AUTOMATED ARCHTITECTS

Our robot integrates advanced sensing and actuation technologies to perform autonomous navigation, object detection, and payload delivery. The system demonstrates a multi-sensor approach for real-world robotics application.

SPECIFICATIONS

Mechanical Design

Dimensions

520 mm (L) × 360 mm (W) × 420 mm (H)

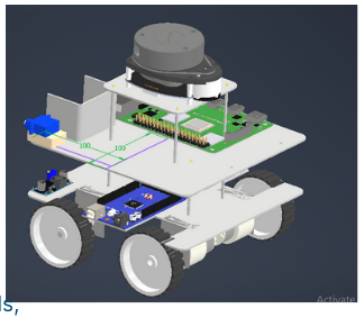
Weight ~9.5 kg (including battery)

Ground Clearance -45 mm

Mobility

-Forward-wheel drive with dual DC motors + encoders

Wheels 85×38 mm off-road front wheels, rear rubber caster (12 mm shaft bearings)



Electronics & Power

Controllers - Arduino Mega 2560 (motor control)
 Raspberry Pi 4 (SLAM & navigation)

Sensors -RPLIDAR A1 (360° LiDAR)
 Quadrature encoders

Motor Driver- MX1616H dual H-bridge

Power System - 12 V battery with buck converter (9.5 V motor supply)

Software & Control

Localization Accuracy- 7 cm over 10 meters – reliable in dynamic environments

DESIGN STRATEGY

Reliability over Complexity

A simplified electrical system using a perfboard reduced wiring failures and allowed faster troubleshooting compared to a custom PCB.

Robustness over Capability

A strong three-tier chassis and off-road wheels provided stability across gravel, sawdust, and ramps

Iterative Improvements

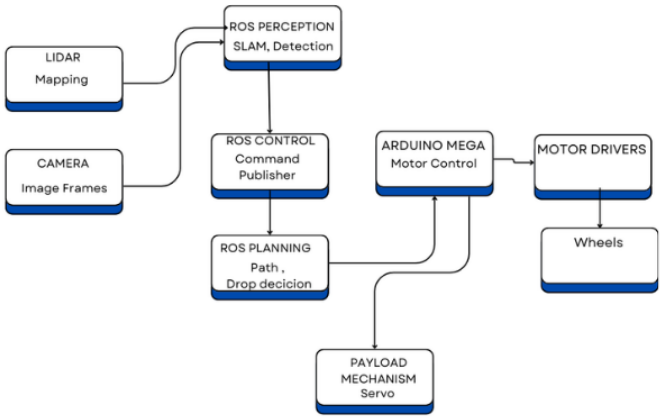
Early trials revealed jamming with standard caster wheels; this challenge was addressed by fabricating custom rubber caster wheels with bearings for smoother motion.

Efficient Control

DClosed-loop motor regulation with encoder feedback and PID tuning ensured consistent speed and reduced drift

SYSTEM ARCHITECTURE

BLOCK DIAGRAM



SENSORS

RPLIDAR A1 provides 360° environmental mapping, enabling spatial awareness in dynamic environments.
An onboard RGB camera supports object recognition using the YOLOv8 deep learning model.

CONTROL

The Raspberry Pi 4, running ROS, manages perception, planning, and decision-making. It fuses data from LiDAR, camera, and encoders into a coherent navigation strategy.
The Arduino Mega 2560 executes precise closed-loop motor control and payload actuation, ensuring seamless coordination between high-level software intelligence and low-level hardware action. The camera-vision pipeline enables real-time payload detection and color-based classification, ensuring reliable loading and deposition.

ACTUATORS

It employs a combination of DC motors with quadrature encoders and a servo-based payload actuator. The two high-torque DC motors drive the front wheels, providing forward-wheel propulsion with closed-loop PID control for speed and direction. Encoders ensure accurate odometry and velocity feedback, essential for stable navigation

CONCLUSION

The Robot proved that a reliability-first approach enables stable navigation and object handling across challenging terrains. By combining LiDAR SLAM with object detection, and distributing control between Raspberry Pi and Arduino, the system achieved robust autonomy. This project showcases practical, student-driven innovation for real-world robotics applications.

AUTHORS

Basil Kenya
Simon Gitonga
Abraham Ogach
Ceyhas Mutua
Dalhemba G. Dalhemba