

**VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY  
UNIVERSITY OF ECONOMICS AND LAW**



**MIDTERM PROJECT**

# **WAREHOUSE AND SHELF MANAGEMENT AT SUPERMARKET**

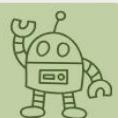


Course  
**SYSTEMS  
ANALYSIS  
AND DESIGN**

Course ID  
**241IS4204**

Lecturer  
**MS. VU THUY  
HANG  
MS. LAM HOANG  
TRUC MAI**

**GROUP 3**



# GROUP 3: MEMBERS

Full Name	Student ID	Evaluation
Nguyễn Trần Thanh Huyền	K224111450	100%
Phạm Tuyết Nhung	K224111460	100%
Vũ Quỳnh Như	K224111461	100%
Lê Nguyễn Minh Thảo	K224111462	100%
Phan Thị Thùy Trang	K224111470	100%

HCM CITY, DECEMBER 2024

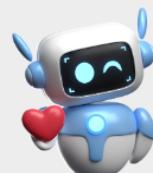


# ACKNOWLEDGEMENT

Our sincere appreciation goes to MS. Vu Thuy Hang and MS. Lam Hoang Truc Mai, the esteemed instructor of the course "Systems Analysis and Design", for meticulously crafting an enriching learning experience and imparting a wealth of invaluable knowledge.

Our team diligently applied our collective efforts to generate innovative ideas and address the initial requirements with utmost dedication. However, we acknowledge that there were obstacles that demanded resolution, and we recognize that mistakes were not entirely avoidable. We humbly seek our instructors' insightful feedback on our project, as we strive to learn from our shortcomings and continuously refine our skills.

Once again, we express our heartfelt gratitude to all those of you who have supported us throughout the course. We are immensely appreciative of the knowledge and skills we have acquired, and we look forward to applying them in future endeavors.



GROUP 3

---

HCM CITY, DECEMBER 2024

## TABLE OF CONTENTS

<b>TABLE OF CONTENTS.....</b>	iv
<b>TABLE OF TABLES .....</b>	vi
<b>TABLE OF FIGURES.....</b>	viii
<b>CHAP 1. PROJECT INTRODUCTION .....</b>	1
<b>1.1 Project Description &amp; Objective .....</b>	1
1.1.1 Purpose .....	1
1.1.2 Scope of project .....	1
1.1.3 Objective .....	2
<b>1.2 Deliverables .....</b>	3
<b>1.3 Business Requirement .....</b>	3
<b>1.4 Solution and Function .....</b>	6
<b>1.5 Roles &amp; Permissions .....</b>	8
<b>CHAP 2. PROJECT ANALYSIS .....</b>	13
<b>2.1 BPMN.....</b>	13
<b>2.2 DFD .....</b>	14
<b>2.3 Use Case .....</b>	17
2.3.1 Sale Department .....	18
2.3.2 Smart Shelf.....	23
2.3.3 Warehouse Robot .....	25
2.3.4 Quality Management Department .....	29
2.3.5 Purchasing Department .....	32
2.3.6 Arranging Robot .....	40
<b>2.4 Main Feature .....</b>	42
2.4.1 Main Feature 1: Handle Out-of-Stock Shelf.....	43
2.4.1.1 <i>Feature description, output and actor</i> .....	43
2.4.1.2 <i>Sequence Diagram</i> .....	44
2.4.1.3 <i>Mockup</i> .....	44
2.4.1.4 <i>Business rule</i> .....	47
2.4.2 Main Feature 2: Handle Expired product.....	48

2.4.2.1	<i>Feature description, ouput and actor .....</i>	48
2.4.2.2	<i>Sequence Diagram.....</i>	49
2.4.2.3	<i>Mockup.....</i>	50
2.4.2.4	<i>Business rule.....</i>	51
2.4.3	Main Feature 3: Handle Misplaced Product .....	52
2.4.3.1	<i>Feature description, output and actor.....</i>	52
2.4.3.2	<i>Sequence Diagram.....</i>	53
2.4.3.3	<i>Mockup.....</i>	53
2.4.3.4	<i>Business rule.....</i>	54
2.4.4	Main Feature 4: Handle Discontinued Product.....	55
2.4.4.1	<i>Feature Description, output and actor .....</i>	55
2.4.4.2	<i>Sequence Diagram.....</i>	56
2.4.4.3	<i>Mockup.....</i>	57
2.4.4.4	<i>Business rule.....</i>	60
2.4.5	Main Feature 5: Manage stockout in warehouse .....	61
2.4.5.1	<i>Feature Description, output and actor .....</i>	61
2.4.5.2	<i>Sequence Diagram.....</i>	62
2.4.5.3	<i>Mockup.....</i>	62
2.4.5.4	<i>Business rule.....</i>	66
2.4.6	Main Feature 6: Receive goods into the warehouse .....	66
2.4.6.1	<i>Feature description, output and actor .....</i>	66
2.4.6.2	<i>Sequence Diagram.....</i>	69
2.4.6.3	<i>Mockup.....</i>	70
2.4.6.4	<i>Business rule.....</i>	72
2.4.7	Main Feature 7: Assign task.....	73
2.4.7.1	<i>Feature description, output and actor .....</i>	73
2.4.7.2	<i>Sequence Diagram.....</i>	74
2.4.7.3	<i>Mockup.....</i>	74
2.4.7.4	<i>Business rule.....</i>	76

**FOLDER DIAGRAM + IMAGE+ MOCKUP: [LINK](#)**

## TABLE OF TABLES

Table 1.1 Business Requirements .....	6
Table 2.1 Use Case Specification Mange Product data, Sales Department .....	21
Table 2.2 Use Case Specification Update Discontinued Product, Sales Department .....	22
Table 2.3 Use Case Specification Create Problem, Smart Shelf .....	24
Table 2.4 Use Case Specification Manage Shelf data, Smart Shelf .....	25
Table 2.5 Use Case Specification Manage Robot Queue, Warehouse Robot.....	26
Table 2.6 Use Case Specification Create GI, Warehouse Robot .....	27
Table 2.7 Use Case Specification Create GR, Warehouse Robot.....	28
Table 2.8 Use Case Specification Manage task, Quality Management Department .....	30
Table 2.9 Use Case Specification Create GR, Quality Management Department .....	31
Table 2.10 Use Case Specification Manage Product data, Purchasing Department .....	34
Table 2.11 Use Case Specification Manage Vendor data, Purchasing Department.....	36
Table 2.12 Use Case Specification Approve PR, Purchasing Department.....	37
Table 2.13 Use Case Specification Create PO, Purchasing Department .....	38
Table 2.14 Use Case Specification Create Return Request, Purchasing Department .....	40
Table 2.15 Use Case Specification Manage Robot Queue, Arranging Robot .....	41
Table 2.16 Use Case Specification Manage Product data, Arranging Robot .....	42
Table 2.17 Output and actor of Hande out-of-stock shelf .....	43
Table 2.18 Business rule Handle Out – of – stock shelf.....	47
Table 2.19 Output and actor of Handle expired product .....	48
Table 2.20 Business rule Handle expired product .....	52
Table 2.21 Output and actor of Handle Misplaced product.....	52
Table 2.22 Business rule Handle misplaced product .....	54
Table 2.23 Output and actor of Handle Discontinued product .....	55
Table 2.24 Business rule Handle discontinued product.....	60

Table 2.25 Output and actor of Manage stockout in warehouse .....	61
Table 2.26 Business rule Manage stockout in warehouse .....	66
Table 2.27 Output and actor of Receive goods into the warehouse .....	68
Table 2.28 Business rule Receive goods into the warehouse .....	73
Table 2.29 Output and actor of Assign task.....	73
Table 2.30 Business rule of Assign task .....	77

## TABLE OF FIGURES

Figure 1.1 Roles & Permissions 1 .....	9
Figure 1.2 Roles & Permissions 2 .....	9
Figure 1.3 Roles & Permissions 3 .....	10
Figure 1.4 Roles & Permissions 4 .....	10
Figure 1.5 Roles & Permissions 5 .....	11
Figure 1.6 Roles & Permissions 6 .....	11
Figure 1.7 Roles & Permissions 7 .....	12
Figure 2.1 BPMN .....	13
Figure 2.2 DFD Level 0.....	14
Figure 2.3 DFD Level 1 of the Assign Task process. ....	16
Figure 2.4 Use Case of Sales Department .....	18
Figure 2.5 Use Case of Smart Shelf .....	23
Figure 2.6 Use Case of Warehouse Robot .....	25
Figure 2.7 Use Case of Quality Management Department.....	29
Figure 2.8 Use Case of Purchasing Department.....	32
Figure 2.9 Use Case of Arranging Robot .....	40
Figure 2.10 Sequence Diagram of Handle out-of-stock shelf .....	44
Figure 2.11 Shelf Management.....	45
Figure 2.12 Shelf Detail.....	46
Figure 2.14 Robot Queue.....	47
Figure 2.15 Sequence Diagram of Handle expried product .....	49
Figure 2.16 Robot Queue.....	50
Figure 2.17 Goods Issue .....	51
Figure 2.18 Sequence Diagram of Handle misplaced product .....	53
Figure 2.19 Robot Queue.....	54

Figure 2.20 Sequence Diagram of Handle discontinued product.....	56
Figure 2.21 Login .....	57
Figure 2.22 Sales Management .....	58
Figure 2.23 Product .....	59
Figure 2.24 Product detail .....	59
Figure 2.25 Edit product status pop up.....	60
Figure 2.26 Sequence Diagram of Manage stockout in warehouse .....	62
Figure 2.27 PO.....	63
Figure 2.28 Create PO manually .....	64
Figure 2.29 Purchase Requisition.....	65
Figure 2.30 Reject PR pop up.....	66
Figure 2.31 Sequence Diagram of Receive goods into the warehouse .....	69
Figure 2.32 Goods Receipt .....	70
Figure 2.33 Create GR.....	71
Figure 2.34 Request Return .....	72
Figure 2.35 Create Request Return.....	72
Figure 2.36 Sequence Diagram of Assign task.....	74
Figure 2.37 Task Management .....	75
Figure 2.39 Robot Queue.....	76
Figure 2.40 Notification .....	76

## CHAP 1. PROJECT INTRODUCTION

### 1.1 Project Description & Objective

#### 1.1.1 Purpose

The purpose of the project "Warehouse and Shelf management at supermarket" is to improve the efficiency of warehouse management and operations in supermarkets through the application of automation technology and smart robot solutions. This system was designed by the team not only to minimize dependence on manual processes, minimize errors in goods management, but also to ensure that the storage and circulation of goods takes place quickly, accurately and effectively.

#### 1.1.2 Scope of project

##### *Organization Scope*

The solution is applied across the entire supermarket system, ensuring consistent inventory management and optimized operations. Customizations are allowed to meet the needs of individual supermarkets while maintaining core processes and features.

##### *Functional Scope*

- Shelf and warehouse inventory management with robot coordination:
- Monitor inventory, restock shelves, and trigger procurement processes when needed.
- Coordinate robots for arranging items, handling misplaced products, and updating new products.
- Track and report activities: Record warehouse events in real time, report the status of goods and shelves.

##### *Integration Scope*

- ERP System: Manage financial data, inventory, and operational processes, including cost tracking, automated ordering, location management, and product information synchronization.
- Robot System: Handle restocking, misplaced items, and expired products.
- POS System: Update sales information and determine inventory levels.

- Reporting System: Export data on inventory, operations, and performance.

### ***Out of Scope***

- Transportation Management: Focus is limited to the scope of a single warehouse for each supermarket.
- Customer Interaction and Wholesale: Staff will handle customer interaction functions, while robots and the system will not participate.
- Robot Algorithms: Task management only; navigation algorithm development is excluded.
- Perishable Goods: Provides basic tracking and management mechanisms only.

#### **1.1.3 Objective**

The “*Warehouse and Shelf Management at Supermarkets*” project is being developed to address current challenges in inventory management and warehouse operations at supermarkets. In the context of increasing demands for operational efficiency and resource optimization, this system will help reduce reliance on manual labor. The main goal of the project is to build a system with intelligent robots to automate critical processes in inventory management, ranging from controlling goods in the warehouse to managing products on supermarket shelves. Specifically, the system will be developed based on the following objectives:

- Ensure that products are always arranged in the correct positions on shelves.
- Ensure that shelves are always fully stocked, preventing stock outs or shortages.
- Ensure that products on shelves are of the highest quality, avoiding issues such as expired items, damage, or abnormalities.
- Control the quality of goods before they are stored in the warehouse.
- Closely monitor inventory levels to ensure timely and efficient supply of goods.
- Automatically detect anomalies, such as expired products or shelf shortages, and send alerts to robots for immediate handling.

By automating and optimizing these processes, the project aims to enhance operational capabilities, improve work efficiency, and elevate service quality at supermarkets,

particularly by achieving the highest level of optimization in warehouse management operations.

## 1.2 Deliverables

The project will provide an internal (private) website for supermarket staff, supporting comprehensive management of activities related to shelves and warehouses. The website will integrate key functions such as: monitoring the status of products on shelves through the Smart Shelf system, real-time inventory management, and automatically assigning tasks based on information from sensors or requests from departments. In addition, the website also provides an interface to track the operating status of robots, helping to optimize operational performance and ensure processes take place seamlessly and efficiently.

## 1.3 Business Requirement

No.	Function Requirement Group	Detail	Next action
1	The process of out - of shelves.	The system receives problems from another system, then notifies the interface and simultaneously activates the restocking process → Ensuring shelves are always replenished promptly.	<ul style="list-style-type: none"> <li>Define in detail the alert process and thresholds, specifying how many products remain on the shelf before a restocking notification is sent.</li> <li>Identify suitable types of sensors/monitoring devices, specifically using Smart Shelves and Arranging Robots.</li> </ul>
		Automate the process of requesting stock	<ul style="list-style-type: none"> <li>Determine the type of robot to be used for restocking items</li> </ul>

		replenishment from the warehouse when empty shelves are detected → Ensure an uninterrupted supply chain.	<p>from the warehouse → Warehouse Robot.</p> <ul style="list-style-type: none"> <li>Define the method/path/logic for the robot to automatically deliver items to the Picking Area.</li> </ul>
2	Product Receiving Process (When Goods Arrive)	The system automatically triggers the warehouse receiving process (when goods arrive).	<ul style="list-style-type: none"> <li>Identify the robot/department responsible for performing the warehouse receiving task.</li> <li>Identify the document generated (specifically the GR).</li> </ul>
3	Procurement Process	The system will automatically check the inventory and trigger the purchasing process.	<ul style="list-style-type: none"> <li>Identify the logic that triggers the purchasing process, integrating with the existing ERP system.</li> <li>Identify the departments/robots that will participate in this process.</li> <li>Identify the documents generated (specifically PR, PO)."</li> </ul>
4	Shelf Management	The smart shelf automatically detects issues when there are changes in weight →	<ul style="list-style-type: none"> <li>Define the criteria for detecting issues on the Smart Shelf (e.g., weight change threshold for in-out, based on product ID).</li> </ul>

		Provides timely alerts for abnormal situations.	<ul style="list-style-type: none"> <li>Analyze potential situations:</li> <li>The shelf is empty (out of stock).</li> <li>Errors in product replenishment.</li> <li>Customers place products in the wrong position.</li> </ul>
5	Process for Managing Wrong Position Products	The system automatically triggers the process for handling wrong position products.	<ul style="list-style-type: none"> <li>Identify the current location and the correct position of the product.</li> <li>Determine the type/method/path/logic through which the robot can automatically move the product to the correct position → Arranging Robot.</li> </ul>
6	Product Discontinuation Management Process	The system receives information about discontinued products and substitute products → Automatically triggers the inventory check process and handles the discontinued products.	<ul style="list-style-type: none"> <li>Determine the department responsible for managing discontinued products (specifically the Sales Department).</li> <li>Identify substitute products based on information received from the Sales Department.</li> </ul>
7	Expiration Date Management	The system automatically checks the	<ul style="list-style-type: none"> <li>Determine which types of products will be managed</li> </ul>

		<p>expiration date and sends an alert when it identifies products nearing expiration. It automatically activates the process to handle products nearing expiration.</p>	<p>(including both packaged goods and fresh items).</p> <ul style="list-style-type: none"> <li>• Determine the type of robot to be used for restocking items from the warehouse → Warehouse Robot.</li> <li>• Determine the method/path/logic for the robot to autonomously deliver items to the designated area for processing and the picking area to fill in new stock.</li> </ul>
8	Task Assignment Process	<p>When the system receives a problem from departments or from the Smart Shelf, it will automatically create a task, assign it to the Robots, and send the problem to the relevant department (if applicable). → Automation.</p>	<ul style="list-style-type: none"> <li>• Build task prioritization logic (which task should be prioritized first).</li> <li>• Build a robot queue for each robot.</li> </ul>

*Table 1.1 Business Requirements*

#### 1.4 Solution and Function

To address the remaining issues, the supermarket has implemented a system that applies multiple technological solutions to facilitate management. The Warehouse and Shelf management at supermarket system consists of the following functions:

- **Arranging Robot:** responsible for arranging goods on shelves (filling goods) according to designated locations, arranging products in the wrong locations. Besides, it also removes discontinued products and expired products, replaces them with new products.

- **Warehouse Robot:** is designed to handle the main tasks related to warehouse management. It performs checking the location of goods in the warehouse, moving products from the warehouse to the Picking Area. This robot is also responsible for checking the status of goods when the shipment is received, ensuring that the product is of the right quality and notifying relevant departments when the goods have abnormal problems, entering the goods into the warehouse, and attaching product codes after checking the products.

- **Smart Shelf:** is a smart shelf system, capable of automatically managing the status of goods on the shelf. It relies on the weight factor on the shelf to recognize the goods being put in or taken out of the shelf. This system is integrated with data and sensor technology and AI Camera to monitor the quantity and information of products, helping to promptly detect the status of shelves running out of stock or products being placed in the wrong position, Smart Shelf will send notifications to related departments.

- **System Automation:** This system plays a role in coordinating and monitoring operating processes in the entire system. It integrates data from different departments such as Arranging Robot, Warehouse Robot and Smart Shelf to ensure that the processes run smoothly and efficiently. This system records notifications from Smart Shelf or requests from related departments (Sales Department, Purchasing Department). From there, the system will analyze, assign tasks to Robots, and coordinate the work.

- **Website:** Website is embedded from System and Robot data. Provides an overview of the system with important information to support managers in controlling the database, monitoring the operation process and receiving notifications when problems occur as well as when decisions need to be made.

- **Sales Department:** Takes on the role of handling requests related to discontinued products. Specifically, the department receives requests to update information about

discontinued products from the Sales Manager, then selects appropriate replacement products and makes a detailed list including discontinued products and corresponding replacement products. Related information or issues will be sent to the Automation System for processing, ensuring the operation process is fast and efficient.

- **Purchasing Department:** Takes on tasks related to processing purchase requests (Purchase Requisition) and return requests. The Purchasing Department reviews and decides to accept or reject the request when receiving a purchase request. If the request is accepted, the department will create a purchase order (PO), save the order information in the database, and then send the PO to the supplier. In case of rejection of the purchase request, this department will save the reason for rejection in the system and send a notification to the supplier if necessary. In addition, the department is also responsible for handling return requests, including sending return notifications to the supplier.
- **Quality Management Department:** performs functions related to checking the quality of goods. If a product is found to be defective, the department will transfer the product to the return area and send a notification to the Purchasing Department. For qualified products, the department will assign a product code to each item. Update the database with new information, as well as create and save Goods Receipt into the system. Ensure that only qualified products are circulated. Additionally, promptly handle problems with defective goods, maintaining the quality standards of the goods.

## 1.5 Roles & Permissions

LINK: [Roles&Permissions](#)

Function	Page	Field Data	CRUD	Smart Shelf	Warehouse Robot	Arranging Robot	Purchasing Department	Sales Department	Quality Management Department
Handle Out-of-Stock Shelf	Page: Task Management		Create						
			Read					✓	
			Update						
			Delete						
	Page: Robot Queue Detail		Create						
			Read		✓	✓		✓	
			Update		✓	✓			
			Delete						
	Page: Product		Create						
			Read	✓	✓	✓		✓	
			Update		✓			✓	
			Delete					✓	
	Page: Goods Issue	Goods issue	Create		✓				
			Read		✓			✓	
			Update		✓				
			Delete						
		Product	Create						
			Read		✓				
			Update		✓				
			Delete						
	Page: Shelf Detail Information		Create					✓	
			Read	✓				✓	
			Update	✓				✓	
			Delete					✓	

Figure 1.1 Roles & Permissions 1

Function	Page	Field Data	CRUD	Smart Shelf	Warehouse Robot	Arranging Robot	Purchasing Department	Sales Department	Quality Management Department
Handle Discontinued Product	Page: Task Management		Create						
			Read					✓	
			Update						
			Delete						
	Page: Robot Queue Detail		Create						
			Read		✓	✓		✓	
			Update		✓	✓			
			Delete						
	Page: Product +Product Detail + Edit Status popup		Create						
			Read	✓	✓	✓		✓	
			Update		✓			✓	
			Delete					✓	
	Page: Goods Issue	Goods issue	Create		✓				
			Read		✓			✓	
			Update		✓				
			Delete						
		Product	Create						
			Read		✓				
			Update		✓				
			Delete						
	Page: Shelf Detail Information		Create					✓	
			Read	✓				✓	
			Update	✓				✓	
			Delete					✓	

Figure 1.2 Roles & Permissions 2

Function	Page	Field Data	CRUD	Smart Shelf	Warehouse Robot	Arranging Robot	Purchasing Department	Sales Department	Quality Management Department
Handle Misplaced Product	Page: Task Management		Create						
			Read					✓	
			Update						
			Delete						
	Page: Robot Queue Detail		Create						
			Read		✓	✓		✓	
			Update		✓	✓			
			Delete						
	Page: Product		Create						
			Read	✓	✓	✓		✓	
			Update		✓	✓		✓	
			Delete						
	Page: Shelf Detail Information		Create					✓	
			Read	✓				✓	
			Update	✓				✓	
			Delete					✓	

Figure 1.3 Roles & Permissions 3

Function	Page	Field Data	CRUD	Smart Shelf	Warehouse Robot	Arranging Robot	Purchasing Department	Sales Department	Quality Management Department
Handle Expired	Page: Task Management		Create						
			Read					✓	
			Update						
			Delete						
	Page: Robot Queue Detail		Create						
			Read		✓	✓		✓	
			Update		✓	✓			
			Delete						
	Page: Product		Create						
			Read	✓	✓	✓		✓	
			Update		✓	✓		✓	
			Delete					✓	
	Page: Goods Issue	Goods issue	Create		✓				
			Read		✓			✓	
			Update		✓				
			Delete						
		Product	Create						
			Read		✓				
			Update		✓				
			Delete						
	Page: Shelf Detail Information		Create					✓	
			Read	✓				✓	
			Update	✓				✓	
			Delete					✓	

Figure 1.4 Roles & Permissions 4

Function	Page	Field Data	CRUD	Smart Shelf	Warehouse Robot	Arranging Robot	Purchasing Department	Sales Department	Quality Management Department
Receive goods into the warehouse	Page: Task Management		Create						
			Read				✓		✓
			Update						✓
			Delete						
	Page: Robot Queue Detail		Create						
			Read		✓		✓		✓
			Update		✓				
			Delete						
	Page: Purchase Order		Create						
			Read		✓		✓	✓	✓
			Update				✓		
			Delete				✓		
	Page: Goods Receipt	Goods receipt	Create		✓				✓
			Read		✓		✓		✓
			Update		✓				✓
			Delete						✓
	Page: Request Return/Create Request Return	Product	Create					✓	
			Read		✓				✓
			Update		✓				✓
			Delete						✓
	Page: Request Return/Create Request Return	Request Return	Create				✓		
			Read				✓		
			Update				✓		
			Delete				✓		
	Page: Request Return/Create Request Return	PO	Create						
			Read				✓		
			Update				✓		
			Delete						

Figure 1.5 Roles & Permissions 5

Function	Page	Field Data	CRUD	Smart Shelf	Warehouse Robot	Arranging Robot	Purchasing Department	Sales Department	Quality Management Department
Manage stockout in warehouse	Page: Purchase Order		Create				✓		
			Read		✓		✓		✓
			Update				✓		
			Delete				✓		
	Page: Purchase Requisition		Create						
			Read				✓		
			Update				✓		
			Delete				✓		
	Page: Create PO	PO	Create				✓		
			Read				✓		
			Update				✓		
			Delete				✓		
	Page: Create PO	Product	Create					✓	
			Read				✓		
			Update				✓		
			Delete						
	Page: Create PO	Vendor	Create				✓		
			Read				✓		
			Update				✓		
			Delete				✓		

Figure 1.6 Roles & Permissions 6

Function	Page	Field Data	CRUD	Smart Shelf	Warehouse Robot	Arranging Robot	Purchasing Department	Sales Department	Quality Management Department
Assign task	Page: Task Management		Create						
			Read				✓	✓	✓
			Update						✓
			Delete						
	Page: Robot Queue Detail		Create						
			Read		✓	✓	✓	✓	✓
			Update		✓	✓			✓
			Delete						

Figure 1.7 Roles & Permissions 7

## CHAP 2. PROJECT ANALYSIS

### 2.1 BPMN

**Diagram:** [LINK](#)

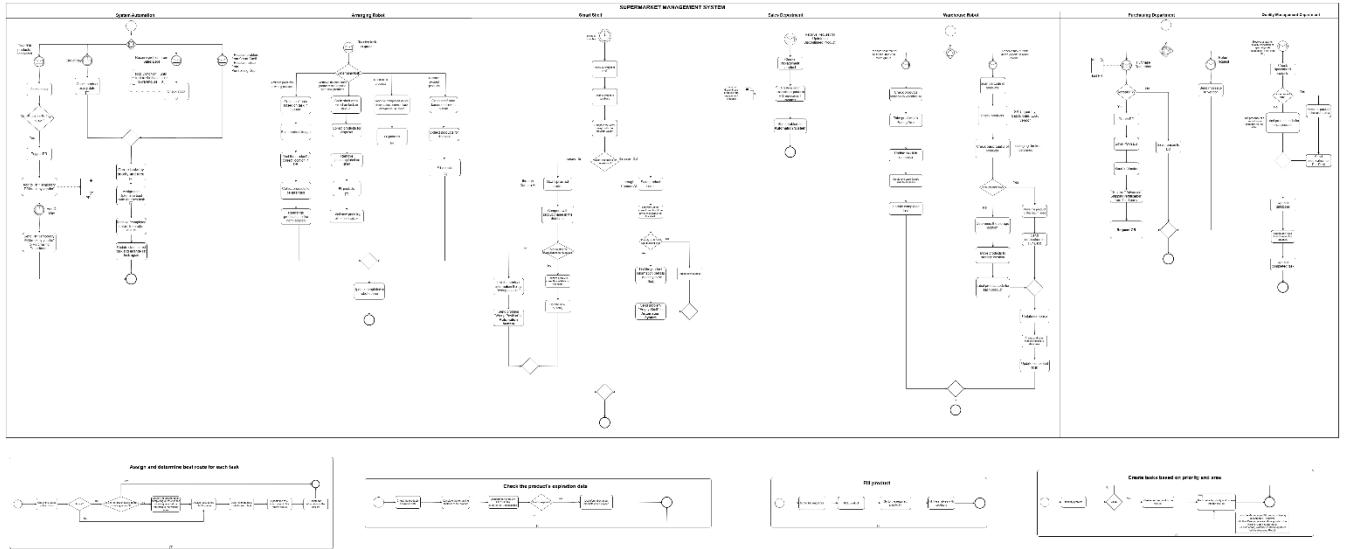


Figure 2.1 BPMN

### Description

The management system is divided into two main processes: **Supermarket Management** and **Warehouse Management**.

- **Supermarket Management:** Smart shelves continuously monitor products, detecting issues such as misplaced items or empty shelves. When a problem is identified, the smart shelves send information to the system, which automatically assigns tasks to various robots based on system logic. **Arranging robots** handle errors such as rearranging misplaced products or resolving identified issues. If a shelf runs out of stock, the system sends a replenishment request to the **Warehouse robot**. Additionally, the **sales department** can provide a list of discontinued products, and the system will manage the removal of these items from the shelves and execute subsequent management steps.
- **Warehouse Management:** The warehouse management process integrates alerts from **smart shelves** and robot automation. When a **smart shelf** detects a stock

shortage, the system sends a replenishment request to the **Warehouse robot**. The robot retrieves stock from the warehouse and transfers it to the picking area for **Arranging robots** to handle. Simultaneously, the system continuously monitors inventory levels. If stock falls below the minimum threshold, the robot generates a purchase requisition (PR) and sends it to the **purchasing department**. After the PR is approved, a purchase order (PO) is created for restocking. Upon the delivery of goods, the **Warehouse robot**, in coordination with the **quality management department**, scans and inspects the product's condition, after which the system updates the database.

*(\*) Note: If customers want to purchase in bulk or wholesale quantities (exceeding the specified product limit per shelf), they will need to contact the market staff for assistance. Robots will not participate in this process, so it will not be represented in the BPMN diagram.*

## 2.2 DFD

**Diagram:** [LINK](#)

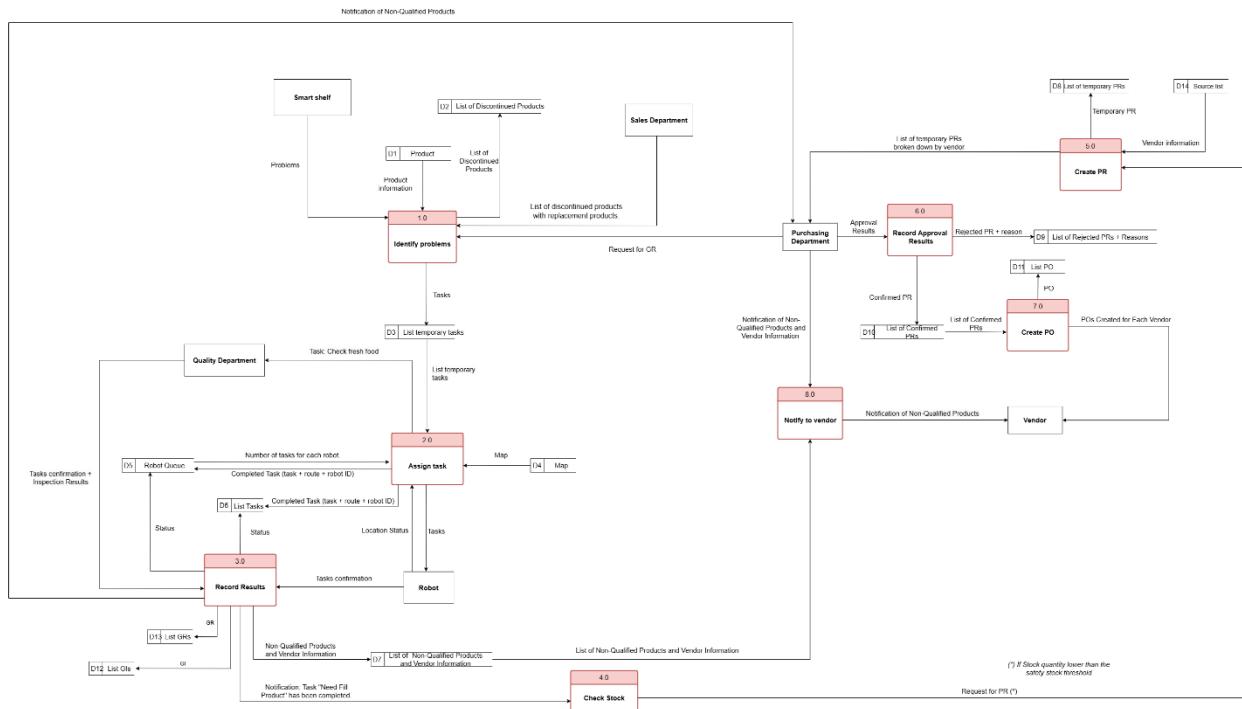
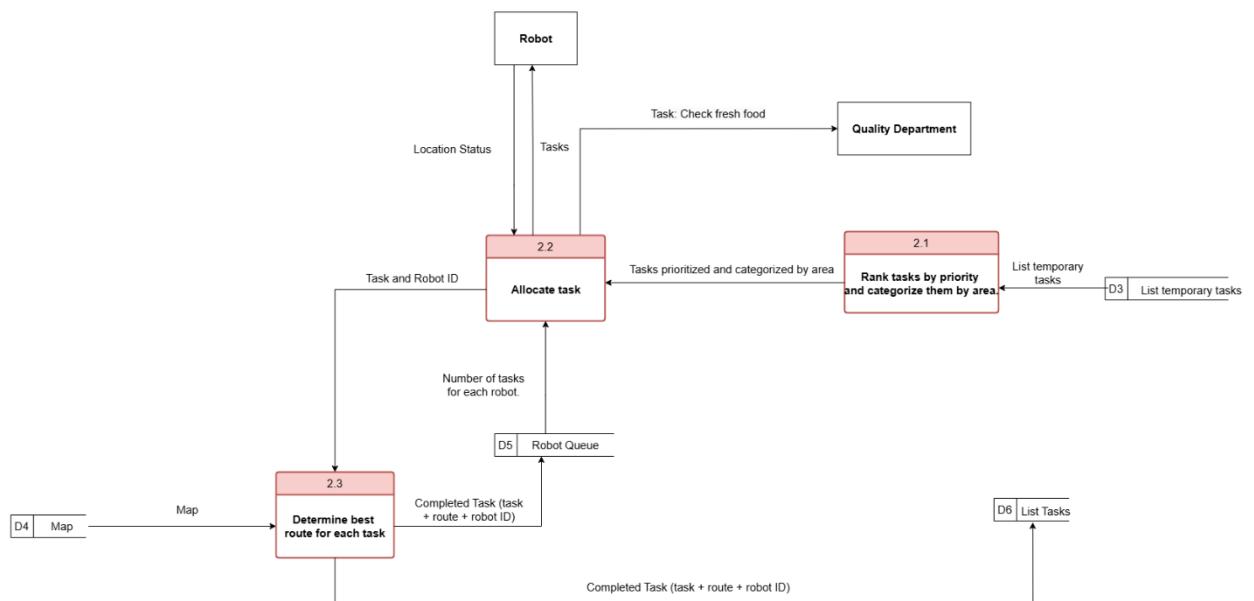


Figure 2.2 DFD Level 0

### **Description**

1. Smart shelf detects and sends **Problems** to the system, **Sales Department** sends **List of discontinued products with replacement products**, **Purchasing Department** sends **Request for GR** to the system. Then the system will go through the **Identify Problem** process based on **Product information** taken from the **Product** data store to create **Tasks** saved into the **List Temporary Tasks** data store and **List of Discontinued Products** saved into the **List of Discontinued Products** data store.
2. The system will perform the **Assign Task** process based on **List temporary tasks** taken from the **List Temporary Tasks** data store, **Map** taken from the **Map** data store, **Number of tasks for each robot** taken from the **Robot Queue** data store, position after completing all tasks in the Robot Queue before returning to the waiting area in **Location Status** provided by **Robot**, thereby creating a **Completed Task (Task, Route, Robot ID)** saved into the **List Tasks** data store and the **Robot Queue** data store. The system assigns **Tasks** to **Robot** and **Task: Check fresh food** to **Quality Department**.
3. The system will perform the **Record Results** process based on **Tasks Confirmation** from **Robot**, save **Status** into the **Robot Queue** data store and the **List Tasks** data store. Besides, based on the **Record Results** process, the system also receives **Tasks Confirmation** and **Inspection Results** from **Quality Department**, saves **Status** into the **List Tasks** data store, saves **GR** into the **List GRs** data store, saves **GI** into the **List GIs** data store if any. If there are products that do not meet quality standards, they will be saved into the **List of Non-Qualified Products and Vendor Information** data store and send **Notification of Non-Qualified Products** to **Purchasing Department**.
4. The system automatically performs the **Check Stock** process after receiving **Notification: Task "Need Fill Product" has been completed**, the system will create a **Request for PR** if the stock quantity is lower than the safety stock threshold.

5. The **Create PR** process is carried out based on **Request for PR** received and **Vendor information** from the **Source list** data store. The system then saves **Temporary PR** into the **List of temporary PRs** data store and sends **List of temporary PRs broken down by vendor** to **Purchasing Department**.
6. The **Record Approval Results** process is executed when the system receives the **Approval Results** from the **Purchasing Department**. If the result is a rejection, the system will save the **Rejected PR and rejected reason** in the **List of Rejected PRs and Reasons** data store. If the result is an approval, the system will save the **Confirmed PR** in the **List of Confirmed PRs** data store.
7. The **Create PO** process is executed upon receiving the **List of Confirmed PRs** from the **List of Confirmed PRs** data store, saves the **POs** to the **List PO** data store, and the system sends **POs Created for Each Vendor** to the **Vendor**.
8. If the system receives a **Notification of Non-Qualified Products and Vendor Information** from the **Purchasing Department** and the **List of Non-Qualified Products and Vendor Information** data from the **List of Non-Qualified Products and Vendor Information** data store, the system will trigger the **Notify to Vendor** process and send a **Notification of Non-Qualified Products** to the **Vendor**.



*Figure 2.3 DFD Level 1 of the Assign Task process.*

### **Description**

1. The **Rank tasks by priority and categorize them by area** process will be carried out based on **List temporary tasks** from the **List Temporary Tasks** data store, thereby creating **Tasks prioritized and categorized by area**
2. Based on **Tasks prioritized and categorized by area**, position after completing all tasks in the Robot Queue before returning to the waiting area in **Location Status** provided by **Robot** and **Number of tasks for each robot** taken from the **Robot Queue** data store, the system will perform the **Allocate Task** process. The system will then assign **Tasks to Robot** and **Task: Check fresh food to Quality Department.**
3. Based on **Map** from the **Map** data store and **Task and Robot ID**, the system will **Determine best route for each task**, thereby creating a **Completed Task (Task, Route, Robot ID)** saved into the **List Tasks** data store and the **Robot Queue** data store.

### **2.3 Use Case**

*Diagram:* [LINK](#)

### 2.3.1 Sale Department

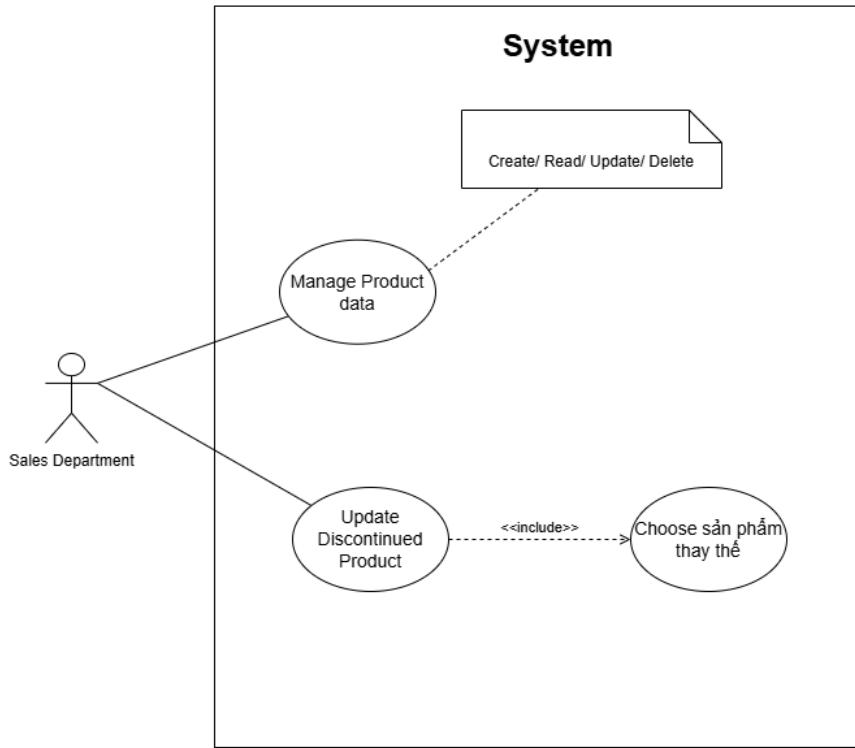


Figure 2.4 Use Case of Sales Department

### USE CASE SPECIFICATION

<b>Use Case Name</b>	Manage Product Data
<b>Description</b>	The Sales Department manages information related to products.
<b>Actor</b>	Sales Department
<b>Priority</b>	Must Have
<b>Trigger</b>	The Sales Department wants to view or edit product data.
<b>Pre-Condition(s):</b>	<ul style="list-style-type: none"> <li>• The Sales Department must be logged into the system.</li> <li>• The user's account must be authorized to perform product data management operations.</li> </ul>

	<ul style="list-style-type: none"> <li>The system must have a database with existing product data records.</li> </ul>
<b>Post-Condition(s):</b>	<ul style="list-style-type: none"> <li>Any changes made to product data (if applicable) are successfully saved in the database.</li> <li>The product data is updated, retrieved, or deleted correctly, reflecting the user's input.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The Sales Staff logs into the system.</li> <li>2. The user navigates to the Warehouse Management → Product</li> <li>3. The user selects the desired action (Create, Read, Update, or Delete). <ul style="list-style-type: none"> <li>•For Create, the user enters new product information and submits the form.</li> <li>•For Read, the user views the product list or details of a specific product.</li> <li>•For Update, the user edits the information of an existing product and saves changes.</li> <li>•For Delete, the user confirms the deletion of a product.</li> </ul> </li> <li>4. The system processes the request and updates the database accordingly.</li> <li>5. The system provides feedback on the success or failure of the operation.</li> </ol>
<b>Alternative Flow</b>	<ol style="list-style-type: none"> <li>2a. User selects specific search filters (e.g. category, price range) to find desired products.</li> </ol>

	<p>2a1. System processes filter and displays refined product list matching criteria.</p> <p><i>Use case continues to step 3</i></p> <p>3a1. User uploads CSV or Excel file containing product data.</p> <p>3a2. System validates uploaded file, processes data and performs corresponding operations (Create, Update or Delete) in bulk.</p> <p><i>Use case continues to step 4</i></p>
<b>Exception Flow</b>	<p>3c. If there is a system error or database failure during any operation:</p> <ul style="list-style-type: none"> <li>• 3c.1. The system displays an error message and logs the incident.</li> <li>• 3c.2. The user selects the option to retry the operation. Use Case continues at the previous step.</li> </ul> <p>3d. If the user does not have sufficient permissions:</p> <ul style="list-style-type: none"> <li>• 3d.1. The system denies access and displays an "Unauthorized Access" message.</li> <li>• 3d.2. The user contacts the system administrator to request appropriate permissions. Use Case stops until permissions are updated.</li> </ul>
<b>Business Rules</b>	<p>BR1.1-1: The system must validate that the following fields are not empty when creating a product: Product Name, Category, Price, and Stock Quantity.</p> <p>BR1.2-1: The system must ensure that the product price is greater than zero. Negative or zero prices are not allowed.</p> <p>BR1.3-1: The system must implement record locking to prevent conflicts during simultaneous updates to the same product. (button “Edit” is unable)</p>

<b>Non-Functional Requirement</b>	NFR1.1-1: The system must ensure that product data operations complete within 2 seconds.
-----------------------------------	--

*Table 2.1 Use Case Specification Mange Product data, Sales Department*

<b>Use Case Name</b>	Update Discontinued Product
<b>Description</b>	The Sales Department wants to update information about a discontinued product.
<b>Actor</b>	Sales Department
<b>Priority</b>	Must Have
<b>Trigger</b>	The Sales Department wants to update the status or details of a discontinued product.
<b>Pre-Condition(s):</b>	<ul style="list-style-type: none"> <li>• The Sales Department must be logged into the system.</li> <li>• The user's account must be authorized to perform product data management operations.</li> <li>• The system must have a database with existing product data records.</li> </ul>
<b>Post-Condition(s):</b>	<ul style="list-style-type: none"> <li>• The discontinued product information is updated successfully in the system.</li> <li>• The replacement product is selected and updated.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The user selects the option to update a discontinued product.</li> <li>2. The user selects a replacement product to update.</li> </ol>

	<p>3. The system displays the product details (e.g., name, price, description, stock).</p> <p>4. The user makes necessary updates to the product details.</p> <p>5. The user saves the updates.</p> <p>6. The system processes the updates and provides feedback on success.</p>
<b>Alternative Flow</b>	<p>1a. User selects specific search filters (e.g. category, price range) to find desired products.</p> <p><i>Use case continues to step 2</i></p>
<b>Exception Flow</b>	<p>5b. If the user does not have sufficient permissions:</p> <ul style="list-style-type: none"> <li>• 5b.1. The system denies access and displays an "Unauthorized Access" message.</li> <li>• 5b.2. The user contacts the system administrator to request appropriate permissions.</li> </ul> <p>Use Case stops until permissions are updated.</p>
<b>Business Rules</b>	BR-DP-1: Button “Update” in Edit Product Status pop up is enabled when the Replacement Product is picked.
<b>Non-Functional Requirement</b>	NFR1.2-1: The system must ensure that product updates are processed efficiently, with a response time of less than 2 seconds for displaying updated product information.

*Table 2.2 Use Case Specification Update Discontinued Product, Sales Department*

### 2.3.2 Smart Shelf

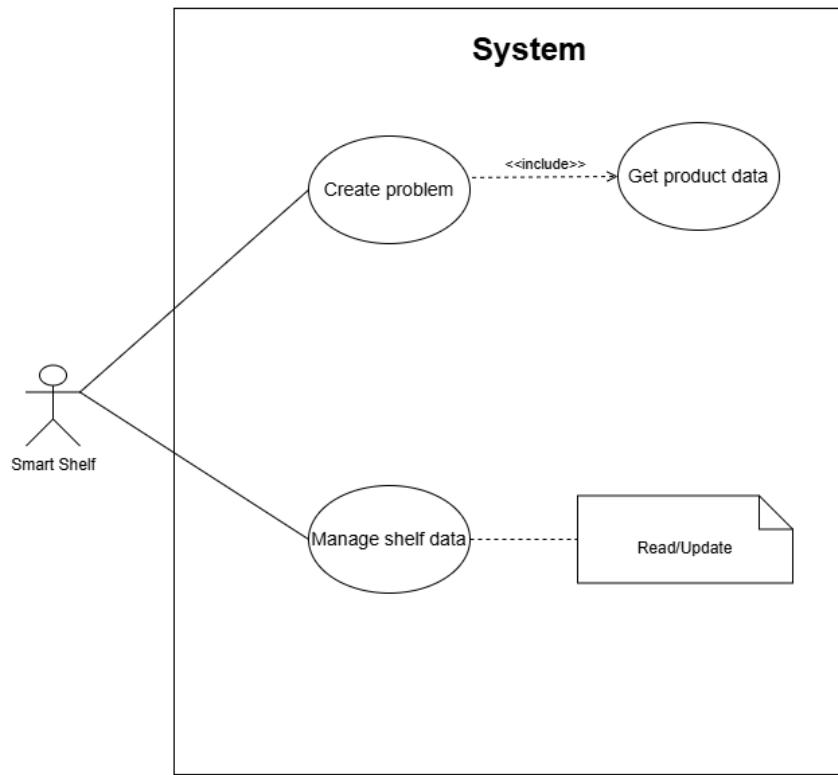


Figure 2.5 Use Case of Smart Shelf

## USE CASE SPECIFICATION

<b>Use Case Name</b>	Create problem
<b>Description</b>	Smart Shelf creates a problem when it detects an issue.
<b>Actor</b>	Smart Shelf
<b>Priority</b>	Must Have
<b>Trigger</b>	When the Smart Shelf detects an issue
<b>Post-Condition(s):</b>	<ul style="list-style-type: none"><li>A new problem is created and stored in the system.</li></ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"><li>Smart Shelf detects an issue or problem.</li></ol>

	<p>2. Smart Shelf uses the data from Get Product Data to create a new problem in the database.</p> <p>3. The system confirms the successful creation of the problem and notifies relevant parties (if applicable).</p>
<b>Business Rules</b>	BR-SS-1: Trigger every 5 minutes → perform action.

*Table 2.3 Use Case Specification Create Problem, Smart Shelf*

<b>Use Case Name</b>	Manage shelf data
<b>Description</b>	Smart Shelf autonomously manages its own data
<b>Actor</b>	Smart Shelf
<b>Priority</b>	Must Have
<b>Trigger</b>	The Smart Shelf detects a change or event that requires an update to its data, such as a change in stock levels, shelf condition
<b>Pre-Condition(s):</b>	<ul style="list-style-type: none"> <li>• The Smart Shelf is installed, operational, and connected to the system.</li> <li>• The Smart Shelf has access to real-time data feeds (e.g., sensor data, inventory systems) to update shelf information.</li> </ul>
<b>Post-Condition(s):</b>	The Smart Shelf updates its own data, including stock levels, condition, and product details
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1.The Smart Shelf starts monitoring its own data (e.g., stock levels).</li> <li>2.The Smart Shelf detects a change, such as a product being added or removed, or a product's stock level changing.</li> </ol>

	<p>3. The Smart Shelf updates its internal records to reflect the new data (e.g., updating the product quantity, status).</p> <p>4. The Smart Shelf sends the updated data to the central system to update the database.</p>
--	--

Table 2.4 Use Case Specification Manage Shelf data, Smart Shelf

### 2.3.3 Warehouse Robot

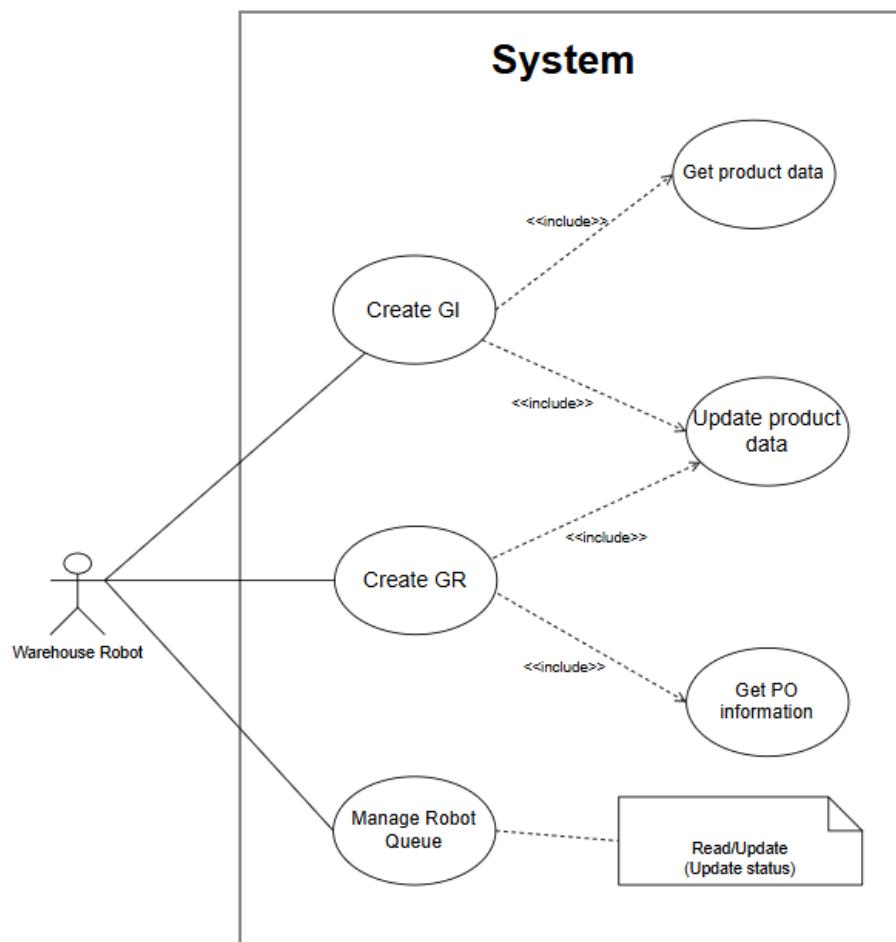


Figure 2.6 Use Case of Warehouse Robot

## USE CASE SPECIFICATION

<b>Use Case Name</b>	Manage Robot Queue
<b>Description</b>	Manage the queue of tasks and update the status of processing tasks.
<b>Actor(s)</b>	Warehouse Robot
<b>Priority</b>	Must Have
<b>Trigger</b>	A new task needs to be added, or an existing task's status is updated.
<b>Pre-Condition(s)</b>	<ul style="list-style-type: none"> <li>The warehouse robot system is operational.</li> <li>The system has an active queue for managing tasks.</li> </ul>
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>The task queue is updated with new tasks.</li> <li>The status of completed or in-progress tasks is updated in the system log.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>The system adds a new task to the queue.</li> <li>The system appends the new task to the existing queue.</li> <li>The warehouse robot processes tasks in the queue sequentially.</li> <li>When a task is completed, the warehouse robot updates its status to "Completed" and logs the operation.</li> <li>The warehouse robot moves to the next task in the queue.</li> </ol>
<b>Non-Functional Requirement</b>	NFR-MRQ-1: The system must support a queue of up to 3 concurrent tasks without performance issues.

Table 2.5 Use Case Specification Manage Robot Queue, Warehouse Robot

<b>Use Case Name</b>	Create GI
----------------------	-----------

<b>Description</b>	Warehouse Robot creates Goods Issue when completing the task “Fill goods”
<b>Actor(s)</b>	Warehouse Robot
<b>Priority</b>	Must Have
<b>Trigger</b>	Warehouse Robot is assigned the task “Fill goods” by the system.
<b>Pre-Condition(s)</b>	Warehouse Robot receives accurate information about the product to be filled (product code, quantity, location in the warehouse).
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>• The product is filled correctly, in the required quantity and brought to the waiting area.</li> <li>• Goods Issue is created.</li> <li>• Update inventory quantity after completing the task.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. Warehouse Robot is assigned the task “Fill goods” from the system.</li> <li>2. The system provides detailed information about the product to be filled in (product code, quantity, location in the warehouse).</li> <li>3. Warehouse Robot creates GI and updates inventory quantity after completing the task.</li> <li>4. Warehouse Robot records the completed task into the Robot Queue.</li> </ol>

Table 2.6 Use Case Specification Create GI, Warehouse Robot

<b>Use Case Name</b>	Create GR
----------------------	-----------

<b>Description</b>	Warehouse Robot creates Goods Receipt when completing the task "Receiving goods"
<b>Actor(s)</b>	Warehouse Robot
<b>Priority</b>	Must Have
<b>Trigger</b>	Warehouse Robot is assigned the task "Importing goods" by the system.
<b>Pre-Condition(s)</b>	Warehouse Robot receives accurate information about PO (Purchase Order) of warehoused goods.
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>• Save a list of products that do not meet quality standards and why. (if any)</li> <li>• Goods Receipt is created.</li> <li>• Update inventory quantity after completing the task.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. Warehouse Robot receives the task "Importing goods" from the system.</li> <li>2. The system provides detailed information about imported shipments (PO code, quantity, vendor, storage location...).</li> <li>3. Warehouse Robot creates GR and updates inventory quantity after completing the task.</li> <li>4. Warehouse Robot records the completed task into the Robot Queue.</li> </ol>

*Table 2.7 Use Case Specification Create GR, Warehouse Robot*

### 2.3.4 Quality Management Department

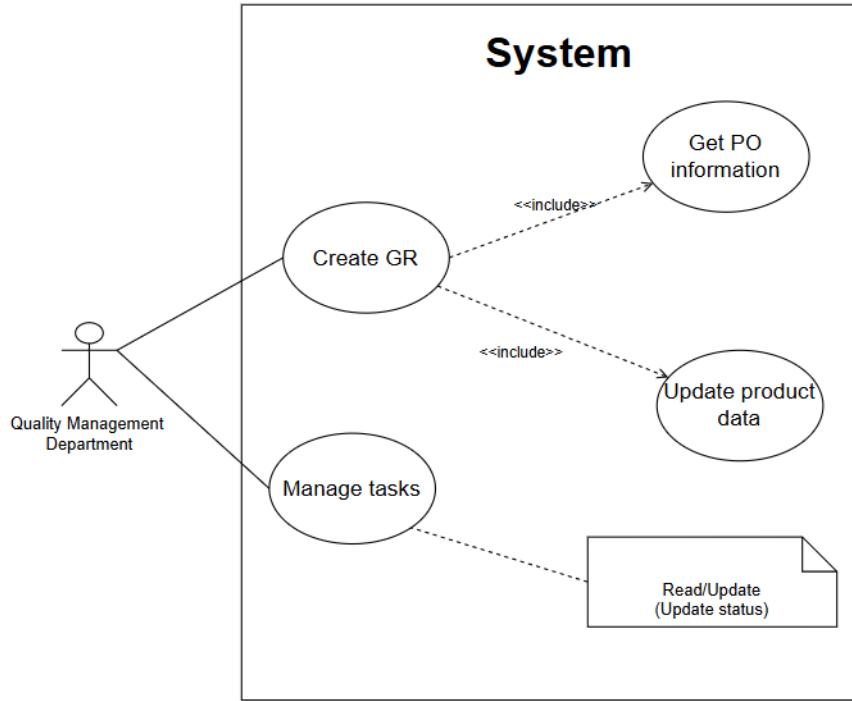


Figure 2.7 Use Case of Quality Management Department

### USE CASE SPECIFICATION

<b>Use Case Name</b>	Manage tasks
<b>Description</b>	The Quality Management Department performs the review and updates the status of assigned tasks in the system.
<b>Actor(s)</b>	Quality Management Department
<b>Priority</b>	Must Have
<b>Trigger</b>	The system updates the task list.
<b>Pre-Condition</b>	<ul style="list-style-type: none"> <li>The Quality Management Department must be logged into the system.</li> </ul>

	<ul style="list-style-type: none"> <li>The user's account must be authorized to read and update tasks status.</li> </ul>
<b>Post-Condition</b>	The status of the tasks in the task list is updated accurately.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The system assigns new tasks to the task list.</li> <li>2. The Quality Management Department checks the task list.</li> <li>3. After completing the task, the Quality Management Department updates the task status to "Completed."</li> </ol>
<b>Non-Functional Requirement</b>	NFR-MRQ-1: The time to update the task status must not exceed 5 minutes after task completion or encountering an issue.

*Table 2.8 Use Case Specification Manage task, Quality Management Department*

Use Case Name	Create GR
<b>Description</b>	Quality Management Department creates Goods Receipt when completing the task "Importing goods"
<b>Actor</b>	Quality Management Department
<b>Priority</b>	Must Have
<b>Trigger</b>	The Quality Management Department is assigned the task "Goods Receipt" by the system
<b>Pre-Condition</b>	The Quality Management Department receives accurate PO (Purchase Order) information for the incoming goods.
<b>Post-Condition</b>	<ul style="list-style-type: none"> <li>A list of non-compliant products and reasons is recorded (if applicable).</li> <li>Goods Receipt is created.</li> </ul>

	<ul style="list-style-type: none"> <li>• Inventory quantity is updated upon completing the "Goods Receipt" task.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The Quality Management Department receives the task "Goods Receipt" from the system.</li> <li>2. The system provides detailed information about the incoming goods (PO number, quantity, vendor, storage location, etc.).</li> <li>3. The Quality Management Department creates a Goods Receipt and updates the inventory count upon task completion.</li> <li>4. The Quality Management Department records the completed task in the system.</li> </ol>
<b>Business Rules</b>	BR-GR-1: Button "Create" in Create GR Page is enabled when "PO ID, Vendor, Items" Area are filled

*Table 2.9 Use Case Specification Create GR, Quality Management Department*

### 2.3.5 Purchasing Department

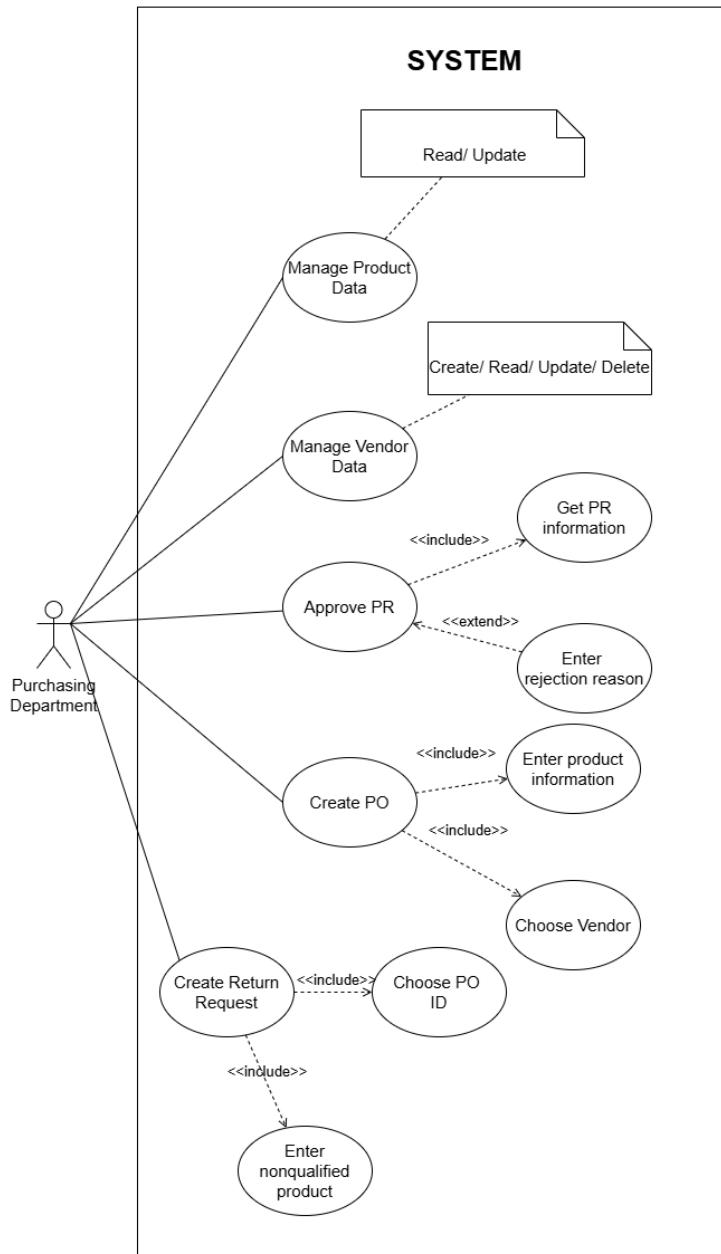


Figure 2.8 Use Case of Purchasing Department

### USE CASE SPECIFICATION

Use Case Name	
	Manage Product Data

<b>Description</b>	The Purchasing Department manages information related to products.
<b>Actor</b>	Purchasing Department
<b>Priority</b>	Must Have
<b>Trigger</b>	The Purchasing Department wants to view or edit product data.
<b>Pre-Condition(s):</b>	<ul style="list-style-type: none"> <li>• The user must be logged into the system.</li> <li>• The user's account must be authorized to perform product data management operations.</li> <li>• The system must have a database with existing product data records.</li> </ul>
<b>Post-Condition(s):</b>	<ul style="list-style-type: none"> <li>• Any changes made to product data (if applicable) are successfully saved in the database.</li> <li>• The product data is updated, retrieved, reflecting the user's input.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The Sales Staff logs into the system.</li> <li>2. The user navigates to the Warehouse Management → Product</li> <li>3. The user selects the desired action (Create, Read, Update, or Delete).             <ul style="list-style-type: none"> <li>• For Read, the user views the product list or details of a specific product.</li> <li>• For Update, the user edits the information of an existing product and saves changes.</li> </ul> </li> <li>4. The system processes the request and updates the database accordingly.</li> </ol>

	5. The system provides feedback on the success or failure of the operation.
<b>Alternative Flow</b>	<p>2a. User selects specific search filters (e.g. category, price range) to find desired products.</p> <p>2a1. The system processes filters and displays refined product list matching criteria.</p> <p><i>Use case continues to step 3</i></p>
<b>Exception Flow</b>	<p>3c. If there is a system error or database failure during any operation:</p> <ul style="list-style-type: none"> <li>• 3c.1. The system displays an error message and logs the incident.</li> <li>• 3c.2. The user selects the option to retry the operation.</li> </ul> <p><i>Use Case continues at the previous step.</i></p> <p>3d. If the user does not have sufficient permissions:</p> <ul style="list-style-type: none"> <li>• 3d.1. The system denies access and displays an "Unauthorized Access" message.</li> <li>• 3d.2. The user contacts the system administrator to request appropriate permissions.</li> </ul> <p><i>Use Case stops until permissions are updated.</i></p>
<b>Business Rules</b>	BR4.1-1: The system must implement record locking to prevent conflicts during simultaneous updates to the same product. (button “Edit” is unable)
<b>Non-Functional Requirement</b>	NFR4.1-1: The system must ensure that product data operations complete within 2 seconds.

*Table 2.10 Use Case Specification Manage Product data, Purchasing Department*

<b>Use Case Name</b>	Manage Vendor Data
<b>Description</b>	The Purchasing Department wants to manage vendor data to ensure the information is accurate and up to date.
<b>Actor(s)</b>	Purchasing Department
<b>Priority</b>	Must Have
<b>Trigger</b>	The purchasing department needs to create, read, update, or delete vendor data in the system.
<b>Pre-Condition(s)</b>	<ul style="list-style-type: none"> <li>• The user has logged in and has permission to access vendor data management functions.</li> <li>• The database system is operational.</li> </ul>
<b>Post-Condition(s)</b>	Vendor information is updated accurately in the system.
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The purchasing staff logs in the system</li> <li>2. The purchasing staff accesses the Vendor Page in PO Management Page.</li> <li>3. The employee selects the action to create, edit, or delete vendor information.</li> <li>4. The employee inputs the required information or confirms the action.</li> <li>5. The system validates the information and updates the database.</li> <li>6. The system notifies the user of the successful operation.</li> </ol>
<b>Alternative Flow</b>	<p>2a. The employee enters Vendor Name in the Search bar in the Purchasing Management Page.</p> <p>2a1. The system returns a list of relevant results.</p>
<b>Exception Flow</b>	4a. The system fails to save the information:

	<ul style="list-style-type: none"> <li>The system displays an error message.</li> <li>The employee reviews the information and retries the operation.</li> </ul>
<b>Business Rules</b>	<ul style="list-style-type: none"> <li>BR3.2-1: When updating vendor information, the 'update' button will only be enabled if all fields are filled out.</li> </ul>
<b>Non-Functional Requirement</b>	<ul style="list-style-type: none"> <li>NFR3.2-1: The interface must support search by name, ID, and filter by country.</li> </ul>

*Table 2.11 Use Case Specification Manage Vendor data, Purchasing Department*

Use Case Name	Approve PR
<b>Description</b>	The purchasing department wants to approve purchase requisitions (PRs) to ensure only valid requests are approved.
<b>Actor(s)</b>	Purchasing Department
<b>Priority</b>	Must Have
<b>Trigger</b>	EOD, A list of purchase requisition (PR) is submitted to the system.
<b>Pre-Condition(s)</b>	<ul style="list-style-type: none"> <li>The list PR has been created breakdown by vendor and submitted to the system.</li> <li>The Purchasing Department employee has logged in and has permission to approve PRs.</li> </ul>
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>The PR is successfully approved or rejected, with the reason documented.</li> <li>The system updates the PR status.</li> </ul>

<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The purchasing employee accesses the list of PRs awaiting approval.</li> <li>2. The employee selects a specific PR and reviews its details.</li> <li>3. The employee selects the "Approve" action.</li> <li>4. The system updates the PR status to "Approved."</li> </ol>
<b>Alternative Flow</b>	<ol style="list-style-type: none"> <li>3a. The employee selects the "Reject" action</li> <li>3a1. The employee provides a rejection reason.</li> <li>3a2. The system updates the PR status to "Rejected."</li> </ol>
<b>Exception Flow</b>	<ol style="list-style-type: none"> <li>4a. The system fails to update the PR status: <ul style="list-style-type: none"> <li>• The system displays an error message.</li> <li>• The employee retries the action or contacts' support.</li> </ul> </li> </ol>
<b>Business Rules</b>	<p>BR3.3-1: Only PRs with complete information can be approved.</p> <p>BR3.3-2: Invalid PRs must be rejected with a specific reason.</p>
<b>Non-Functional Requirement</b>	NFR3.3-1: The rejection reason must contain at least 20 characters.

*Table 2.12 Use Case Specification Approve PR, Purchasing Department*

<b>Use Case Name</b>	Create PO
<b>Description</b>	Purchasing Management wants to create a purchase order (PO) manually to provide complete information to the vendor.
<b>Actor(s)</b>	Purchasing Department
<b>Priority</b>	Must Have
<b>Trigger</b>	A PR has been created and requires a PO to be created manually.

<b>Pre-Condition(s)</b>	<ul style="list-style-type: none"> <li>• PR has been created.</li> <li>• The purchasing department employee has logged in and has permission to create POs.</li> </ul>
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>• The PO is successfully created and stored in the system.</li> <li>• The vendor receives the purchase order information.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>1. The purchasing department employee selects the approved PR.</li> <li>2. The employee inputs the product details, quantities and vendor information.</li> <li>3. The employee confirms and submits to the PO.</li> <li>4. The system saves the PO and sends a notification to the vendor.</li> </ol>
<b>Exception Flow</b>	<p>4a. The system fails to send the PO due to a connectivity error:</p> <ul style="list-style-type: none"> <li>• The system displays an error message.</li> <li>• The employee reviews the data and retries later.</li> </ul>
<b>Business Rules</b>	BR3.4-1: Button “Create” in Create PO Page is enabled when all text areas are filled.
<b>Non-Functional Requirement</b>	NFR3.4-1: The PO must be formatted correctly before sending.

*Table 2.13 Use Case Specification Create PO, Purchasing Department*

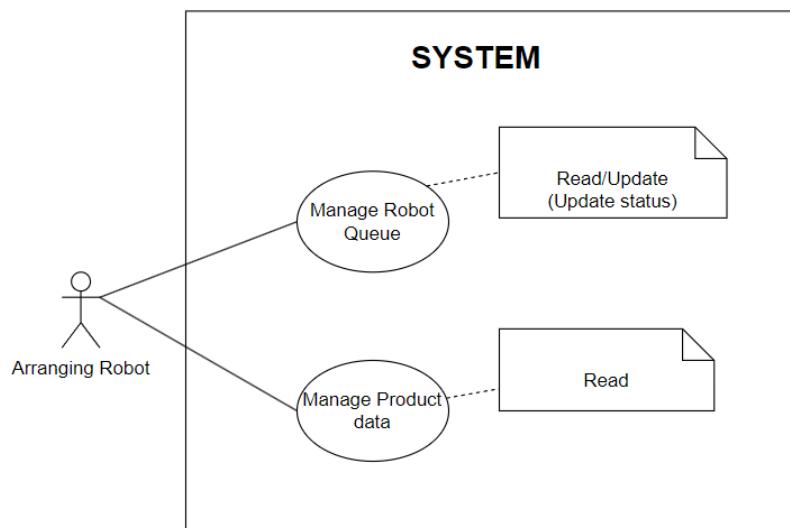
<b>Use Case Name</b>	Create Return Request
<b>Description</b>	When the QM department detects defects in special goods, they notify the Purchasing Department, and the Purchasing Department employee creates a return request to return goods to the vendor.
<b>Actor(s)</b>	Purchasing Department

<b>Priority</b>	Must Have
<b>Trigger</b>	Receive Notification about special goods that are identified as non-qualified during inspection.
<b>Pre-Condition(s)</b>	<ul style="list-style-type: none"> <li>Defective goods have been identified and flagged by Quality Management Department</li> <li>The Purchasing Department employee has logged in and has permission to create return requests.</li> </ul>
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>The return request is successfully created.</li> <li>The system sends a notification to the vendor.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>The QM department notifies the Purchasing Department.</li> <li>The Purchasing Department employee receives the notification and accesses the create return request function.</li> <li>The employee selects the related PO and inputs the non-qualified goods information.</li> <li>The employee confirms the return request.</li> <li>The system saves the return request and sends a notification to the vendor.</li> </ol>
<b>Alternative Flow</b>	3a. The purchasing employee manually inputs non-qualified goods information if the PO is not available.
<b>Exception Flow</b>	4a. The system fails to send the return request: <ul style="list-style-type: none"> <li>The system displays an error message.</li> <li>The employee reviews the data and retries the action.</li> </ul>
<b>Business Rules</b>	BR3.5-1: Button "Send to Vendor" in Create a Return Request Page is enabled when related task of Warehouse robot and QM (check and

	goods receipt tasks) are marked as “Completed” and “PO ID, Vendor, Items, Evidence” Area are filled.
<b>Non-Functional Requirement</b>	NFR3.5-1: The interface must support viewing return history by vendor.

*Table 2.14 Use Case Specification Create Return Request, Purchasing Department*

### 2.3.6 Arranging Robot



*Figure 2.9 Use Case of Arranging Robot*

## USE CASE SPECIFICATION

Use Case Name	Manage Robot Queue
Description	Manage the queue of tasks and update the status of processing tasks.
Actor(s)	Arranging Robot
Priority	Must Have

<b>Trigger</b>	A new task needs to be added, or an existing task's status is updated.
<b>Pre-Condition(s)</b>	<ul style="list-style-type: none"> <li>The arranging robot system is operational.</li> <li>The system has an active queue for managing tasks.</li> </ul>
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>The task queue is updated with new tasks.</li> <li>The status of completed or in-progress tasks is updated in the system log.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>The automation system adds a new task to the queue.</li> <li>The system appends the new task to the existing queue.</li> <li>The arranging robot processes tasks in the queue sequentially.</li> <li>When a task is completed, the arranging robot updates its status to "Completed" and logs the operation.</li> <li>The arranging robot moves to the next task in the queue.</li> </ol>
<b>Non-Functional Requirement</b>	NFR4.1-1: The system must support a queue of up to 3 concurrent tasks without performance issues.

*Table 2.15 Use Case Specification Manage Robot Queue, Arranging Robot*

<b>Use Case Name</b>	Manage Product Data
<b>Description</b>	Read product information to complete tasks.
<b>Actor(s)</b>	Arranging Robot
<b>Priority</b>	Must Have
<b>Trigger</b>	A task requires the robot to access product information to proceed.

<b>Pre-Condition(s)</b>	<ul style="list-style-type: none"> <li>Product information is available in the system database.</li> <li>The arranging robot is operational and connected to the database.</li> </ul>
<b>Post-Condition(s)</b>	<ul style="list-style-type: none"> <li>The robot successfully retrieves the required product information.</li> <li>Tasks related to filling or correcting product placement are completed accurately.</li> </ul>
<b>Basic Flow</b>	<ol style="list-style-type: none"> <li>The robot receives a task requiring product information.</li> <li>The system retrieves the relevant product data (e.g., product ID, location, quantity, specifications).</li> <li>The robot uses the retrieved data to locate or manipulate the product.</li> </ol>
<b>Exception Flow</b>	<p>2b. The robot fails to retrieve product data due to a system error:</p> <ul style="list-style-type: none"> <li>The system retries accessing the database after 10 seconds.</li> <li>If the issue persists, an alert is sent to the IT team, and the task is flagged as “Pending”.</li> </ul>
<b>Non-Functional Requirement</b>	<p>NFR4.2-1: The system must maintain 99.9% uptime for database accessibility.</p> <p>NFR4.2-2: All data read by the robot must be logged for monitoring purposes.</p>

*Table 2.16 Use Case Specification Manage Product data, Arranging Robot*

## 2.4 Main Feature

*Diagram: [LINK](#)*

*Mockup: [LINK](#)*

## 2.4.1 Main Feature 1: Handle Out-of-Stock Shelf

### 2.4.1.1 Feature description, output and actor

The Smart Shelf is equipped with sensors and AI cameras to automatically monitor the weight and quantity of goods on the shelf every 5 minutes. When the quantity of goods falls below **60%** of the specified threshold, the Smart Shelf will send a notification to the system, which will then trigger the process of “**Fill product on shelf**”: restocking goods from the warehouse and addressing the empty shelf following the FIFO principle.

#### *Output + Actor*

Actor	Activity	Output
Smart Shelf	Send problem	Problem is shown in Notification Page.
System	Create and Assign task	Task is shown in the Task Management Page, Robot Queue Detail Page.
Warehouse robot	Provide the result	Task status, Goods Issue and New Quantity in warehouse are shown in the Task Management Page, Robot Queue Detail Page, Warehouse Management (Product, Goods Issue Page).
Arranging Robot	Send status	Task status is shown in the Task Management Page, Robot Queue Detail Page.
Smart Shelf	Update product	New quantity on the shelf is shown in the Warehouse Management Page.

Table 2.17 Output and actor of Hande out-of-stock shelf

### 2.4.1.2 Sequence Diagram

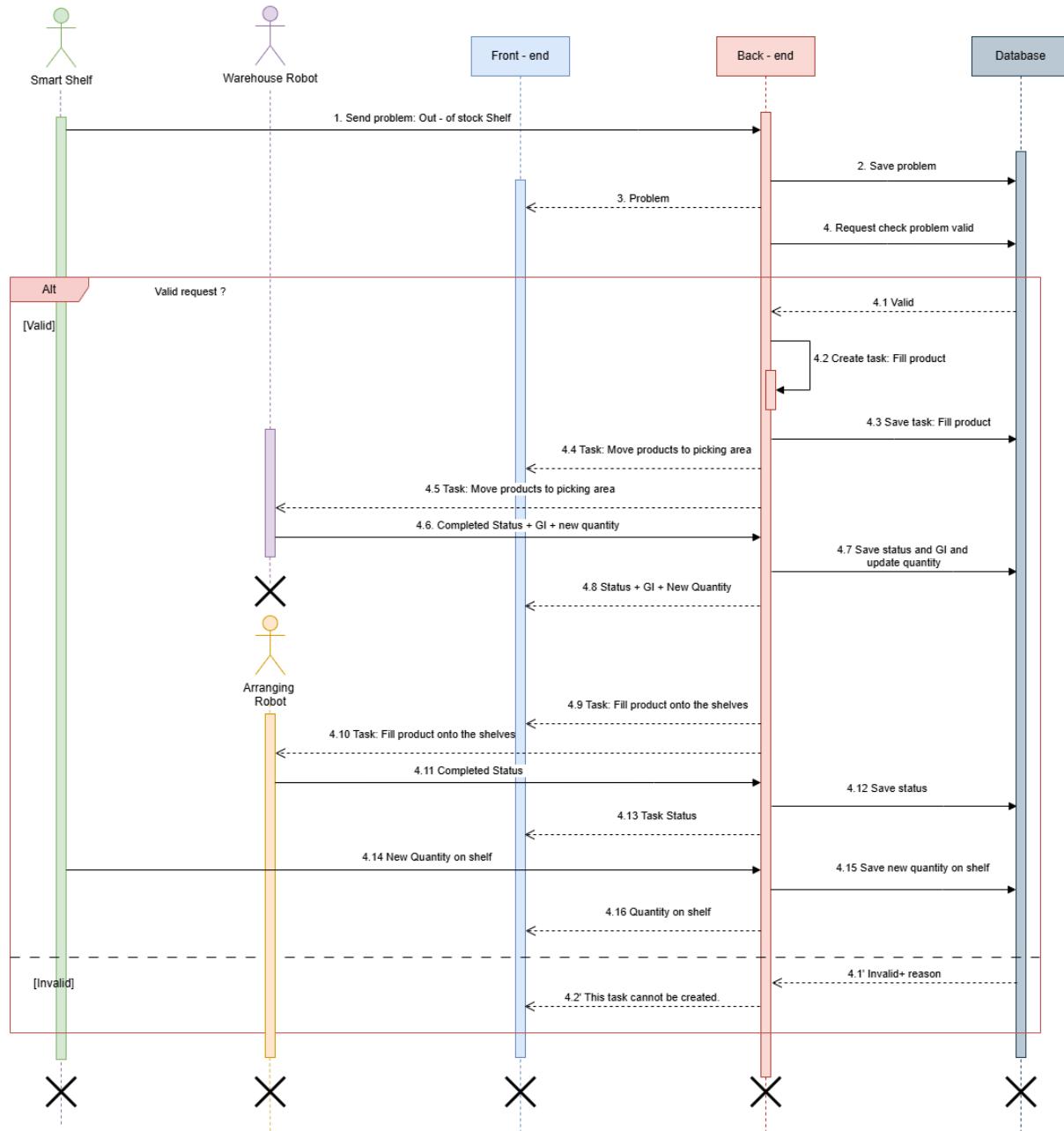


Figure 2.10 Sequence Diagram of Handle out-of-stock shelf

### 2.4.1.3 Mockup

**Shelf Management:** Here, the supermarket's shelf map with assigned shelf IDs is displayed. Staff can quickly see the shelf status through the displayed color and check information about a specific product by

The screenshot shows the 'Shelf Management' section of the GreenView Market application. On the left, a sidebar lists various management modules: Dashboard, Staff Management, Task Management, Warehouse Management, Shelf Management (which is currently selected and highlighted in green), Robot Management, Purchasing Management, and Sales Management. Below these are notification and settings icons. The main area is titled 'Shelf Management' and displays a grid of shelves labeled A through G. Each shelf contains a 3x8 grid of cells, each representing a specific shelf ID like SS01A or SS01B. Some cells are highlighted in red or orange, indicating specific status or alerts. A search bar and filter button are located at the top right of the grid area. Below the grid, there are three small icons representing different operations: picking, stocking, and reporting.

Figure 2.11 Shelf Management

**Shelf Detail:** Here, employees can view detailed information about products on a selected shelf, including product name, ID, quantity, expiry date, update history and shelf data.

This screenshot shows a detailed view of the 'Shelf Management' interface for Shelf ID SS01A. The left sidebar is identical to the previous screenshot, with 'Shelf Management' selected. The main content area is titled 'Shelf ID: SS01A' and 'Shelf : A.01'. It displays a table of products with columns for Product name, Product ID, Quantity, and Expiry. The table shows Lay's Natural Classic Pack 90g with three entries: SNK11003 (30 units, 07/03/2026), SNK11002 (10 units, 07/12/2025), and SNK11001 (10 units, 07/11/2025). Below this table is another table titled 'Shelf Data' with columns for ID Period, Time - Date, Quantity, and Status. This table shows five time periods (S10, S09, S08, S07, S06) with their respective quantities (50, 50, 50, 50, 20) and statuses (Normal, Normal, Normal, Filled, Out Of Shelf).

Figure 2.12 Shelf Detail

**Robot Management:** This tab contains two components. The left part is an overview of all the robots running in the system. The other part is detailed information about each robot. Each robot is listed with details such as robot ID, work location, job queue, and current operating status.

The screenshot shows the GreenView Market software interface. The top navigation bar includes a logo, the title "GreenView Market", a search bar, and user icons. The left sidebar has a tree view with "Robot Management" selected. The main content area is titled "Robot Management" and displays "All Robots". It features a summary table "Information" with counts for Total (25), Warehouse Robot (10), Arranging Robot (15), Active (20), Inactive (3), and Error (2). Below this is a detailed table with columns for Robot ID, Location, Queue, and Status. The data is as follows:

	Robot ID	Location	Queue	Status
Total:	25			
Warehouse Robot:	RBA01	Supermarket	<a href="#">See Detail</a>	Inactive
Arranging Robot:	RBA21	Supermarket	<a href="#">See Detail</a>	Inactive
Active:	RBA03	Supermarket	<a href="#">See Detail</a>	Inactive
Inactive:	RBA01	Supermarket	<a href="#">See Detail</a>	Error
Error:	RBW01	Warehouse	<a href="#">See Detail</a>	Error
	RBW02	Warehouse	<a href="#">See Detail</a>	Active
	RBW03	Warehouse	<a href="#">See Detail</a>	Active
	RBA04	Supermarket	<a href="#">See Detail</a>	Active
	RBA03	Supermarket	<a href="#">See Detail</a>	Active

Showing 9 of 25 Robots

Figure 2.13 Robot Management

**Robot Queue:** Task of “Handle out-of- stock shelf” of robot will be shown on this page.

Figure 2.14 Robot Queue

#### 2.4.1.4 Business rule

ID	Rule Type	Business Rule
BR-SS-1	Smart Shelf <i>(Rule for Robot)</i>	Trigger: every 5 minutes → perform action.
BR-SS-2	BE	Trigger: if smart_shelf.problem == "Out of stock shelf"
BR-SS-3	BE	Check if problem exists in database within the same time frame → if duplicate (invalid), skip task creation; else, create task and assign task.
BR-SS-4	Arranging Robot and Warehouse Robot <i>(Rule for Robot)</i>	Sort inventory by received date, place oldest items first (FIFO)

Table 2.18 Business rule Handle Out – of – stock shelf

## 2.4.2 Main Feature 2: Handle Expired product

### 2.4.2.1 Feature description, output and actor

The system automatically checks the expiration dates (EXP) of goods in the database on a scheduled basis (once per day at the end of the day). When it detects goods nearing their expiration, the system triggers the process “**Remove expired products**”, which includes removing the old product from the shelf, restocking with new items from the warehouse, and ensuring proper arrangement following the FIFO principle.

#### *Output + Actors*

Actor	Activity	Output
System	Daily auto check expiration status	Product status in Warehouse Management Page if expired products exist.
System	Create and Assign task	Task is shown in the Task Management Page, Robot Queue Detail Page
Warehouse robot	Provide the result	Task status, Goods Issue and New Quantity in warehouse are shown in the Task Management Page, Robot Queue Detail Page, Warehouse Management (Product, Goods Issue Page)
Arranging Robot	Send status	Task status is shown in the Task Management Page, Robot Queue Detail Page
Smart Shelf	Update product	New quantity on the shelf is shown in Warehouse Management Page.

Table 2.19 Output and actor of Handle expired product

### 2.4.2.2 Sequence Diagram

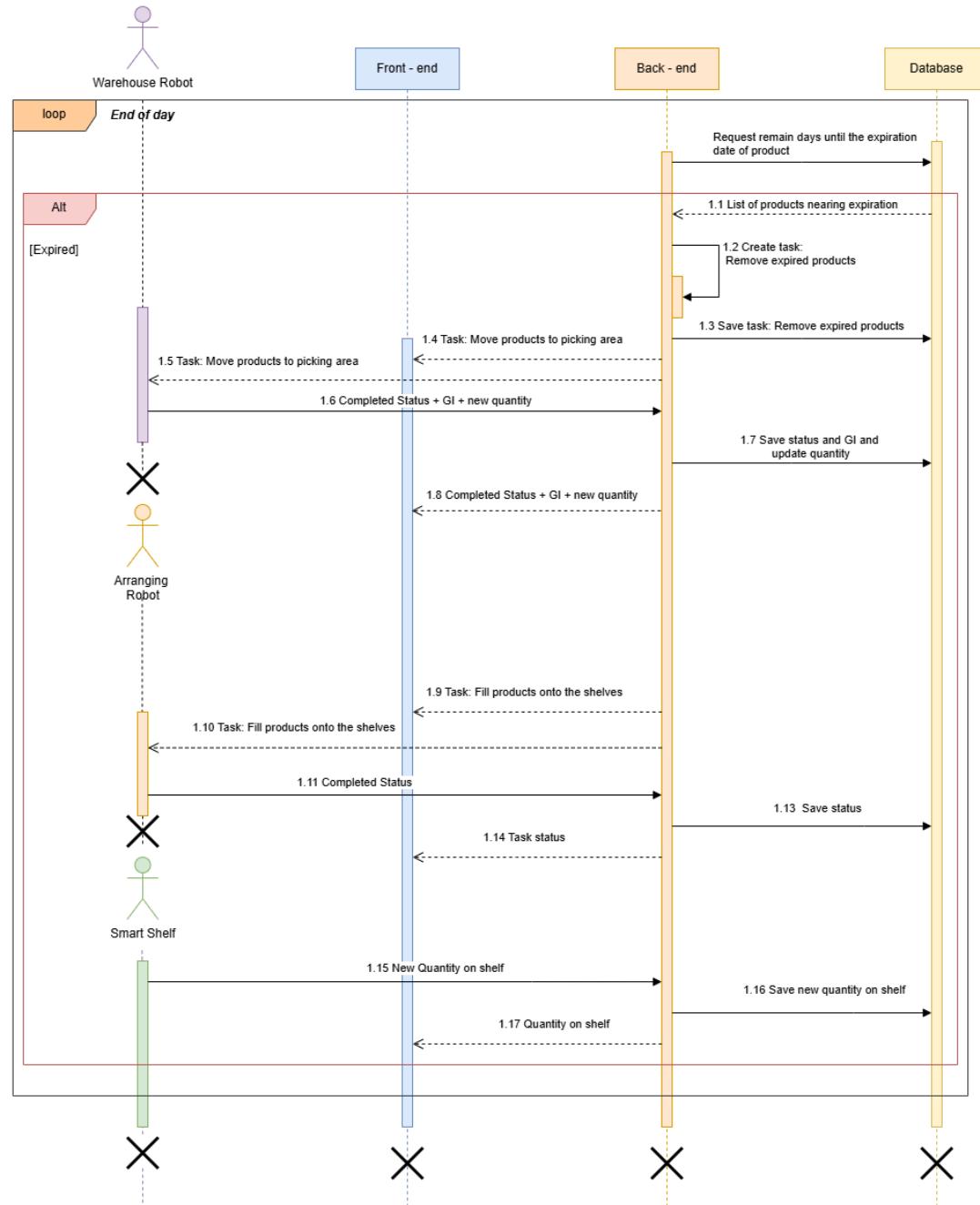


Figure 2.15 Sequence Diagram of Handle expired product

### 2.4.2.3 Mockup

**Robot Queue:** which clearly displays the operating status of each robot and the tasks being assigned. Staff can view details about each task, including description, execution time, and status.

The screenshot shows the 'Robot Management' section of the GreenView Market application. On the left, there's a sidebar with various management options like Dashboard, Staff Management, Task Management, Warehouse Management, Shelf Management, Robot Management (which is currently selected and highlighted in green), Purchasing Management, and Sales Management. Below these are Notification and Settings icons. The main content area is titled 'Robot Management' and shows a sub-section 'Robot Queue' under 'Robot Management'. It displays a table for 'Robot ID : RBA04' with the following data:

Task ID	Task Name	During Time	Description	Time	Status
T01	Arrange products in the wrong shelf	5-10 minutes	Arrange products SNK20004 in shelf A.03 at \$10	16:00 - 03/12/2024	Waiting
T10	Fill products on shelf	5-10 minutes	Fill products SNK10087 on shelf F.05	14:45 - 03/12/2024	Waiting
T15	Collect products for disposal	5-10 minutes	Collect products SNK11002 on shelf B.02	14:30 - 02/12/2024	Doing
T16	Label new price tag label	5-10 minutes	Label new price tag label on shelf C.01	15:00 - 01/12/2024	Done
T18	Arrange products in the wrong shelf	5-10 minutes	Arrange products MBL10009 in shelf A.03 at \$20	9:00 - 01/12/2024	Done

Figure 2.16 Robot Queue

**Goods Issue:** This screen describes the goods issue created after each time export products from the warehouse to fill on the shelves in the supermarket

The screenshot shows the GreenView Market application's warehouse management module. The sidebar on the left lists various management categories. The 'Warehouse Management' category is expanded, and its sub-item 'Goods Issue' is selected, highlighted with a green background. The main content area displays a table titled 'All Goods Issue' with the following data:

	Goods Issue ID	Quantity	Price	Movement Type	Created by
<input type="checkbox"/>	GI051201	40	\$140.50	552	RBW06
<input checked="" type="checkbox"/>	<b>GI051202</b>	<b>65</b>	<b>\$111.20</b>	<b>552</b>	<b>RBW02</b>
<input type="checkbox"/>	GI051203	30	\$89.50	552	RBW05
<input type="checkbox"/>	GI051204	90	\$85.50	552	RBW01
<input type="checkbox"/>	GI051205	25	\$100.50	552	RBW05
<input type="checkbox"/>	GI051206	70	\$93.00	552	RBW08
<input type="checkbox"/>	GI051207	50	\$45.00	552	RBW02
<input type="checkbox"/>	GI051208	80	\$28.00	552	RBW01
<input type="checkbox"/>	GI051209	60	\$140.50	552	RBW09

At the bottom of the table, there are buttons for 'More', 'Edit', and 'Delete'. Below the table, it says 'Showing 9 of 80 Goods Issue' and has a page navigation bar from 1 to 9.

Figure 2.17 Goods Issue

#### 2.4.2.4 Business rule

ID	Rule Type	Business Rule
BR-EXP-1	BE	Auto-check product expiration daily at end of day
BR-EXP-2	BE	Trigger: if expired products are found
BR-EXP-3	BE	Check if problem exists in database within the same time frame → if duplicate (invalid), skip task creation; else, create task and assign task.
BR-EXP-4	Arranging Robot and Warehouse Robot	Sort inventory by received date, place oldest items first (FIFO)

	<i>(Rule for Robot)</i>	
--	-------------------------	--

*Table 2.20 Business rule Handle expired product*

### 2.4.3 Main Feature 3: Handle Misplaced Product

#### 2.4.3.1 Feature description, output and actor

The Smart Shelf is equipped with sensors and AI cameras to automatically monitor the weight and quantity of goods on the shelf every 5 minutes. When detecting a product in the wrong position, Smart Shelf sends the “Wrong Shelf” to the system. The system will activate the process “**Arrange product in the wrong shelf**”.

#### *Output + Actors*

Actor	Activity	Output
Smart Shelf	Send problem	Problem shown in Notification Page
System	Create and Assign task	Task shown in the Task Management Page, Robot Queue Detail Page
Arranging Robot	Send status	Task status shown in the Task Management Page, Robot Queue Detail Page
Smart Shelf	Update product	New quantity on the shelf is shown in the Warehouse Management Page.

*Table 2.21 Output and actor of Handle Misplaced product*

### 2.4.3.2 Sequence Diagram

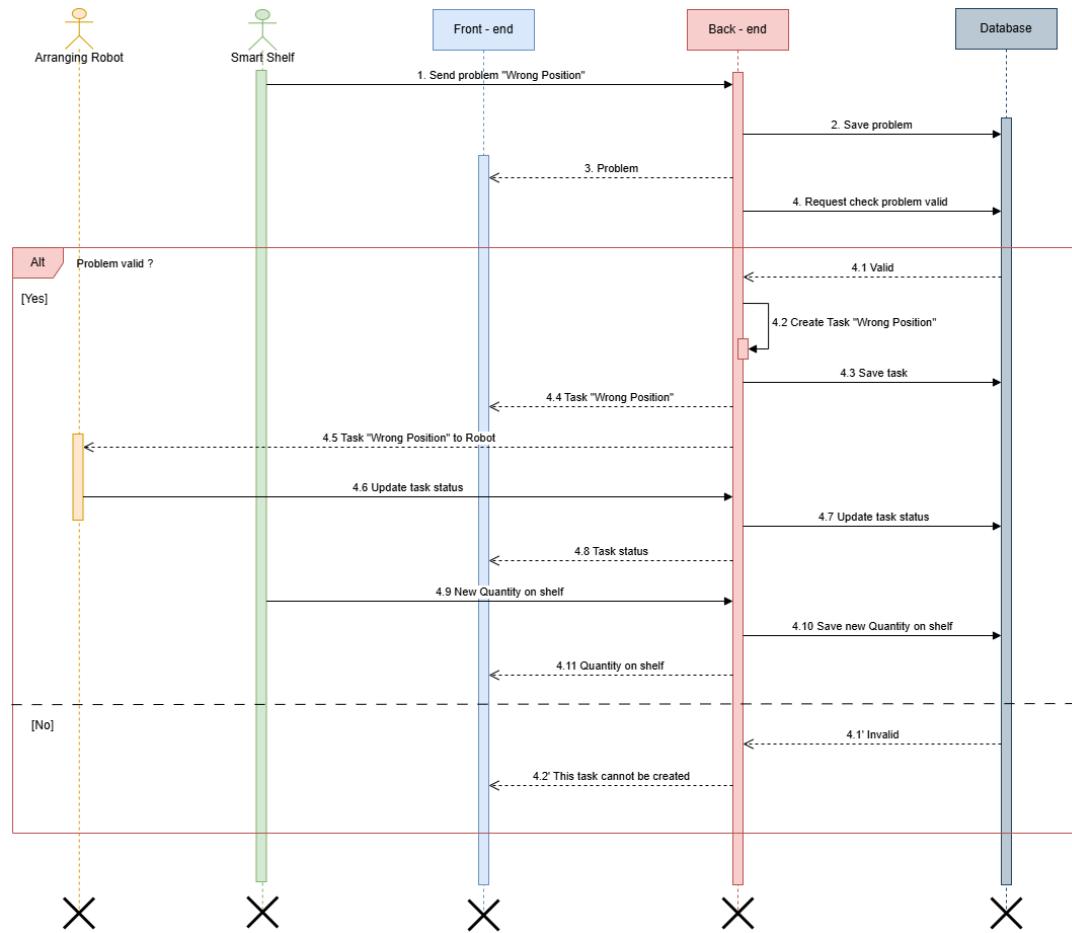


Figure 2.18 Sequence Diagram of Handle misplaced product

### 2.4.3.3 Mockup

**Robot Queue:** Task “Handle misplaced product” will be shown on this page for each robot.

Figure 2.19 Robot Queue

#### 2.4.3.4 Business rule

ID	Rule Type	Business Rule
BR-WS-1	Smart Shelf (Rule for Robot)	Trigger every 5 minutes → perform action
BR-WS-2	BE	Trigger: if smart_shelf.problem == "Wrong Shelf"
BR-WS-3	BE	Check if problem exists in database within the same time frame → if duplicate (invalid), skip task creation; else, create task and assign task.

Table 2.212 Business rule Handle misplaced product

## 2.4.4 Main Feature 4: Handle Discontinued Product

### 2.4.4.1 Feature Description, output and actor

The Sales Department selects replacement products for discontinued items and sends them to the system. The system will trigger the "Handle Discontinued Product" process, automatically checking the inventory of the discontinued product and repeating this until the stock reaches zero (both on the shelf and in the warehouse). After that, the system will initiate the process of restocking the replacement product.

#### *Output + Actors*

Actor	Activity	Output
Sales Department	Select discontinued products and replacement products	Information of discontinued products and replacement products are shown in the Sales Management Page and Status "Discontinued" shown on Product Detail Page.
System	Create and Assign task	If stock_quantity == 0: Task is shown in the Task Management Page, Robot Queue Detail Page.
Warehouse robot	Provide the result	Task status, Goods Issue and New Quantity in warehouse are shown in the Task Management Page, Robot Queue Detail Page, Warehouse Management (Product, Goods Issue Page)
Arranging Robot	Send status	Task status is shown in the Task Management Page, Robot Queue Detail Page.
Smart Shelf	Update product	New quantity on the shelf is shown in the Warehouse Management Page.

Table 2.23 Output and actor of Handle Discontinued product

#### 2.4.4.2 Sequence Diagram

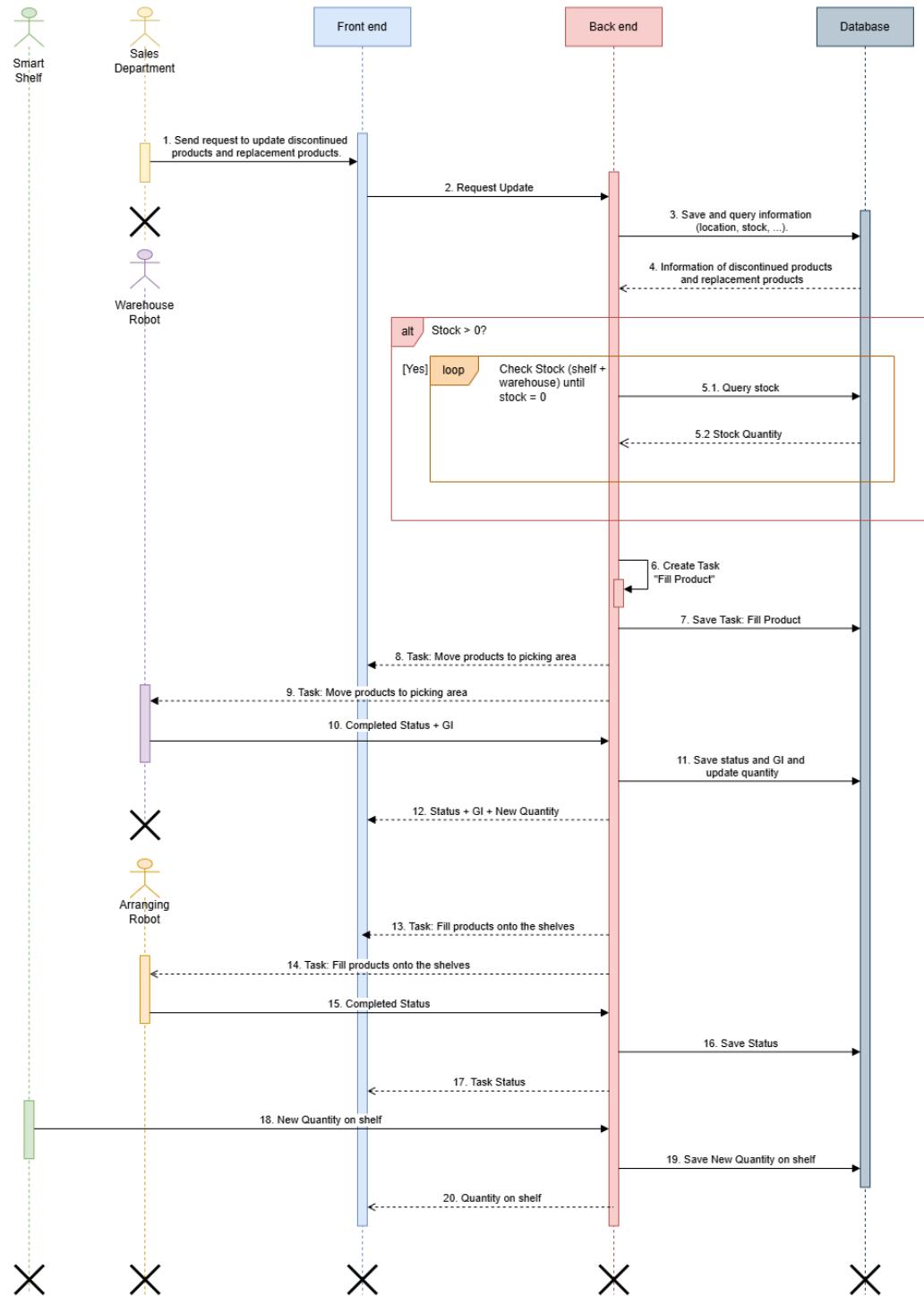
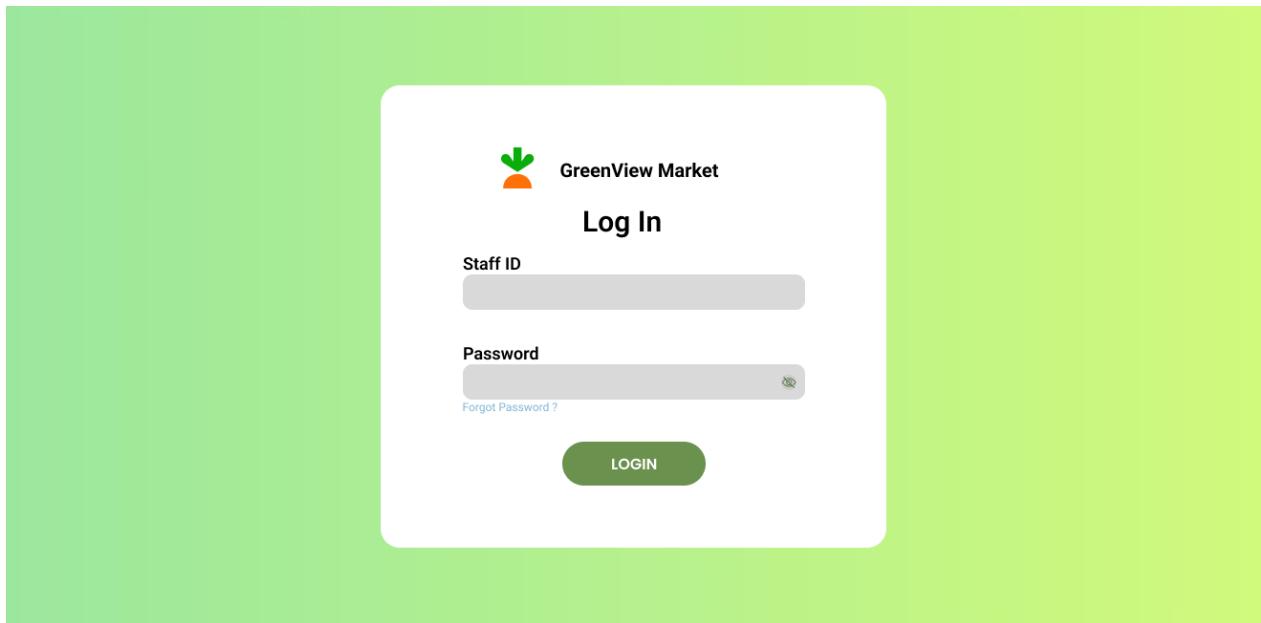


Figure 2.20 Sequence Diagram of Handle discontinued product

#### **2.4.4.3 Mockup**

**Login:** Staff use the provided account and password to access the system and perform operations such as inventory management, operation status tracking and robot management, etc.



*Figure 2.21 Login*

**Sales Management:** This interface provides an overview of daily sales, revenue and top-selling products. View and manage notifications related to discontinued products to help employees quickly grasp the business situation.

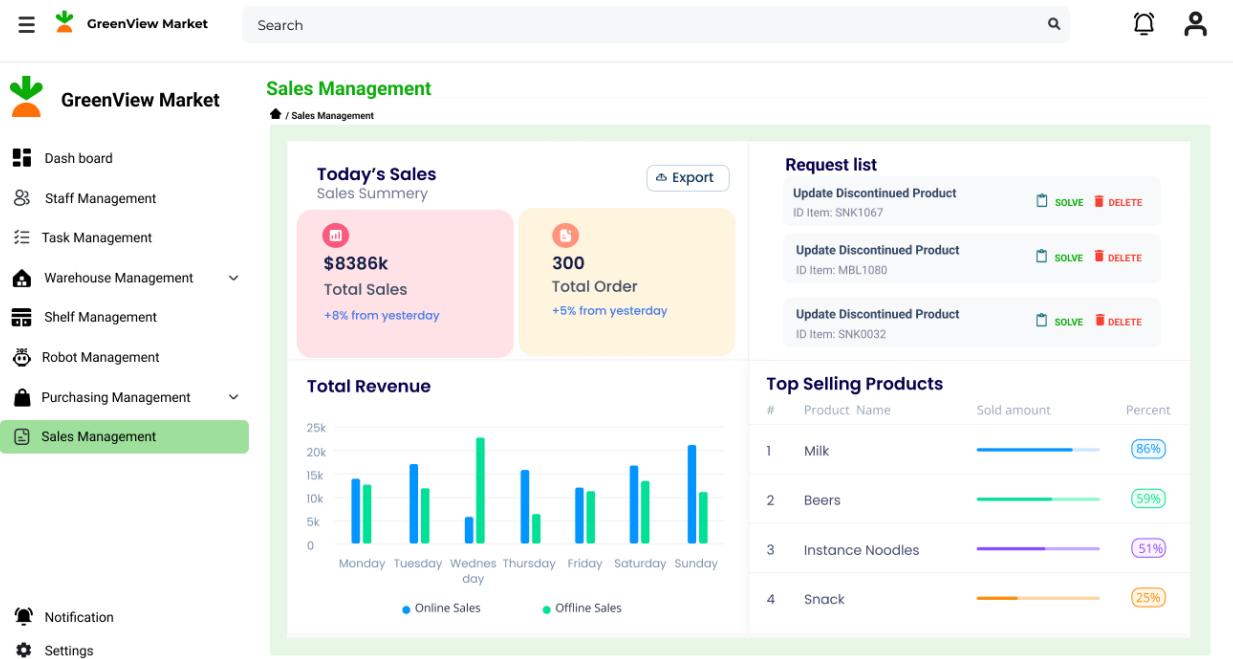


Figure 2.22 Sales Management

**Product:** This is the Product tab for Warehouse. It displays detailed product information such as name, description, category, quantity in warehouse, quantity on shelves, and price. Users can view detailed information about the product by ticking the checkbox.

**Warehouse Management**

**Product**

	Product	Description	Category	Quantity In Warehouse	Quantity On Shelves	Price
<input type="checkbox"/>	Hugo mixed fruit candy	Assorted candies in a convenient pack.	Food	100	50	\$3.50
<input type="checkbox"/>	Indo Noodle	Instant noodles, quick and flavorful.	Food	250	100	\$1.20
<input checked="" type="checkbox"/>	Tipto matcha cookie	Crispy cookies in a handy pack.	Food	50	30	\$2.80
<input type="checkbox"/>	Lays snack potato	Tasty snacks for anytime munching.	Food	90	45	\$1.50
<input type="checkbox"/>	Thien Long pencil	Essential pencil for writing or drawing.	Stationery	50	35	\$0.50
<input type="checkbox"/>	Tihon notebook	Handy notebook for notes or plans.	Stationery	100	65	\$3.0
<input type="checkbox"/>	Morton salt shaker	Practical salt container for daily use.	Spice	80	58	\$2.0
<input type="checkbox"/>	Omo washing powder	High-efficiency detergent for laundry.	Grocery	50	47	\$8.00
<input type="checkbox"/>	Royal strawberry jam	Strawberry jam in a reusable jar.	Food	40	29	\$4.50

Showing 9 of 100 products

Figure 2.23 Product

**Product detail:** This tab displays detailed information about each product. Users can view detailed information including the product ID, imported date, expiration date, current quantity in stock, and on shelves. Additionally, the interface provides functional buttons to edit product information, view history, and add new products.

The screenshot shows the 'Warehouse Management' section of the 'GreenView Market' application. On the left, there's a sidebar with various icons for navigation. The main area is titled 'Warehouse Management' and shows a product detail for 'Tipo matcha cookie'. The product image is a bag of matcha cookies. Below the image, it says 'Sales \$10,344' and 'ROAS 4.5x'. To the right of the product image is a table showing inventory details:

Product ID	Imported day	Expired day	Quantity In Warehouse	Quantity On Shelf	Action
#TX01	Jan 18, 2024	Jun 15, 2025	10	3	<span>Edit</span> <span>Delete</span>
#TX02	Feb 22, 2024	Apr 22, 2025	10	2	<span>Edit</span> <span>Delete</span>
#TX03	Mar 9, 2024	Jan 20, 2025	20	5	<span>Edit</span> <span>Delete</span>
#TX04	July 13, 2024	Jan 1, 2026	40	15	<span>Edit</span> <span>Delete</span>
#TX05	Aug 5, 2024	Mar 18, 2026	40	15	<span>Edit</span> <span>Delete</span>

At the top right, there are buttons for 'History', 'Search', 'Upload', 'Export', and '+ Add New Product'. The URL in the address bar is '/Warehouse Management / Product / Detail'.

Figure 2.24 Product detail

**Edit product status pop up:** This tab displays a pop-up window being used to edit the status of products. Specifically, this pop-up allows users to change the product's status, select a replacement product, and update the new price.

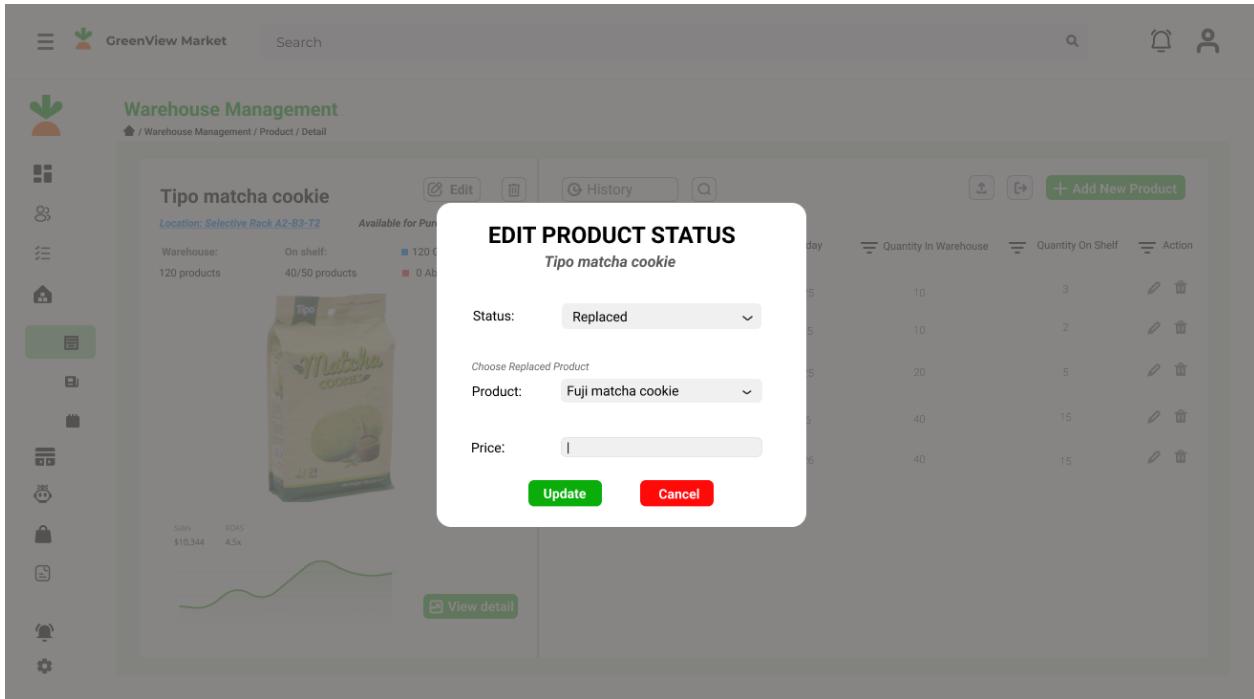


Figure 2.25 Edit product status pop up

#### 2.4.4.4 Business rule

ID	Rule Type	Business Rule
BR-DP-1	FE	Button "Update" in Edit Product Status pop up is enabled when the Replacement Product is picked.
BR-DP-2	BE	Trigger: If product.status == "Discontinued", initiate "Handle Discontinued Product" process.
BR-DP-3	BE	Loop: Check stock of the discontinued product until stock_quantity == 0 (shelf + warehouse). If stock_quantity == 0, create restocking tasks for replacement products.
BR-DP-4	Warehouse Robot and Arranging Robot <i>(Rule for Robot)</i>	Follow FIFO (First In, First Out) rule when restocking replacement products from warehouse to shelf.

Table 2.24 Business rule Handle discontinued product

## 2.4.5 Main Feature 5: Manage stockout in warehouse

### 2.4.5.1 Feature Description, output and actor

When the inventory reaches the Safety Stock level, the system automatically generates a Purchase Requisition (PR). At the end of the day, this list is sent to the Purchasing Department for approval. The Purchasing Department approves each PR; if rejected, the reason is recorded, and if approved, a Purchase Order (PO) is created and sent to the vendor.

#### *Output + Actors*

Actor	Activity	Output
System	Generate PR	PR is shown in the Purchasing Management (PR Page)
Purchasing Department	Approve PR	PR status (approved/rejected) shown in the Purchasing Management Page. If rejected, the rejection reason is saved and displayed in the PR Detail Page.
System/ Purchasing Department	Create PO	PO is created and shown in the Purchasing Management Page (PO page)

Table 2.25 Output and actor of Manage stockout in warehouse

### 2.4.5.2 Sequence Diagram

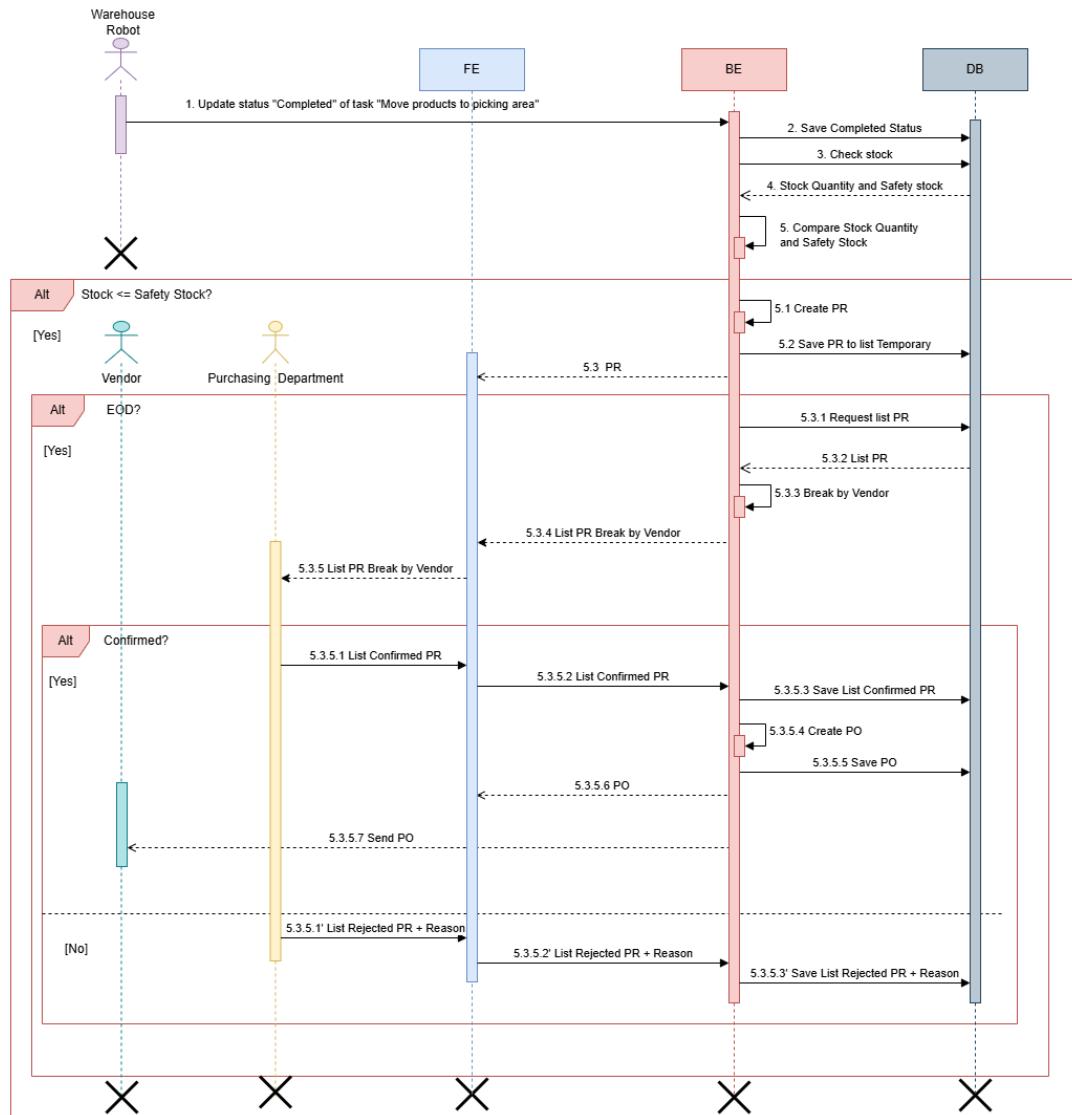


Figure 2.26 Sequence Diagram of Manage stockout in warehouse

### 2.4.5.3 Mockup

**Purchase Order:** which provides detailed information about orders, such as order codes, suppliers, order dates, delivery dates, product categories, prices, and order statuses. Users can select PO items to send or print.

The screenshot shows the GreenView Market platform's Purchasing Management section. On the left, a sidebar menu includes options like Dashboard, Staff Management, Task Management, Warehouse Management, Shelf Management, Robot Management, Purchasing Management (selected), Purchase Order (highlighted), Purchase Requisition, Request Return, Sales Management, Notification, and Settings. The main area is titled 'Purchasing Management' and shows a table of 'Purchase Order' details. The table columns are: PO ID, Vendor Name, Order Date, Delivery Date, Category, Price, and Status. A search bar, filter button, and 'Create New PO' button are at the top of the table. The table data is as follows:

PO ID	Vendor Name	Order Date	Delivery Date	Category	Price	Status
P001	SweetWorld Confectionery	Nov 22, 2024	Dec 1, 2024	Food	\$304.60	Approved
<input checked="" type="checkbox"/> P002	Instant Gourmet Co.	Oct 15, 2024	Oct 30, 2024	Food	\$215.89	Pending
P003	Crunchy Bites Ltd.	Nov 1, 2024	Nov 28, 2024	Food	\$143.25	Approved
P004	SnackTime Distributors	Sep 15, 2024	Oct 1, 2024	Food	\$431.12	Denied
P005	EduTools Supplies	Aug 29, 2024	Sep 7, 2024	Stationery	\$154.56	Received
P006	Stationery Pro Co.	Oct 21, 2024	Nov 3, 2024	Stationery	\$231.32	Pending
P007	Kitchen Essentials Inc.	Sep 13, 2024	Sep 29, 2024	Spice	\$298.10	Performing
P008	Clean&Fresh Solutions	Nov 12, 2024	Nov 28, 2024	Grocery	\$341.47	Shipping
P009	Berry Delight Farms	Nov 30, 2024	Dec 10, 2024	Food	\$199.11	Received

At the bottom, there are buttons for 'More', 'Send', and 'Print'. The page footer indicates 'Showing 9 of 100 purchase orders' and a page navigation bar from 1 to 12.

Figure 2.27 PO

**Create PO:** The tab for creating a new purchase order manually (not through PR), which provides fields to input information about the supplier, shipping address, date, list of products to purchase, quantity, unit price, and other additional costs such as taxes. After completing all the required information, users can proceed to create the purchase order.

The screenshot shows the GreenView Market application's Purchasing Management section. On the left, a sidebar lists various management modules: Dashboard, Staff Management, Task Management, Warehouse Management, Shelf Management, Robot Management, Purchasing Management (selected), Purchase Order (highlighted in green), Purchase Requisition, Request Return, Sales Management, Notification, and Settings. The main area is titled 'Purchasing Management' and 'Create Purchase Order'. It includes fields for Vendor (P002), Shipping Address, Date (Oct 15, 2024), and Terms. A table lists an item with Part #, Description, Quantity (100), Unit (100), and Total (\$215.89). Below the table is a message input field and a dropdown for Staff A. To the right, a breakdown of costs shows Subtotal (\$215.89), Freight Cost (\$0.00), Other Cost (\$0.00), Discount (\$0.00), Tax (\$0.00), and Total (\$215.89). An attachment section allows dragging files or selecting them from a file browser. A screenshot from Oct 15, 2024 is attached. A 'Generate PO' button is at the bottom right.

*Figure 2.28 Create PO manually*

**Purchase Requisition:** This is a list of purchase requisitions automatically created by the system. Each requisition is displayed with complete information, including the requisition code, vendor name, creation date, category, price, and the current status of the requisition.

The screenshot shows the GreenView Market platform's Purchasing Management section. On the left, a sidebar menu includes options like Dashboard, Staff Management, Task Management, Warehouse Management, Shelf Management, Robot Management, Purchasing Management (which is currently selected), Purchase Order, Purchase Requisition (highlighted in green), Request Return, Sales Management, Notification, and Settings. The main area is titled "Purchasing Management" and shows a table of purchase requisitions (PRs) with columns for PR ID, Vendor Name, PR Date, Category, Price, and Status. One row for PR04 is selected and highlighted in green. At the bottom right of the table are buttons for Accept, Edit, and Reject. Below the table, it says "Showing 9 of 100 purchase requisition" and has a page navigation bar.

*Figure 2.29 Purchase Requisition*

**Reject PR pop up:** This is a pop-up window for rejecting PR. The Purchasing Staff can enter the rejection reason in the text box and confirm to complete the rejection process.

This screenshot shows the same purchasing management interface as above, but with a modal dialog box overlaid. The dialog is titled "REJECT PR" and specifies "PR ID: PR04". It contains a text input field labeled "Reason:" with the placeholder "Type here...". Below the input field is a checkbox labeled "Confirm: ". At the bottom of the dialog are two buttons: "Reject" (green) and "Cancel" (red). The background of the main interface is dimmed to indicate the modal is active.

*Figure 2.30 Reject PR pop up*

#### **2.4.5.4 Business rule**

<b>ID</b>	<b>Rule Type</b>	<b>Business Rule</b>
BR-SO-1	BE	Trigger: If stock_quantity $\leq$ Safety Stock, automatically generate a Purchase Requisition (PR).
BR-SO-2	DB	Breakdown the list of PRs in Temporary PR by vendor.
BR-SO-3	FE	If PR status == "Rejected", Button "Reject" in Reject PR popup is enabled when the "Reason" area is filled.
BR-SO-4	FE	Button "Create" in Create PO Page is enabled when all text areas are filled.

*Table 2.26 Business rule Manage stockout in warehouse*

#### **2.4.6 Main Feature 6: Receive goods into the warehouse**

##### **2.4.6.1 Feature description, output and actor**

When a vendor delivers goods to the warehouse, the system triggers the process “**Receive goods into the warehouse**”, which involves assigning robots and the inventory team to handle and inspect the quantity and quality of the goods. The system ensures that all receiving information is recorded fully and accurately, generates a Goods Receipt report, and notifies relevant departments if any issues arise.

##### ***Output + Actors***

<b>Actor</b>	<b>Activity</b>	<b>Output</b>

Purchasing Department	Confirm goods arrival	PO status shown in Purchasing Management Page
System	Create and Assign task	Task shown in the Task Management Page, Robot Queue Detail Page
Warehouse robot	Provide the result (for packaged products)	If the products pass quality inspection: Task status, Goods Receipt and New Product information in warehouse shown in the Task Management Page, Robot Queue Detail Page, Warehouse Management (Product, Goods Receipt Page). If the products fail quality inspection: Task status + Unqualified Product Information in warehouse shown in the Task Management Page, Robot Queue Detail Page, Product Page and Notification
Purchasing Department	Provide the result (for Fresh products)	If the products pass quality inspection: Task status, Goods Receipt and New Product information in warehouse shown in the Task Management Page, Warehouse Management (Product, Goods Receipt Page). If the products fail quality inspection: Task status + Unqualified Product Information in warehouse shown in the Task Management Page, Product Page and Notification

Purchasing Department	Send notification to vendor	If the products fail quality inspection: A request return shown on Return Request Page
-----------------------	-----------------------------	--

*Table 2.27 Output and actor of Receive goods into the warehouse*

### 2.4.6.2 Sequence Diagram

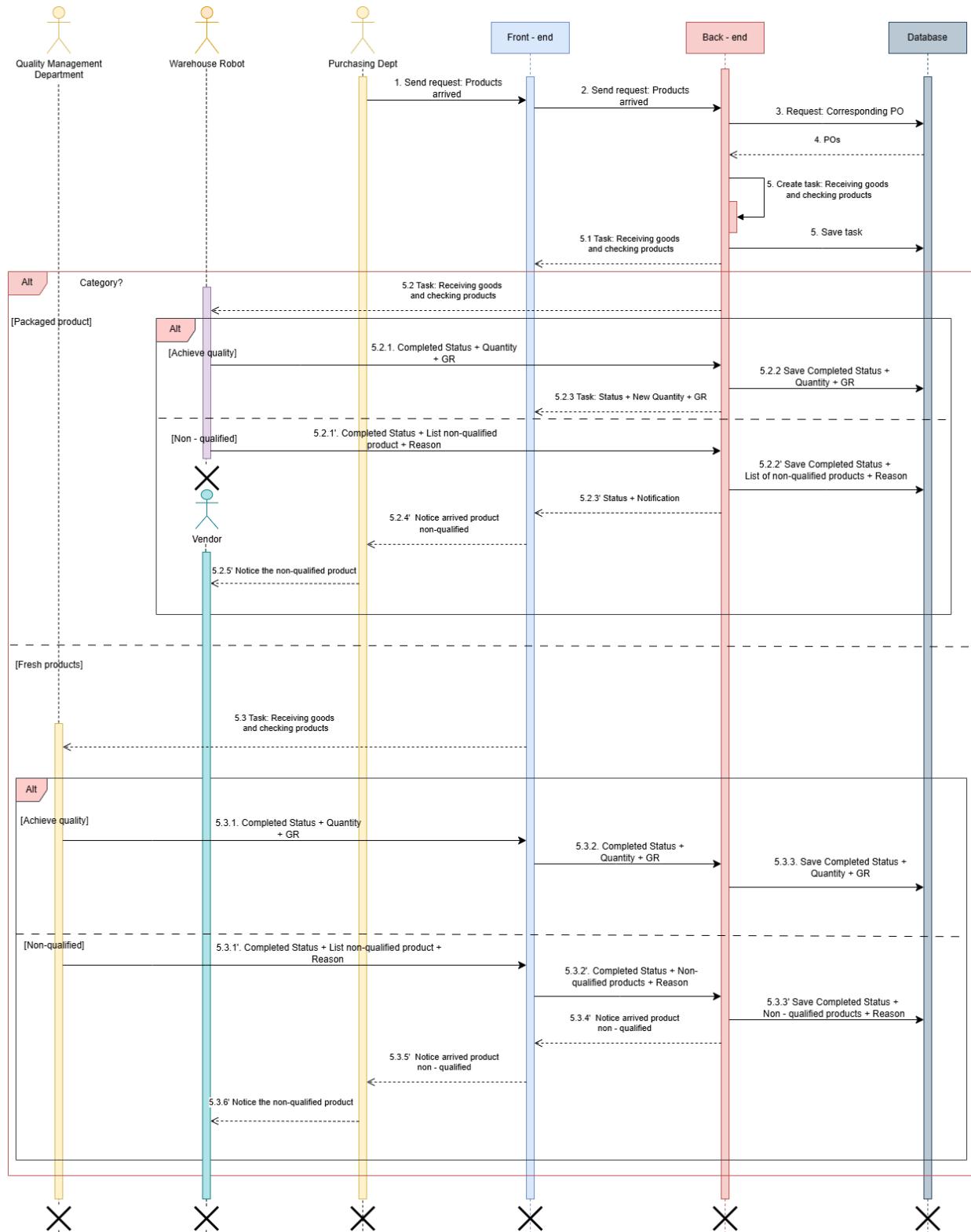


Figure 2.31 Sequence Diagram of Receive goods into the warehouse

### 2.4.6.3 Mockup

**Goods Receipt:** This tab shows a good receipt created when the vendor delivers products to the warehouse, created by the warehouse robot or employee. The interface shows a list of all goods receipts, including GR ID, created date, quantity, goods value and other relevant information.

	Goods Receipt ID	Quantity	Price	Movement Type	Created by	Stock Type
<input type="checkbox"/>	GR301101	100	\$20.50	412	STF1004	Unrestricted Use
<input type="checkbox"/>	GR301102	250	\$31.20	412	STF1002	Unrestricted Use
<input checked="" type="checkbox"/>	GR301103	50	\$22.80	412	STF1109	Quality Inspection
<input type="checkbox"/>	GR301104	90	\$35.50	412	RBW01	Unrestricted Use
<input type="checkbox"/>	GR301105	50	\$10.50	412	RBW05	Blocked
<input type="checkbox"/>	GR301106	100	\$103.0	412	STF1002	Quality Inspection
<input type="checkbox"/>	GR301107	80	\$42.0	412	RBW02	Unrestricted Use
<input type="checkbox"/>	GR301108	50	\$28.00	412	RBW01	Blocked
<input type="checkbox"/>	GR301109	40	\$14.50	412	RBW09	Unrestricted Use

Figure 2.32 Goods Receipt

**Create GR:** The tab for creating a new Goods Receipt, which provides fields for QM staff to create GR manually. After completing all the required information, users can proceed to create the Goods Receipt.

**Warehouse Management**

Warehouse Management / Goods Receipt/ Create Goods Receipt

**Create Goods Receipt**

Product ID	Quantity	Description	Status	Unit Price	Total
...	...	...	Unrestricted Use	...	\$215.89

Type your message here...

Staff A

Terms & Condition may apply.

**Attachment**

Drag and drop files here, or click to select files

VAT  
00.00 %  
Total  
00.00 %

Qty  
P  
Freight  
kg  
Customs  
P  
Cost Price  
S  
Ext. Tax  
S  
Sub total  
S

200  
00  
00.00  
00.00  
00.00

**Create**

Figure 2.33 Create GR

**Request return:** This Request return tab provides detailed information about each request return when has non-qualified product, such as Request ID, PO ID, vendor name, request date, creator.

**Purchasing Management**

/ Purchasing Management / Request Return

	Request ID	PO ID	Vendor Name	Request Date	Creator
<input type="checkbox"/>	RQ01	P001	SweetWorld Confectionery	Nov 12, 2024	ST01
<input type="checkbox"/>	RQ02	P002	Instant Gourmet Co.	Oct 5, 2024	ST02
<input type="checkbox"/>	RQ03	P003	Crunchy Bites Ltd.	Oct 20, 2024	ST03
<input type="checkbox"/>	RQ04	P004	SnackTime Distributors	Sep 4, 2024	ST04
<input type="checkbox"/>	RQ05	P005	EduTools Supplies	Aug 19, 2024	ST05
<input type="checkbox"/>	RQ06	P006	Stationery Pro Co.	Oct 11, 2024	ST06
<input checked="" type="checkbox"/>	<b>RQ07</b>	<b>P007</b>	<b>Kitchen Essentials Inc.</b>	<b>Sep 3, 2024</b>	<b>ST07</b>
<input type="checkbox"/>	RQ08	P008	Clean&Fresh Solutions	Nov 2, 2024	ST08
<input type="checkbox"/>	RQ09	P009	Berry Delight Farms	Nov 20, 2024	ST09

Search Filter + Create Return Request

1 item selected

Showing 9 of 100 purchase requisition

Figure 2.34 Request Return

**Create request return:** Create request return tab for Purchasing Staff includes fields for entering PO ID, supplier information, delivery address, expected return date, a list of products to be returned, quantities, reasons for the return, and allows users to attach files such as images and invoices as evidence.

The screenshot shows the GreenView Market application interface. On the left is a sidebar with various management options like Dashboard, Staff Management, Task Management, etc. The 'Request Return' option is highlighted. The main area is titled 'Purchasing Management' and shows a sub-section 'Purchase Order / Create Return Request'. The 'Create Return Request' form contains fields for 'PO ID', 'Vendor', 'Picking Address', 'Date', 'Staff', and a table for 'Items' with columns for Part #, Description, Quantity, Unit, and Total. Below this is a 'Description detail product' text area and an 'Evidence' section for attaching files. A 'Send to Vendor' button is at the bottom right.

Figure 2.35 Create Request Return

#### 2.4.6.4 Business rule

ID	Rule Type	Business Rule
BR-RG-1	BE	Trigger: if PO status changes to "Received"

BR-RG-2	BE	Check if problem exists in database within the same time frame → if duplicate (invalid), skip task creation; else, create task and assign task.
BR-RG-3	FE	Button "Create" in Create GR Page is enabled when "PO ID, Vendor, Items" Area are filled
BR-RG-4	FE	Button "Send to Vendor" in Create a Return request Page is enabled when related task of Warehouse robot and QM (check and goods receipt tasks) are marked as "Completed" and "PO ID, Vendor, Items, Evidence" Area are filled.

Table 2.28 Business rule Receive goods into the warehouse

## 2.4.7 Main Feature 7: Assign task

### 2.4.7.1 Feature description, output and actor

The system automatically performs the "**Assign Task**" process every 10 minutes from 8:00 AM to 10:30 PM daily, which includes ranking tasks by priority and allocating tasks to robots and relevant departments.

#### Output + Actors

Actor	Activity	Output
System	Rank tasks <i>(if multiple tasks are created simultaneously)</i>	Ranked tasks shown in the Task Management Page
System	Allocate and Assign task	Task shown in the Task Management Page, Robot Queue Detail Page

Table 2.2922 Output and actor of Assign task

#### 2.4.7.2 Sequence Diagram

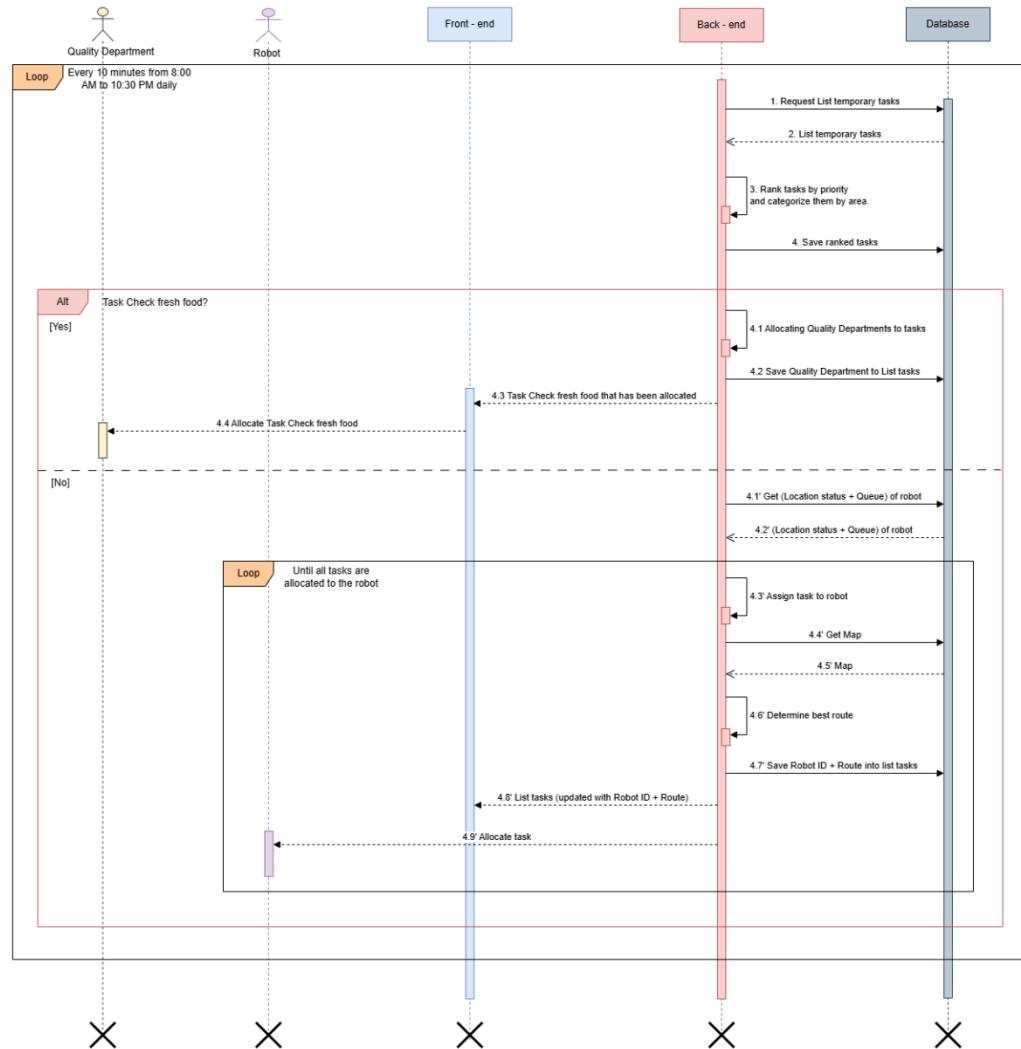


Figure 2.36 Sequence Diagram of Assign task

#### 2.4.7.3 Mockup

**Task management:** It clearly displays the tasks to be performed including task ID, task name, duration, location, the status of each task, and information related to the robot executing the task.

The screenshot shows the 'Task Management' section of the GreenView Market application. On the left, a sidebar menu includes 'Dashboard', 'Staff Management', 'Task Management' (which is highlighted in green), 'Warehouse Management', 'Shelf Management', 'Robot Management', 'Purchasing Management', 'Sales Management', 'Notification', and 'Settings'. The main area is titled 'Task Management' and shows a table of 'All tasks' with the following columns: Task ID, Task Name, During Time, Location, Robot ID, and Status. The tasks listed are:

Task ID	Task Name	During Time	Location	Robot ID	Status
T01	Arrange products in the wrong shelf	5-10 minutes	Supermarket	RBS01	Doing
T02	Handle discontinued products	5-10 minutes	Supermarket	RBS21	Doing
T03	Replenish expires products on shelf	5-10 minutes	Supermarket	RBS03	Doing
T04	Fill products on shelf	5-10 minutes	Supermarket	RBS01	Failed
T05	Check products position in warehouse	5-10 minutes	Warehouse	RBW01	Failed
T06	Check basic quality of products	5-10 minutes	Warehouse	RBW02	Done
T07	Check products information	5-10 minutes	Warehouse	RBW03	Done
T08	Arrange products in the wrong shelf	5-10 minutes	Supermarket	RBS04	Done
T09	Replenish expires products on shelf	5-10 minutes	Supermarket	RBS03	Done

*Figure 2.37 Task Management*

**Robot Queue:** Which clearly displays the operating status of each robot and the tasks being assigned. Staff can view details about each task, including description, execution time, and status.

The screenshot shows the 'Robot Management' section of the GreenView Market application. On the left, a sidebar menu includes 'Dashboard', 'Staff Management', 'Task Management', 'Warehouse Management', 'Shelf Management', 'Robot Management' (which is highlighted in green), 'Purchasing Management', 'Sales Management', 'Notification', and 'Settings'. The main area is titled 'Robot Management' and shows a table for 'Robot ID : RBA04' with the following columns: Task ID, Task Name, During Time, Description, Time, and Status. The tasks listed are:

Task ID	Task Name	During Time	Description	Time	Status
T01	Arrange products in the wrong shelf	5-10 minutes	Arrange products SNK2004 in shelf A.03 at \$10	16:00 - 03/12/2024	Waiting
T10	Fill products on shelf	5-10 minutes	Fill products SNK10087 on shelf F.05	14:45 - 03/12/2024	Waiting
T15	Collect products for disposal	5-10 minutes	Collect products SNK11002 on shelf B.02	14:30 - 02/12/2024	Doing
T16	Label new price tag label	5-10 minutes	Label new price tag label on shelf C.01	15:00 - 01/12/2024	Done
T18	Arrange products in the wrong shelf	5-10 minutes	Arrange products MBL10009 in shelf A.03 at \$20	9:00 - 01/12/2024	Done

Figure 2.39 Robot Queue

**Notification:** Managers and staff can view notifications such as the robot is having problems, products with code SNK10008 are sold out, or warnings when the shelves have reached the minimum quantity. Managers can also view updates on the completion of created tasks or import processes.

Figure 2.40 Notification

#### 2.4.7.4 Business rule

ID	Rule Type	Business Rule
BR-AT-1	BE	Trigger every 10 minutes from 8:00 AM to 10:30 PM daily → start process
BR-AT-2	BE	Prioritize and rank tasks by area into the List of Tasks based on the following rules:

		<ul style="list-style-type: none"> <li>• if area == "Market" → Task Priority: Fill Product &gt; Correct Wrong Position &gt; Remove Product</li> <li>• if area == "Warehouse" → Task Priority: Transfer to Picking Area &gt; Replenish Stock</li> <li>• if area == "Cross-Area" → Execution Priority: Warehouse Robot &gt; Arranging Robot</li> </ul>
BR-AT-3	BE	<p>Allocation for Tasks:</p> <ul style="list-style-type: none"> <li>• if task.type == "Check Fresh Food" → allocate task == "Quality Department"</li> <li>• if task.type != "Check Fresh Food" → allocate task == "Robot"</li> </ul>
BR-AT-4	BE	<p>Robot Allocation for Tasks if allocate task == "Robot"</p> <ul style="list-style-type: none"> <li>• if robot.status == "Inactive" → assign task to robot</li> <li>• if all robots.status == "Active" and robot.queue.size &lt;= 3 → check robot.location after completing all tasks in robot.queue and calculate shortest route to task.location → assign task to robot with the shortest route to task location</li> </ul>

Table 2.30 Business rule of Assign task



**THANK YOU FOR  
YOUR SUPPORT**