

Designer Risk Assessment for Cube Robot

Introduction

The Cube Robot / Mini ASRS is an automated solution designed to handle the storage and retrieval of small totes/trays in structured warehouse environments. It supports trays/totes up to:

- **Size:** 600mm (L) x 400mm (W) x 240mm (H)
- **Weight:** Max 20kg
- **Environment:** 20–55°C operational temperature
- **Layout Requirements:** 1meter buffer space above for safe operation

Assessment Overview

- **Project:** Leapmile Cube Robotic Solution
- **Assessment Date:** 09-09-2024
- **Conducted By:** Leapmile Engineering Team
- **Scope:** automating storage and retrieval of small to medium-sized items like totes, cartons, and trays in various industries such as e-commerce, manufacturing, pharmaceuticals, and spare parts distribution.

Identified Risks & Mitigation Strategies

Risk ID	Risk Description	Impact	Likelihood	Risk Level	Mitigation Strategy
R1	Overloaded totes (exceeding 20kg) may cause mechanical failure or safety hazards.	High	Medium	High	Implement weight sensors and alarms; provide training on tote loading limits.
R2	Oversized totes may jam or damage robot mechanisms.	Medium	Medium	Medium	Use size detection at entry points; enforce strict tote dimension compliance.
R3	Operating outside the temperature range (20–55°C) may degrade components or cause system failure.	High	Low	Medium	Install temperature monitoring; restrict use in uncontrolled environments; use industrial-rated components.
R4	Insufficient buffer space (1meter clearance above) could interfere with robot movement or cause collisions.	High	Medium	High	Enforce physical design checks before installation; use proximity sensors to detect obstructions.

R5	Electrical or software failure could stop operations or cause erratic behavior.	High	Medium	High	Include failsafe modes; implement redundant systems; schedule regular maintenance and software updates.
R6	Collision with human workers due to unclear boundaries or sensor failure.	High	Low	High	Use IR, emergency stop mechanisms, and zone access controls; ensure operator training.
R7	Fire risk from battery or electrical malfunction.	Very High	Low	High	Use certified battery/electrical systems (in case of internal UPS)
R8	Data loss or system hack from insecure software interfaces.	High	Low	Medium	Secure network connections, enforce strong authentication, and conduct periodic security audits.
R9	Inability to retrieve damaged or misaligned totes automatically.	Medium	Medium	Medium	Include manual override/retrieval tools; train staff on manual handling procedures.
R10	Dust or debris buildup in the cube area may affect robot performance.	Medium	Medium	Medium	Implement regular cleaning schedules; use sealed components where possible.

General Mitigation Recommendations

- **Design Controls:** Include physical safeguards, sensors, and compliance checks at system interfaces.
- **Operational Procedures:** Train staff on proper loading, safety zones, and emergency responses.
- **Preventive Maintenance:** Schedule inspections and component replacements based on usage hours.
- **Environmental Control:** Maintain temperature and cleanliness within system tolerances.
- **System Monitoring:** Use real-time dashboards to flag anomalies in load, size, or temperature.

Conclusion

While the Cube Robot / Mini ASRS significantly increases efficiency in handling small items, its performance and safety are contingent upon compliance with tote specifications, environmental controls, and proactive maintenance. A combination of technical safeguards and operational discipline is key to minimising risks.