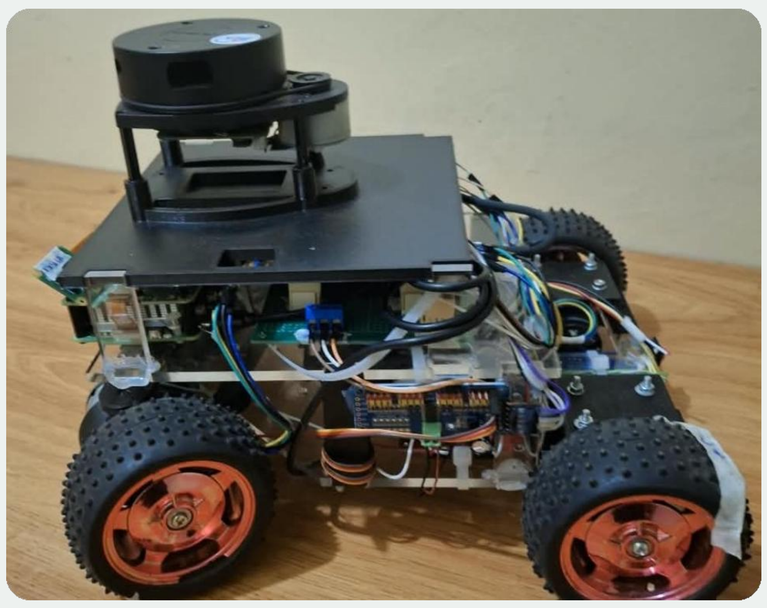
ROBOTICS DOJO CHALLENGE 2026 · TECHNICAL POSTER

EIGEN

An autonomous robot that detects, sorts and delivers waste

TEAM EIGEN

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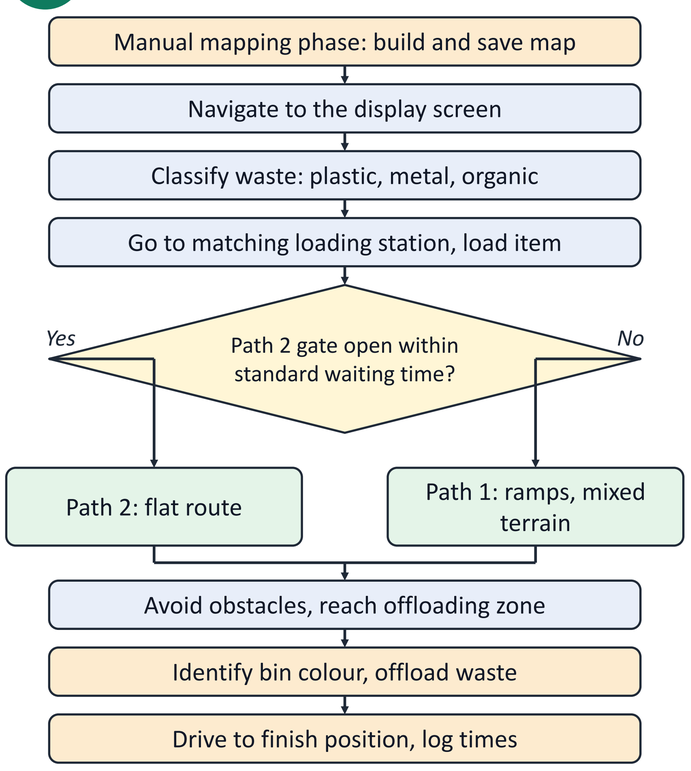


1 THE CHALLENGE

Waste management is a pressing urban problem. After a **3 min manual mapping run**, the robot works alone for **3 min**: it reads a screen, classifies the waste as **plastic, metal or organic**, loads the matching item, chooses a ramp or gated route, avoids moving workers, and offloads into the correct colour-coded bin.

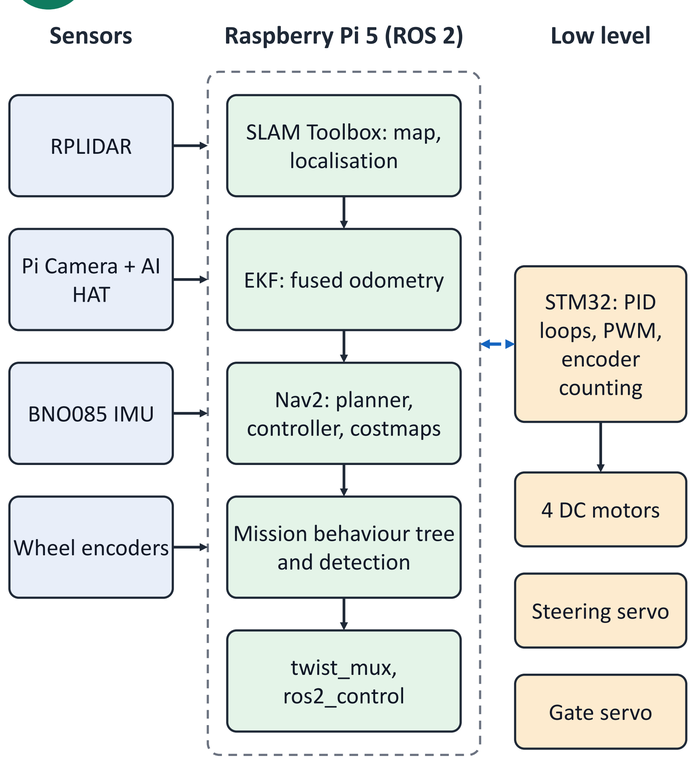
Our aim: do it reliably, on a low-cost build from local parts.

2 MISSION LOGIC



One decision, the gate, keeps the route choice easy to test and log.

3 SYSTEM ARCHITECTURE



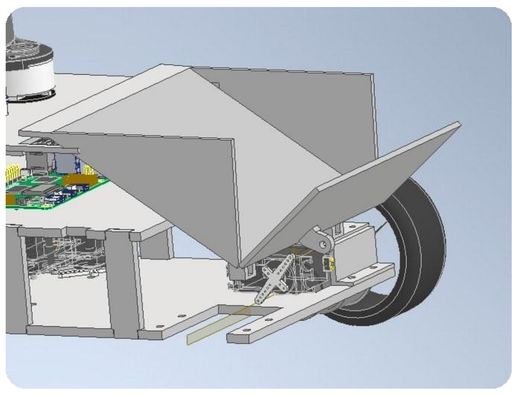
The Pi 5 runs perception and planning. The STM32 runs the motor loops, so a navigation fault cannot stop motor control.

4 TECHNOLOGY

Compute	Raspberry Pi 5 + AI HAT+
Real time	STM32F401 Black Pill
Sensing	RPLIDAR, Pi Camera V2, BNO085 IMU, encoders
Drive	4 geared DC motors, 112 mm wheels, 0.65 m/s max
Steering	Ackermann, switchable to differential drive; MG996R servo
Offload	Hinged gate, MG996R servo
Power	3S LiPo 11.1 V, 2.2 Ah (24.4 Wh), two buck converters
Software	ROS 2, Zenoh, SLAM Toolbox, Nav2 (Smac planner, MPPI)

5 GRAVITY-FED OFFLOADING

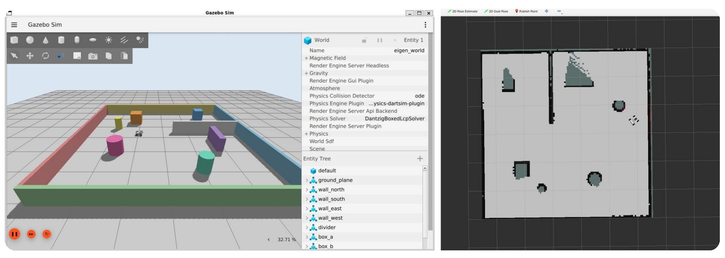
One servo opens a hinged rear gate that becomes a ramp, and **gravity unloads the bin**. One actuator means fewer failure points and low power draw. Waste is loaded from outside, so no manipulator is needed.



6 FUSION, AI AND ZENOH

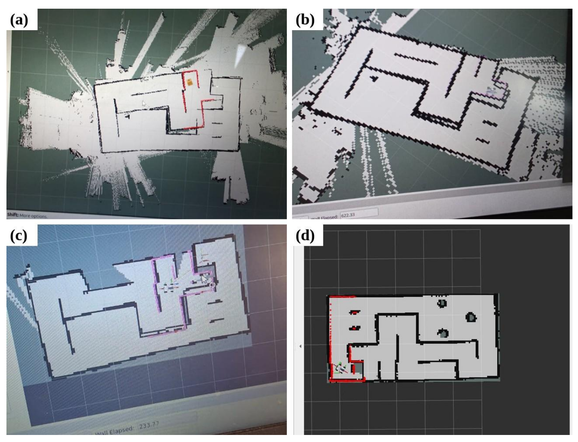
Encoders and the IMU feed an **extended Kalman filter** to limit drift. A **YOLO** model on the AI HAT+ got 9 of 10 test detections right, with no outside link. **Zenoh** routers on the Pi and the laptop share topics, so any laptop can watch the robot.

7 RESULTS: DIGITAL TWIN



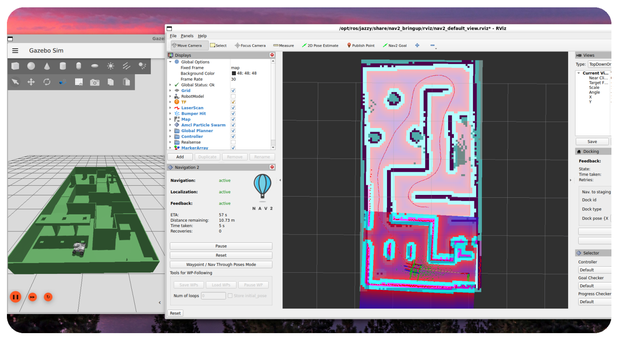
Gazebo gamefield (left) and the SLAM Toolbox map (right). Walls and obstacles appear in the right places, so the twin is used for tuning.

8 REAL ARENA MAP



Real arena map from the first scan (a) to the latest (d): walls close and straighten as drift is reduced.

9 NAV2 ON THE ROBOT



Gazebo twin (left) and Nav2 costmap in RViz on the robot (right).

Built to scale: laser-cut acrylic, 3D-printed parts, standard connectors and local suppliers, so the design is cheap to repeat and repair.