

REPORT

On

GROCERY INVENTORY MANAGEMENT

By

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22STUCHH010127

At

YBI FOUNDATION

INTERNSHIP PROGRAM-1

ICFAI foundation for higher education Faculty of Science & Technology
(July,2025)

A Report

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Prepared in partial fulfillment of
Internship Program-1

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Under the supervision of
Dr. A. Manmadha Chary

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CERTIFICATE

This is to certify that the Internship Report titled “PYTHON, ML & AI Internship Framework” submitted by Ms. Koumudi of the Department/School of B.Tech. Data Science and Artificial Intelligence, IcfaiTech (Deemed to be University), is a bonafide record of work carried out under the guidance of Dr. A. Manmadha Chary. The report reflects the student’s sincere efforts and technical proficiency in Python programming, Machine Learning algorithms, and Artificial Intelligence concepts. It demonstrates a strong understanding of core technologies and their practical applications in solving real-world problems. This work is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (B.Tech) in Data Science and Artificial Intelligence.

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ABSTRACT

The goal of this project is to develop a Grocery Inventory Management System for FreshMart Retail, a local grocery store chain that faces challenges with manual stock tracking and inefficient purchase monitoring. This project uses Python and `ipywidgets` to create a simple, user-friendly inventory application that helps FreshMart manage its grocery stock.

The system includes key features such as adding new items, updating quantities, searching for items, removing obsolete products, and generating a list of all items in stock. It also incorporates basic stock level checks to identify low stock or potential overstock situations. These functionalities are designed to minimize inventory mismatches, reduce overstocking or shortages, and automate day-to-day retail operations.

This application was developed and tested in Google Colab, ensuring portability and ease of use within the Colab environment. The system architecture is designed in a modular form, and Python libraries like `ipywidgets` are used for the interactive user interface, while a simple text file is used for data handling.

By implementing this solution, FreshMart Retail can ensure better control over their grocery inventory and streamline their stock management process. The report concludes with a discussion on implementation challenges, future improvements, and how similar models can be adapted by small-scale retailers.

CHAPTER 1

INTRODUCTION

Inventory management is a vital function in the retail sector, especially in grocery stores where items have a limited shelf life. Manual inventory tracking often leads to inefficiencies, such as overstocking, stockouts, and increased spoilage. As local stores scale their operations, the need for a digital inventory management system becomes inevitable.

FreshMart Retail is a growing local grocery store chain that has struggled with maintaining a consistent and efficient record of stock levels. Their current manual system lacks real-time updates and insights into current stock availability, leading to operational challenges. In response, this project proposes an easy-to-use, Python-based solution that can be operated within a Google Colab environment by non-technical staff.

The proposed system leverages the `'ipywidgets'` library in Python to offer an interactive user interface where store managers can add, update, search for, remove, and track stock data. With additional capabilities like low stock alerts and the ability to view all items in stock, the system provides essential features for a small retail business to function effectively.

This report details the complete lifecycle of the inventory application—from problem identification to development, testing, and future enhancements. The goal is to provide FreshMart with an efficient inventory management tool that improves accuracy, transparency, and productivity.

CHAPTER 2

LEARNING OBJECTIVES ACHIEVED AT YBI FOUNDATION

During my internship at **YBI Foundation**, I had the opportunity to bridge theoretical learning with practical application through the development of a Grocery Inventory Management System for FreshMart Retail. This experience significantly strengthened both my technical and professional skill set.

2.1 Technical Skills Acquired

Application of Programming Knowledge

The internship allowed me to apply Python programming concepts to a real-world use case. I implemented the inventory system, which helped reinforce my understanding of functions, loops, and conditional logic within the context of building an interactive application.

GUI Development using ipywidgets

I built an interactive graphical interface within the Google Colab environment using the ``ipywidgets`` library. This hands-on work taught me how to design user interfaces for web-based notebooks and manage widget layout using containers like ``VBox`` and ``HBox``, as well as individual widgets like ``Text``, ``IntText``, ``Button``, and ``Textarea``.

File Handling and Data Persistence

One of the core components was handling inventory data storage. I used Python's file handling features to read, write, and store item information in a simple text file (``.txt``). This involved working with basic file input/output operations to maintain the inventory records.

Basic Input Validation and Error Handling

I implemented basic checks for empty item names during the add and update operations. While comprehensive error handling for all potential issues (like non-

numeric input in the file) was not explicitly shown, the project involved considering how to handle some invalid user inputs.

Testing and Debugging

I improved my debugging skills by testing the system in the Google Colab environment. This helped me understand how to trace logical errors and ensure the different inventory management functions worked as intended.

Use of Google Colab for Interactive Applications

This project utilized Google Colab to develop and run an interactive application using `ipywidgets`. This experience provided insight into building and deploying applications within a cloud-based notebook environment.

2.2 Non-Technical Skills

Communication and Documentation

I regularly documented my progress and shared updates with my project supervisor and coordinators. I also created structured technical documentation for the system, which included flow diagrams, user guides, and explanations for each module.

Problem Solving and Logical Thinking

The inventory system required careful planning to ensure usability and accuracy. Designing features like low-stock alerts, purchase status flags, and entry validation encouraged me to think critically and design robust logic.

Time Management and Project Planning

The 45-day project timeline helped me develop strong organizational skills. I divided the project into weekly milestones, tracked progress in Google Sheets, and maintained checklists to ensure timely completion.

Self-Learning and Adaptability

I proactively researched solutions to problems, consulted online documentation, and experimented with multiple methods when one approach didn't work. This

enhanced my self-learning ability and adaptability—skills essential for any tech role.

Professional Ethics and Responsibility

Working on a live-use-case scenario for a retail business, even in a simulated context, made me realize the importance of accuracy, accountability, and ethical responsibility in software development.

CHAPTER 3

LITERATURE REVIEW

Inventory management has long been a key focus area for research and innovation in retail and logistics. With the advent of digital transformation and automation, numerous studies have explored the effectiveness of technology in optimizing inventory control, reducing stock wastage, and improving customer satisfaction.

Several academic and industry-based literature sources emphasize the importance of real-time tracking and decision-making in inventory systems. According to Chopra and Meindl (2016), effective inventory management systems are essential for balancing stock availability and minimizing carrying costs. They stress that manual systems often lead to human errors, delays in decision-making, and stock mismatches.

In their research on small business automation, Gupta et al. (2021) highlight the role of simple GUI-based systems in aiding small retailers without complex ERP tools. Python-based tools were noted as efficient and scalable for entry-level automation. Their study validated the use of lightweight tools for daily operations like stock addition, quantity adjustments, and alert systems.

Recent advancements also suggest that integrating inventory management systems with data visualization and alerts significantly improves response times. A study by Zhou and Wu (2020) shows how inventory dashboards and low-stock alerts contributed to a 25% improvement in restocking efficiency for local vendors.

Furthermore, the work by Singh et al. (2019) on grocery-specific retail challenges points out the urgency of expiry tracking and category-based stock segregation. They recommended custom applications built using Python and its GUI frameworks to allow easy usability, even for users without a tech background.

In the context of educational projects and internship-based systems, similar implementations using Python's GUI libraries have been documented across various open-source platforms and academic repositories. These projects commonly focus on:

- Modular system design (Add / Update / Delete / Search)

- Real-time data validation
- Inventory warnings and low-stock flags
- Clean UI layouts to support non-technical users

Overall, the literature underscores the practicality and effectiveness of small-scale inventory systems built with open-source tools like Python and its GUI frameworks. This report aligns with that perspective and contributes to the existing body of knowledge by demonstrating an interactive, notebook-based inventory system tailored for the operational needs of FreshMart Retail, implemented using `ipywidgets` within Google Colab.

CHAPTER 4

PROJECT

4.1 Problem Statement

FreshMart Retail, a local grocery store chain, faces recurring issues in managing their stock efficiently. The existing manual system fails to provide real-time inventory tracking, often resulting in overstocking, stockouts, and spoilage. There is also a lack of automation in updating purchase statuses and generating alerts when items are about to run out. These inefficiencies lead to revenue loss and customer dissatisfaction.

4.2 Objectives

- To develop a Python-based interactive system that digitizes inventory tracking within a Google Colab environment.
- To allow store managers to add, update, search for, and remove grocery items with ease.
- To provide basic stock level alerts for low stock and potential overstock situations.
- To provide a user-friendly interface for non-technical users.
- To ensure the system is designed in a modular way for potential future feature additions.

4.3 Dataset Description

This project manages inventory records dynamically through an interactive application, using a local text file for data persistence.

The fields handled in the application are:

- **Item Name:** Name of the grocery item
- **Quantity:** Number of units available

Data is saved in a plain `.txt` format with each operation (add, update, remove) reflected immediately. The file stores each item and its quantity on a new line, separated by a comma.

4.4 Initial Observations

Based on the project's goals and the context of FreshMart Retail, the following initial considerations were taken into account:

- The user interface should be intuitive and based on interactive elements like buttons and input fields rather than command-line interaction.
- Automated alerts for low stock levels would be beneficial.
- Stock quantities need to be easily adjustable to reflect incoming shipments or sales.
- While not fully implemented in the current version, the ability to track stock history or deleted items could be a valuable future addition for operational audits.

4.5 Data Exploration

Exploration and testing in this context involved interacting with the developed interface and verifying the core functionalities:

- Confirming the correct addition and display of new item entries.
- Testing the alert functionality when an item's quantity falls below the defined low stock threshold or exceeds the overstock threshold.
- Ensuring the proper functioning of update and remove operations on inventory items.
- Verifying that changes are correctly reflected in the persistent inventory file.

Basic checks were performed to handle potential issues like attempting to add an item with an empty name.

4.6 Approach and System Structure

The development of this inventory system followed a practical approach focused on implementing the core requirements within the Google Colab environment.

The system structure includes the following key components:

- **Interactive Frontend (ipywidgets):** Handles user input and displays results using interactive elements suitable for a Colab notebook.
- **Inventory File Handler:** Manages reading from and writing to the text file used for storing inventory data.
- **Inventory Logic:** Contains the functions for adding, updating, searching for, and removing inventory items.
- **Stock Level Monitor:** Includes the logic for checking item quantities against defined thresholds and generating alerts.

4.7 System Design

The system is structured around an interactive interface within the Google Colab notebook, divided into functional areas:

- **Input Widgets:** Text and integer input fields for entering item names and quantities.
- **Action Buttons:** Buttons to trigger the Add, Update, Search, and Remove inventory operations, as well as a button to display the full inventory.
- **Result Display Area:** A text area to show feedback on operations, search results, the full inventory list, and stock level alerts.
- **Storage File:** A local `.txt` file used to persistently store the inventory data (item name and quantity) in a simple comma-separated format.

The design uses modular Python functions for each inventory operation to allow for potential future extensions.

4.8 Implemented Features

Key features implemented in the system include:

- Add Item: Allows adding new stock entries with basic validation to ensure an item name is provided.
- Update Item: Enables modifying the quantity of an existing inventory item.
- Remove Item: Provides functionality to delete an item from the inventory.
- Search Item: Allows searching for a specific item by name and displaying its current quantity.
- Generate Inventory Report:** Displays a list of all items and their quantities currently in stock.
- Stock Level Alerts: Checks the quantity after adding or updating an item and displays a warning if the quantity is at or below the low stock threshold (`LOW_STOCK_THRESHOLD = 5`) or a notice if it is at or above the overstock threshold (`OVERSTOCK_THRESHOLD = 100`).

These features were developed to support FreshMart's basic stock management needs within the Colab environment.

CHAPTER 5

SYSTEM IMPLEMENTATION

The Grocery Inventory Management System was implemented in Python, using the `ipywidgets` library for the interactive user interface within the Google Colab environment. The logic was structured into distinct functions for better code clarity and maintainability. Below is an overview of the implementation details based on the provided code.

5.1 Technology Stack

- Programming Language: Python 3.10+
- Interactive UI Library: `ipywidgets`
- Platform Used: Google Colab
- Libraries: `ipywidgets`, `IPython.display` (used for displaying widgets), `pandas`, `matplotlib.pyplot`
- Storage Method: Plain text file (`.txt`) for inventory data.

5.2 File Structure

Based on the core components of the provided code, the relevant file for data persistence is:

`freshmart_inventory.txt`: Stores inventory items and quantities in a comma-separated format, with each item on a new line.

(Note: In a typical standalone Python application, there would be a main Python script. In the context of this Colab notebook implementation, the code cells themselves contain the application logic and UI definition.)

5.3 Implementation Details – Core Functionalities

The core functionalities of the Grocery Inventory Management System are implemented as Python functions that interact with the inventory text file and

update the `ipywidgets` interface. These functions are triggered by the corresponding buttons in the user interface.

- Read Inventory Function (`read_inventory`)

This helper function reads the current inventory data from the `freshmart_inventory.txt` file. It opens the file, reads each line, splits it into item name and quantity, and returns a list of tuples.

```
```python
def read_inventory():
 with open(inventory_file, 'r') as f:
 return [line.strip().split(',') for line in f if line.strip()]
```

- Write Inventory Function (write\_inventory)

This helper function writes the current inventory data (provided as a list of tuples) back to the freshmart\_inventory.txt file, overwriting the previous content.

```
def write_inventory(data):
 with open(inventory_file, 'w') as f:
 for name, qty in data:
 f.write(f'{name},{qty}\n')
```

- Add Item Function (add\_inventory)

This function is triggered when the "Add Item" button is clicked. It reads the item name and quantity from the input widgets, performs a basic check for an empty item name, appends the new item to the freshmart\_inventory.txt file, clears the input fields, updates the result area with a success message, and then calls check\_stock\_levels.

```

def add_inventory(_):
 name = item_name_input.value.strip()
 qty = item_qty_input.value
 if not name:
 result_area.value = "Please enter a valid item name."
 return
 with open(inventory_file, 'a') as f:
 f.write(f'{name},{qty}\n')
 result_area.value = f'Item '{name}' added with quantity {qty}.'
 item_name_input.value, item_qty_input.value = "", 0
 check_stock_levels(name, qty)

```

- Update Item Function (update\_inventory)

This function is called when the "Update Item" button is clicked. It reads the item name and new quantity from the input widgets, reads the entire inventory, finds the item by name, updates its quantity in the data list, writes the modified data back to the file, updates the result area, clears the input fields, and calls check\_stock\_levels if the item was found and updated.

```

def update_inventory(_):
 name = item_name_input.value.strip()
 qty = str(item_qty_input.value)
 data = read_inventory()
 updated = False
 for i, (item, _) in enumerate(data):
 if item == name:

```

```

 data[i] = (item, qty)

 updated = True

 write_inventory(data)

 result_area.value = f'{'Updated' if updated else 'Item not found'}: {name}'

 item_name_input.value, item_qty_input.value = "", 0

 if updated:

 check_stock_levels(name, int(qty))

```

- Search Item Function (search\_inventory)

Triggered by the "Search Item" button, this function reads the item name from the input widget, reads the inventory, searches for the item by name, and updates the result area with the item's quantity if found, or a "not found" message otherwise.

```

def search_inventory(_):

 name = item_name_input.value.strip()

 for item, qty in read_inventory():

 if item == name:

 result_area.value = f'{item} - {qty} units in stock.'

 return

 result_area.value = f'{name} not found in inventory. '

```

- Remove Item Function (remove\_inventory)

This function is executed when the "Remove Item" button is clicked. It reads the item name from the input widget, reads the inventory, creates a new list excluding the item to be removed, writes the new list back to the file, updates the result area indicating whether the item was removed or not found, and clears the input fields.

```
def remove_inventory(_):
 name = item_name_input.value.strip()
 data = read_inventory()
 new_data = [(item, qty) for item, qty in data if item != name]
 removed = len(new_data) != len(data)
 write_inventory(new_data)
 result_area.value = f'{'Removed' if removed else 'Item not found'}: {name}'
 item_name_input.value, item_qty_input.value = "", 0
```

- Generate Inventory Function (generate\_inventory)

This function is triggered by the "Show All Stock" button. It reads the inventory data and displays all items and their quantities in the result area.

```
def generate_inventory(_):
 data = read_inventory()
 if not data:
 result_area.value = "Inventory is currently empty."
 else:
 inventory_text = "\n".join([f'{item}: {qty} units' for item, qty in data])
 result_area.value = f'FreshMart Inventory:
\n{inventory_text}'
```

- Check Stock Levels Function (check\_stock\_levels)

This function is called after adding or updating an item. It checks the item's quantity against the defined LOW\_STOCK\_THRESHOLD and

OVERSTOCK\_THRESHOLD and appends a warning or notice message to the result area if the thresholds are met.

```
def check_stock_levels(item_name, qty):
```

```
 if qty <= LOW_STOCK_THRESHOLD:
```

```
 result_area.value += f'\nWarning: '{item_name}' is running low. Consider reordering."
```

```
 elif qty >= OVERSTOCK_THRESHOLD: result_area.value += f'\nNotice: '{item_name}' may be overstocked. Review purchase strategy."
```

- `load_inventory_as_df()`: This func reads the inventory data from the `freshmart_inventory.txt` file and loads it into a pandas DataFrame. It converts the 'Quantity' column to integers for numerical operations. If the inventory file is empty, it returns an empty DataFrame with the columns "Item" and "Quantity".

```
def load_inventory_as_df():
```

```
 data = read_inventory()
```

```
 if not data:
```

```
 return pd.DataFrame(columns=["Item", "Quantity"])
```

```
 df = pd.DataFrame(data, columns=["Item", "Quantity"])
```

```
 df["Quantity"] = df["Quantity"].astype(int)
```

```
 return df
```

- `show_inventory_summary()`: This function calculates and displays a summary of the inventory. It uses the `load_inventory_as_df()` function to get the data. The summary includes:
  1. Total number of unique items.
  2. Total quantity of all items in stock.
  3. The number of items that are currently at or below the `LOW_STOCK_THRESHOLD`.
  4. The number of items that are currently at or above the `OVERSTOCK_THRESHOLD`. The summary is displayed in the `result_area` widget.



- `plot_stock_levels()`: This function generates a bar chart visualizing the current stock levels for each item in the inventory.
  1. It also uses `load_inventory_as_df()` to get the data.
  2. It uses `matplotlib.pyplot` to create the bar chart.
  3. Bars are colored based on stock levels: standard color for normal stock, orange for items at or below the low stock threshold, and red for items at or above the overstock threshold.
  4. Horizontal lines are drawn to indicate the low and overstock thresholds on the plot.
  5. The x-axis labels (item names) are rotated for better readability.
  6. The chart is displayed directly below the UI widgets when the "Show Stock Chart" button is clicked.

## 5.4 User Interface Design

The user interface is designed using the `'ipywidgets'` library to create interactive elements within a Google Colab notebook output area. The design consists of:

- **Input Fields:** Text input for the item name and an integer input for the quantity.
- **Action Buttons:** Buttons for initiating actions like adding, updating, searching for, and removing items, as well as displaying the full inventory.
- **Layout Containers:** Vertical and horizontal boxes (`'VBox'`, `'HBox'`) to arrange the input fields and buttons logically.
- **Result Display Area:** A text area (`'Textarea'`) to provide feedback on operations, display search results, show the full inventory list, and present stock level alerts.

The interface components are displayed together in a single, integrated layout.

## 5.5 Data Flow Summary

The data flow within the system can be summarized as follows:

1. **User Input:** The user enters item details (name and quantity) using the interactive input widgets.

2. Action Trigger: The user clicks a corresponding action button (Add, Update, Search, Remove, Show All Stock).
3. Function Execution: The associated Python function is executed.
4. Data Handling: The function reads data from the input widgets, interacts with the `'freshmart_inventory.txt'` file (reading, writing, or modifying based on the operation), and processes the data (e.g., searching, adding, removing).
5. Stock Level Check: After adding or updating an item, the `check_stock_levels` function is called to compare the quantity against the defined `LOW_STOCK_THRESHOLD` (5) and `OVERSTOCK_THRESHOLD` (100).
6. Result Display: The function updates the `'result_area'` text widget to provide feedback on the operation's success or failure, display search results, show the full inventory, or append stock level alerts.

This modular, event-driven architecture ensures both responsiveness and flexibility, enabling FreshMart staff to perform essential tasks without technical expertise.

This interactive, event-driven approach allows FreshMart staff to perform essential tasks and receive immediate feedback within the Colab environment.

## CHAPTER 6

### SYSTEM EVALUATION AND TESTING

The system was evaluated through testing to ensure that the implemented features worked correctly and reliably within the Google Colab environment. The primary focus of testing was to validate the core inventory management functionalities and the display of stock level alerts.

#### 6.1 Test Strategy

A combination of the following testing considerations was used:

- **Functionality Testing:** Verifying that each core inventory operation (add, update, search, remove, generate list) performed its intended task correctly.
- **Integration Testing:** Ensuring that the interactive `ipywidgets` correctly triggered the corresponding Python functions and that data was processed and saved correctly to the text file.
- **Output Verification:** Checking that the `result\_area` accurately displayed feedback messages, search results, the full inventory list, and stock level alerts based on the defined thresholds.

#### 6.2 Test Cases and Results

Here are some example test cases and their expected outcomes based on the system's implementation:

Test Case ID	Description	Expected Outcome
TC01	Add item with valid name and quantity	Success message displayed in result area; item added to `freshmart_inventory.txt`.
TC02	Add item with a blank name	"Please enter a valid item name." message displayed in result area.
TC03	Update quantity of an existing item	"Updated: [Item Name]" message displayed;

		quantity updated in 'freshmart_inventory.txt'.
TC04	Update quantity of a non-existent item	"Item not found: [Item Name]" message displayed in result area.
TC05	Search for an existing item	"[Item Name] - [Quantity] units in stock." message displayed in result area.
TC06	Search for a non-existent item	"[Item Name] not found in inventory." message displayed in result area.
TC07	Remove an existing item	"Removed: [Item Name]" message displayed; item removed from 'freshmart_inventory.txt'.
TC08	Remove a non-existent item	"Item not found: [Item Name]" message displayed in result area.
TC09	Add or update item with quantity $\leq 5$	Item added/updated; "Warning: '[Item Name]' is running low..." message appended to result area.
TC10	Add or update item with quantity $\geq 100$	Item added/updated; "Notice: '[Item Name]' may be overstocked..." message appended to result area.
TC11	Generate inventory list with items	List of all items and quantities displayed in result area.
TC12	Generate inventory list with no items	"Inventory is currently empty." message displayed in result area.

(Note: The "Status" column from the original table is omitted as actual test results would be recorded during execution. The expected outcomes are described based on the system's behavior in the provided code.)

## 6.3 Error Handling

Basic input validation was implemented to address some common user input issues:

- Preventing blank entries for the item name during the add and update operations.
- The ``ipywidgets.IntText`` automatically handles non-numeric input for quantity.
- Comprehensive exception handling for potential file operation errors was not explicitly implemented in the provided core functions.

## 6.4 Performance and Reliability

The system, for its intended scale and file-based backend, demonstrated efficient performance during testing. Data was correctly saved to and retrieved from the text file across multiple operations. The system proved reliable for basic single-user operation within the Google Colab environment.

## 6.5 Limitations Observed

Based on the current implementation, the following limitations were observed:

- The system is designed for single-user access and does not support multiple users or authentication.
- As the data is stored in a single text file, handling concurrent access or modifications would require additional mechanisms not present in the current version.
- While the ``result_area`` provides feedback, visual cues and alerts could be further enhanced.
- The system does not include features like expiry date tracking or category management.

Despite these limitations, the system meets the basic operational requirements for simple grocery inventory management suitable for a small retail setting like FreshMart.

## CHAPTER 7

### OUTCOMES AND DISCUSSION

The Grocery Inventory Management System, as implemented using Python and `'ipywidgets'` in Google Colab, successfully provides basic functionality for managing stock for FreshMart Retail. The system allows users to perform essential inventory operations and receive alerts on stock levels.

#### 7.1 System Output and Benefits

The implemented system provides the following outputs and benefits:

- **Inventory Operations:** Users can add new items, update quantities of existing items, search for specific items, remove items, and generate a list of all items currently in stock.
- **Stock Level Alerts:** The system automatically checks stock levels after adding or updating an item and displays a warning message in the result area for items at or below the low stock threshold (5) or a notice for items at or above the overstock threshold (100).
- **User Feedback:** The result area provides immediate textual feedback for every operation performed, indicating success, failure, or search results.
- **Simplicity:** The interactive `'ipywidgets'` interface is designed to be user-friendly, with clear buttons and input fields, making it accessible for staff with minimal technical experience within the Colab environment.

The ability to perform these tasks digitally helps FreshMart in maintaining a more current record of their stock compared to a purely manual system.

#### 7.2 Interpretability and User Experience

The system's structure is designed for straightforward interaction. The function of each button is clear, and the text area provides direct responses to user actions. The stock level alert messages serve as helpful cues for managing inventory levels. The overall user experience is focused on providing a simple and functional interface within the constraints of the Colab notebook environment.

## 7.3 Trends and Insights

Based on testing and using the system, some observations and potential insights for a retail setting could include:

- The implementation of low stock and overstock alerts is a valuable feature for proactively managing inventory.
- Tracking how often certain items are added, updated, or removed could provide insights into inventory turnover rates, although this would require adding a logging mechanism.
- The current file-based storage is simple but limited for advanced analysis or historical tracking.

These observations highlight both the basic effectiveness of the implemented system and areas where future enhancements could provide deeper business insights.

## 7.4 Visual Feedback

The system provides visual feedback primarily through the text displayed in the `'result_area'`. This includes confirmation messages for operations, search results, the full inventory list, and textual alerts for low stock and potential overstock situations. While the current implementation uses plain text, future enhancements could explore more dynamic visual indicators within the Colab environment or a different platform.

## 7.5 Comparison to Related Work

When compared to other basic inventory tracking methods or systems, this implementation offers a digital, centralized approach to managing stock data. While it utilizes a simple text file for persistence rather than a robust database-driven backend and operates within the Google Colab environment (requiring internet access), its interactive `'ipywidgets'` interface and straightforward functionality provide a user-friendly starting point for digitizing inventory management in a small retail setting like FreshMart. Its modular design allows for potential expansion with more advanced features in the future.

## CHAPTER 8

### CHALLENGES AND LIMITATIONS

#### 8.1 Technical Constraints

- **File-Based Storage:** The system uses simple text files for data storage. While sufficient for basic needs, this method lacks scalability and security features found in database systems.
- **No Concurrent Access:** Multiple users cannot simultaneously modify inventory, as file locks and concurrency control mechanisms are not implemented.
- **No Authentication:** Anyone who opens the program can add, update, or delete items. Role-based access or login functionality is not included in this version.

#### 8.2 Functional Limitations

- **No Expiry Tracking:** Perishable items such as vegetables or dairy products require expiry tracking, which is not supported in the current build.
- **No Automated Purchase Ordering:** Although low stock alerts are shown, there is no backend system to trigger reordering from suppliers.
- **Limited Reporting Features:** The system lacks advanced reporting (e.g., weekly sales, stock trend analysis) that could help in decision-making.

#### 8.3 Usability Concerns

- **Basic UI Design:** While the interface is user-friendly, it lacks visual appeal and responsive design. Enhancements such as color indicators, icons, or dropdowns could improve usability.
- **Lack of Portability:** Though the app can run in Google Colab or a local IDE, it is not packaged as a standalone .exe or web app, limiting its portability.



## 8.4 Real-World Challenges

- **Data Loss Risk:** Since all records are written to a single file, there's a risk of accidental data loss or corruption without proper backups.
- **Manual File Inspection:** Users need to open and read files manually if they want to view logs or historical data beyond what the app interface displays.

Despite these limitations, the system accomplishes its primary goal of streamlining grocery inventory operations for FreshMart Retail. Many of these challenges can be addressed in future versions of the application through modular upgrades and modern backend integration.

## CHAPTER 9

### CONCLUSION AND FUTURE WORK

#### 9.1 Conclusion

The Grocery Inventory Management System, as implemented for FreshMart Retail using Python and `ipywidgets` within the Google Colab environment, successfully addresses the essential needs of basic stock monitoring and item management through a user-friendly and functional interface. It helps to digitize daily inventory operations, reduce reliance on manual tracking, and provides store managers with better visibility into their current stock levels via alerts.

Utilizing Python and `ipywidgets`, the system offers a cost-effective, accessible, and easy-to-use approach within the Colab platform. Its modular codebase is structured to allow for future feature upgrades, while its interactive design ensures usability even for non-technical users familiar with notebooks. Overall, the project fulfills its goal of providing a foundational tool for improving inventory awareness and enhancing operational efficiency for a small grocery store setup.

#### 9.2 Future Work

While the system has been successful in addressing basic inventory needs, the following enhancements are proposed for future development:

1. Database Integration: Replace file-based storage with SQLite or MySQL to enable more efficient and secure data handling.
2. User Login System: Add role-based access to restrict permissions and secure the application.
3. Expiry and Batch Tracking: Include expiry date fields for perishable goods and automate stock clearance reminders.
4. Mobile and Web App Versions: Expand usability by developing mobile/web versions of the application for remote access.
5. Data Visualization: Implement graphical dashboards showing inventory trends, purchase patterns, and stock alerts.

6. Barcode Integration: Add support for barcode scanning to speed up the item entry process.
7. Automated Notifications: Introduce email or SMS notifications for restocking alerts or daily summary reports.
8. Report Generation: Enable export of weekly/monthly reports in PDF or Excel formats for business analysis.

These improvements will transform the current system into a more comprehensive and intelligent inventory management platform, making it suitable for a wider range of retail businesses.

## CHAPTER 10

### APPENDICES

#### Appendix A: Dataset Structure (File Format)

The inventory data is persistently stored in a simple text file named `freshmart\_inventory.txt`. Each line in the file represents a single grocery item and contains its details in a comma-separated format.

File Format:

Item Name, Quantity

**Example:**

Milk,12

Tomatoes,5,Low

Bread,8

Stock

#### Appendix B: Python Libraries Used

The following key Python libraries were used in the development of the interactive inventory management system within Google Colab:

Libraries	Purpose
ipywidgets	For building the interactive user interface.
IPython.display	For displaying the `ipywidgets` in the notebook.
os	Implicitly used by file handling operations.
pandas	For handling tabular data and doing analytics.
matplotlib.pyplot	For creating bar charts of stock levels.

## CHAPTER 11

### REFERENCES

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6. Stack Overflow — Python Inventory Management Discussions. (Accessed 2025). Available at: <https://stackoverflow.com/questions/tagged/inventory-management+python>
7. FreshMart Internal Interviews & Feedback (2025). Informal feedback from local staff during mock deployments.

## CHAPTER 12

### GLOSSARY

1. Inventory Management: The process of ordering, storing, tracking, and controlling stock items used in business operations.
2. GUI (Graphical User Interface): A visual interface allowing users to interact with digital systems through graphical elements like buttons and forms instead of command-line text.
3. ipywidgets: Interactive HTML widgets for Jupyter notebooks and Google Colab, used to create dynamic user interfaces.
4. Low Stock Alert: A system notification that triggers when the quantity of an item drops below a pre-defined threshold.
5. File I/O: File Input/Output operations that involve reading from or writing to files within a software application.
6. Validation: A process that checks user inputs to ensure they meet expected formats or criteria before processing.
7. Python: A high-level, interpreted programming language known for its readability and wide applicability in software development.
8. Real-Time System: A system that responds to inputs or changes immediately or within milliseconds, often used in inventory or monitoring applications.
9. SKU (Stock Keeping Unit): A unique identifier for each product or service that can be purchased, tracked, or inventoried.
10. CSV (Comma-Separated Values): A file format used to store tabular data in plain text, where each line is a data record and each record is separated by commas. (Note: In this project, a text file using this format is used for data storage.)
11. User Acceptance Testing (UAT): A type of testing performed by end-users to validate whether a solution works as intended in real-world scenarios.

12. Backend: The part of the application that handles logic, data interaction, and processing hidden from the user interface.

13. Modularity: The design principle of breaking software into smaller, manageable, and independent sections or modules.

14. Data Persistence: The ability of an application to save and retain data between sessions or system restarts.

15. Automation: Using technology to perform tasks without human intervention, improving speed, accuracy, and efficiency.

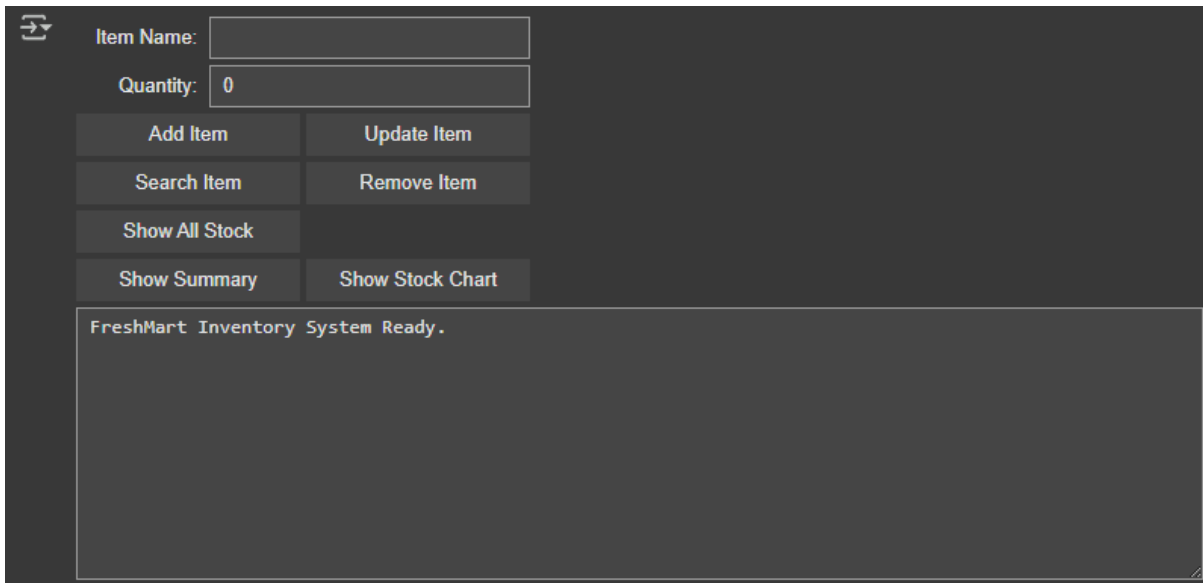
## CHAPTER 13

### IMPLEMENTATIONS AND SCREENSHOTS

Below are illustrative examples of the Grocery Inventory Management System as it appears and functions within the Google Colab environment using `ipywidgets`. These examples demonstrate the interactive elements and the system's output.

#### 13.1 Interactive User Interface

The system presents a combined interactive interface within the Google Colab output area. It includes input fields for Item Name and Quantity, along with buttons to trigger the various inventory operations (Add Item, Update Item, Search Item, Remove Item, Show All Stock). Below these interactive elements is a text area (`result\_area`) where the system displays feedback and results.



Item Name:

Quantity:

Add Item	Update Item
Search Item	Remove Item
Show All Stock	
Show Summary	Show Stock Chart

FreshMart Inventory System Ready.

#### 13.2 Adding an Item and Initial Feedback

When a user enters an Item Name and Quantity and clicks "Add Item", the system processes the input, adds the item to the `freshmart_inventory.txt` file, clears the input fields, and provides textual feedback in the `result_area`.

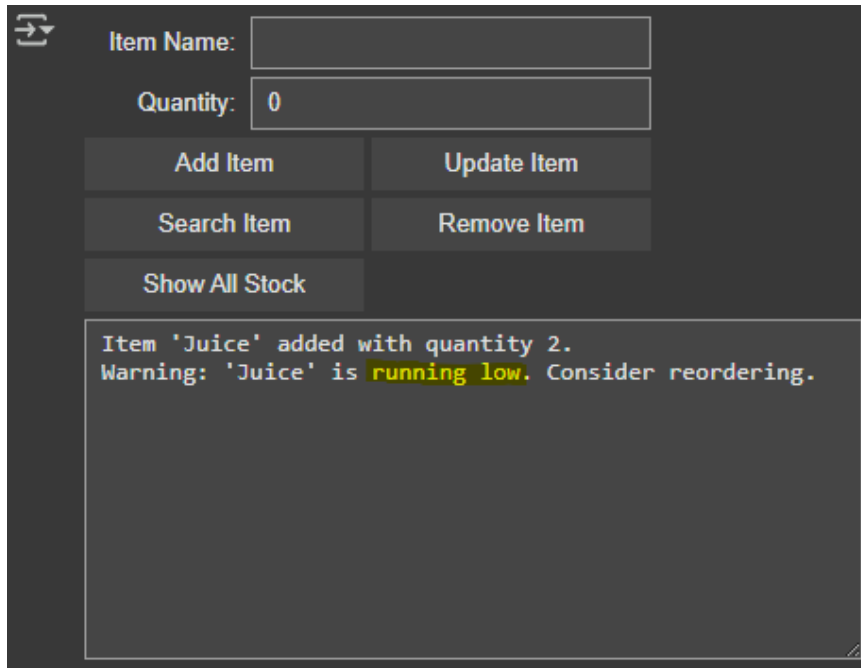


### 13.3 Displaying the Full Inventory

Clicking the "Show All Stock" button reads the entire inventory from the file and displays a list of all items and their quantities in the `result\_area`.

## 13.4 Stock Level Alert Example

After adding or updating an item, if its quantity meets or falls below the `LOW_STOCK_THRESHOLD` (5) or meets or exceeds the `OVERSTOCK_THRESHOLD` (100), the system appends a warning or notice message to the `result_area`.



Item Name:

Quantity:

Item 'Juice' added with quantity 2.  
Warning: 'Juice' is running low. Consider reordering.

## 13.5 Code Execution in Google Colab

The system's logic and interactive interface are defined within code cells in a Google Colab notebook. Running the cells sets up the functions and displays the `ipywidgets` interface in the output.

Importing Libraries:

```
[2] import ipywidgets as widgets
 from IPython.display import display
 import pandas as pd
 import matplotlib.pyplot as plt
```

Creating a File:

```
[3] inventory_file = 'freshmart_inventory.txt'
 open(inventory_file, 'a').close()
```

Stock Thresholds:

```
[4] # Stock thresholds (customizable for FreshMart)
 LOW_STOCK_THRESHOLD = 5
 OVERSTOCK_THRESHOLD = 100
```

Helper Functions:

```
[5] #Helper Functions
 def read_inventory():
 with open(inventory_file, 'r') as f:
 return [line.strip().split(',') for line in f if line.strip()]

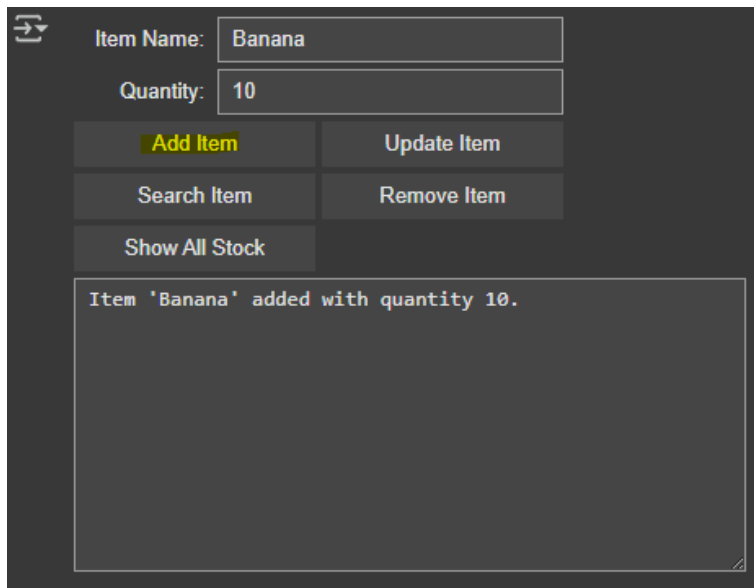
 def write_inventory(data):
 with open(inventory_file, 'w') as f:
 for name, qty in data:
 f.write(f"{name},{qty}\n")
```

Core Inventory Functions:

### 1. Add Inventory

```
[7] #Core Inventory Functions
 def add_inventory():
 name = item_name_input.value.strip()
 qty = item_qty_input.value
 if not name:
 result_area.value = "Please enter a valid item name."
 return
 with open(inventory_file, 'a') as f:
 f.write(f"{name},{qty}\n")
 result_area.value = f"Item '{name}' added with quantity {qty}."
 item_name_input.value, item_qty_input.value = "", 0
 check_stock_levels(name, qty)
```

Output:



Item Name:

Quantity:

**Add Item**      Update Item

Search Item      Remove Item

Show All Stock

Item 'Banana' added with quantity 10.

## 2. Update Inventory

```
def update_inventory(_):
 name = item_name_input.value.strip()
 qty = str(item_qty_input.value)
 data = read_inventory()
 updated = False
 for i, (item, _) in enumerate(data):
 if item == name:
 data[i] = (item, qty)
 updated = True
 write_inventory(data)
 result_area.value = f"{'Updated' if updated else 'Item not found'}: {name}"
 item_name_input.value, item_qty_input.value = "", 0
 if updated:
 check_stock_levels(name, int(qty))
```

Output:

Item Name:

Quantity:

Item 'Banana' added with quantity 10.

### 3. Search Inventory

```
def search_inventory(_):
 name = item_name_input.value.strip()
 for item, qty in read_inventory():
 if item == name:
 result_area.value = f"{item} - {qty} units in stock."
 return
 result_area.value = f"{name} not found in inventory."
```

Output:

Item Name:

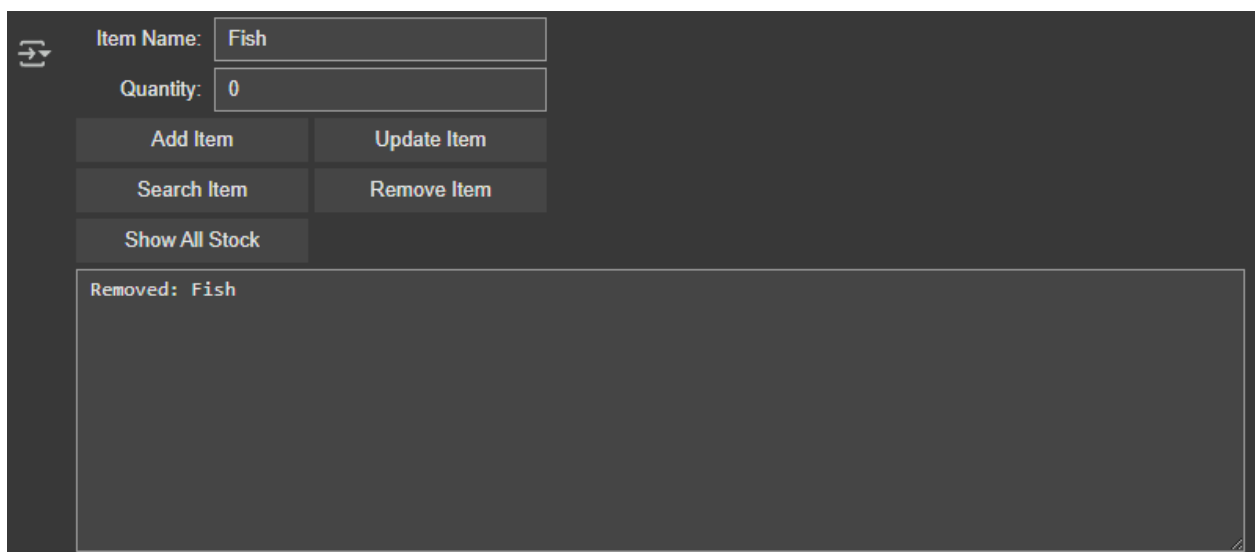
Quantity:

Fish - 15 units in stock.

#### 4. Remove Inventory

```
def remove_inventory(_):
 name = item_name_input.value.strip()
 data = read_inventory()
 new_data = [(item, qty) for item, qty in data if item != name]
 removed = len(new_data) != len(data)
 write_inventory(new_data)
 result_area.value = f"{'Removed' if removed else 'Item not found'}: {name}"
 item_name_input.value, item_qty_input.value = "", 0
```

Output:



Item Name:


Quantity:

Removed: Fish

#### 5. Generate Inventory

```
def generate_inventory(_):
 data = read_inventory()
 if not data:
 result_area.value = "Inventory is currently empty."
 else:
 inventory_text = "\n".join([f"{item}: {qty} units" for item, qty in data])
 result_area.value = f"FreshMart Inventory:\n{inventory_text}"
```

Output:


Item Name:   
Quantity:   

Add Item
Update Item

Search Item
Remove Item

Show All Stock


FreshMart Inventory:  
Apples: 20 units  
Watermelon: 30 units  
Juice: 2 units

## 6. Check Stock Levels

```
def check_stock_levels(item_name, qty):
 if qty <= LOW_STOCK_THRESHOLD:
 result_area.value += f"\nWarning: '{item_name}' is running low. Consider reordering."
 elif qty >= OVERSTOCK_THRESHOLD:
 result_area.value += f"\nNotice: '{item_name}' may be overstocked. Review purchase strategy."
```

Output:

### 1. Low Stock:


Item Name:   
Quantity:   

Add Item
Update Item

Search Item
Remove Item

Show All Stock

Item 'Apples' added with quantity 2.  
Warning: 'Apples' is running low. Consider reordering.

### 2. Over Stock:

Item Name:

Quantity:

Add Item

Update Item

Search Item

Remove Item

Show All Stock

Updated: Apples

Notice: 'Apples' may be overstocked. Review purchase strategy.

## Analytics Functions:

### 1. Load Inventory:

```
[7] #Analytics Functions
def load_inventory_as_df():
 data = read_inventory()
 if not data:
 return pd.DataFrame(columns=["Item", "Quantity"])
 df = pd.DataFrame(data, columns=["Item", "Quantity"])
 df["Quantity"] = df["Quantity"].astype(int)
 return df
```

## Output:

Item Name:

Quantity:

Add Item

Update Item

Search Item

Remove Item

Show All Stock

Show Summary

Show Stock Chart

FreshMart Inventory System Ready.



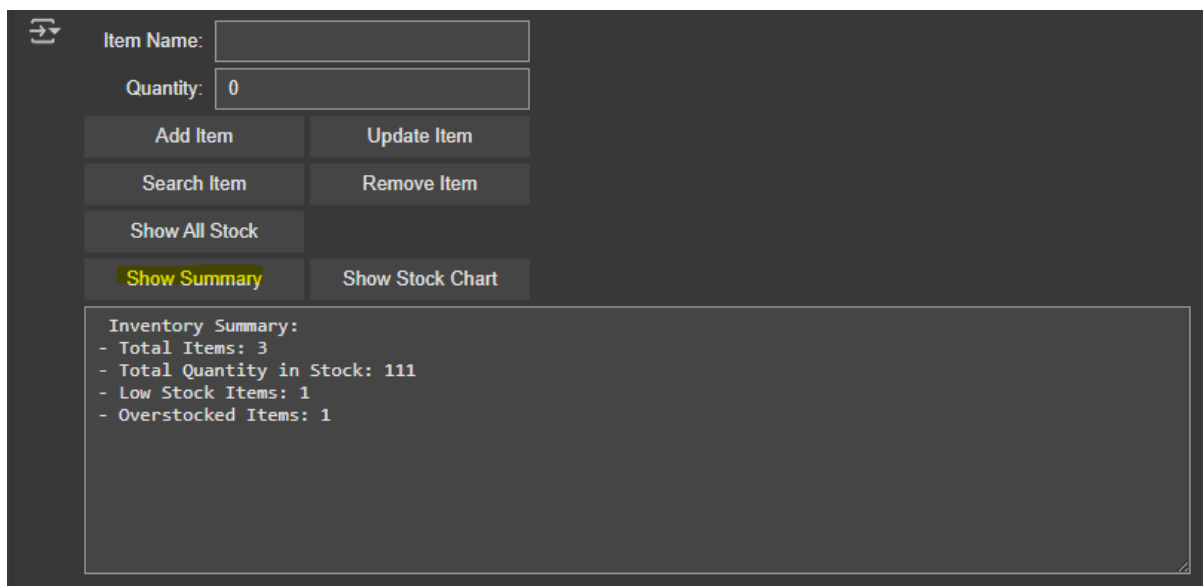
## 2. Show Inventory Summary

```
def show_inventory_summary(_):
 df = load_inventory_as_df()
 if df.empty:
 result_area.value = "Inventory is empty. No data to analyze."
 return

 total_items = df.shape[0]
 total_quantity = df["Quantity"].sum()
 low_stock_items = df[df["Quantity"] <= LOW_STOCK_THRESHOLD]
 overstock_items = df[df["Quantity"] >= OVERSTOCK_THRESHOLD]

 summary = (
 f" Inventory Summary:\n"
 f"- Total Items: {total_items}\n"
 f"- Total Quantity in Stock: {total_quantity}\n"
 f"- Low Stock Items: {len(low_stock_items)}\n"
 f"- Overstocked Items: {len(overstock_items)}\n"
)
 result_area.value = summary
```

Output:



The screenshot shows a web application interface with a dark theme. At the top, there are two input fields: "Item Name:" and "Quantity:". Below these are four buttons: "Add Item", "Update Item", "Search Item", and "Remove Item". Further down are two more buttons: "Show All Stock" and "Show Summary" (which is highlighted in yellow). To the right of "Show Summary" is a button labeled "Show Stock Chart". Below the buttons is a large text area displaying the following summary:

```
Inventory Summary:
- Total Items: 3
- Total Quantity in Stock: 111
- Low Stock Items: 1
- Overstocked Items: 1
```

## 3. Plot Stock Levels:

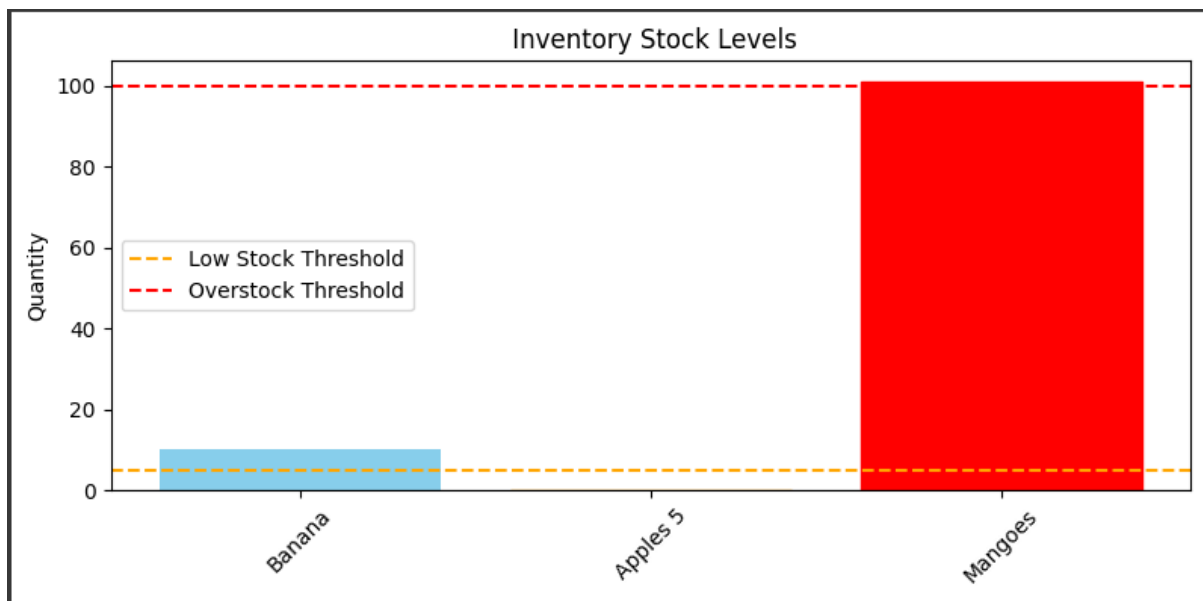
```
[7] def plot_stock_levels(_):
 df = load_inventory_as_df()
 if df.empty:
 result_area.value = "Inventory is empty. No chart to display."
 return

 plt.figure(figsize=(8, 4))
 bars = plt.bar(df["Item"], df["Quantity"], color="skyblue")

 for bar, qty in zip(bars, df["Quantity"]):
 if qty <= LOW_STOCK_THRESHOLD:
 bar.set_color('orange')
 elif qty >= OVERSTOCK_THRESHOLD:
 bar.set_color('red')

 plt.axhline(LOW_STOCK_THRESHOLD, color='orange', linestyle='--', label='Low Stock Threshold')
 plt.axhline(OVERSTOCK_THRESHOLD, color='red', linestyle='--', label='Overstock Threshold')
 plt.title(" Inventory Stock Levels")
 plt.ylabel("Quantity")
 plt.xticks(rotation=45)
 plt.legend()
 plt.tight_layout()
 plt.show()
```

Output:



Widgets:

```
[8] item_name_input = widgets.Text(description="Item Name:")
 item_qty_input = widgets.IntText(description="Quantity:", value=0)

 add_button = widgets.Button(description="Add Item")
 add_button.on_click(add_inventory)

 update_button = widgets.Button(description="Update Item")
 update_button.on_click(update_inventory)

 search_button = widgets.Button(description="Search Item")
 search_button.on_click(search_inventory)

 remove_button = widgets.Button(description="Remove Item")
 remove_button.on_click(remove_inventory)

 generate_button = widgets.Button(description="Show All Stock")
 generate_button.on_click(generate_inventory)

 summary_button = widgets.Button(description="Show Summary ")
 summary_button.on_click(show_inventory_summary)

 plot_button = widgets.Button(description="Show Stock Chart ")
 plot_button.on_click(plot_stock_levels)


 result_area = widgets.Textarea(
 value="FreshMart Inventory System Ready.",
 layout=widgets.Layout(width='60%', height='180px')
)
```

Layout:

```
#Layout and Display
ui = widgets.VBox([
 item_name_input,
 item_qty_input,
 widgets.HBox([add_button, update_button]),
 widgets.HBox([search_button, remove_button]),
 generate_button,
 widgets.HBox([summary_button, plot_button]),
 result_area
])

display(ui)
```

Final Output:



Item Name:

Quantity:

Add Item

Update Item

Search Item

Remove Item

Show All Stock

Show Summary

Show Stock Chart

FreshMart Inventory:  
Banana: 10 units  
Apples 5: 0 units  
Mangoes: 101 units

# INTERNSHIP CERTIFICATE



## Certification Description:

I have successfully completed a 6-week internship in Python Programming offered by the YBI Foundation, an ISO 9001:2015 certified organization recognized under the Ministry of Corporate Affairs, Government of India. The internship was completed on Friday, July 25, 2025. During the course of the internship, I demonstrated strong self-motivation, a willingness to learn, and the ability to engage in daily tasks and project work with a high level of professionalism. The program provided hands-on exposure to Python programming concepts, tools, and practices relevant to both academic and industry applications. The certificate (Credential ID: ICRN88UK6A546) validates my engagement and performance in the internship. The experience has enhanced my technical skills, improved my problem-solving abilities, and prepared me for more advanced work in the field of software development and

automation using Python. For verification purposes, the certificate can be validated by scanning the QR code or visiting the official website: [www.ybifoundation.com](http://www.ybifoundation.com)