

# Warehouse Automation System

## Warehouse Automation Algorithm

1. Start the system (activate robot arm, AGV, sensors).
2. Move the robot arm to its home position.
3. Is there a package?
  - No: wait a few seconds, then check again.
  - Yes: go to next step.
4. Move the arm to the package location.
5. Pick up the package using a gripper or suction cup.
  - If successful: continue.
  - If failed: retry up to 3 times. If still failed, skip.
6. Move the package to the bin and drop it in.
7. Is the bin full?
  - No: go back to step 3.
  - Yes: send AGV to pick up the bin.
8. AGV moves the bin to the delivery point.
9. AGV returns, and the process restarts.

## Mechanical Components

- Robotic Arm (5 or 6 DOF)
- Gripper or Suction Cup
- Bin/Container
- AGV (Autonomous Ground Vehicle)
- Frame/Structure for mounting

## Electronic Components

- Arduino or Raspberry Pi
- Servo Motors (for the robotic arm)
- DC Motors with Encoders (for AGV)
- IR Sensor or Camera
- Load Cell (for grip/bin weight detection)
- Rotary Encoders
- Battery or Power Supply

## Control System

- Use Arduino for basic control.
- Use Raspberry Pi + Python for camera/vision systems.
- Optional: Wi-Fi or Bluetooth module for wireless control.

## Workspace Planning

- Operating Area: Full working zone of the system.
  - Arm Envelope: Reachable area of the robotic arm.
  - Dead Zone: Areas that the arm or AGV cannot reach.
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# Detailed Workspace Layout

## 1. Operating Zones

The workspace is divided into several functional zones:

- Input Zone: This is the area where food packages first arrive from the supply chain or loading dock. It should be spacious enough to temporarily store packages before processing (around 1 meter by 1 meter).
- Pick-up Zone: This is where the packages are placed in a fixed location that the robotic arm can access easily. It should be well-aligned with the arm's reach (approximately  $0.8\text{m} \times 0.8\text{m}$ ).
- Processing Zone: This area includes the robotic arm's working space, where it moves packages from the pick-up point to the bin. The zone should be clear of obstacles and have enough clearance for smooth arm motion (about  $1.2\text{m} \times 1.2\text{m}$ ).
- Bin Zone: This is where a collection bin is placed to receive the packages. The robotic arm must be able to release packages into the bin accurately (roughly  $0.5\text{m} \times 0.5\text{m}$ ).
- Delivery Zone: The final location where the AGV (autonomous vehicle) drops off or picks up the bin for delivery. It should be easily accessible and aligned with AGV path planning (around  $1\text{m} \times 1\text{m}$ ).
- AGV Docking Zone: A standby area where the AGV can wait when not active. This zone must be out of the robotic arm's way but within easy driving distance to the delivery zone.

## 2. Arm Envelope Area

- Type: 5-DOF Robotic Arm (e.g., OWI or uArm)
- Maximum Reach Radius: 40-50 cm from base

- Shape: Semi-circle or full circle depending on design
- Must Cover:
  - Package position
  - Bin location
  - Nearby shelf or workspace boundaries

### **3. Dead Zones**

- Behind the robotic arm base (limited reach)
- Corners of the floor space (AGV cannot turn easily)
- Under tables or shelves (blocked for both robot and AGV)
- Near walls or tightly enclosed spaces