**Synopsis:**

In this task we had to implement a Warehouse Management System to sort the packages based on incoming orders from different cities.

We identified the color of 9 packages, three of each color on shelf using Camera#1 by using color detection method(QR Code reading in our case) and after this as the packages are identified we update the inventory sheet of Inventory Management Spreadsheet of the warehouse using ROS-IOT bridge.

After one minute, as the total of 9 orders publish on MQTT Topic at the different intervals we use the ROS-IOT Bridge to get the orders from the MQTT Topic and put the package on the conveyor belt on the basis of priority of the packages. After this we update the order Dispatched Sheet which give the status of the packages picked up by the UR5#1 Arm and send an email notification to the user. As the conveyor belt take the packages to UR5#2,the UR5#2 arm sort the package color and put the package in the respective color bin and we update the Order Shipped Sheet which give the status of the packages picked and dropped in the bins by the UR5#2 arm. We update the Warehouse Inventory Dashboard in real-time by using the Dashboard sheet as a JSON endpoint.

**Detailed Implementation:**

* **UR5#1 Arm:** The task of UR5#1 Arm is to pick up the package from the shelf(Kiva Pod) and place it on the conveyor. To achieve this we have used combination of Joint Angles[to make UR5#1 go to drop location, home\_pose, above the conveyor], Cartesian Path[to pull out packages from shelf in order to avoid collision with other packages or shelf] and Playing Planned Trajectory from Yaml file[to make UR5#1 go from home\_pose to the required package and back from package(after it has been pulled out) to the home\_pose]. To sort the priorities of packages we have made use of the Priority Queuedata structure.
* **2-D Camera:** This has been used for color detection of packages using QR Decoding method.
* **Logical Camera#1:**
* **Logical Camera#2:**
* **Conveyor Belt:** It carries the package from UR5#1 to UR5#2 Arm and its speed is controlled using the ‘Rosservice‘ /eyrc/vb/conveyor/set\_power
* **UR5#2 Arm:** The task for this UR5 arm is to pick the packages from conveyor and sort them in the bins of respective color. Here only Playing Planned Trajectory from Yaml file technique has been used.

**Inventory Management Spreadsheets Used:**

* **Inventory:** This sheet contain details of 9 packages, three of each color, on the shelf of the warehouse and identified by Camera#1.

|  |  |
| --- | --- |
| **Name** | **Description** |
| Timestamp | This column represents the timestamp at which data is updated into the Inventory Management Spreadsheet |
| Team Id | This column represents the Team ID: **VB#291** |
| Unique Id | This column represents the unique-id for MQTT: **dbMBsyVV** |
| SKU | This is the Inventory's **Stock Keeping Unit**. For e.g. If the package is of ‘Red’ color, kept in storage number ‘12’ and the month is February 2021, the SKU will be : R120221 |
| Item | This column represents the package item, **Red Packages** symbolize **Medicines**, **Yellow Packages** symbolize **Food** and **Green Packages** symbolize **Clothes** |
| Priority | **Red Packages** are of High Priority written as **HP**, **Yellow Packages** are of Medium Priority written as **MP**, **Green Packages** are of Low Priority written as **LP** |
| Storage Number | This column denotes the storage number of the package depending on where it is placed such as 00, 01, 02 and so on. |
| Cost | Red Packages(HP): ₹450/-  Yellow Packages(MP): ₹300/-  Green Packages(LP): ₹150/- |
| Quantity | This column represents the quantity of the package in the warehouse inventory |

* **IncomingOrders:** This is updated as per the orders received through MQTT topic.

|  |  |  |  |
| --- | --- | --- | --- |
| | **Name** |  | | --- | --- | | **Description** |
| |  | | --- | | Timestamp | | This column represents the timestamp at which data is updated into the Inventory Management Spreadsheet |
| |  | | --- | | Team Id | | This column represents the Team ID: **VB#291** |
| |  | | --- | | Unique Id | | This column represents the unique-id for MQTT: **dbMBsyVV** |
| |  | | --- | | Order ID | | ID specified in the incoming order details. |
| |  | | --- | | Order Date and Time | | This column represents the time at which the warehouse receives the order through the MQTT Protocol. |
| |  | | --- | | Item | | This column represents the package item, **Red Packages** symbolize **Medicines**, **Yellow Packages** symbolize **Food** and **Green Packages** symbolize **Clothes** |
| |  | | --- | | Priority | | **Red Packages** are of High Priority written as **HP**, **Yellow Packages** are of Medium Priority written as **MP**, **Green Packages** are of Low Priority written as **LP** |
| |  | | --- | | Order Quantity | | This column represents the quantity of orders coming into the warehouse |
| |  | | --- | | City | | This column represents the city of incoming orders |
| |  | | --- | | Longitude | | This column represents the longitude of the city |
| |  | | --- | | Latitude | | This column represents the latitude of the city |
| |  | | --- | | Cost | | Red Packages(HP): ₹450/-  Yellow Packages(MP): ₹300/-  Green Packages(LP): ₹150/- |

* **OrdersDispatched:** Once the package is placed on the conveyor belt by the UR5#1 Arm, this sheet is simultaneously updated.

|  |  |
| --- | --- |
| **Google Spreadsheet Column** | **Description** |
| Timestamp | This column represents the timestamp at which data is updated into the Inventory Management Spreadsheet |
| Team Id | This column represents the Team ID: **VB#291** |
| Unique Id | This column represents the unique-id for MQTT: **dbMBsyVV** |
| Order ID | This column represents the Order ID of the package |
| City | This column represents the city of incoming orders |
| Item | This column represents the package item, **Red Packages** symbolize **Medicines**, **Yellow Packages** symbolize **Food** and **Green Packages** symbolize **Clothes** |
| Priority | **Red Packages** are of High Priority written as **HP**, **Yellow Packages** are of Medium Priority written as **MP**, **Green Packages** are of Low Priority written as **LP** |
| Dispatch Quantity | This column represents the dispatch quantities of the packages in the warehouse inventory. This column is updated as the UR5#1 Arm picks the package from the shelf and places it on the conveyor belt |
| Cost | Red Packages(HP): ₹450/-  Yellow Packages(MP): ₹300/-  Green Packages(LP): ₹150/- |
| Dispatch Status | This column represents the status of dispatch. This column is updated as “Yes” once the order is dispatched. |
| Dispatch Date and Time | This column represents the date and time in which the packages are dispatched. |

* **OrdersShipped:** As the UR5#2 Arm sorts the individual packages into the bins based on package color this sheet is simultaneously updated.

|  |  |
| --- | --- |
| **Google Spreadsheet Column** | **Description** |
| Timestamp | This column represents the timestamp at which data is updated into the Inventory Management Spreadsheet |
| Team Id | This column represents the Team ID: **VB#291** |
| Unique Id | This column represents the unique-id for MQTT: **dbMBsyVV** |
| Order ID | This column represents the Order ID of the package |
| City | This column represents the city of incoming orders |
| Item | This column represents the package item, **Red Packages** symbolize **Medicines**, **Yellow Packages** symbolize **Food** and **Green Packages** symbolize **Clothes** |
| Priority | **Red Packages** are of High Priority written as **HP**, **Yellow Packages** are of Medium Priority written as **MP**, **Green Packages** are of Low Priority written as **LP** |
| Shipped Quantity | This column represents the shipped quantities of the packages in the warehouse inventory. This column is updated as the UR5#2 Arm picks the package from the conveyor belt and places it into priority corresponding bins. |
| Cost | Red Packages(HP): ₹450/-  Yellow Packages(MP): ₹300/-  Green Packages(LP): ₹150/- |
| Shipped Status | This column represents the status of shipment. This column is updated “Yes” once the order is shipped. |
| Shipped Date and Time | This column represents the date and time in which the packages are shipped. |
| Estimated Time of Delivery | This column indicates the time taken for the package to reach the customer through a drone delivery.  Estimated Time of Delivery:  High Priority Packages: 1 Day  Medium Priority Packages: 3 Days  Low Priority Packages: 5 Days |