. System generates a graphical trend analysis, highlighting key sales patterns.

Alternative flows	AF-1: Insufficient data 1. If a user selects a specific date range, but insufficient data is available, the system could provide partial results instead of failing outright.
Exceptions	EX-1: Insufficient data prevents accurate forecasting. 1. System sends our notification saying at least 3 months worth of data is required
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.21.3 Functional Requirements

REQ-1: Allow users to click the forecast tab.

4.22. Tutorial Display

4.22.1 Description and Priority

StockSight allows users to view tutorials for each tab.

Overall Priority	Description
Medium	Users view a tutorial that introduces the function of a tab

4.22.2 Stimulus/Response Sequences

Use Case ID	SYSTEM_UC_3		
Use Case Name	Tutorial Display		
Created By	Gong Yuelong	Last Updated By	Gong Yuelong
Date Created	18.02.2025	Date Last Updated	18.02.2025

Aspect	Details
Actor	Managers/ Employees
Description	Users view a tutorial that introduces the function of a tab
Preconditions	User has logged in to their account
Postconditions	System displays tutorials of that particular tab
Priority	Medium
Frequency of use	3
Flow of events	<ol style="list-style-type: none"> 1. User navigates to any tab 2. User clicks tutorial button
Alternative flows	
Exceptions	
Includes	
Special requirements	Stable Internet Connectivity
Assumptions	NA
Notes and Issues	NA

4.22.3 Functional Requirements

REQ-1: Allow users to click the button to display tutorials

5. Non-functional Requirements

5.1. Performance Requirements

1. System must respond to typical user interactions (loading pages, submitting forms, generating forecasts) within 2 seconds.
2. Machine learning forecasting must return results within 5 seconds per request.

5.2. Safety Requirements

1. Application must ensure secure storage and handling of sensitive user and transactional data to prevent data breaches and unauthorized access.

5.3. Security Requirements

1. Authentication required for accessing sensitive functionalities, such as managerial access level for approval and deletion of purchase orders.
2. Secure password policy enforcement (minimum 8 characters, special characters, mixed-case).
3. JWT-based secure session management.
4. User input will be validated to prevent against common web vulnerabilities: SQL Injection, XSS attacks, CSRF, and similar security breaches.

5.4. Software Quality Attributes

1. Maintainability: Component-based architecture enabling easy updates and code management.
2. Reliability: System uptime target of 99%, with clearly defined backup and recovery procedures
3. Robustness: The system should be modular in nature so that the individual components (Dashboard, Forecast, Inventory etc) have minimal impact on other components and can be updated independently
4. Usability: Clear, responsive, and user-friendly UI designed for easy learning and intuitive use by all target user classes. The code will be accompanied with relevant comments when necessary for code interpretability, reusability, collaboration and maintenance.
5. Scalability: Backend and database design capable of accommodating increased load (user growth, data volume, order transactions)

5.5. Business Rules

1. Only managers and administrators can approve purchase orders and manage user accounts.
2. Employees can create sales transactions but cannot approve or alter inventory levels directly.
3. System administrators have exclusive access to managing user permissions and security settings.
4. Forecasting functionality accessible to managers and business analysts only.

6. Other Requirements

6.1. Database Requirements

1. MongoDB must provide efficient querying, indexing, and aggregation capabilities
2. Regular backups and data redundancy measures are required to prevent data loss

6.2. Internationalisation Requirements

1. All application components must be designed in English; future language support should be achievable with minimal refactoring.

6.3. Legal Requirements

1. Compliance with Singapore's Personal Data Protection Act (PDPA) for handling user data and privacy

6.4. Reuse Objectives

1. Design modular frontend components and backend APIs that facilitate reuse in future projects or enhancements.
2. Maintain comprehensive documentation of APIs and database schemas for future extensibility.

7. Appendix

Appendix A: Data Dictionary

Term	Definition
User	A person who has a registered account and is using the services provided by the application.
Account	The profile of the user in our system which contains details (Name, Username, Email, Phone Number, Rating) associated with them.
Username	A unique name that is associated with the user.
Password	A string of characters (letters, numbers, special symbols) that allow the user to access their account
Inventory	A product or material tracking system that includes the name, SKU, quantity, price, supplier, expiration date etc.
Stock	An agreement which is created when a requester has accepted the help from a Servicer(s).
Product	A user who creates a job request in the system

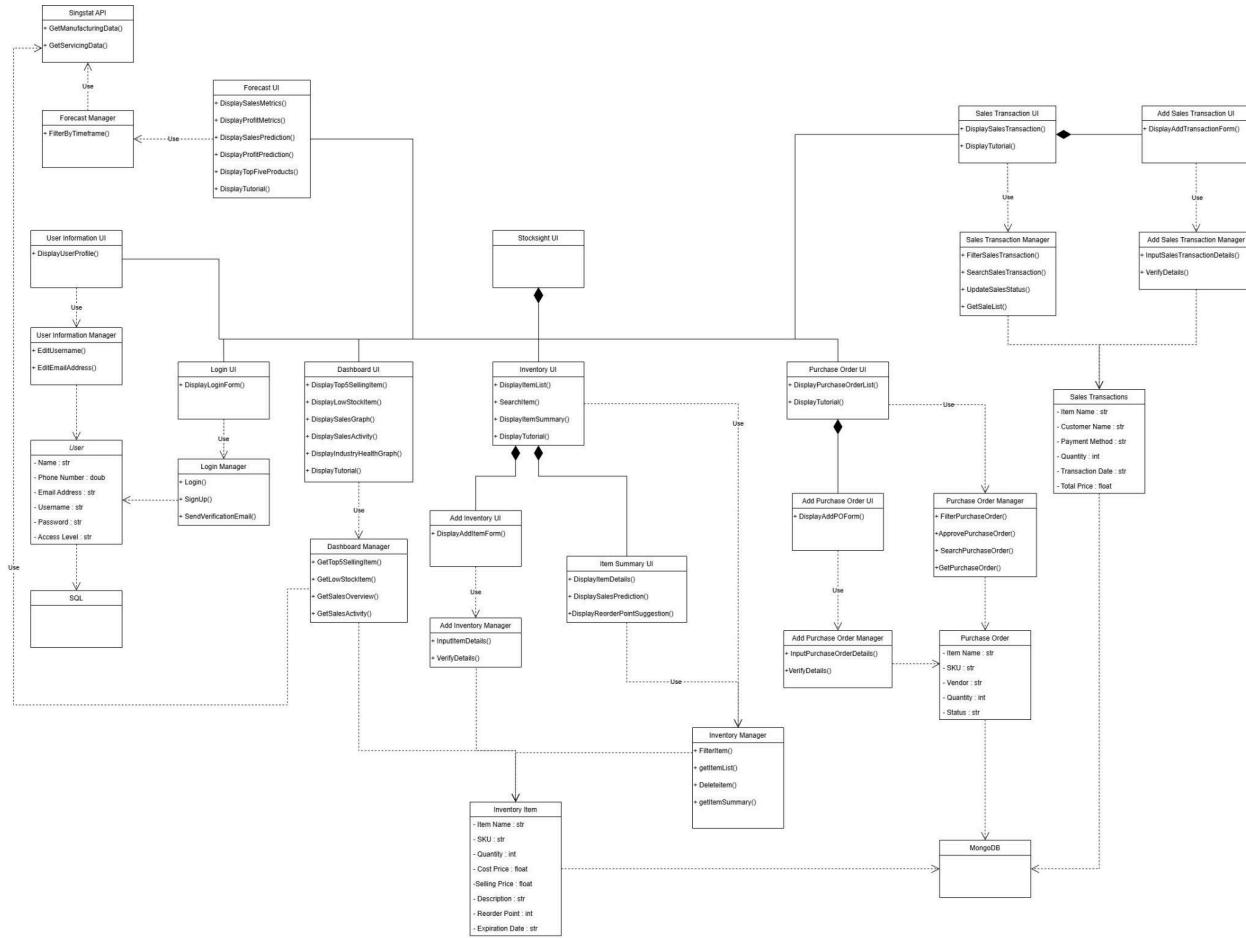
Supplier	A user who does the job created by a requester
Purchase Order (PO)	A formal request sent to a supplier to restock inventory. Includes item details, quantities, and expected delivery date.
Demand Forecasting	The process of predicting future sales based on historical data to optimize inventory replenishment.
Stock Turnover Rate	The frequency of which inventory is sold and replaced over a period of time
Perishable Inventory	Inventory that includes raw materials and finished products that lose their value over time and eventually become worthless
Dead Stock	Inventory that is no longer sellable and will likely never sell in the future, oftentimes because it's expired, obsolete, low quality, or out of season
FIFO (First In, First Out)	An inventory management method where the oldest stock is used or sold before newer stock.
Economic Order Quantity (EOQ)	The optimal order quantity that minimizes total inventory costs, balancing ordering and holding costs.
Shipments	A delivery method of goods overseas through the sea route
Invoices	A document listing the products or services provided, along with the amounts due for payment.
Bills	A document with the amount owed for products or services that have been received or are about to be received.
Reorder Point	The stock level at which an inventory item must be reordered to prevent stockouts.
Confidence Interval	Statistical range providing estimated prediction reliability generated by forecasting models

Appendix B: Analysis Models

Class Diagram

High definition image can be found here:

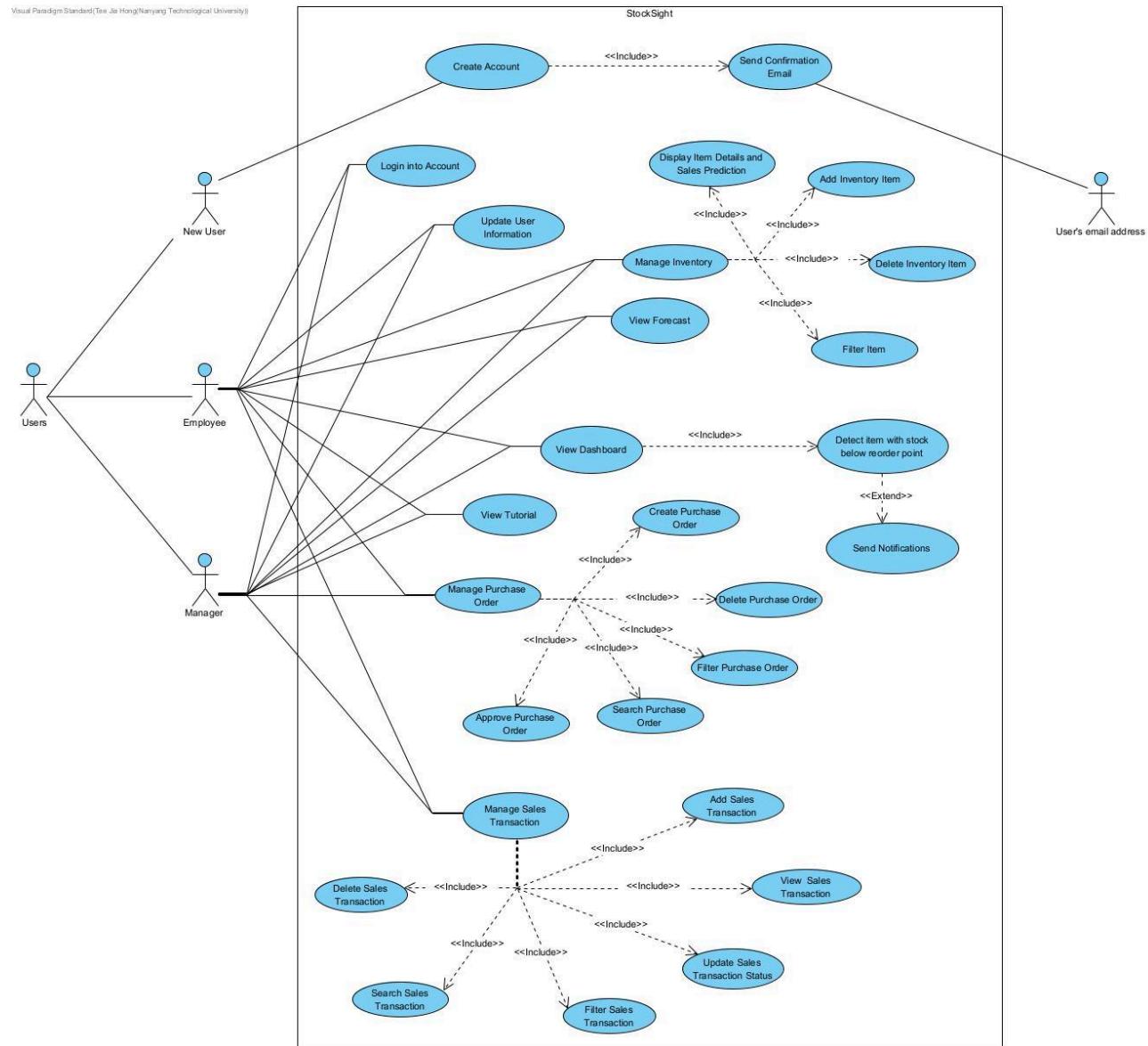
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_3/Class%20Diagram.jpg



Use Case Diagram

High definition image can be found here:

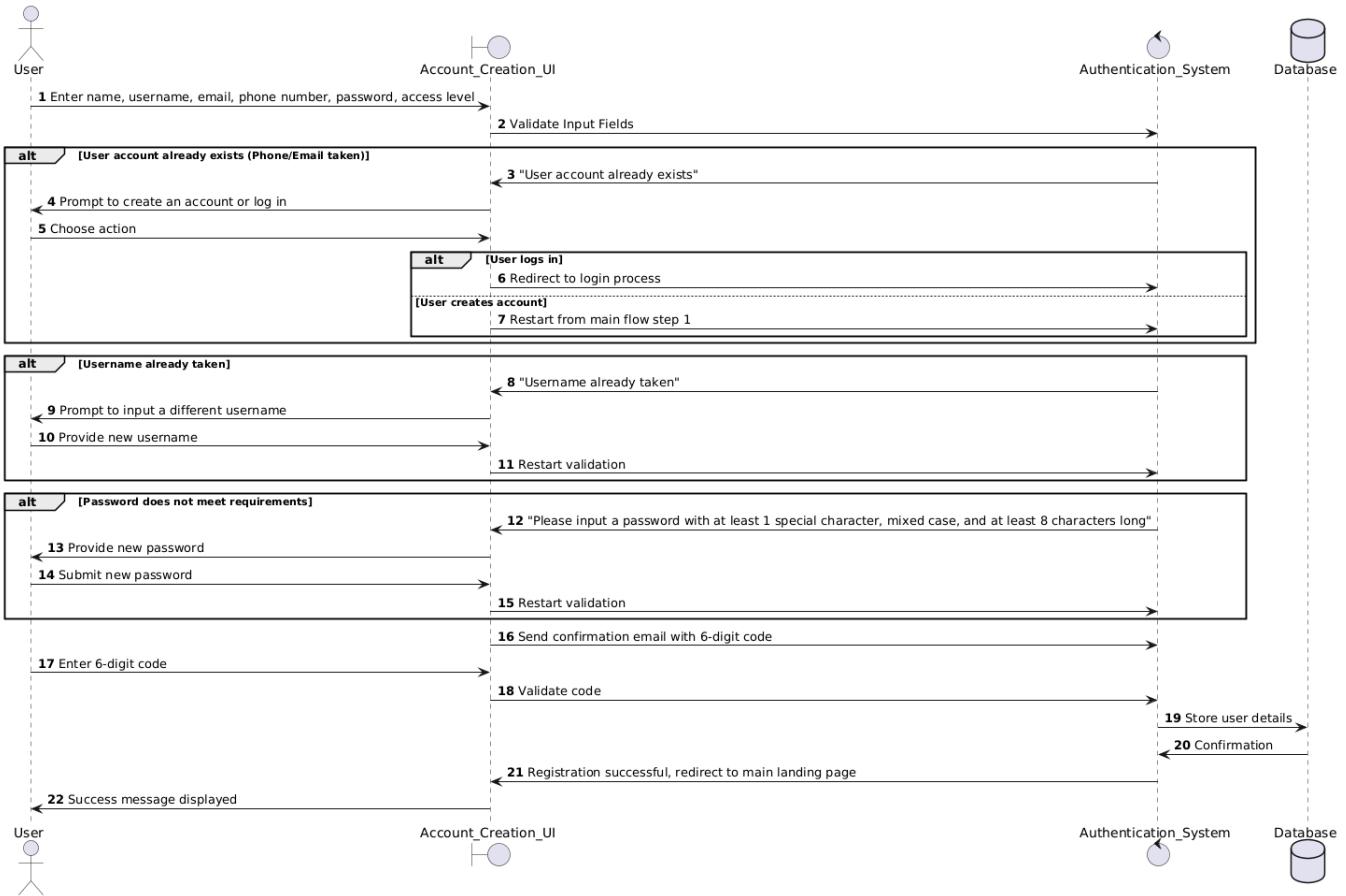
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_3/User%20Case%20Diagram.jpg



Sequence Diagram for creating account

High definition image can be found here:

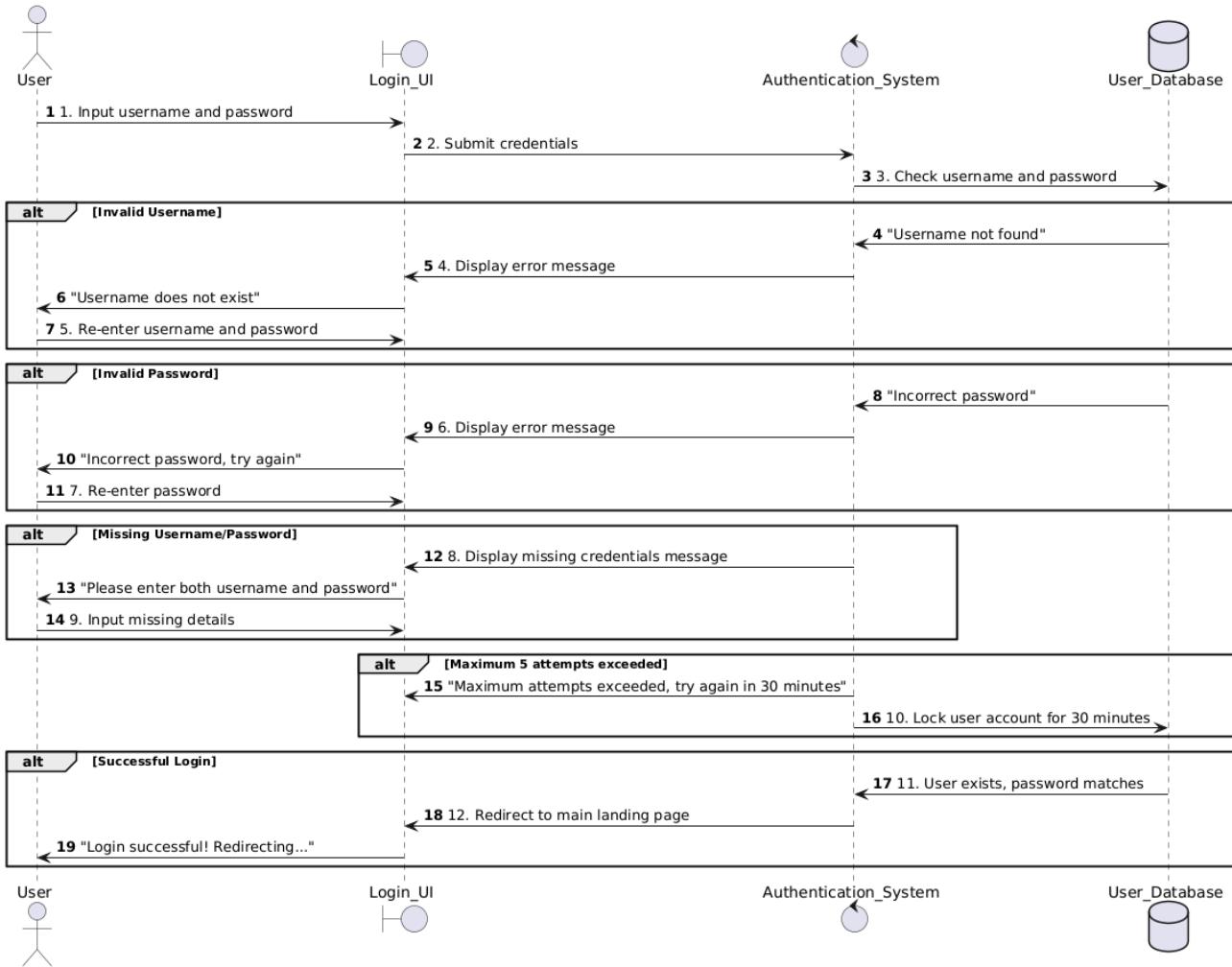
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_3/SC2006_Lab%203_Deliverables_Final.pdf



Sequence Diagram for Login

High definition image can be found here:

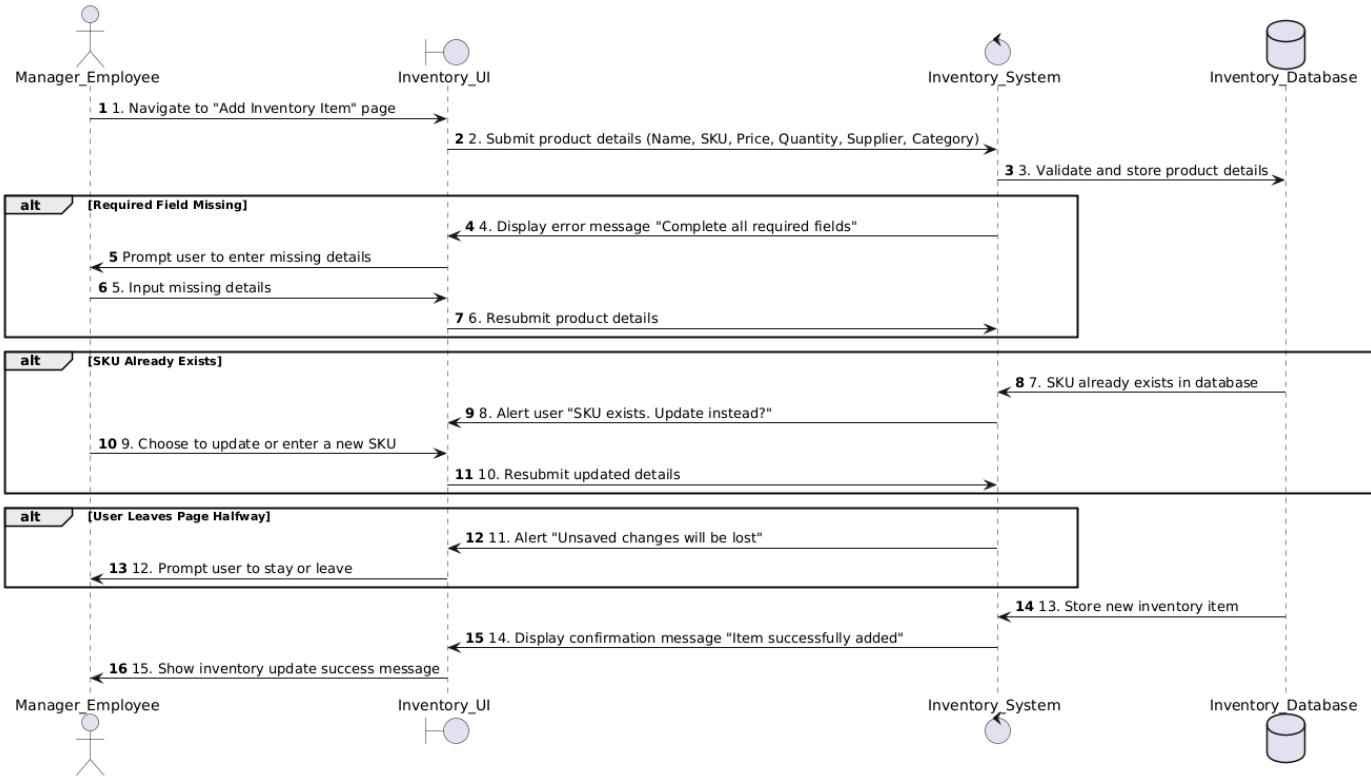
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_3/SC2006_Lab%203_Deliverables_Final.pdf



Sequence Diagram for adding inventory

High definition image can be found here:

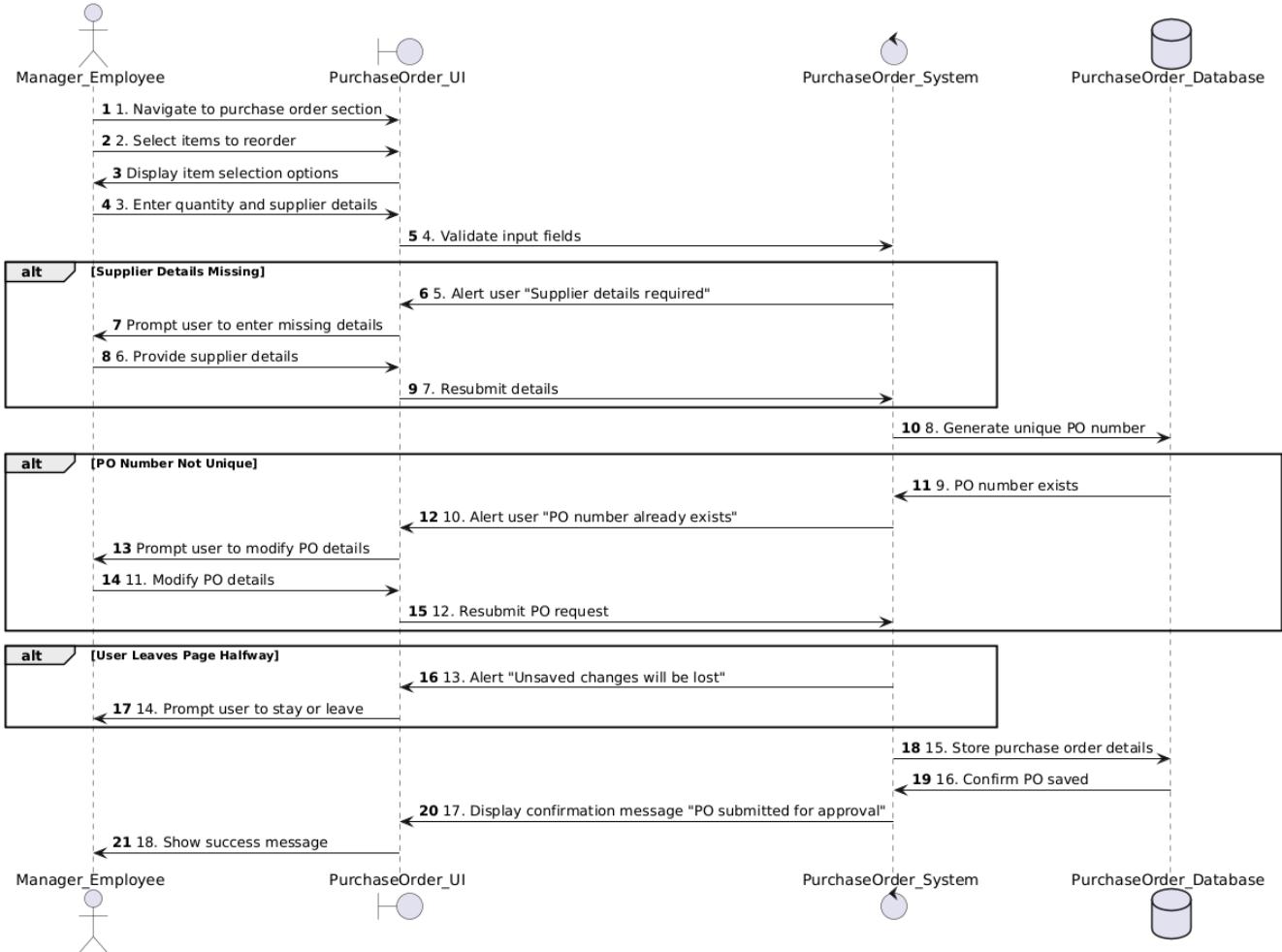
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_3/SC2006_Lab%203_Deliverables_Final.pdf



Sequence Diagram for creating purchase order

High definition image can be found here:

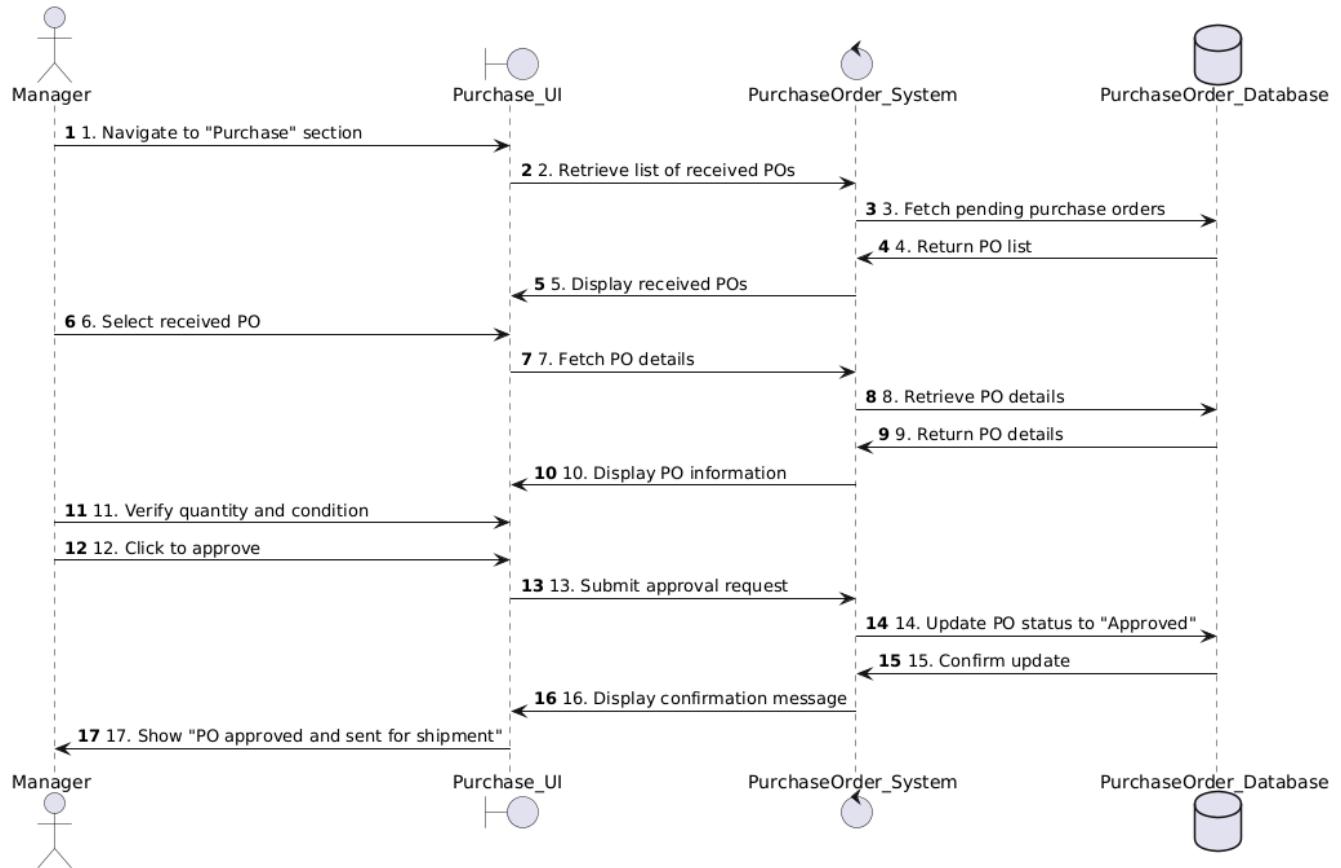
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_2/SC2006_Lab%202%20Deliverables_Final.pdf



Sequence Diagram for approving purchase order

High definition image can be found here:

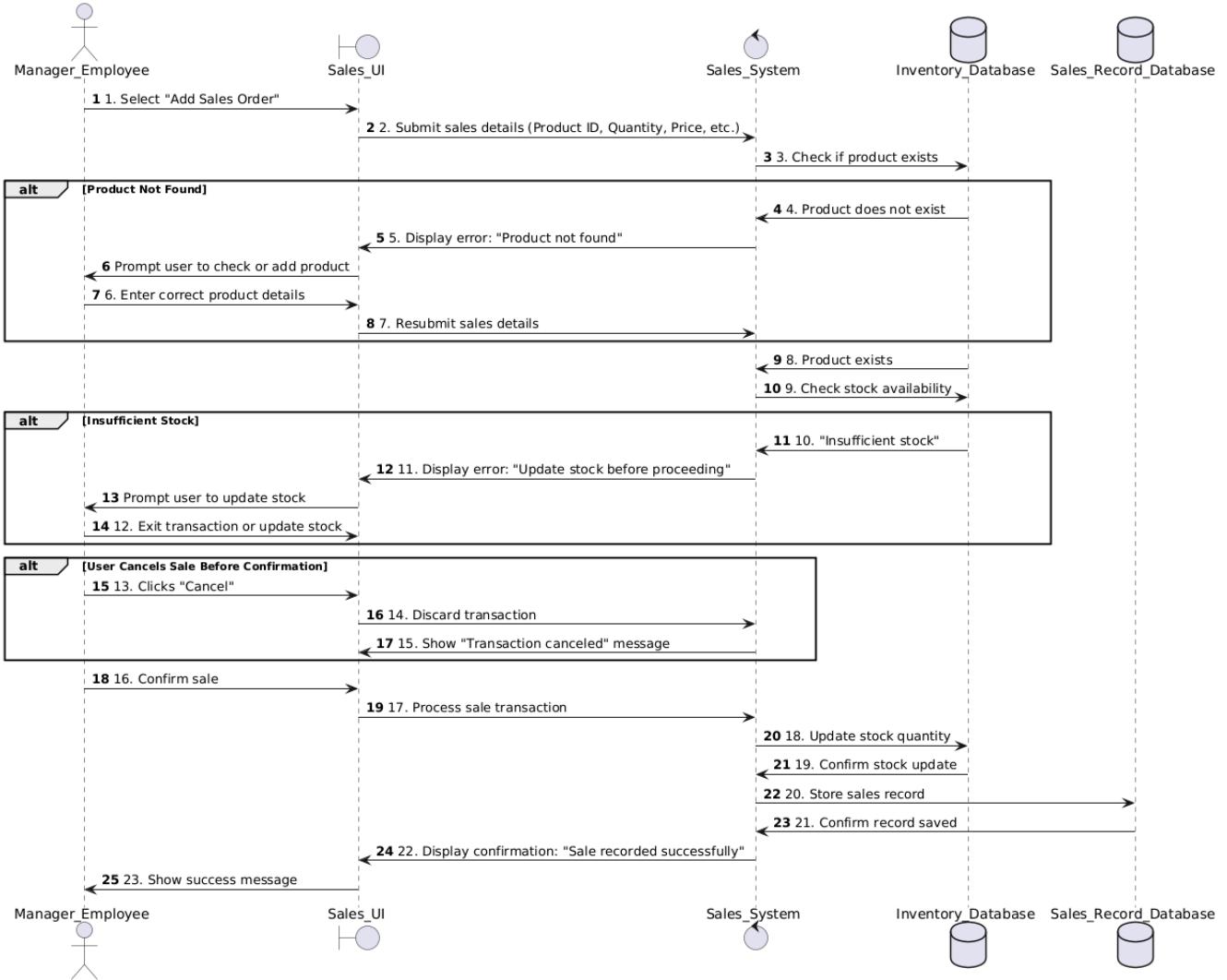
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_2/SC2006_Lab%202%20Deliverables_Final.pdf



Sequence Diagram for adding sales transactions

High definition image can be found here:

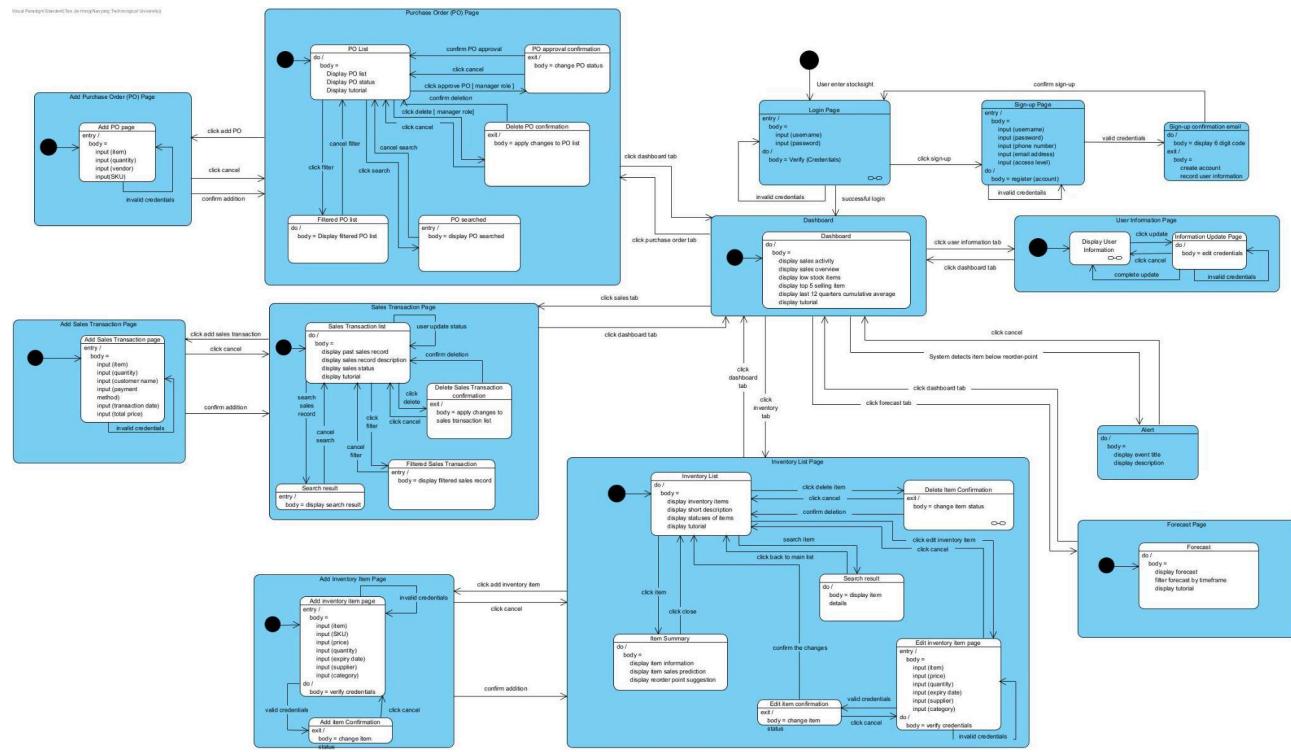
https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_2/SC2006_Lab%202%20Deliverables_Final.pdf



Dialog Map

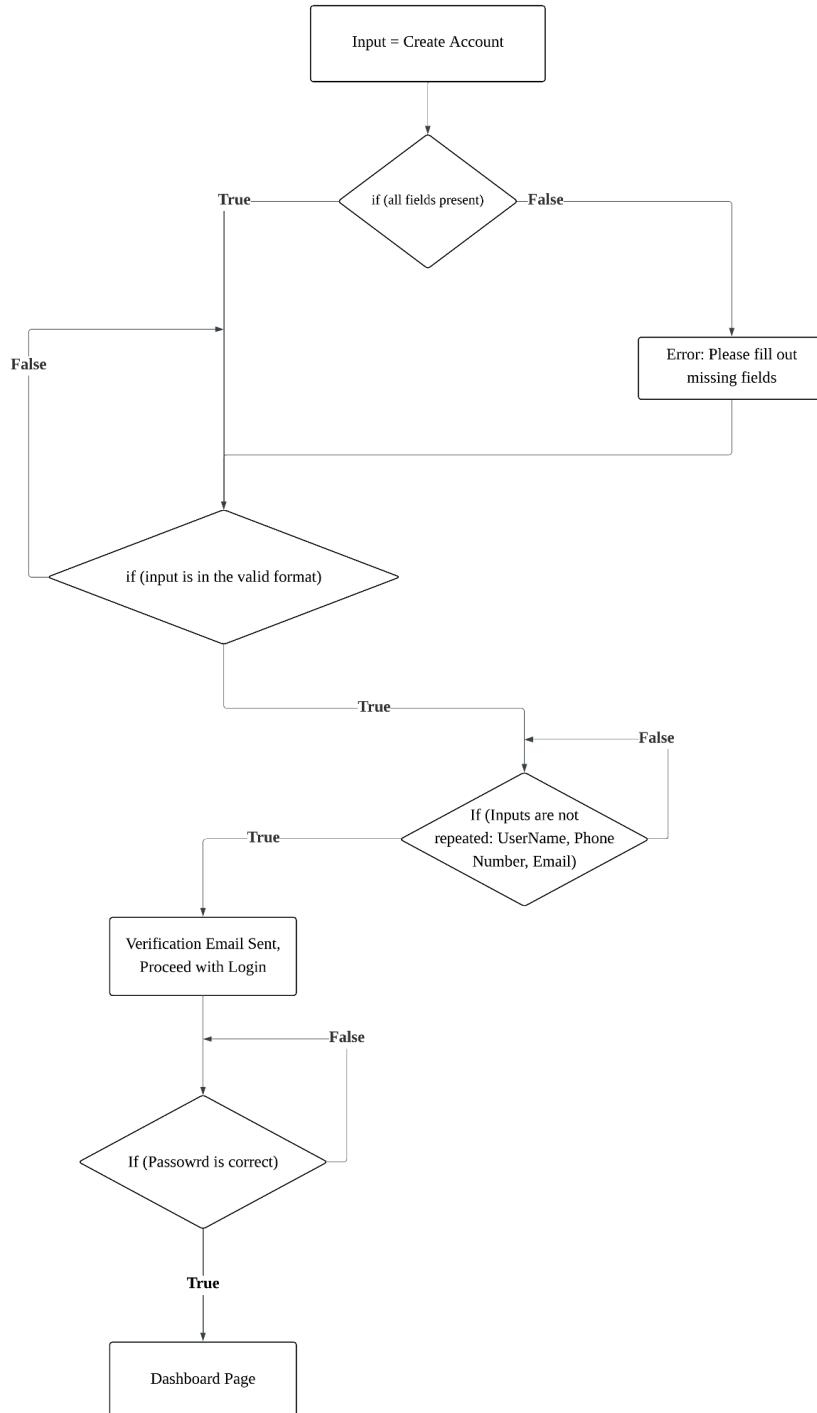
High definition image can be found here:

https://github.com/softwarelab3/2006-SCEA-I3/blob/main/Lab_3/State%20Machine%20Dialogue%20Map.jpg



White Box Testing

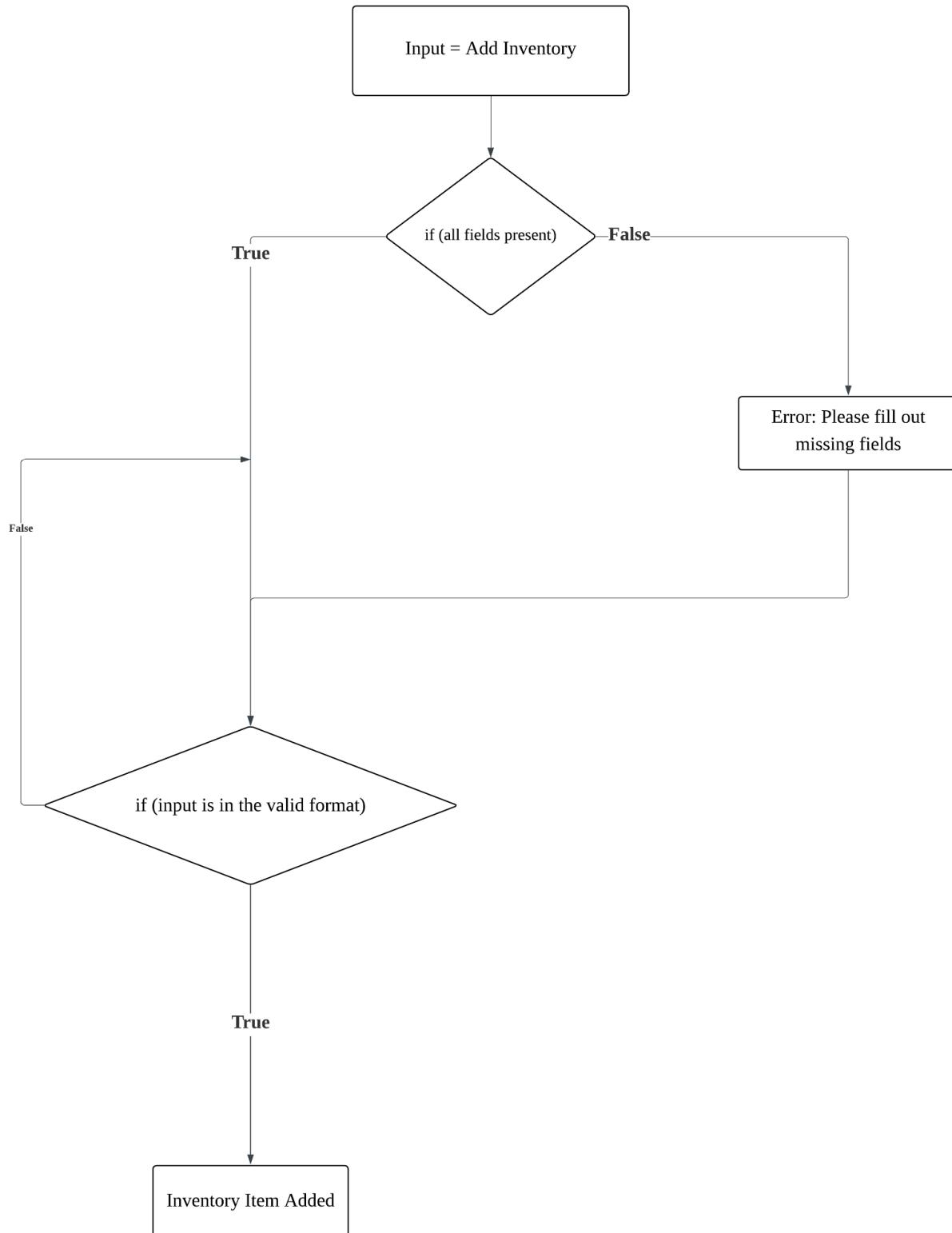
User Account Sequence



Test Case ID	Login-1		Test Case Priority	High	
Test Case Description	Login - Positive Test Case				
Prerequisite	Stable Network Connection		Postrequisite		
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Sign-Up Page		Form is displayed	Form is displayed	Pass
2	Enter all required fields	Username: alice, Email: a@mail.com, Phone: 98765432, Password: Test1234	Inputs accepted	Inputs accepted	Pass
3	Submit with valid, unique inputs	-	Verification email sent	Verification email sent	Pass
4	Login with verified credentials	Username: alice, Password: Test1234	Redirect to dashboard	Redirect to dashboard	Pass
Test Case Status					
Comments					

Test Case ID	Login-2		Test Case Priority	High	
Test Case Description	Login - Negative Test Case				
Prerequisite	Stable Network Connection		Postrequisite		
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Sign-Up Page		Form is displayed	Form is displayed	Pass
2	Leave out required fields	Email: ", Username: alice	Error: Please fill out missing fields	Error: Please fill out missing fields	Pass
3	Enter duplicate email or username	Email: a@mail.com (existing)	Error: Email/username already exists	Error: Email/username already exists	Pass
4	Enter weak password	Password: 123	Error: Invalid password format	Error: Invalid password format	Pass
5	Login with incorrect password	Username: alice, Password: wrongpass	Error: Invalid credentials	Error: Invalid credentials	Pass
Test Case Status					
Comments					

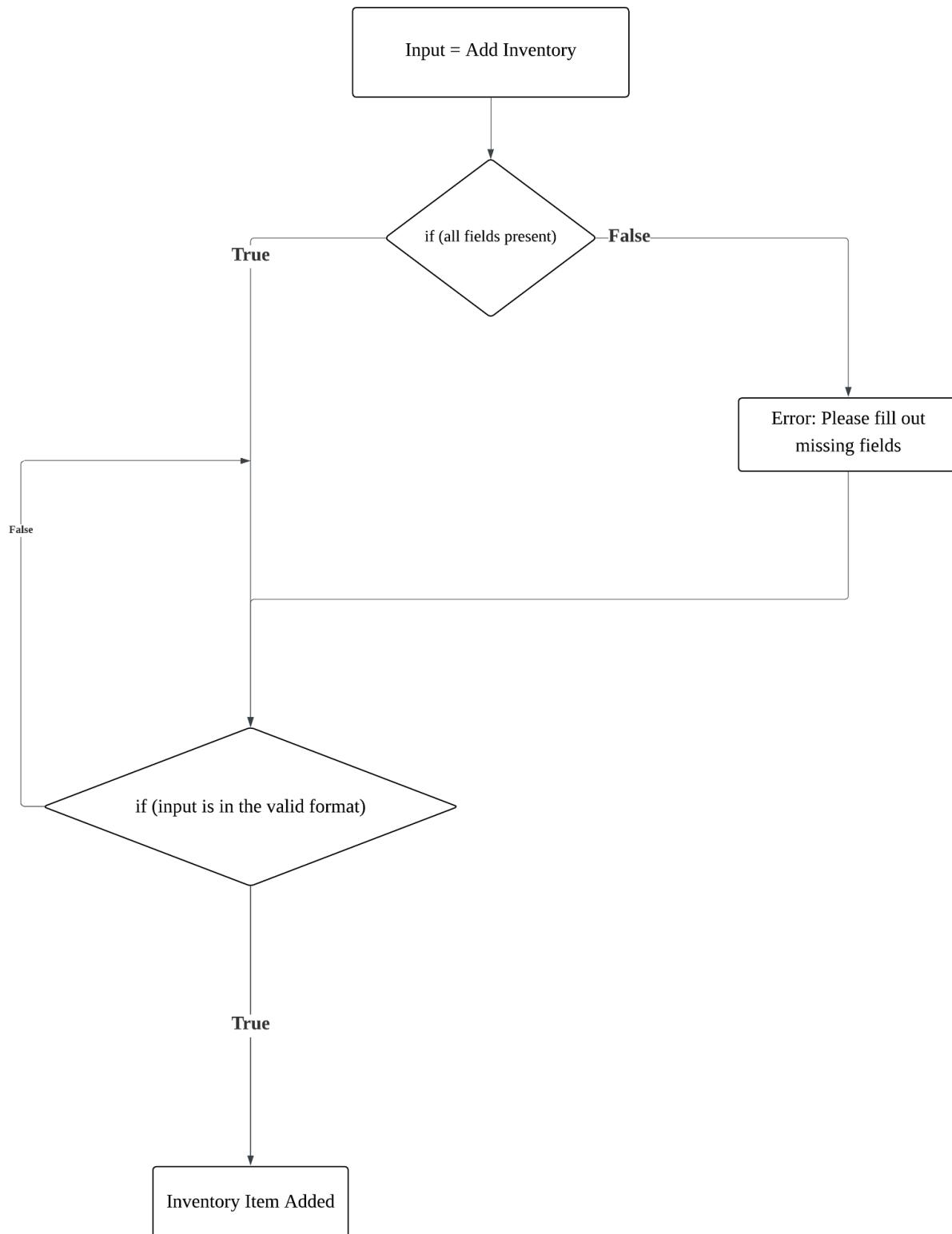
Add Inventory Items



Test Case ID	Inventory-1		Test Case Priority	High	
Test Case Description	Add Inventory - Positive Test Case				
Prerequisite	Stable Internet Connection		Postrequisite	NA	
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Add Inventory Page	-	Form is displayed	Form is displayed	Pass
2	Input all required fields with valid formats	Name: 'Milk', Quantity: 10, Expiry: 2025-01-01	Fields accepted	Fields accepted	Pass
3	Submit the form	-	Inventory item added successfully	Inventory item added successfully	Pass
Test Case Status					
Comments					

Test Case ID	Inventory-2		Test Case Priority	High	
Test Case Description	Add Inventory - Negative Test Case				
Prerequisite	Stable Internet Connection		Postrequisite	NA	
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Add Inventory Page	-	Form is displayed	Form is displayed	Pass
2	Input all required fields with valid formats	Name: 'Milk', Quantity: ,	Error: Please fill out missing fields	Error: Please fill out missing fields	Pass
3	Enter all fields with invalid format	Quantity: -5, Expiry: Not a date	Error: Invalid input format	Error: Invalid input format	Pass
Test Case Status					
Comments					

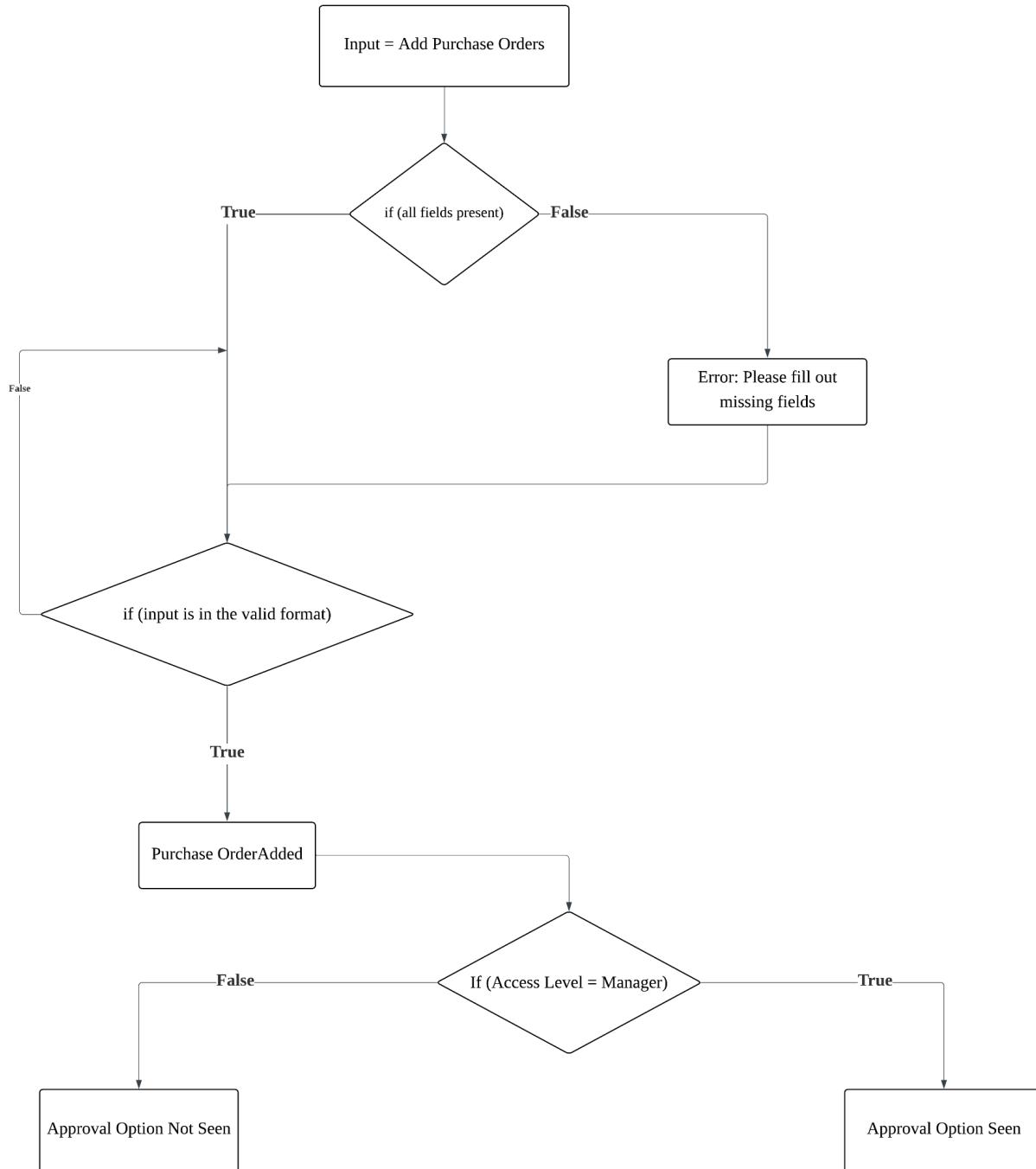
Add Sales Records



Test Case ID	SalesRecord-1		Test Case Priority	High	
Test Case Description	Add Inventory - Positive Test Case				
Prerequisite	Stable Internet Connection		Postrequisite	NA	
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Sales Page	-	Form is displayed	Form is displayed	Pass
2	Input all required fields with valid formats	Name: 'Milk', Quantity: 10, Customer: Shawn, Payment Method: Cash, Transaction Date: 2025-01-01, Total Price: \$60	Fields accepted	Fields accepted	Pass
3	Submit the form	-	Inventory item added successfully	Inventory item added successfully	Pass
Test Case Status					
Comments					

Test Case ID	SalesRecord -2		Test Case Priority	High	
Test Case Description	Sales Record - Negative Test Case				
Prerequisite	Stable Internet Connection		Postrequisite	NA	
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Add Inventory Page	-	Form is displayed	Form is displayed	Pass
2	Input all required fields with valid formats	Name: 'Milk', Quantity: 10, Customer: Shawn, Payment Method: NIL, Transaction Date: NIL, Total Price: \$60	Error: Please fill out missing fields	Error: Please fill out missing fields	Pass
3	Enter all fields with invalid format	Transaction Date: Not a date	Error: Invalid input format	Error: Invalid input format	Pass
Test Case Status					
Comments					

Add Purchase Orders



Test Case ID	PurchaseOrder -1		Test Case Priority	High	
Test Case Description	Purchase Order - Positive Test Case				
Prerequisite	Stable Internet Connection		Postrequisite	NA	
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Purchase Order Page	-	Form is displayed	Form is displayed	Pass
2	Input all required fields with valid formats	Item Name: 'Milk', SKU: M000111, Vendor: Oatside, Quantity: 15	Fields accepted	Fields accepted	Pass
3	Submit the form	-	Purchase Order added successfully	Purchase Order added successfully	Pass
Test Case Status					
Comments					

Test Case ID	PurchaseOrder-2		Test Case Priority	High	
Test Case Description	Purchase Order - Negative Test Case				
Prerequisite	Stable Internet Connection		Postrequisite	NA	
Test Execution Steps					
Step No.	Action	Input	Expected Output	Actual Output	Test Result
1	Navigate to Purchase Order Page	-	Form is displayed	Form is displayed	Pass
2	Input all required fields with valid formats	Item Name: 'Milk', SKU: NIL, Vendor: Oatside, Quantity: 15	Error: Please fill out missing fields	Error: Please fill out missing fields	Pass
3	Enter all fields with invalid format	SKU: Not a SKU number	Error: Invalid input format	Error: Invalid input format	Pass
Test Case Status					
Comments					

Appendix C: Machine Learning Models

This section goes over the Statistical methods and AI integration that StockSightAI uses to deliver accurate predictions and valuable business insights and information.

System Overview

StockSightAI is an integrated inventory management system with advanced forecasting capabilities. The system combines:

- **Inventory Management:** Track items, quantities, prices, and reorder points
- **Sales Tracking:** Record and manage sales transactions
- **Purchase Orders:** Create and manage purchase orders for restocking
- **Forecasting:** Predict future sales and profits using AI and statistical models
- **Industry Health Analysis:** Incorporate external economic data to improve forecasts

The system architecture consists of:

- **Frontend:** React with TypeScript, using Recharts for data visualization
- **Backend:** Flask (Python) with RESTful API endpoints
- **Database:** MongoDB for storing inventory, sales, and purchase order data
- **Machine Learning:** Python-based ML models for classification and forecasting

Data Sources and APIs

MongoDB Collections

The system uses MongoDB with the following collections:

- `inventory`: Stores item details (SKU, name, quantity, prices, etc.)
- `sales`: Records sales transactions
- `purchase_orders`: Manages purchase orders
- `item_categories`: Caches item category classifications

SingStat API Integration

The system integrates with Singapore's Department of Statistics (SingStat) API to retrieve economic indicators that help improve forecast accuracy.

API Implementation:

The system fetches data from SingStat API using HTTP requests with the following parameters:

- URL:
`https://tablebuilder.singstat.gov.sg/api/table/tabledata/{resource_id}?offset=0&limit=10000`
- Headers: User-Agent and Accept headers for JSON response

- Response: JSON data containing quarterly economic indicators

Resource IDs Used:

- M250141: Manufacturing sector data
- M250431: Services sector data

The API data is processed to extract quarterly performance indicators for different industry sectors, which are then used as external factors in the forecasting models.

Data Processing Pipeline

1. **Raw Data Collection:**
 - Sales transactions from MongoDB
 - Industry health indicators from SingStat API
2. **Data Aggregation:**
 - Weekly sales aggregation: Groups sales by item, SKU, year, and week
 - Monthly sales aggregation: Derived from weekly data
 - Yearly sales aggregation: Derived from weekly data
3. **Data Transformation:**
 - Calculation of industry health coefficients
 - Normalization of external indicators to 0-0.5 range
 - Categorization of items using ML model

Machine Learning Models

Item Category Classification

The system uses a machine learning model to automatically classify inventory items into industry categories, which helps in applying the appropriate industry health coefficients.

Model Architecture:

- **Embedding Model:** Sentence Transformer ([all-MiniLM-L6-v2](#))
- **Classifier:** Support Vector Machine (SVM) with linear kernel

Mathematical Formulation:

Text Embedding: Item names are converted to dense vector representations using a pre-trained sentence transformer:

$$\vec{x}_i = \text{Encoder}(\text{item_name}_i)$$

1. **SVM Classification:** The SVM classifier finds a hyperplane that maximizes the margin between different categories:

$$f(\vec{x}) = \vec{w} \cdot \vec{x} + b$$

where w is the normal vector to the hyperplane and b is the bias term.

2. Optimization Problem:

$$\min_{\vec{w}, b} \frac{1}{2} \|\vec{w}\|^2$$

subject to $y_i(\vec{w} \cdot \vec{x}_i + b) \geq 1$ for all training examples i

Performance Metrics:

- Cross-validation scores
- Classification report (precision, recall, F1-score)
- Confusion matrix visualization

Industry Health Prediction Models

Linear regression models are trained for each industry category to predict future health coefficients based on historical data.

Mathematical Formulation:

For each industry category, a linear regression model is trained to predict future health coefficients:

$$y = \beta_0 + \beta_1 x + \varepsilon$$

where:

- y is the industry health coefficient
- x is the year
- β_0 is the intercept
- β_1 is the slope (annual rate of change)
- ε is the error term

The parameters β_0 and β_1 are estimated by minimizing the sum of squared residuals:

$$\min_{\beta_0, \beta_1} \sum_{i=1}^n (y_i - \beta_0 - \beta_1 x_i)^2$$

Statistical Methods and Calculations

Industry Health Coefficient

The industry health coefficient is a key factor in the forecasting models, representing the economic health of different industry sectors.

Mathematical Formula:

The industry health coefficient is calculated as:

$$\text{IHC}_{c,y,q} = \text{Normalize}(\text{CumulativeAvg}_{c,y,q})$$

where:

- $\text{IHC}_{c,y,q}$ is the industry health coefficient for category , year , and quarter
- $\text{CumulativeAvg}_{c,y,q}$ is the cumulative average of raw values up to the specified quarter

The normalization function scales the value to a 0-0.5 range:

$$\text{Normalize}(x) = \frac{x - \min(x)}{\max(x) - \min(x)} \times 0.5$$

For future periods, a growth factor is applied based on recent trends:

$$\text{IHC}_{c,y+\Delta,q} = \text{IHC}_{c,y,q} + \text{Growth}_c \times \Delta$$

where Growth_c is the average growth rate for category c and Δ is the number of periods ahead.

The coefficient is calculated by:

1. Retrieving raw quarterly data for the specific category
2. Calculating cumulative average up to the target quarter
3. Normalizing the value to a 0-0.5 range
4. For future periods, applying a growth factor based on recent trends

Yearly Averages Calculation

Mathematical Formula:

The yearly average calculation involves two main steps:

1. **Quarterly to Yearly Aggregation:**

For each category c and year y :

$$\text{YearlyAvg}_{c,y} = \frac{1}{n_{c,y}} \sum_{q=1}^4 \text{QuarterlyValue}_{c,y,q}$$

where $n_{c,y}$ is the number of available quarterly values for category c in year y .

2. Normalization to 0-0.5 Range:

For each category c:

$$\text{NormalizedCoef}_{c,y} = \frac{\text{YearlyAvg}_{c,y} - \min_{y'}(\text{YearlyAvg}_{c,y'})}{\max_{y'}(\text{YearlyAvg}_{c,y'}) - \min_{y'}(\text{YearlyAvg}_{c,y'})} \times 0.5$$

where \min_y and \max_y represent the minimum and maximum values across all years for category c.

Holiday Boost Factors

The system incorporates holiday boost factors to account for seasonal sales increases:

Holiday Boost Factors:

The system applies multiplicative factors to sales predictions during holiday periods:

$$\text{AdjustedSales} = \text{BaseSales} \times (1 + \text{HolidayBoost})$$

where HolidayBoost is defined as:

Holiday	Boost Factor
Christmas	0.20 (20%)
Black Friday	0.15 (15%)
New Year	0.10 (10%)
Valentine's Day	0.05 (5%)
Easter	0.05 (5%)

Forecasting Algorithms

SARIMAX Time Series Forecasting

For items with sufficient historical data, the system uses SARIMAX (Seasonal AutoRegressive Integrated Moving Average with eXogenous factors) for forecasting.

Mathematical Formulation:

The SARIMAX model combines autoregressive, moving average, and seasonal components with exogenous variables:

$$y_t = c + \sum_{i=1}^p \phi_i y_{t-i} + \sum_{i=1}^q \theta_i \epsilon_{t-i} + \sum_{i=1}^P \Phi_i y_{t-i \times s} + \sum_{i=1}^Q \Theta_i \epsilon_{t-i \times s} + \sum_{i=1}^r \beta_i X_{i,t} + \epsilon_t$$

where:

- y_t is the sales value at time t
- c is a constant term
- ϕ_i are the autoregressive parameters (order) $p=1$
- θ_i are the moving average parameters (order) $q=1$
- Φ_i are the seasonal autoregressive parameters (order) $P=1$
- Θ_i are the seasonal moving average parameters (order) $Q=1$
- s is the seasonal period (52 for weekly, 12 for monthly, 1 for yearly)
- β_i are the coefficients for exogenous variables
- $X_{i,t}$ are the exogenous variables (industry health coefficient)
- ϵ_t is the error term at time t

Key Parameters:

- **order=(1,0,1):** ARIMA parameters (p,d,q)
 - $p=1$: Autoregressive order
 - $d=0$: Integration order (no differencing)
 - $q=1$: Moving average order
- **seasonal_order=(1,0,1,seasonal_period):** Seasonal component
 - Seasonal period depends on time frame (52 for weekly, 12 for monthly, 1 for yearly)

Exogenous Variables:

- Industry health coefficient: Derived from SingStat data
- Future coefficients are predicted using linear regression models

Linear Growth Model for Limited Data

For items with limited historical data (less than 3 data points), a simpler linear growth model is used:

Mathematical Formulation:

For items with limited historical data, a linear growth model is used:

1. Historical Growth Rate Calculation:

$$r_{\text{hist}} = \left(\frac{y_{\text{last}}}{y_{\text{first}}} \right)^{\frac{1}{n-1}} - 1$$

where:

- y_{last} is the most recent sales value
- y_{first} is the oldest sales value
- n is the number of data points

2. Industry-Adjusted Growth Rate:

$$r_{\text{adj}} = r_{\text{hist}} \times (1 + \text{IHC}_{c,y,q})$$

where $\text{IHC}_{c,y,q}$ is the industry health coefficient for category c, year y, and quarter q

3. Future Value Prediction:

$$y_{t+k} = y_t \times (1 + r_{\text{adj}})^k$$

where:

- y_t is the current sales value
- k is the number of periods ahead
- r_{adj} is the industry-adjusted growth rate

Confidence Interval Calculation

The system calculates confidence intervals for all forecasts:

Mathematical Formulation:

For SARIMAX models:

The 95% confidence intervals are calculated based on the model's standard errors:

$$\text{CI}_{t+k} = \hat{y}_{t+k} \pm 1.96 \times \text{SE}(\hat{y}_{t+k})$$

where:

- \hat{y}_{t+k} is the predicted value at time t+k
- $\text{SE}(\hat{y}_{t+k})$ is the standard error of the prediction
- 1.96 is the z-score for a 95% confidence level

For linear growth models:

1. Growth Rate Variability:

$$\sigma_r = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n-1} (r_i - \bar{r})^2}$$

where:

- $r_i = \frac{y_{i+1}}{y_i} - 1$ is the period-to-period growth rate
- \bar{r} is the mean growth rate
- n is the number of data points

2. Confidence Interval Calculation:

$$CI_{t+k} = \hat{y}_{t+k} \pm 1.96 \times \sigma_r \times \sqrt{k} \times \hat{y}_{t+k}$$

where:

- \hat{y}_{t+k} is the predicted value at time t+k
- σ_r is the standard deviation of growth rates
- k is the number of periods ahead
- 1.96 is the z-score for a 95% confidence level
- The confidence interval widens as increases (square root scaling) k

Frontend Visualization and Metrics

Sales Metrics Calculation

The frontend calculates several key metrics based on the forecast data:

Mathematical Formulation:

Predicted Sales and Growth Rate:

The growth rate is calculated as the percentage change between consecutive periods:

$$\text{GrowthRate} = \frac{y_{\text{current}} - y_{\text{previous}}}{y_{\text{previous}}} \times 100\%$$

where:

- y_{current} is the predicted value for the current period
- y_{previous} is the value from the previous period

Forecast Confidence Level:

The confidence level is calculated based on the coefficient of variation (CV) of historical data:

1. Mean and Variance Calculation:

$$\mu = \frac{1}{n} \sum_{i=1}^n y_i$$

$$\sigma^2 = \frac{1}{n} \sum_{i=1}^n (y_i - \mu)^2$$

2. Coefficient of Variation:

$$CV = \frac{\sigma}{\mu}$$

3. Time Frame-Specific Scaling:

$$S_{tf} = \begin{cases} 3 & \text{if time frame is weekly} \\ 5 & \text{if time frame is monthly} \\ 8 & \text{if time frame is yearly} \end{cases}$$

4. Data Point Factor:

$$F_{dp} = \min(1, \frac{n}{10})$$

5. Confidence Level Calculation:

$$\text{Confidence} = \max(0, \min(100, 100 - CV \times S_{tf} \times 100 \times F_{dp}))$$

This formula produces higher confidence levels for data with lower relative variability and more data points.

Industry Health Visualization

The Dashboard component displays industry health trends using cumulative averages:

Mathematical Formulation:

The cumulative average for each sector is calculated as:

$$\text{CumulativeAvg}_{c,t} = \frac{1}{t} \sum_{i=1}^t v_{c,i}$$

where:

- CumulativeAvg_c,t is the cumulative average for category c at time point t
- v_c,i is the raw value for category c at time point i
- t is the number of time points included in the calculation

This approach gives equal weight to all historical values and produces a smoothed trend that reduces the impact of short-term fluctuations while preserving long-term patterns.

The cumulative average approach helps smooth out short-term fluctuations and highlight long-term trends in industry performance.

Top Products Prediction

The system identifies products with the highest predicted growth potential:

Mathematical Formulation:

The top products prediction is based on the industry health coefficient:

1. Predicted Increase Calculation:

$$\text{PredictedIncrease}_p = \text{IHC}_{c(p)} \times 100\%$$

where:

- PredictedIncrease_p is the predicted percentage increase for product p
- IHC_c(p) is the industry health coefficient for the category of product p
- The multiplication by 100 converts the decimal coefficient to a percentage

2. Product Ranking:

Products are ranked by their predicted increase values, and the top 5 are selected:

$$\text{TopProducts} = \text{Top}_5(\{p_1, p_2, \dots, p_n\}, \text{PredictedIncrease})$$

where Top5 selects the 5 products with the highest predicted increase values.

This approach leverages the industry health indicators as a proxy for product-specific growth potential, allowing businesses to focus on products in the most promising industry sectors.

This calculation uses the industry health coefficient as a direct predictor of product growth potential, helping businesses focus on products with the highest growth opportunities.

Appendix D: References

Source: http://www.frontiernet.net/~kwiegers/process_assets/srs_template.doc