UNIVERSITY OF ECONOMICS AND LAW
FACULTY OF INFORMATION SYSTEM

SYSTEM ANALYSIS AND DESIGN

TOPIC: WAREHOUSE AND SHELF MANAGEMENT AT SUPERMARKET

Supervisor: Ms. Vu Thuy Hang

Member of group:

1. Nguyễn Thái Ngọc Sương: K204061411
2. Trần Nhật Nguyên: K204061440
3. Thái Thiên Trúc: K204060310
4. Man Đắc Sang: K204061446

TEAM MEMBER

STT	Student ID	Full name	Class	Role
1	K204061411	Nguyễn Thái Ngọc Sương	K20406T	Leader
2	K204061440	Trần Nhật Nguyên	K20406T	Member
3	K204060310	Thái Thiên Trúc	K20406C	Member
4	K204061446	Man Đắc Sang	K20406C	Member

TABLE OF CONTENTS

CATEGORIES OF IMAGES

Link all diagrams: LINK

I. Project Overview:

1. Introduction:

The supermarket is a place which offers a wide variety of food, beverages and household products, organized into sections. Due to the large number of goods consumed everyday, along with the crowded customers, it is very difficult for the staff to keep track of the flow of shelf and warehouse management. Whenever they want to fill products on the shelves, they have to work very hard to deliver products from warehouse to store and make sure that the shelves are always full of products for customers to buy. Moreover, all those jobs are done manually so the process will be hard to control and a lot of mistakes may be caused . This problem dramatically affects business operations, customer experiences and wastes employees' time and effort. With the advancement of technology, this is the time when we should apply advanced equipment and technology to improve the traditional supermarket model.

2. Problems:

About 2/3 of customers choose to leave the supermarket when they can't find the product they want to buy. It shows that the current supermarket model businesses are facing difficulties such as: consuming a lot of labor, not updating the exact amount of inventory, not filling the products on shelf on time, cumbersome processes,... Finally, more and more customers are leaving business and moving to their competitors who own advanced technology and processes.

3. Recommended solutions:

For many stores, they choose to make use of a lot of labor with manual processes for operations. However, this causes various issues and leads to bad performance.

Understanding the urgency of the problem, our team apply the knowledge of the Analysis and Design Information System course to propose solutions:

- Analyze and propose new process for businesses

- Use an automatic system to reduce the number of labor at stores and warehouses to increase accuracy and efficiency.
- Use robots to complete manual tasks.
- Use cameras to detect products in the wrong shelf and sensors to warn about out of product shelves .

4. Permissions:

FUNCTION PERMISSION						
User Permission	Sensor	WH Manager	Store Manager	Store Robot	WH Robot	Store Camera
Get the highest priority tasks				x	x	
Create task: Purchase product from vendor		x				
Create task: Check delivered product and update quantity		x			x	
Create task: shelf out of stocks	x		x	x		
Create task: products in wrong shelf			x	x		x

DATA PERMISSION						
User Permission	Sensor	WH Manager	Store Manager	Store Robot	WH Robot	Store Camera
Shelf	x		x	x		x
Product	x	x	x	x	x	x
Task		x	x	x	x	
Purchase order		x				
Good receipt		x			x	
Good issue		x			x	

5. User of the system:

- Store manager: keep track of store, shelf, robot through camera. They will address emergency cases when the robots or system cause errors. Moreover, they can update, delete data of shelf, product and robot.
- Warehouse manager: keep track of warehouse, robot through camera. They will address emergency cases when the robots or system cause errors. Moreover, they can update, delete data of warehouse products and robots. Warehouse managers can create purchase orders or good receipts, good issues manually in case of system failure.

II. Detailed process:

1. Overall business process:

1.1 BPMN diagram:

The process includes a lot of automation that do not need the interference of human. Moreover, most of the time, robot will be assigned to task instead of using labor. Manager only view and check (if necessary) and handle some unique cases.

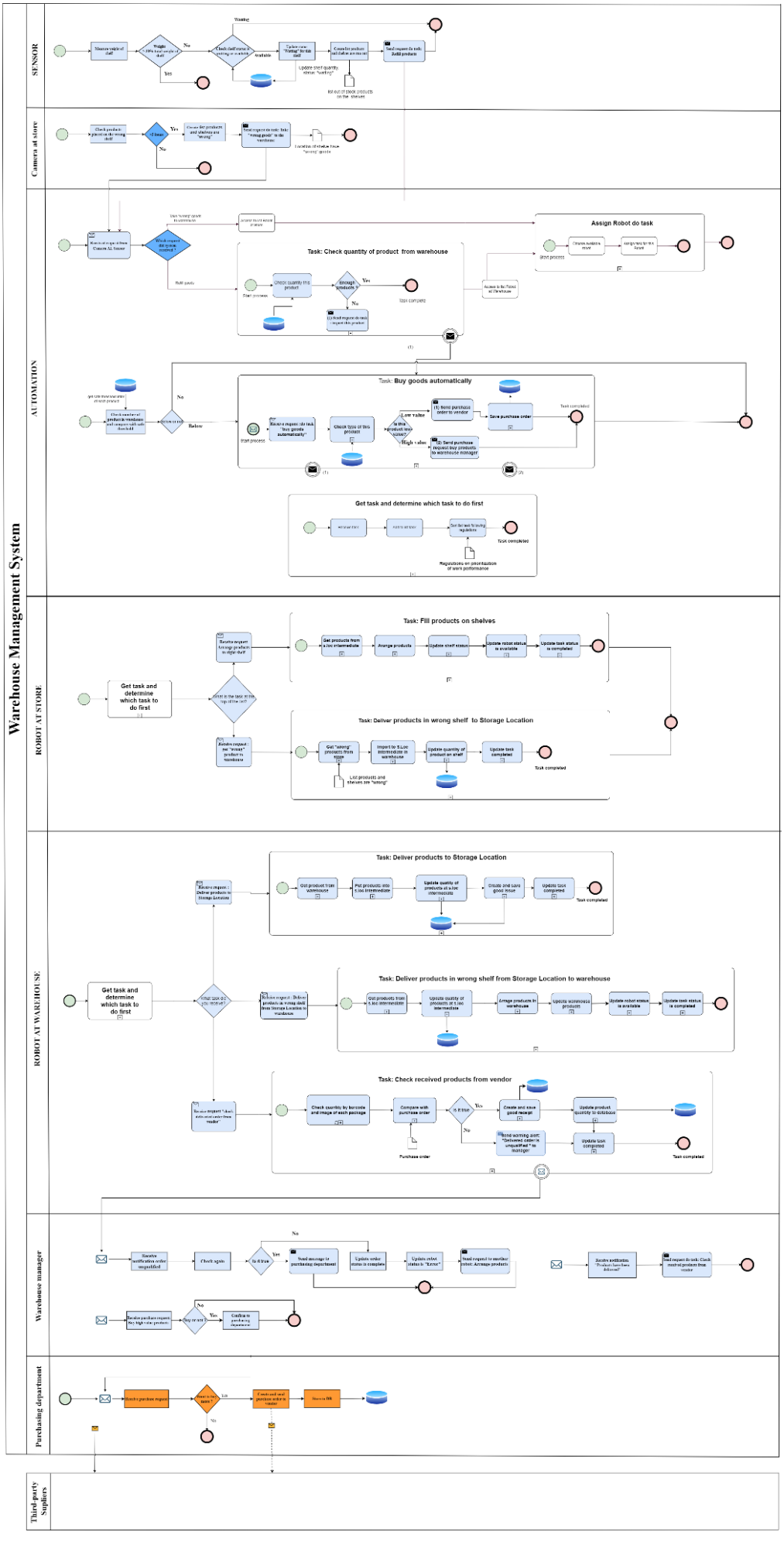
Warehouse Management System
SENSOR
Camera at store
AUTOMATION
ROBOT AT STORE
ROBOT AT WAREHOUSE
Warehouse manager
Purchasing department
Third party Suppliers
Task: Check quantity of product from warehouse
Assign Robot do task
Task: Buy goods automatically
Get task and determine which task to do first
Task: Fill products on shelves
Get task and determine which task to do
Task: Deliver products in wrong shelf to Storage Location
Task: Deliver products to Storage Location
Get task and determine which task to do first
Task: Deliver products in wrong shelf from Storage Location to warehouse
Task: Check received products from vendor

Image 1: BPMN diagram

1.2 Use case diagram:

To implement the process, some actors below are required:

- Camera (at store): keep track the products which are put at the wrong shelf. A lot of customers tend to change their mind after taking away products and then they do not return products back to the right shelf, they just leave the products at random shelf.
- Sensor: This device will help measure shelf ‘s weight, if the weight <30% per total, it sends a warning message to system.
- Robot at store: they are responsible for taking products from storage location, fill on shelves and deliver products in wrong shelf to storage location.
- Robot at warehouse: they will transport products from warehouse to storage location, collect products in wrong shelves back to warehouse, check and arrange received products from vendors.
- Warehouse manager: They have responsible to check document such as purchase order, good receipt or good issue and update if necessary.

1.2.1 Sensor Weight

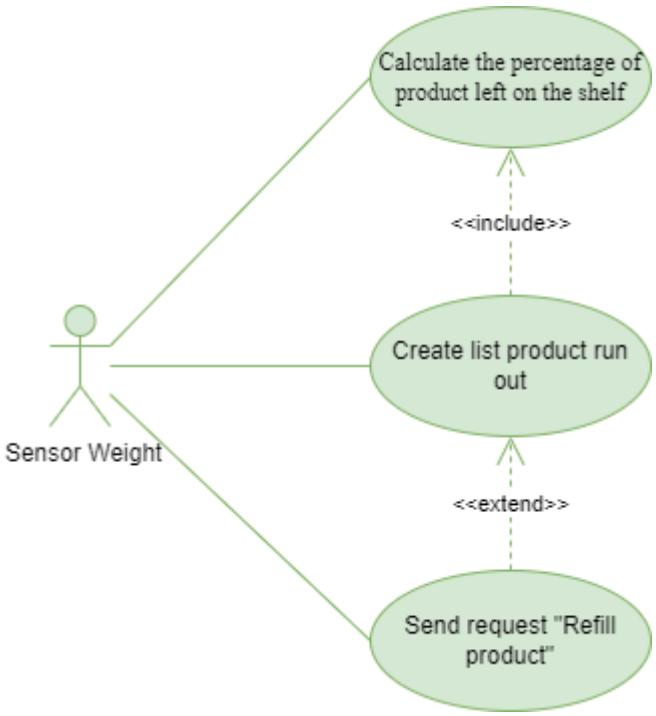

Image 2: Sensor

1.2.2 Camera

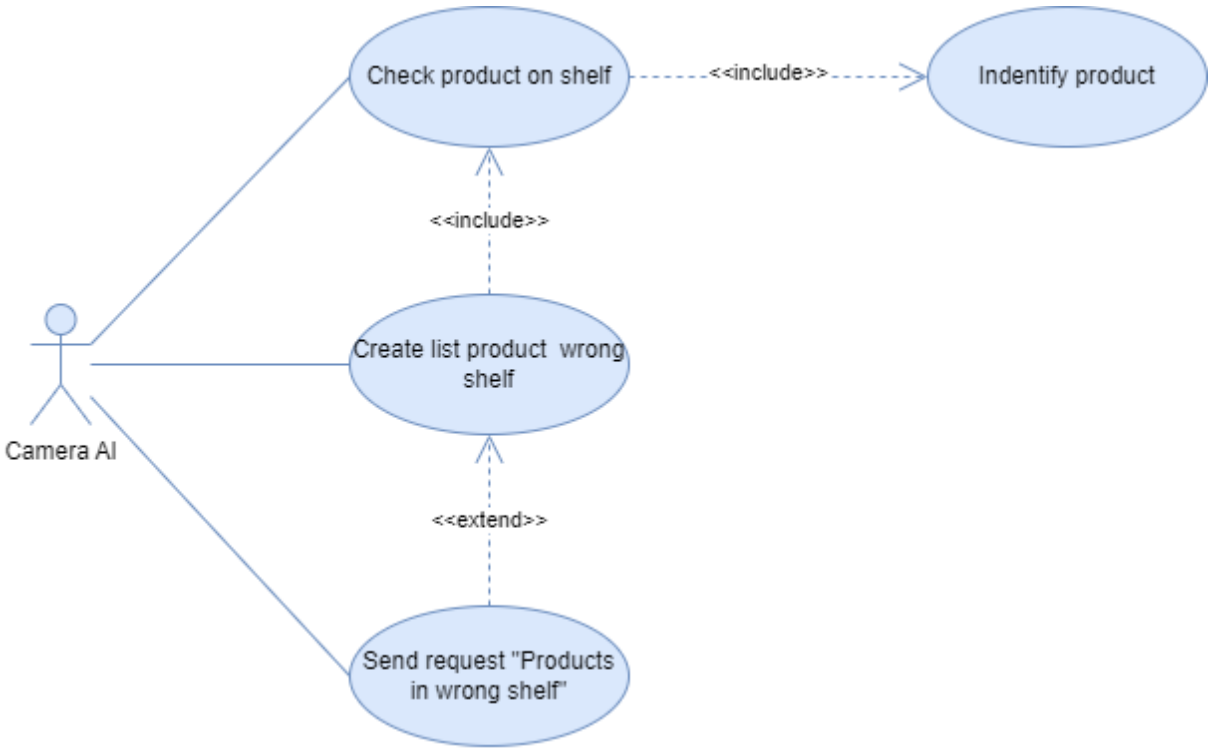

Image 3: Camera

1.2.3 Robot store

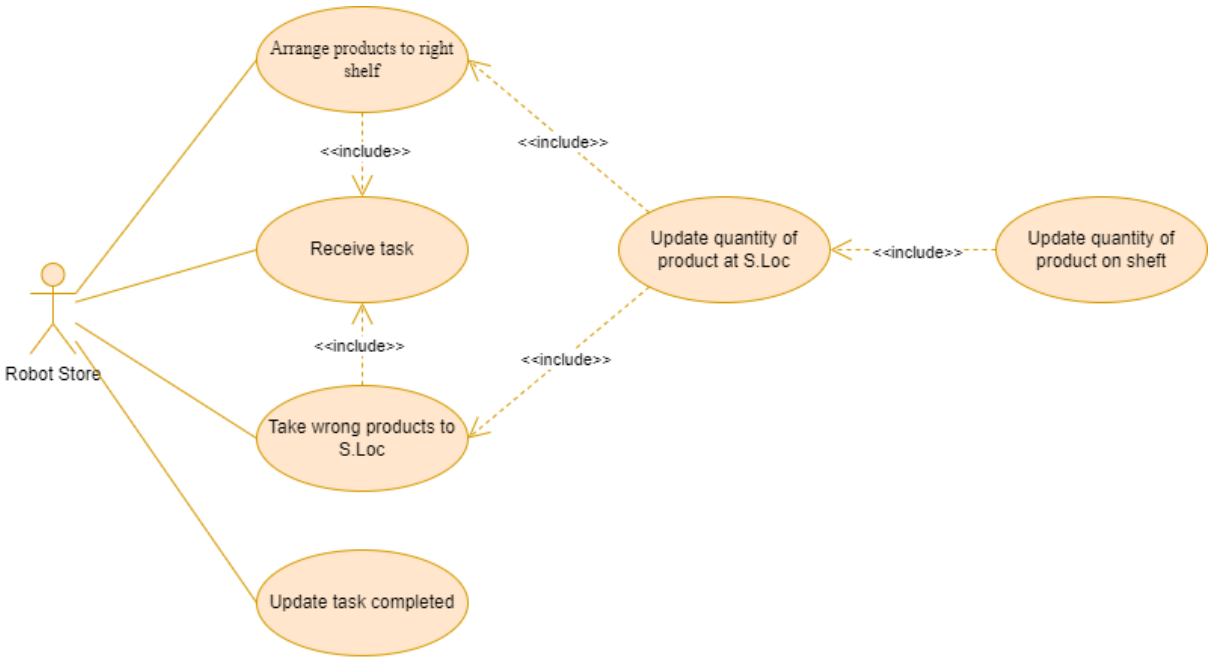

Image 4: Robot store

1.2.4 Robot warehouse

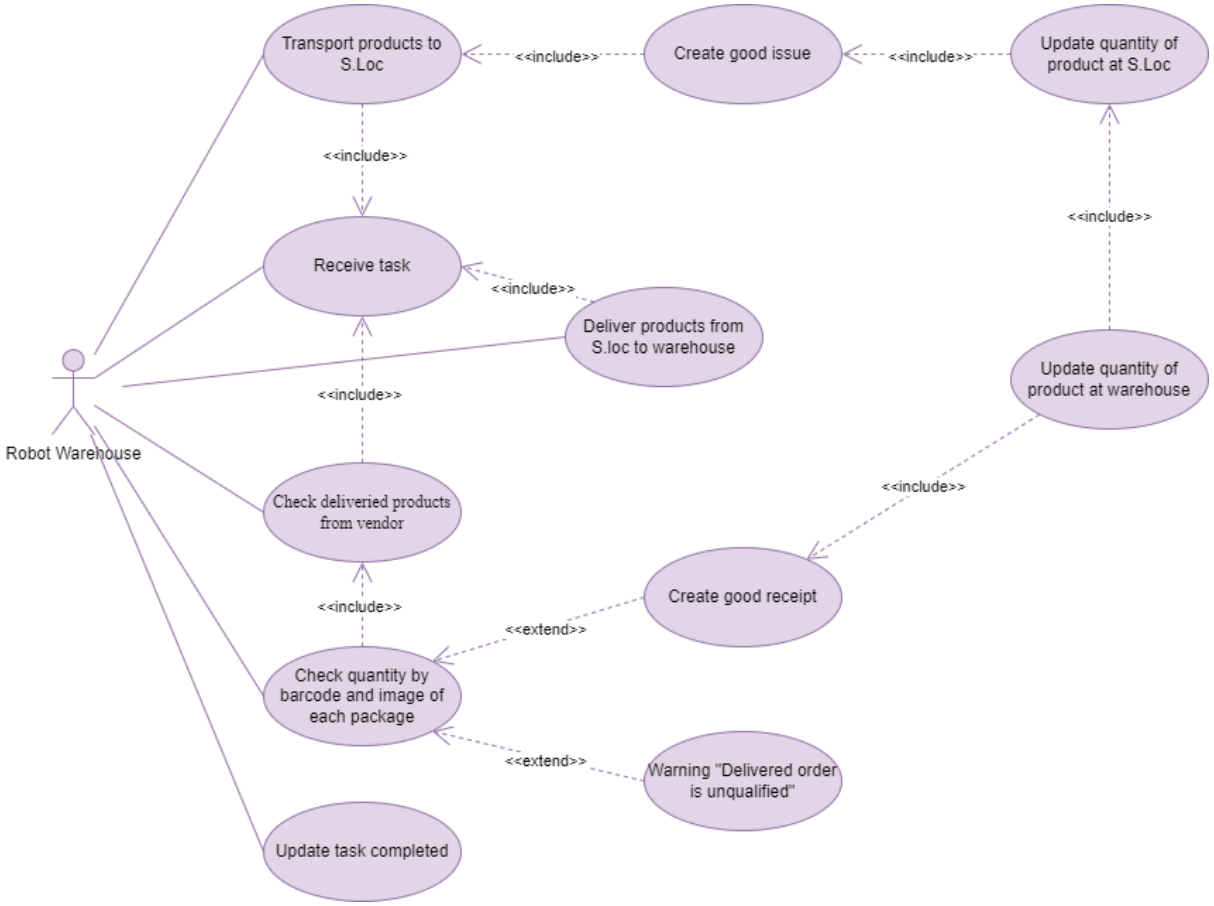

Image 5: Robot warehouse

1.2.5 Manager warehouse

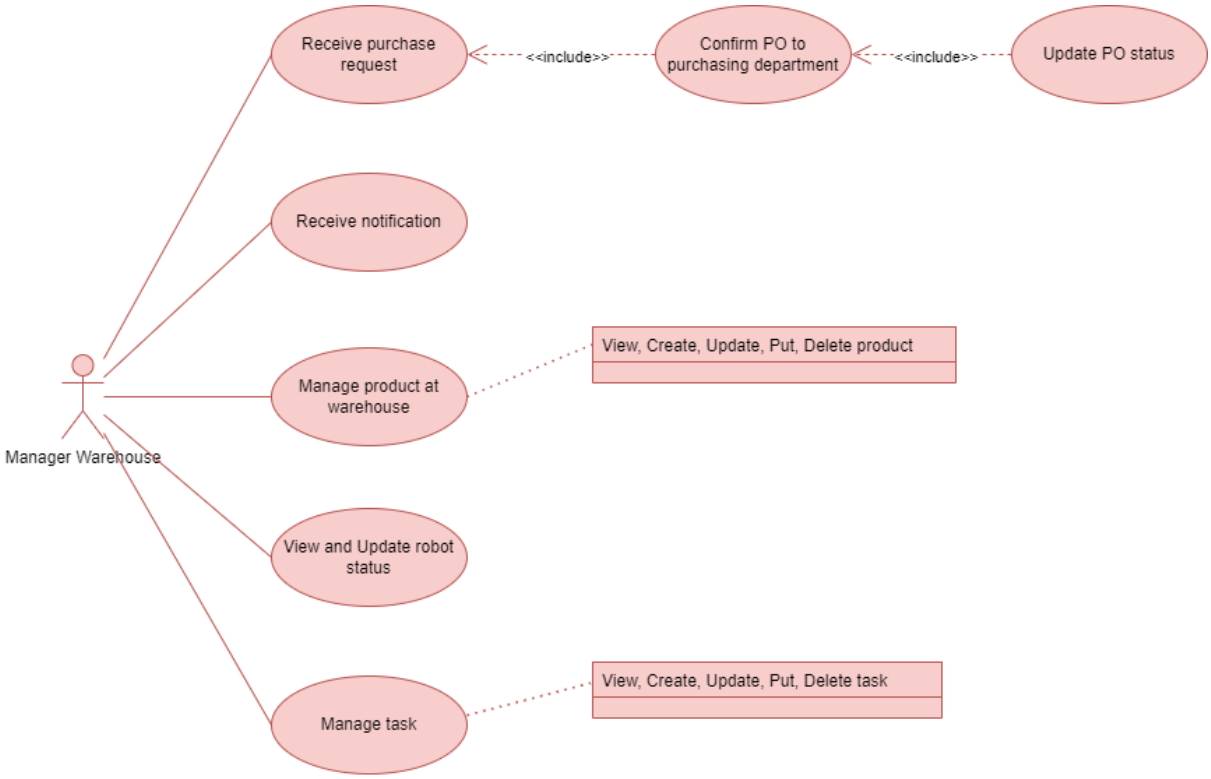

Image 6: Manager warehouse

1.3 DFD level 0

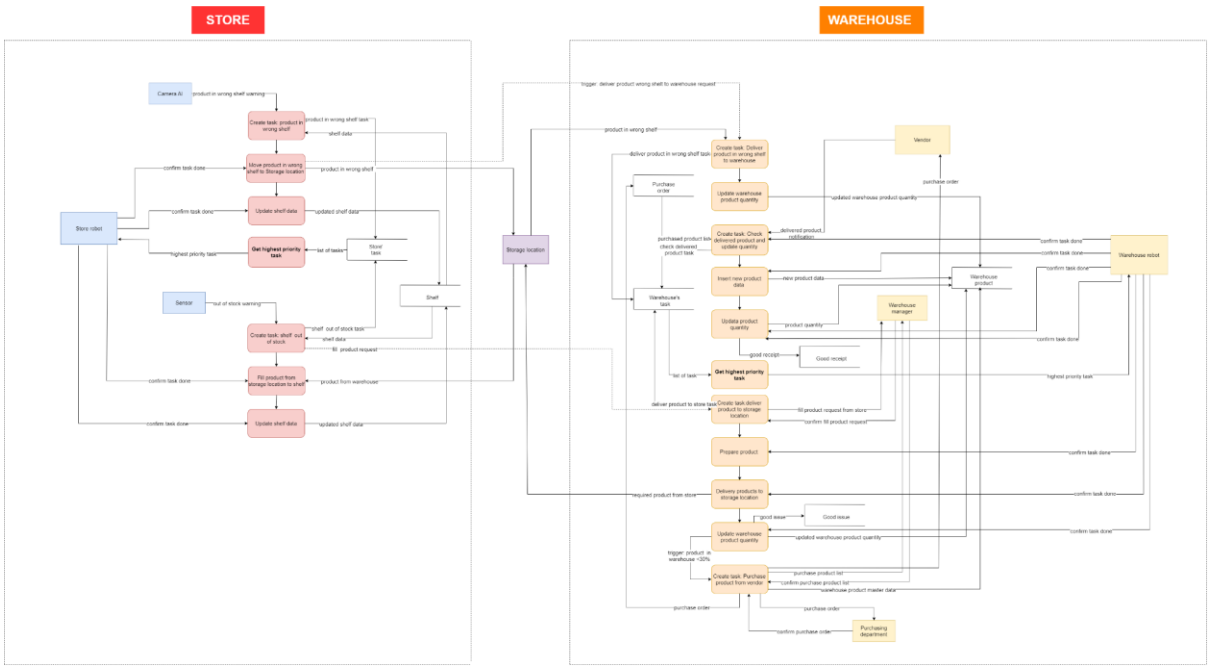

Image 7: DFD level 0

2. Detailed solutions:

2.1. Manage stockout warehouse:

2.1.1. Describe process:

Trigger: After many times that warehouse exports products to the store, the system will keep track of the number of stock left. If the number of stock below 30, it will trigger the manage stockout warehouse process.

- With low value stocks, the system will automatically create purchase orders and send them to vendors.
- With high value stocks, the system will automatically create a purchase order and then send it to the warehouse manager to confirm (warehouse manager can update the purchase order if necessary). Next, PO is sent to the purchasing department for confirmation before sending it to the vendor.

2.1.2. Sequence diagram:

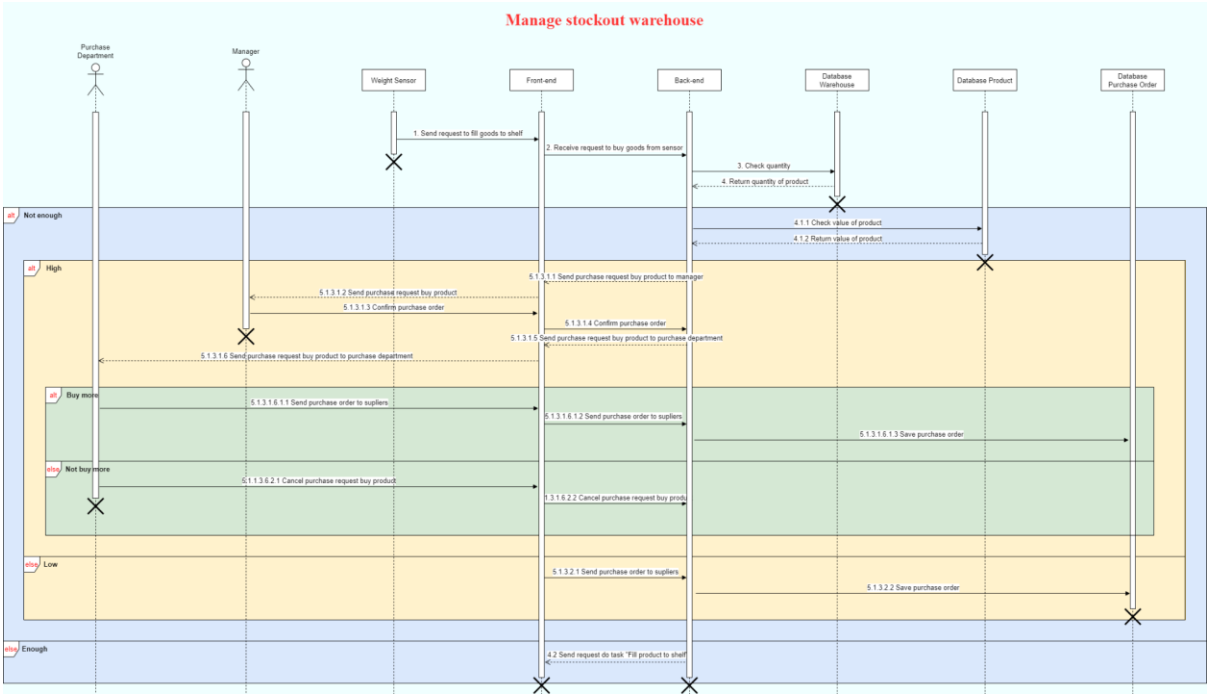

Image 8: Sequence diagram: Manage stockout warehouse

2.1.3. Validations:

PURCHASER ORDER

Data	Data type	Required?	Default value	Validation
Order ID	Int(10)			Read only
Order date	Datetime	Yes	Time at creation	
Product ID	Char(10)	Yes		Read only
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0
Delivery date	Datetime	Yes	Time at creation	
Vendor ID	Char(10)	Yes		Read only
Status	Varchar(10)	Yes		Read only

PRODUCT

Data	Data type	Required?	Default value	Validation
Product ID	Char(10)	Yes		Read only
Category	Varchar (20)	Yes		
Description	Text			
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0
Minimum product level	Int	Yes		Must be greater than 0

Image	Varbinary(max)	Yes		
Status	Boolean	Yes	No	No: full product Yes: run-out product

2.2. Manage delivered products from vendor:

2.2.1. Describe process:

Trigger: Vendor delivers product to the warehouse. It will trigger the process of managing delivered products from vendors.

When receiving products, the system will enable function: create task check delivered products and update product quantity in the warehouse, then robots will be assigned to tasks. After finishing all the tasks, a good receipt is automatically created and saved into the database.

2.2.2. Sequence diagram:

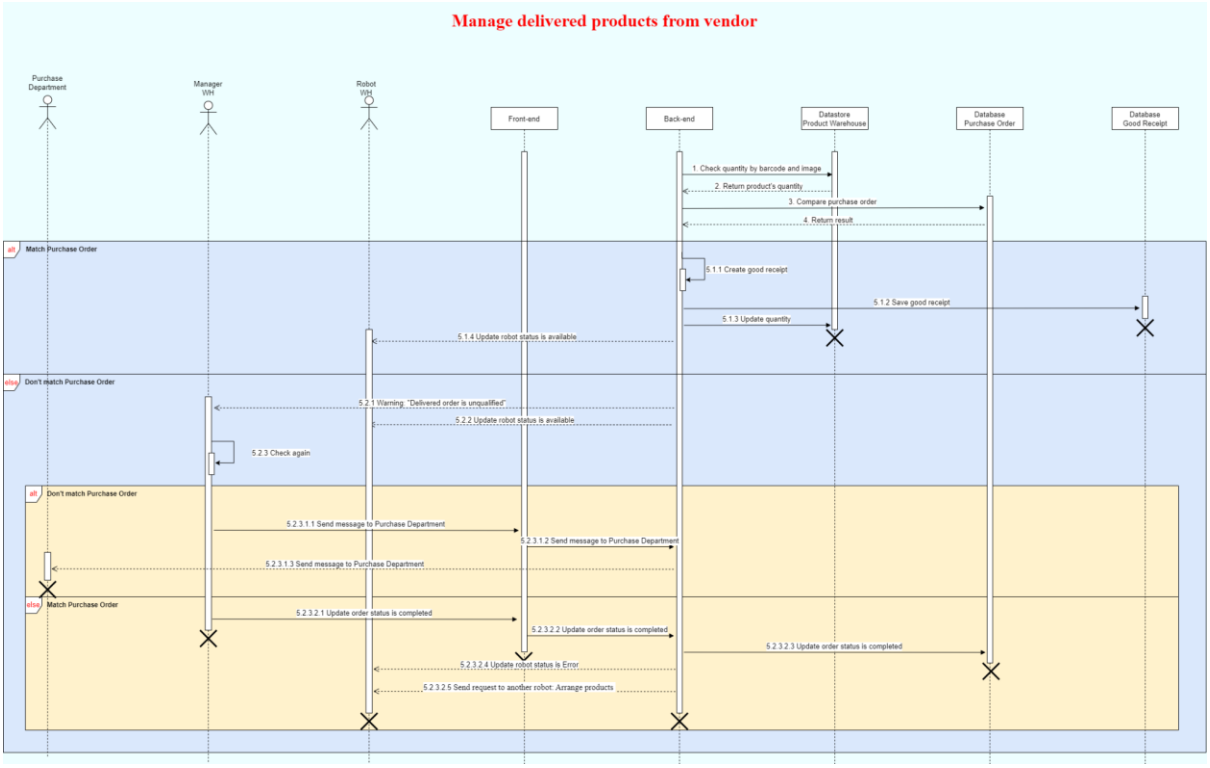

Image 9: Sequence diagram: Manage delivered products from vendor

2.2.3. Validations:

PURCHASER ORDER

Data	Data type	Required?	Default value	Validation
Order ID	Int(10)			Read only
Order date	Datetime	Yes	Time at creation	
Product ID	Char(10)	Yes		Read only
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0
Delivery date	Datetime	Yes	Time at creation	

Vendor ID	Char(10)	Yes		Read only
Status	Varchar(10)	Yes		Read only

PRODUCT

Data	Data type	Required?	Default value	Validation
Product ID	Char(10)	Yes		Read only
Category	Varchar (20)	Yes		
Description	Text			
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0
Minimum product level	Int	Yes		Must be greater than 0
Image	Varbinary(max)	Yes		
Status	Boolean	Yes	No	No: full product Yes: run-out product

GOOD RECEIPT

Data	Data type	Required?	Default value	Validation
GR No	Int(10)	Yes		Read only
Date created	Datetime	Yes	Time at creation	
Product ID	Char(10)	Yes		Read only
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0

Description	Text			
Vendor ID	Char(10)	Yes		Read only

TASK

Data	Data type	Required?	Default value	Validation
Task ID	Char(10)	Yes		Read only
Task name	Varchar (50)	Yes		
Description	Text			
Status	Varchar(10)	Yes	No	Priority In-progress Completed
During time	Time	Yes		
Robot ID	Char(10)	Yes		Read only

2.3. Manage out of product shelf:

2.3.1. Describe process:

Trigger: Each shelf has its own sensor which will measure the weight of the shelf. If weight < 30%, the sensor sends a warning message to the system.

Then, the system will check the number of stock in the warehouse, if it is not enough for the required number of products from the store, the system will automatically start the process: manage stockout warehouse. In contrast, system enable function: create task deliver stock from warehouse to storage location and assign it to available warehouse robots. Then, the system continues to enable function: create task fill products from the storage location to shelf, the store robots collect products from the storage location and arrange them on shelves. After finishing all the tasks, robots will update the quantity in the warehouse and shelves. Finally, the system creates good issues for the warehouse.

2.3.2. Sequence diagram:

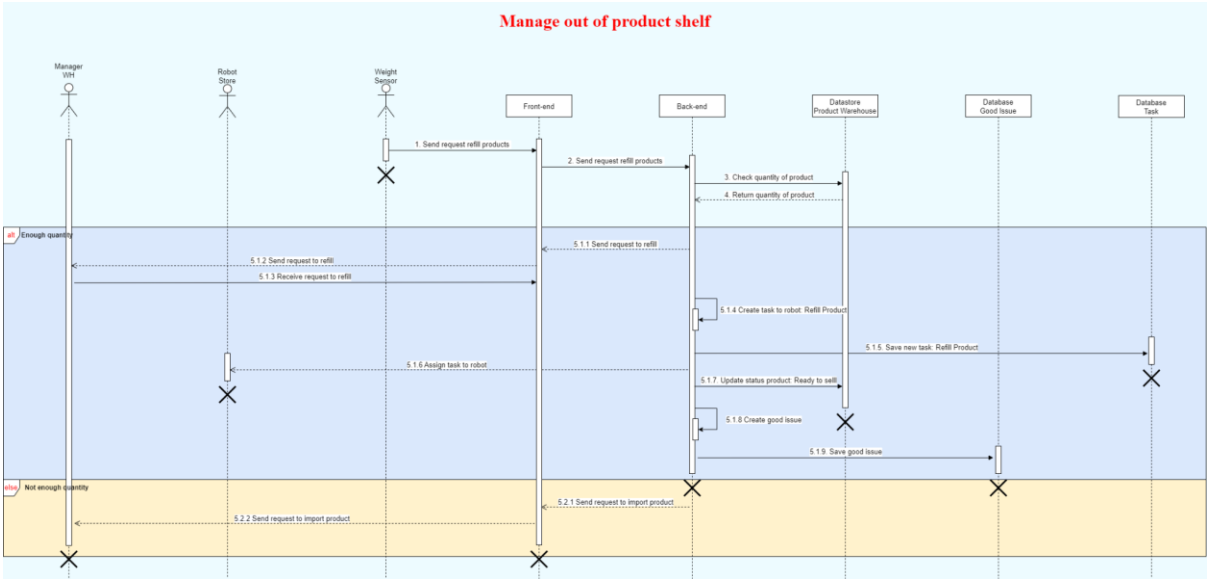

Image 10: Sequence diagram: Manage out of stock shelf

2.3.3. Validations:

TASK

Data	Data type	Required?	Default value	Validation
Task ID	Char(10)	Yes		Read only
Task name	Varchar (50)	Yes		
Description	Text			
Status	Varchar(10)	Yes	No	Priority In-progress Completed
During time	Time	Yes		
Robot ID	Char(10)	Yes		Read only

ROBOT

Data	Data type	Required?	Default value	Validation
Robot ID	Char(10)	Yes		Read only
Type	Varchar (10)	Yes		
Description	Text			
Status	Varchar(10)	Yes	No	Inactive Active Error
Location	Varchar (20)	Yes		
Image	Varbinary(max)	Yes		

PRODUCT

Data	Data type	Required?	Default value	Validation
Product ID	Char(10)	Yes		Read only
Category	Varchar (20)	Yes		
Description	Text			
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0
Minimum product level	Int	Yes		Must be greater than 0
Image	Varbinary(max)	Yes		
Status	Boolean	Yes	No	No: full product Yes: run-out product

GOOD ISSUE

Data	Data type	Required?	Default value	Validation

GI No	Int(10)			Read only
Date created	Datetime	Yes	Time at creation	
Product ID	Char(10)	Yes		Read only
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0
Description	Text			

2.4. Manage products in wrong shelf:

2.4.1. Describe process:

Trigger: camera will keep track of the shelves, if any shelf has products that are put in the wrong shelf, camera sends a warning message to the system. Then, the system will automatically enable the function: create task product in wrong shelf, assign store robots to move the wrong-shelf product to storage location. Next, the system will enable function: create task deliver wrong-shelf products from storage location to warehouse. After finishing all the steps, the robots will update the quantity in the warehouse and shelves.

2.4.2. Sequence diagram:

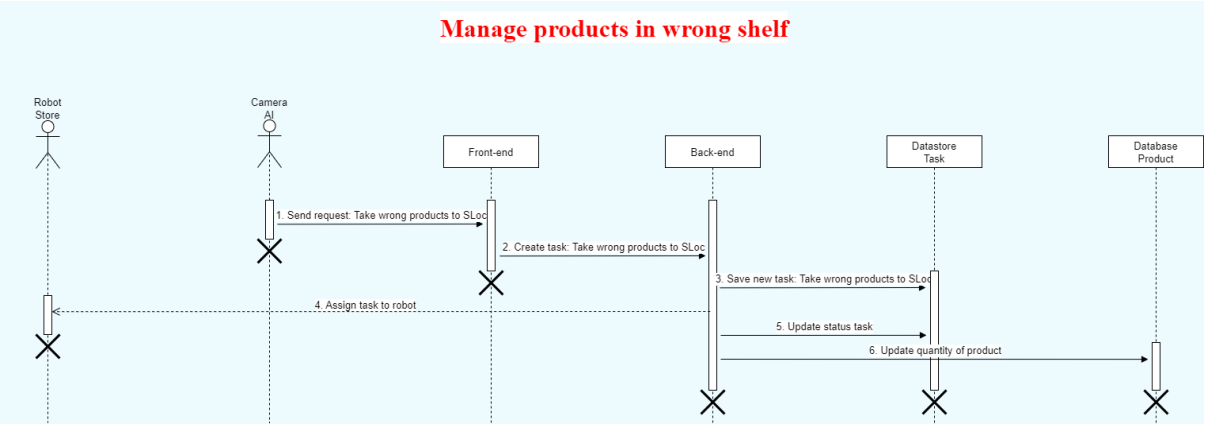

Image 11: Sequence diagram: Manage products in wrong shelf

2.4.3. Validations:

TASK

Data	Data type	Required?	Default value	Validation
Task ID	Char(10)	Yes		Read only
Task name	Varchar (50)	Yes		
Description	Text			
Status	Varchar(10)	Yes	No	Priority In-progress Completed
During time	Time	Yes		
Robot ID	Char(10)	Yes		Read only

ROBOT

Data	Data type	Required?	Default value	Validation
Robot ID	Char(10)	Yes		Read only
Type	Varchar (10)	Yes		
Description	Text			
Status	Varchar(10)	Yes	No	Inactive Active Error
Location	Varchar (20)	Yes		
Image	Varbinary(max)	Yes		

PRODUCT

Data	Data type	Required?	Default value	Validation
Product ID	Char(10)	Yes		Read only
Category	Varchar (20)	Yes		
Description	Text			
Quantity	Int	Yes		Must be greater than 0
Price	Int	Yes		Must be greater than 0
Minimum product level	Int	Yes		Must be greater than 0
Image	Varbinary(max)	Yes		
Status	Boolean	Yes	No	No: full product Yes: run-out product

2.5. Function get highest priority task:

2.5.1. Describe function:

This is the function that will be called in all processes after the system creates tasks. This function will collect all the tasks created and then prioritize them into the correct orders so that robots can get the highest priority task. This function is really important because the robot can know what, when to do the tasks, therefore, the process can be completed successfully with less error.

2.5.2. Sequence diagram:

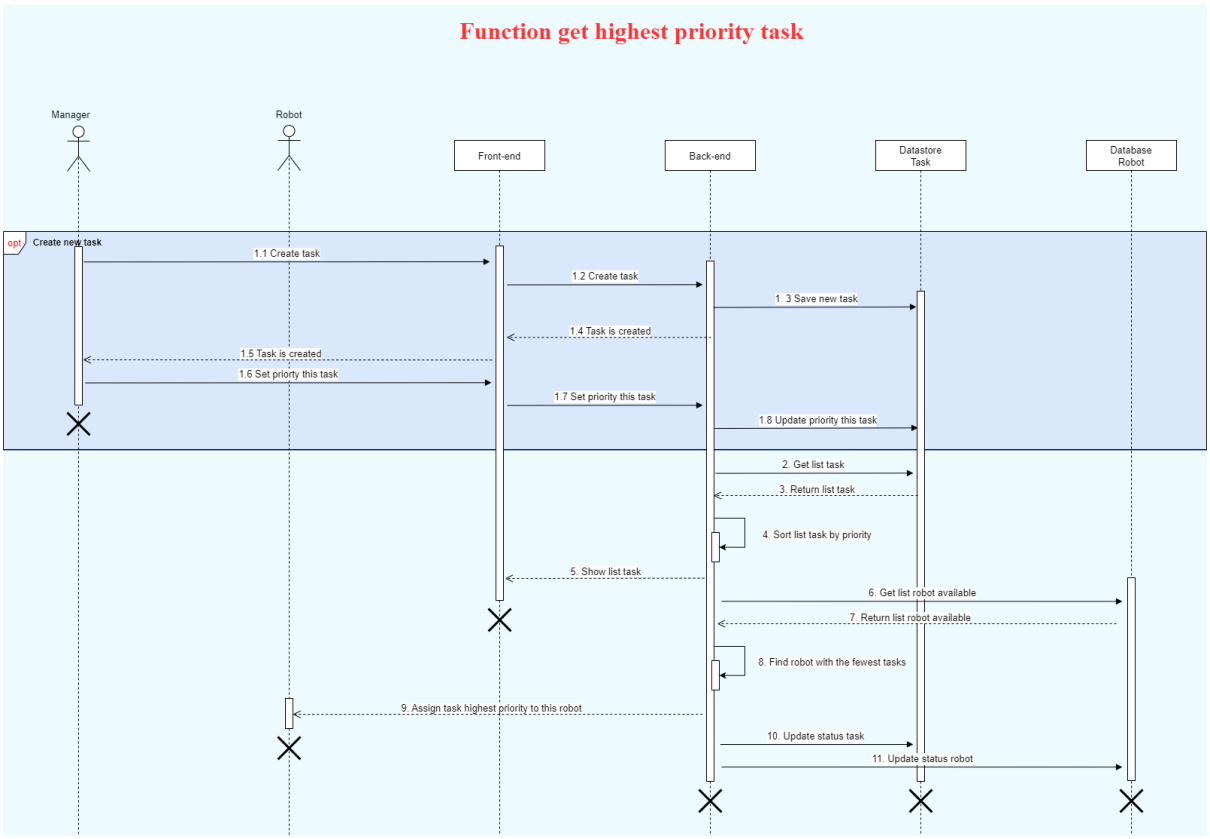

Image 12: Sequence diagram: Function get highest priority task

2.5.3. Validations:

TASK

Data	Data type	Required?		Default value	Validation
Task ID	Char(10)	Yes			Read only
Task name	Varchar (50)	Yes			
Description	Text				
Status	Varchar(10)	Yes		No	Priority In-progress Completed
During time	Time	Yes			
Robot ID	Char(10)	Yes			Read only

ROBOT

Data	Data type	Required?	Default value	Validation
Robot ID	Char(10)	Yes		Read only
Type	Varchar (10)	Yes		
Description	Text			
Status	Varchar(10)	Yes	No	Inactive Active Error
Location	Varchar (20)	Yes		
Image	Varbinary(max)	Yes		

3. Mockup

3.1. Dashboard

This screen aims to view the report of selling revenue at the store with top selling items, moreover it also has total orders from vendors to compare between the number of products bought and sold. Finally, we can keep track of marketing strategy at the store.

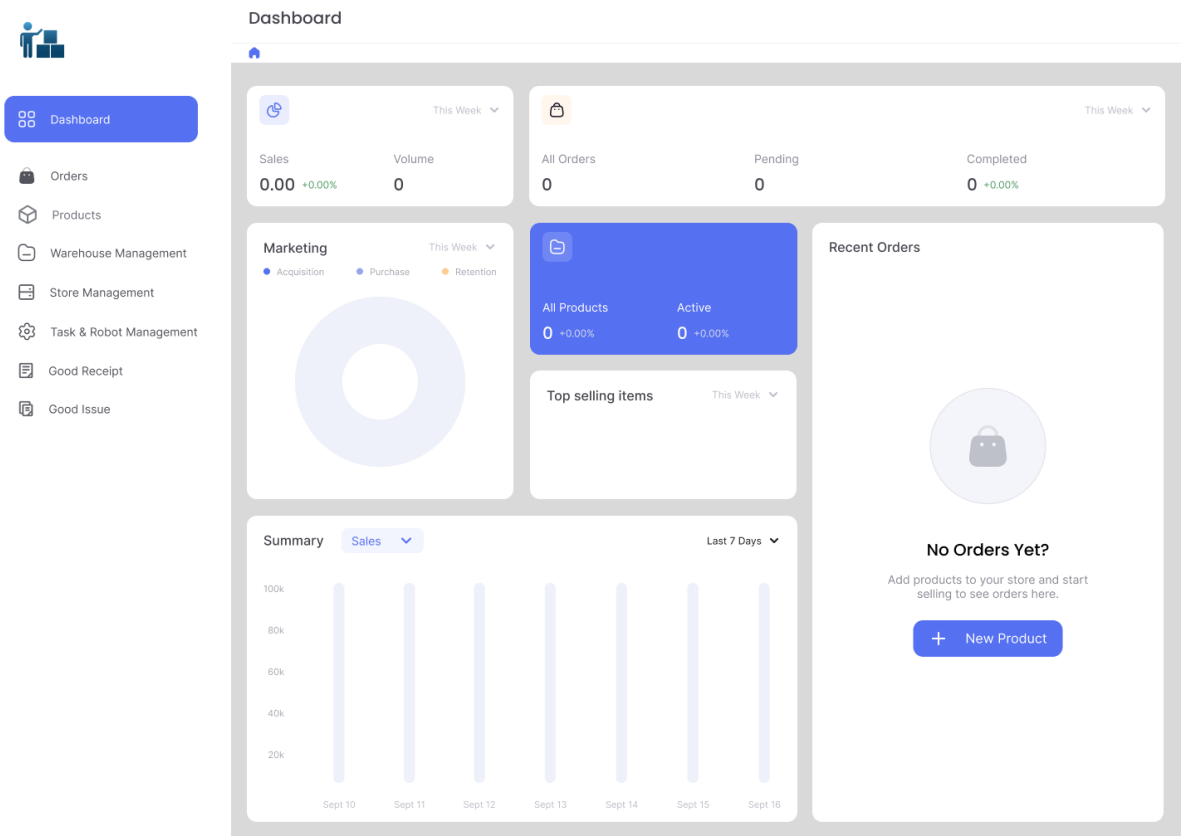

Image 13: Mockup: Dashboard

3.2. Purchase order

The tab Orders lists all orders created automatically and manually. We can search by order ID or filter by vendor name.

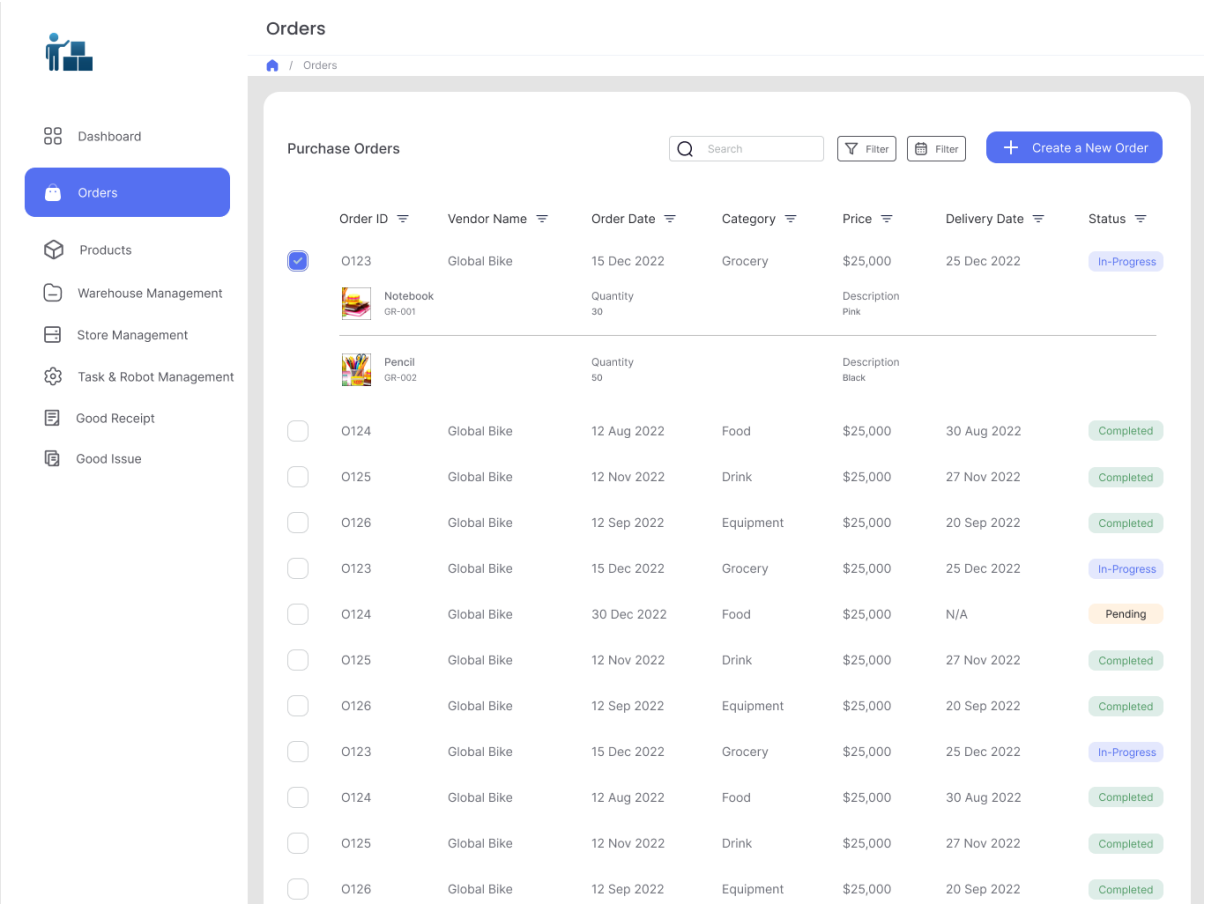

Image 14 Mockup: Purchase order

If you want to create Purchase order manually, you can choose “Create a new Order”, then you can fill in all the information in the screen below.

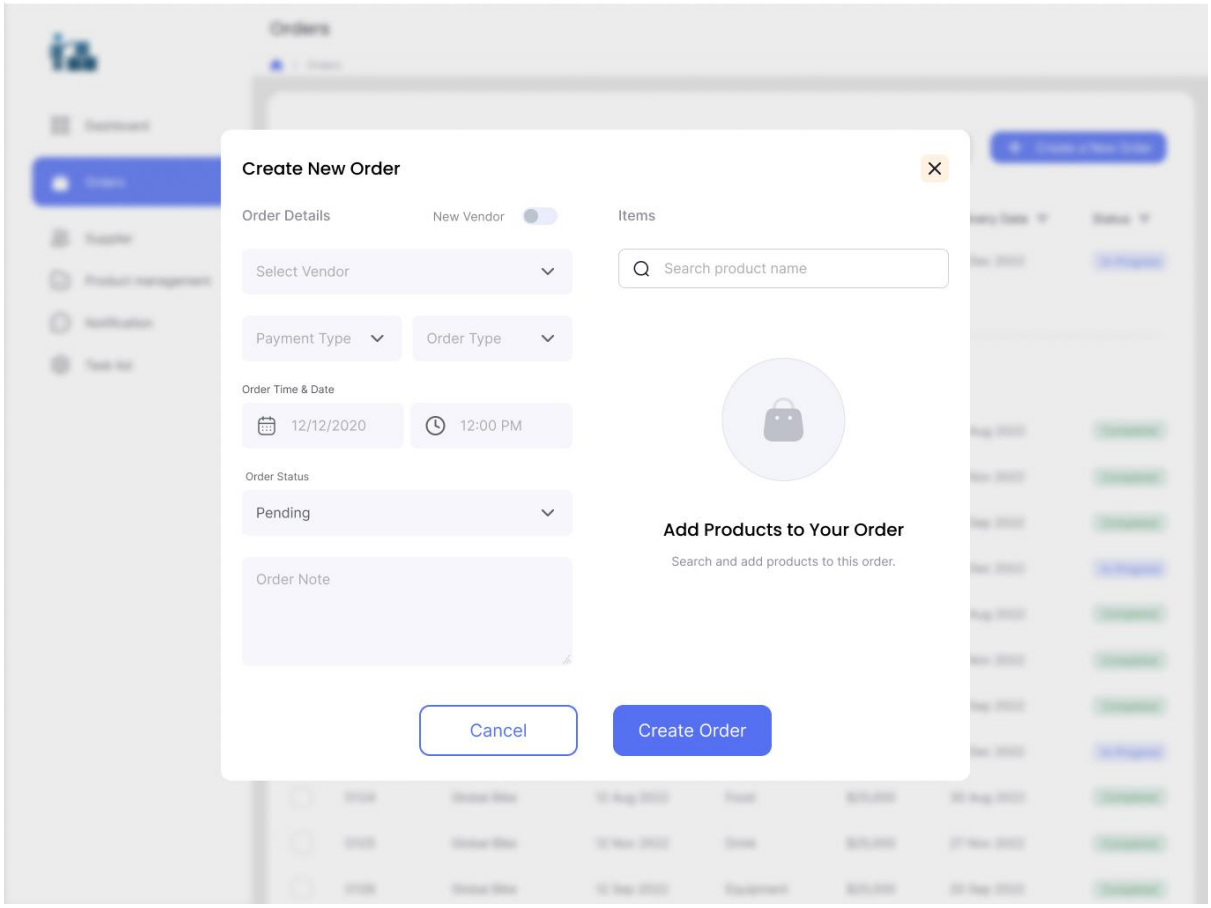

Image 15: Mockup: Create purchase order

3.3. Product

With this screen, we can view product's master data. However, the store manager can only have permission on products at the store while the warehouse manager can only have permission on warehouse products. It is also true with robots in the store and robots in the warehouse. They are allowed to update the quantity of product in their location.

We can search, filter based on product name or product ID to find products.

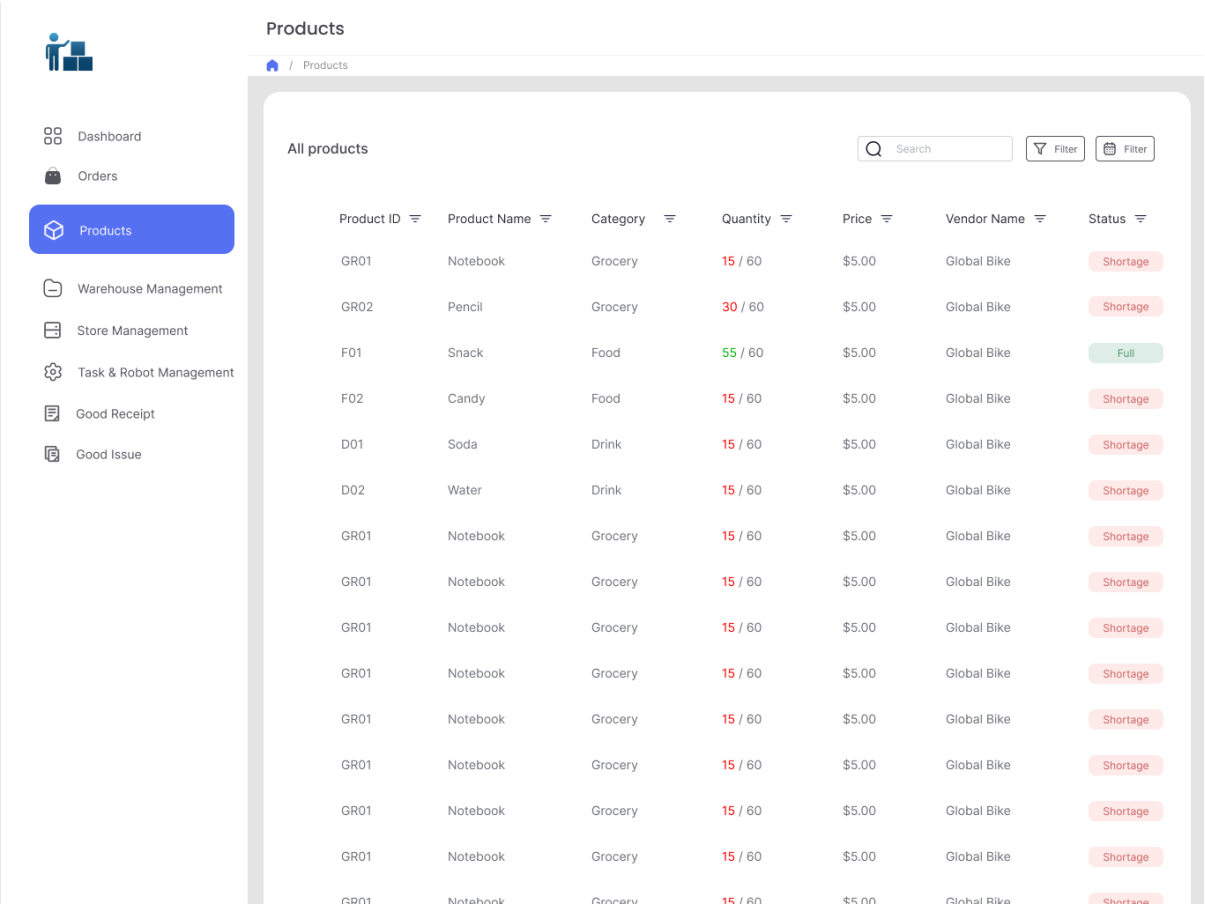

Image 16: Mockup: Product

Moreover, when clicking on the product line on the above screen, we are able to see detail information about that product. Especially, we can view the number of products at warehouse and on shelves.

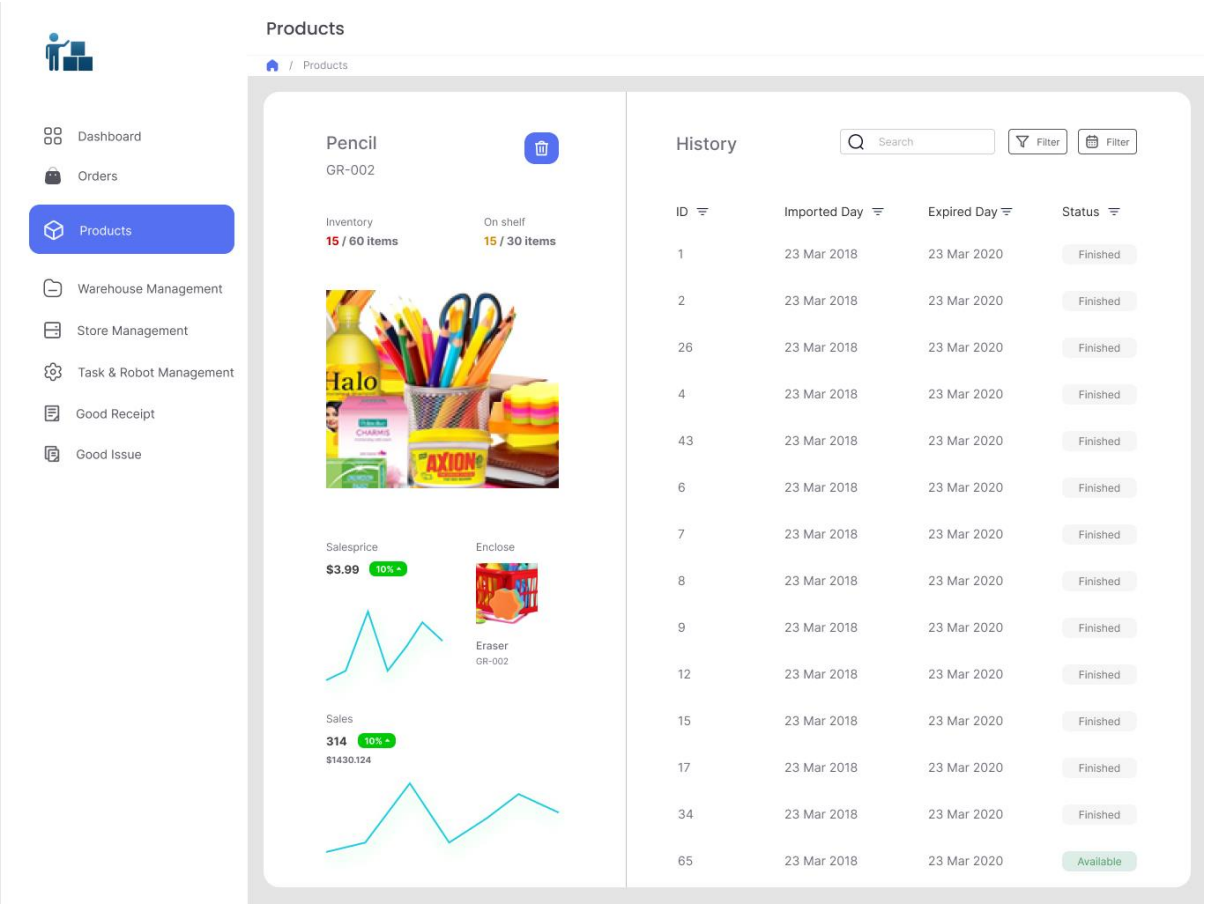

Image 17: Mockup: Detail Product

3.4. Warehouse management

The tab Warehouse management includes two components. The left one is the map of the shelf at the warehouse containing products. The right one is the product list at the warehouse. When we click on one product at the right side, the left side will show the location of the shelf of that product.

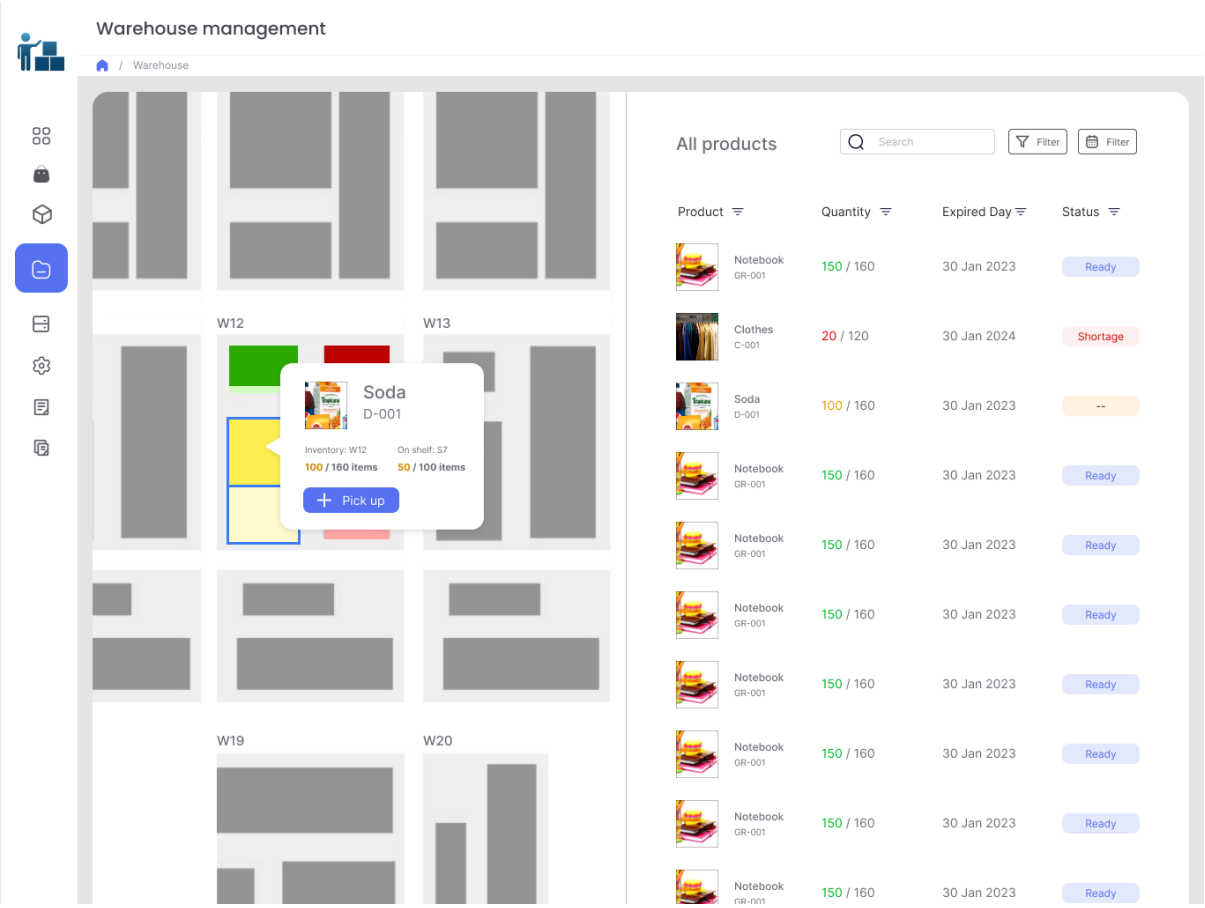

Image 18: Mockup: Warehouse management

3.5. Store management

The same as Warehouse management, the tab Store management includes two components. The left one is the map of the shelf at the store containing products. The right one is the product list at the store. When we click on one product at the right side, the left side will show the location of the shelf of that product.

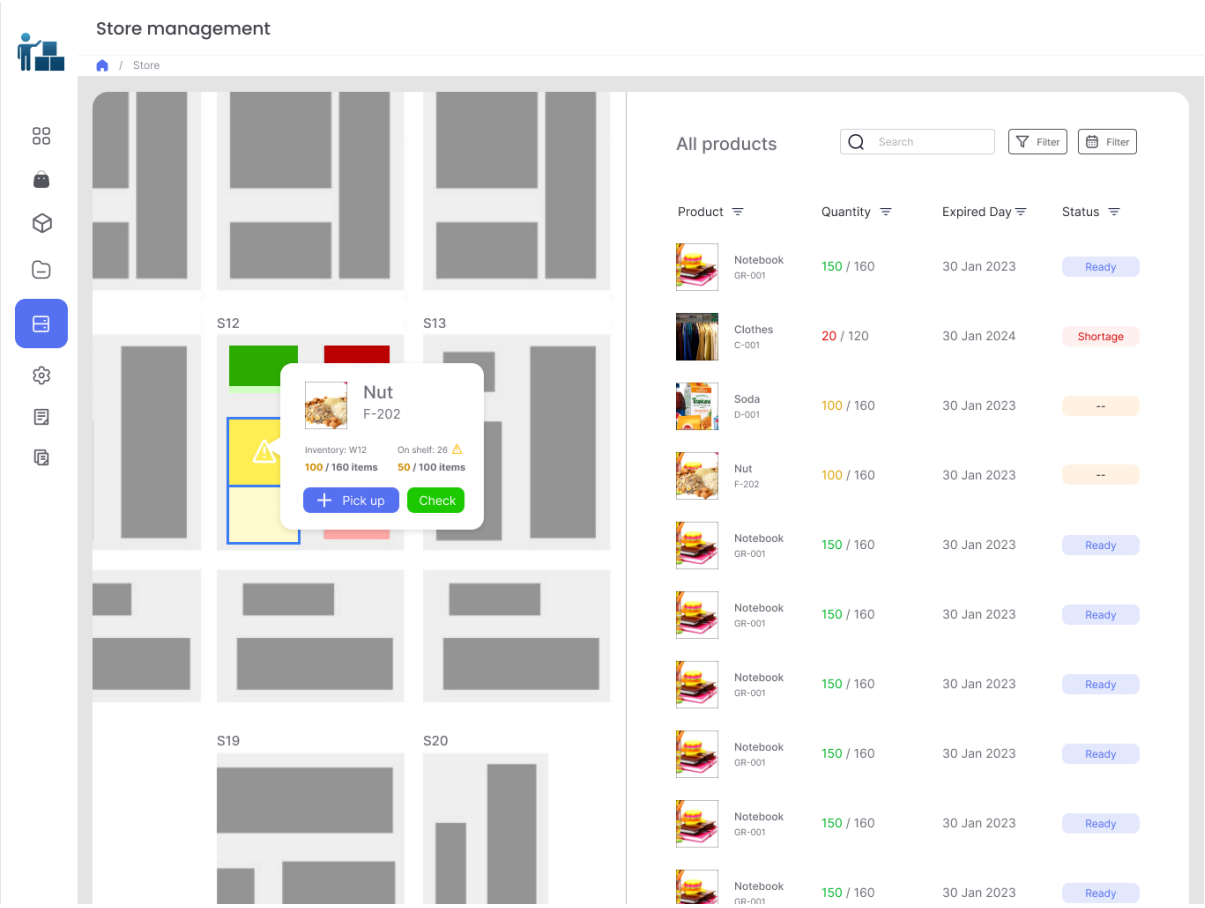

Image 19: Mockup: Store management

3.6. Task list

This screen illustrates all the tasks of robots in both warehouse and store. There is a column about robot ID which is assigned to the task.

Whenever there is trigger, system will enable function and task created, system assigns robot to suitable task. The function Get highest priority task will arrange and prioritize task. After task is completed, robot will update task status.

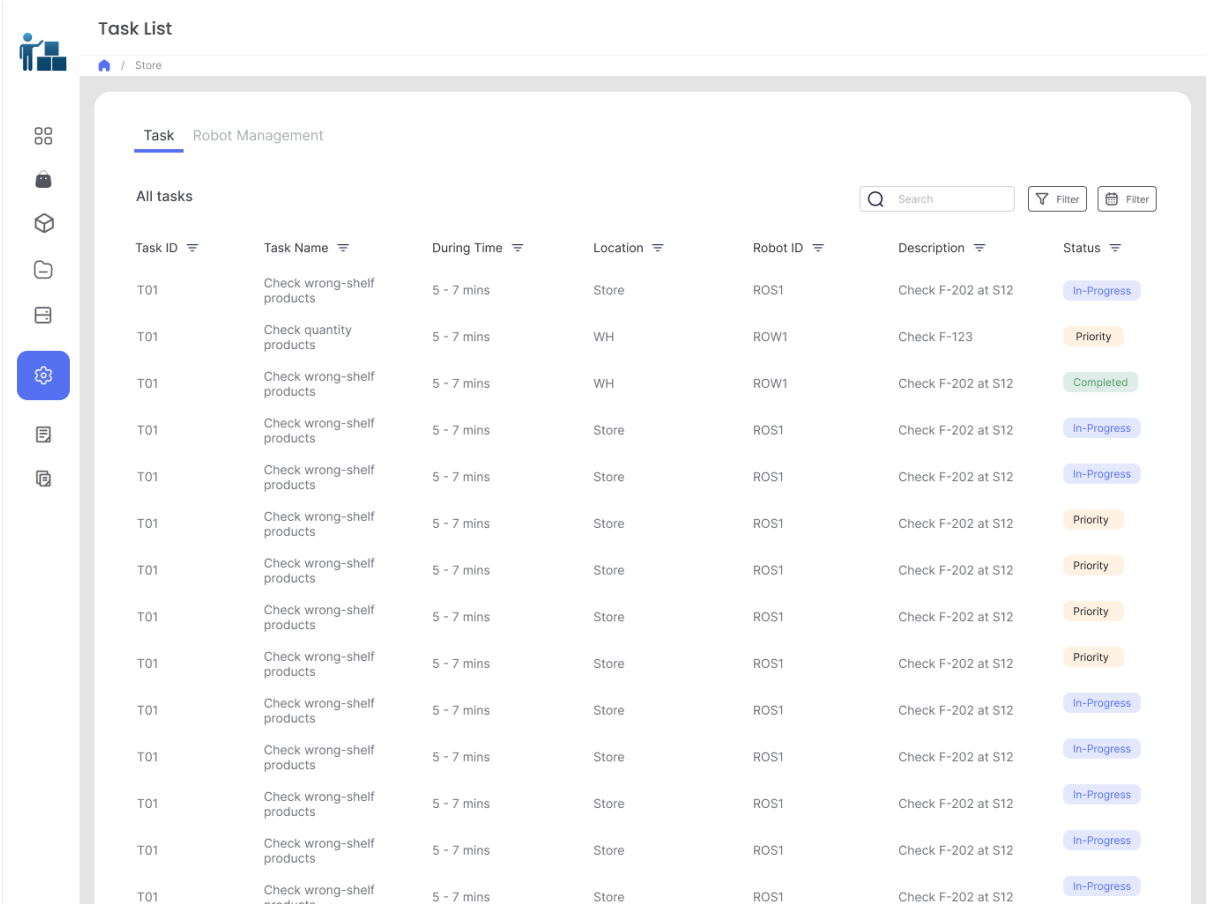

Image 20: Mockup: Task

3.7. Robot management

This tab contains two components. The left one is the map where the robot is located, the start and end point of the robot. Another one is the robot id, location and status of the robot.

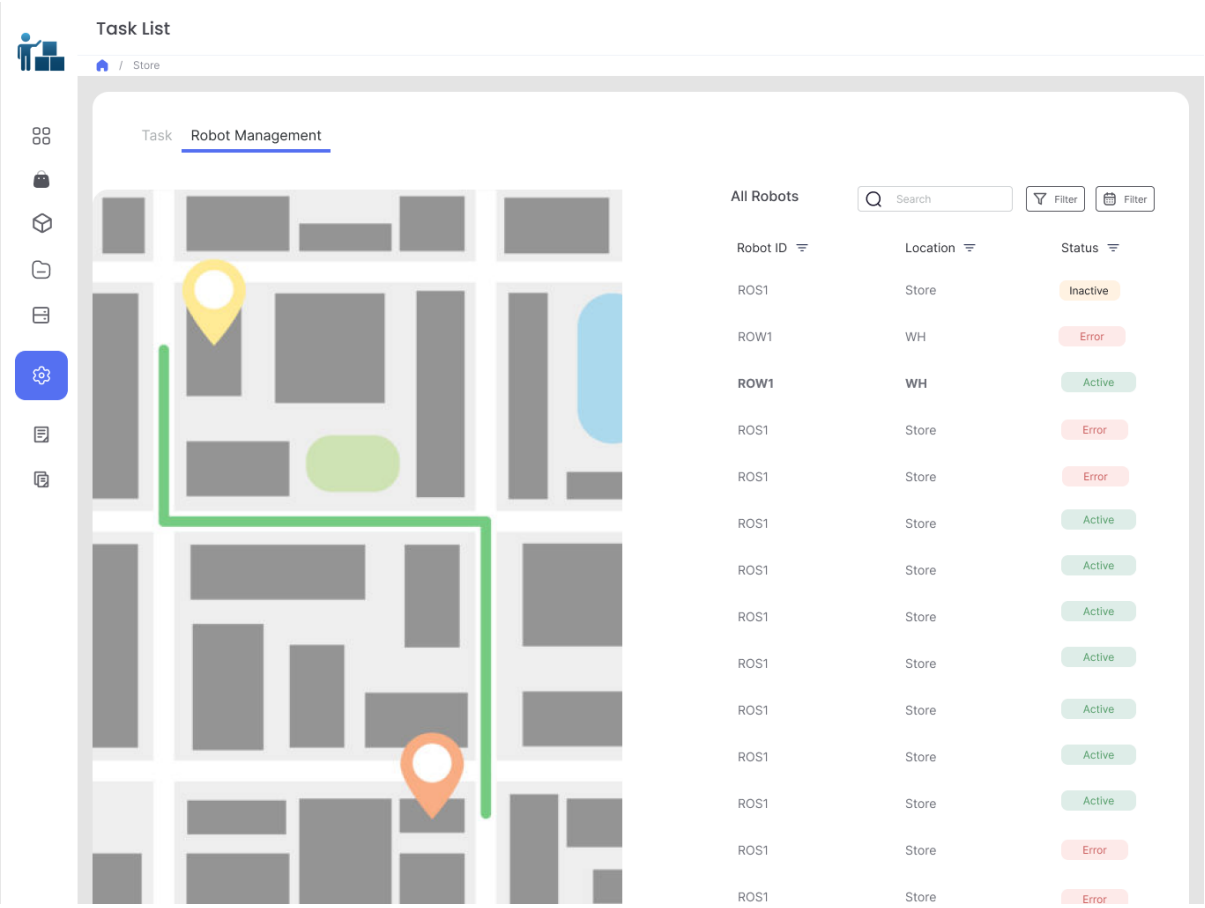

Image 21: Mockup: Robot management

3.8. Good receipt

This tab shows a good receipt created when the vendor delivers products to the warehouse.

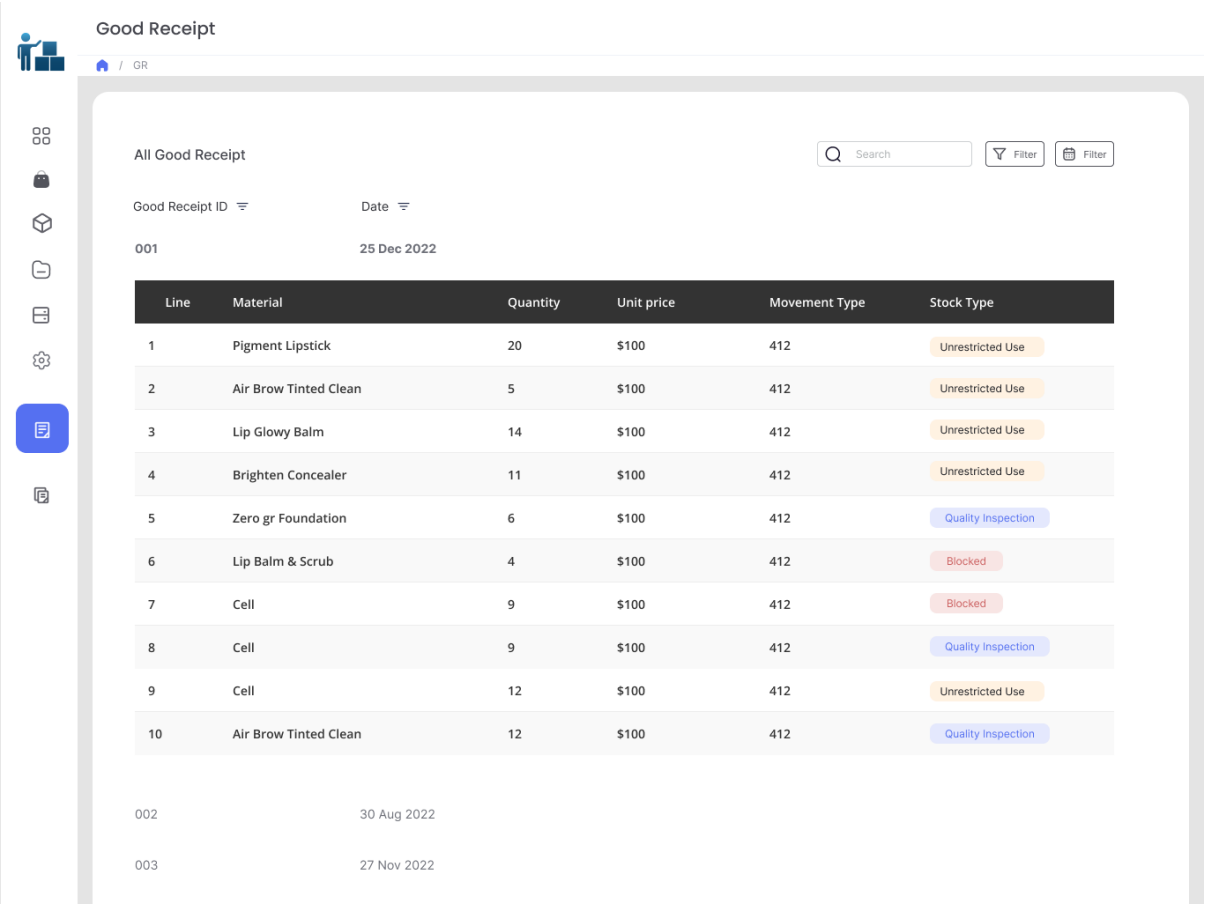

Image 22: Mockup: Good receipt

3.9. Good issue

This screen describes the good issue created after each time export products from the warehouse to fill on the shelves at the store.

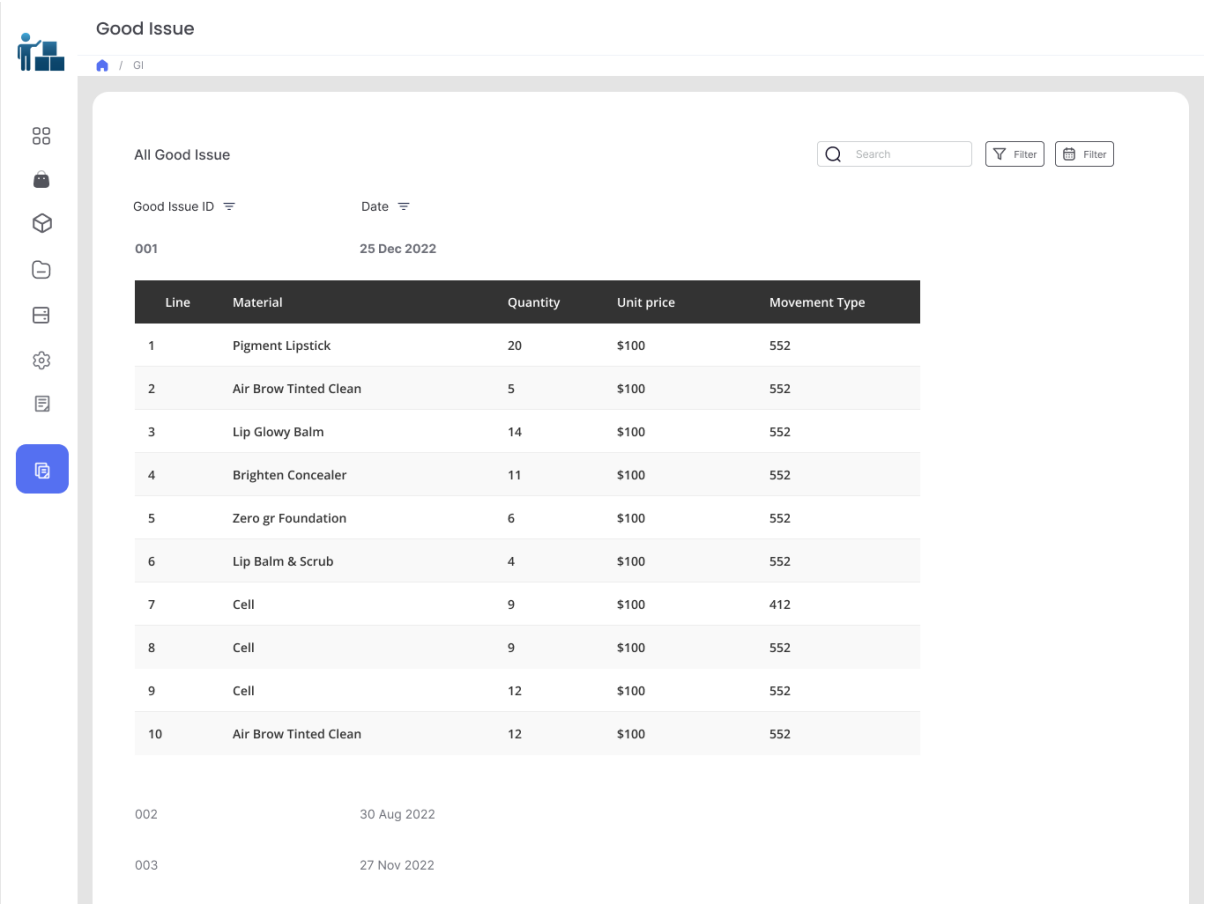

Image 23: Mockup: Good issue

III. Conclusion

With the support of Ms. Tran Thi Anh and Ms. Vu Thuy Hang, our group had the opportunity to challenge themselves by using the knowledge from the Analysis and Design Information System course with an extremely practical topic. It shows the frequent occurrence in traditional supermarkets, especially in Vietnam, from which many gaps in the management process can be seen and should be recommended. application of some solutions to improve the quality of management better.

Because this topic is still quite foreign to our group, the lack of or incompleteness is fully possible to happen. However, this was an extremely enjoyable experience for the group. We hope to receive many suggestions to improve the product in the future.