Smart Warehouse

Capstone Project Mentor Evaluation-1

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Product Perspective Using Block Diagram

First, the goods are received at the logistics center and stored in the warehouse. The stored goods are real-time monitored and the data is sent to the WMS and Data Analysis System. This, in turn, assists the decision maker in making appropriate decisions. An administrator is present to provide necessary technical help and oversee the maintenance of the whole system. And when a customer comes to buy the stored goods, they are sent out through logistics.

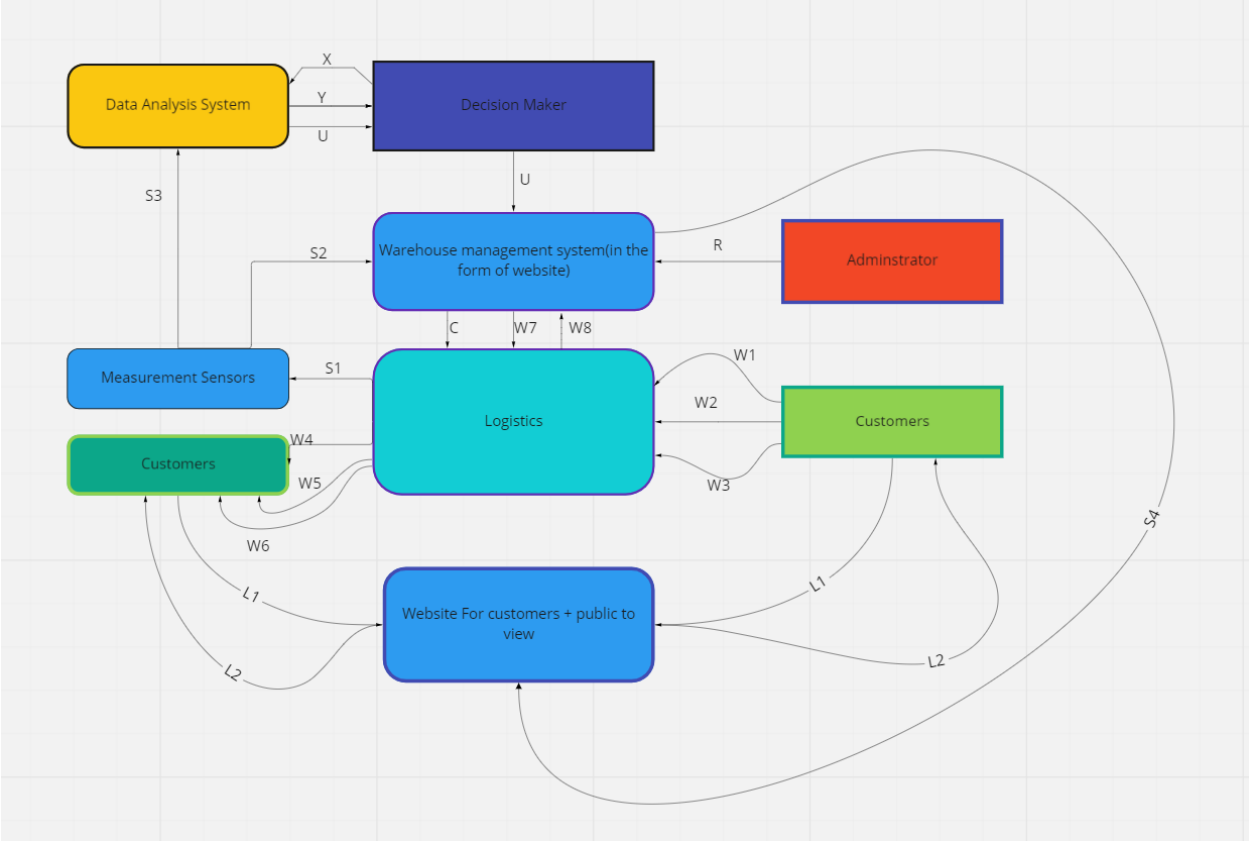

Figure 1.1: Block Diagram of Smart Warehouse.

Figure 1.2: Block Diagram Key

Use Case Diagram

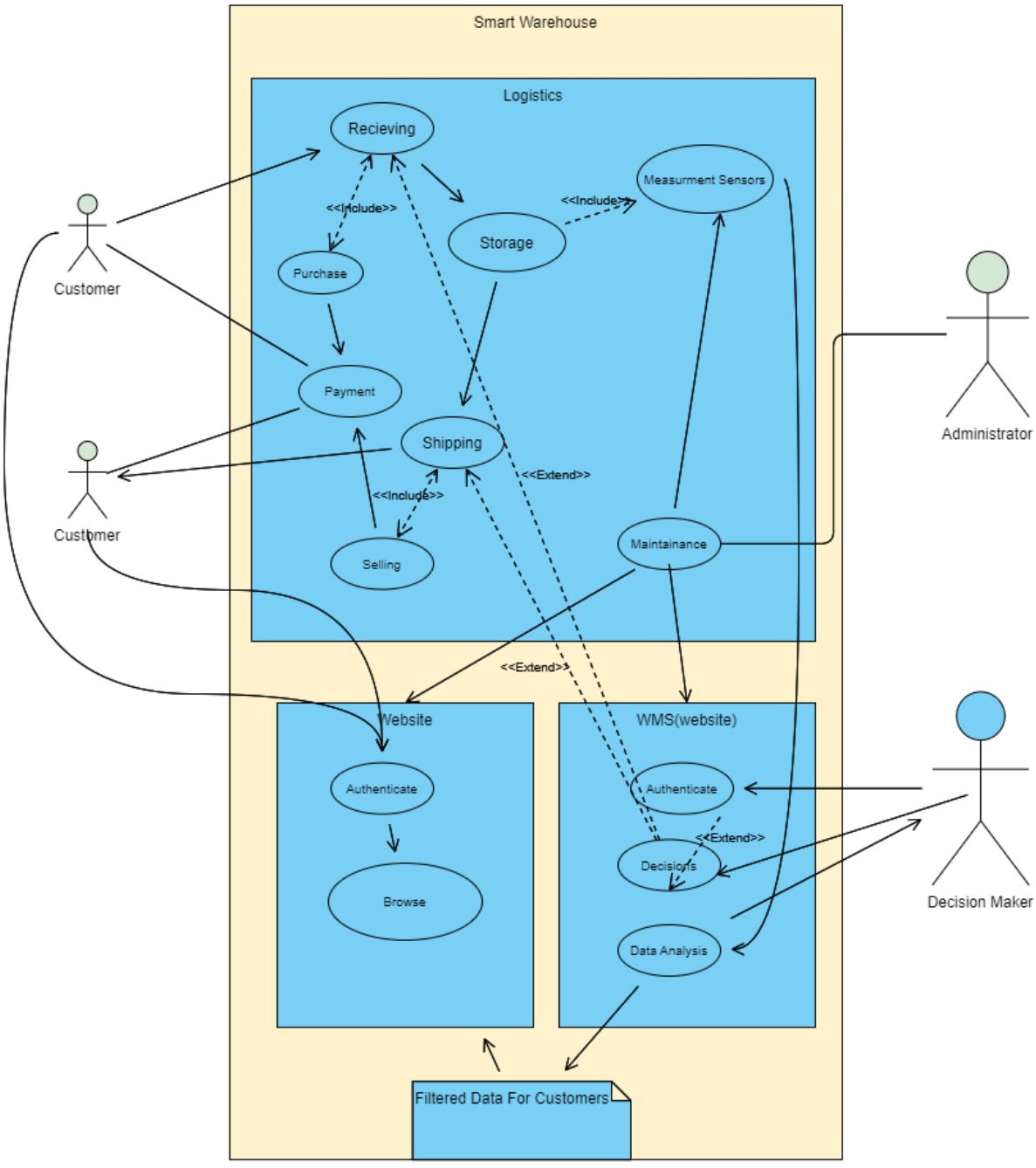

Figure 2: Use Case Diagram

Use case template: 1

1	**Use Case Title**	**Receiving**
2	Abbreviated Title	Receiving
3	Use Case Id	1
4	Actors	Customer, Decision maker
5	Description Goods are purchased that are to be stored in the warehouse.	
5.1	Pre-Condition 1. The user must be clear about the action he wants to perform.	
5.2	Task Sequence 1. The customer brings the goods. 2. The goods are purchased by the decision maker.	
5.3	Post-Condition 1. The food will be stored and data will be taken.	

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Use case template: 2

1	**Use Case Title**	**Storage**
2	Abbreviated Title	Storage
3	Use Case Id	2
4	Actors	Decision maker
5	Description Goods will be stored in their designated positions.	
5.1	Pre-Condition 1. New goods must be present. 2. The decision maker must be clear about the action he is about to perform.	

5.2	Task Sequence 1. Goods are purchased. 2. The decision maker makes decisions about the storage.
5.3	Post-Condition 1. The food will be stored and data will be taken through a combination of sensors.
6	Modification History Date: May 13, 2022
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Use case template: 3

1	**Use Case Title**	**Measurement Sensors**
2	Abbreviated Title	Measurement Sensors
3	Use Case Id	3
4	Actors	Administrator

5	Description Various data about the food stored in the warehouse will be taken through the sensors.
5.1	Pre-Condition 1. The sensors should be working. 2. The sensors should be calibrated.
5.2	Task Sequence 1. Sensors measure the data. 2. It provides it to the Data Analysis System.
5.3	Post-Condition 1. The data taken will be sent to the Data Analysis System.
6	Modification History Date: May 13, 2022
7	Author Aditya, Rohan, Saarthak, Vasal

Use case template: 4

1	**Use Case Title**	**Data Analysis System**
2	Abbreviated Title	The Data Analysis System
3	Use Case Id	4
4	Actors	Administrator
5	Description Here Data taken by sensors is analyzed through an Artificial Neural Network Architecture and provided to the decision maker for making appropriate decisions.	
5.1	Pre-Condition 1. Data analysis models should be trained and checked properly. 2.Sensors should be maintained and regularly checked to reduce errors.	
5.2	Task Sequence 1. First, data is sent to the Data Analysis System. 2. Then the ANN model starts working and self-programming to better suit the data. 3. Analyzed information is sent to WMS.	

5.3	Post-Condition 1. The Decision Maker makes decisions according to the information generated.
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7	Author Aditya, Rohan, Saarthak, Vasal

Use case template: 5

1	**Use Case Title**	**WMS**
2	Abbreviated Title	Warehouse Management System
3	Use Case Id	5
4	Actors	Administrator, Decision Maker
5	Description Here, all the information and control of the warehouse are provided to the decision maker.	

5.1	Pre-Condition 1.Data about the decision maker should be there on the system for him to authenticate. 2.An administrator should regularly maintain the system.
5.2	Task Sequence 1. The decision maker logs in and authenticates to make decisions. 2. Then a decision is made after consulting through the information in the system. 3. The design made will be then sent to the respective places.
5.3	Post-Condition 1. A filtered version of the information will be automatically sent to the website for customers and the public.
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Use case template: 6

1	**Use Case Title**	**Shipping**
2	Abbreviated Title	Shipping
3	Use Case Id	6
4	Actors	Customer, Decision maker
5	Description The goods are sold to the customers.	
5.1	Pre-Condition 1.After consulting the information generated by the ANN model, the decision should be made by the decision maker.	
5.2	Task Sequence 1. The decision maker makes the decision to sell goods. 2. The customer pays for the product.	
5.3	Post-Condition 1. Data will be sent to WMS	

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7	Author Aditya, Rohan, Saarthak, Vasal

Activity/Swimlane Diagrams

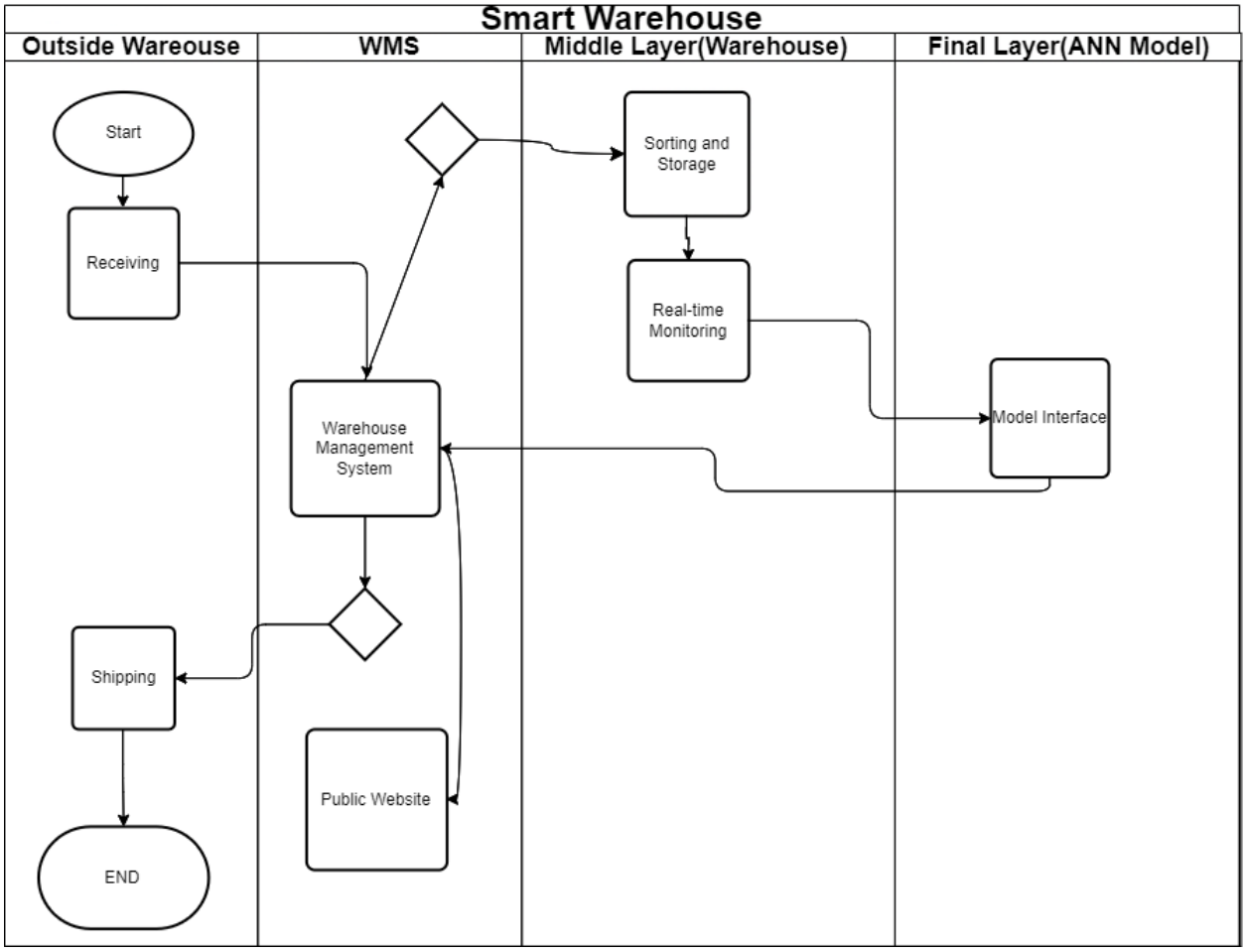

Figure. 3: Swimlane Diagram

Completed Tasks and Subtasks of the Project

1. **Capstone Team Formation**

   We made a team of four members.

   The following are the names of all the team members:

   Aditya Kumar, Rohan, Saarthak Bhatia, Vatsal Kumar

2. **Mentor Selection**

3. **Idea Selection & Literature Survey**

   We did a bit of brainstorming and concluded that nowadays, grain merchants and farmers are suffering from unfair valuation of their products; that they lose a significant portion of their produce due to weighing errors, weather issues, and so on; And a considerable part of the food stored in the warehouse gets spoiled due to mismanagement and negligence.

   This is the reason we chose this as our capstone project.

4. **Requirement Gathering**

5. **Data Collection**

6. **Research on available resources**

7. **Project Proposal**

8. **Planning of the design of the prototype**

Work Breakdown Structure

1. The initial step involves doing a literature review, which involves reading several research papers. In our case, the research to read focuses on building a warehouse that measures a variety of data and makes it available to decision makers for automated control and analysis of the data, using deep learning. Attempts to contain the spoilage of food in the warehouse.
2. The next step involves exploring all the datasets that we can use for predicting food spoilage through sensors and preventing it.
3. Since we are still in the modeling stage, we first need to test various deep learning models in the simulator to visualize the results produced by the models. This is required to get an idea of the prediction accuracy of our model before we start working with the actual prototype.
4. The next task is to set up an initial pipeline which involves first using a dataset to train our deep learning model to predict food spoilage and then checking the information generated by the ANN model.
5. This is followed by an iterative process using different datasets and deep learning models until the highest possible efficiency and classification accuracy is reached.
6. After finding the right combination of models and datasets, we will shift to capturing data from the real world using various sensors. We will iteratively work on that data to fine-tune our model further until we get a model that can perform accurately and efficiently in real-life scenarios.
7. We will also be simultaneously designing the prototype, which will be 3D printed later on to be used for the standard model, and this will be used to demonstrate the final results of our trained model.
8. After our implementation is finalized, we will integrate the systems, optimize them, and finish testing.
9. And at the end, we will prepare the report of all the work.

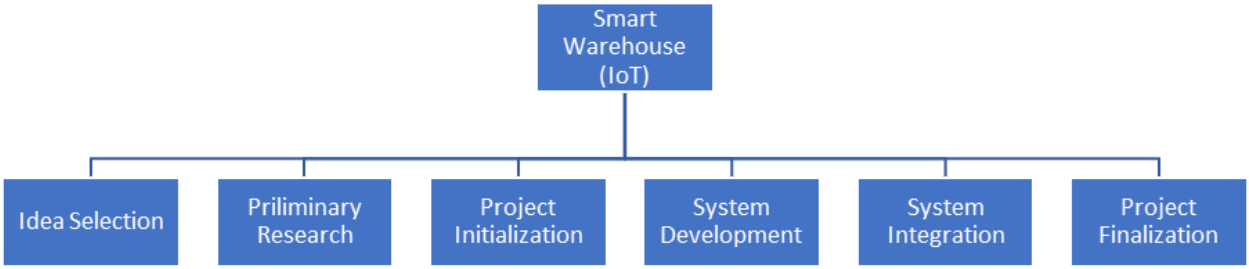

Figure. 5: Swimlane Diagram

Gantt Chart

Figure. 6: Swimlane Diagram

Functional and Non-Functional Requirements

Functional Requirements

- The smart warehouse should be able to weigh goods accurately and precisely without external interference to provide customers with an appropriate price for their goods.
- The weight and price generated then shall be provided to both the customer and decision maker of the warehouse.
- The goods stored in the warehouse will then be monitored in real-time through a combination of sensors.
- All the data obtained from the sensors will be sent to an IoT device (eg. Nvidia Jetson, Raspberry Pi) and the model inference will occur there.
- The outputs will then be sent to WMS.
- Along with a hardware version of the smart warehouse, a simulation of the smart warehouse should also be prepared to detect any discrepancies or hardware errors.

Non-functional Requirements

- The deep learning models will be trained on the PyTorch or TensorFlow frameworks because of their portability.
- The deep learning models should also be optimized using TensorRT and mixed-precision.

- It should be easy to change the deep learning model according to the subject's specifications (e.g., weather, geographical, and product itself), or a generalized model should be created that can handle all kinds of specifications.
- The model used should be able to handle the real-time monitoring data.
- The model should have high accuracy for classifying food, so that food doesn't get spoiled.
- Various suggestions should be made for the UI of the website and WMS.