

Introduction

Industrial high-risk zones restrict wireless communication, limiting the use of conventional inspection robots. A safer, interference-free communication method is needed for remote inspection in such environments.

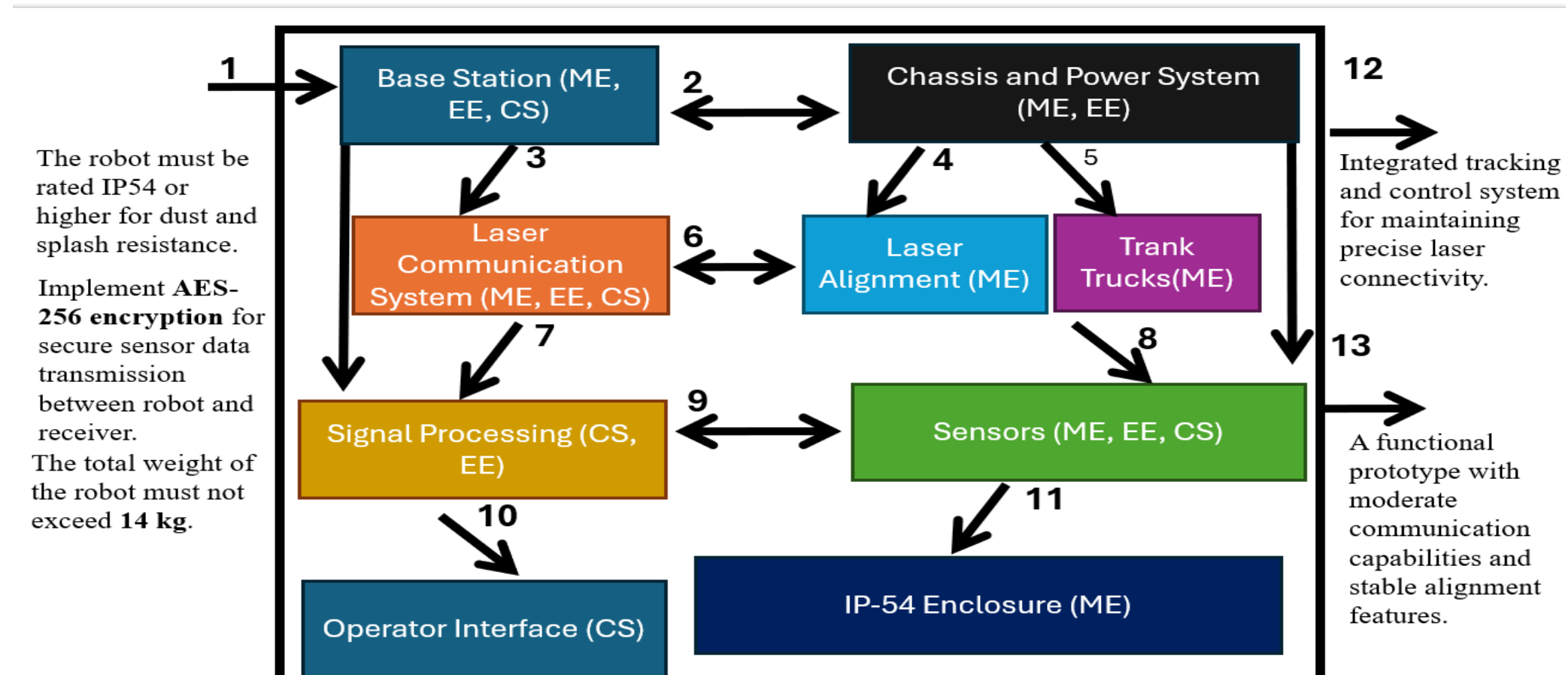
Project Objective

Traditional robots cannot operate in RF-restricted or high-radiation areas due to communication limits, creating the need for a reliable non-RF inspection system..

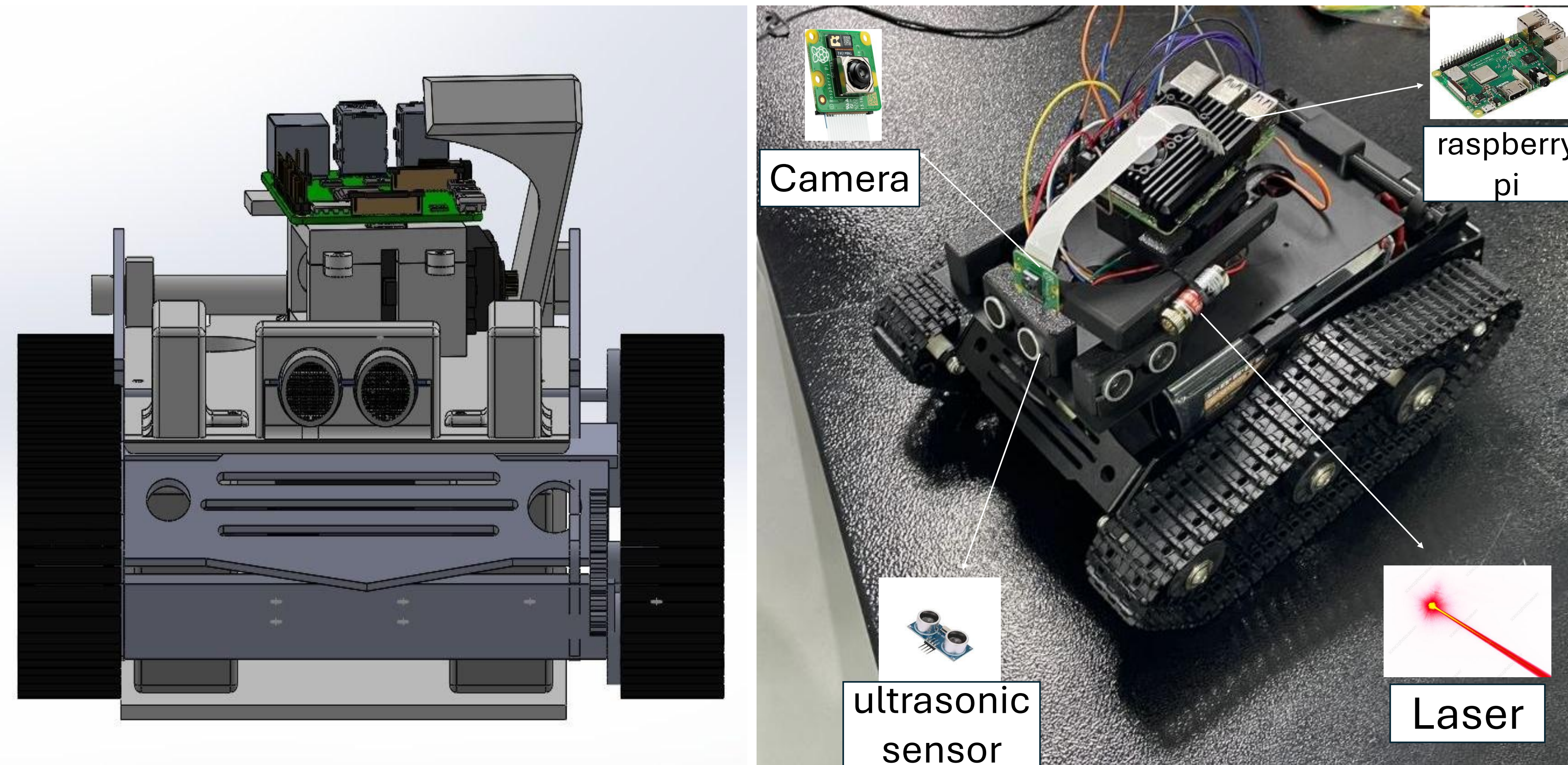
Problem Statement

Develop an autonomous inspection robot that uses laser-based communication as a safe and reliable alternative to RF in sensitive industrial environments.

Design Block Diagram

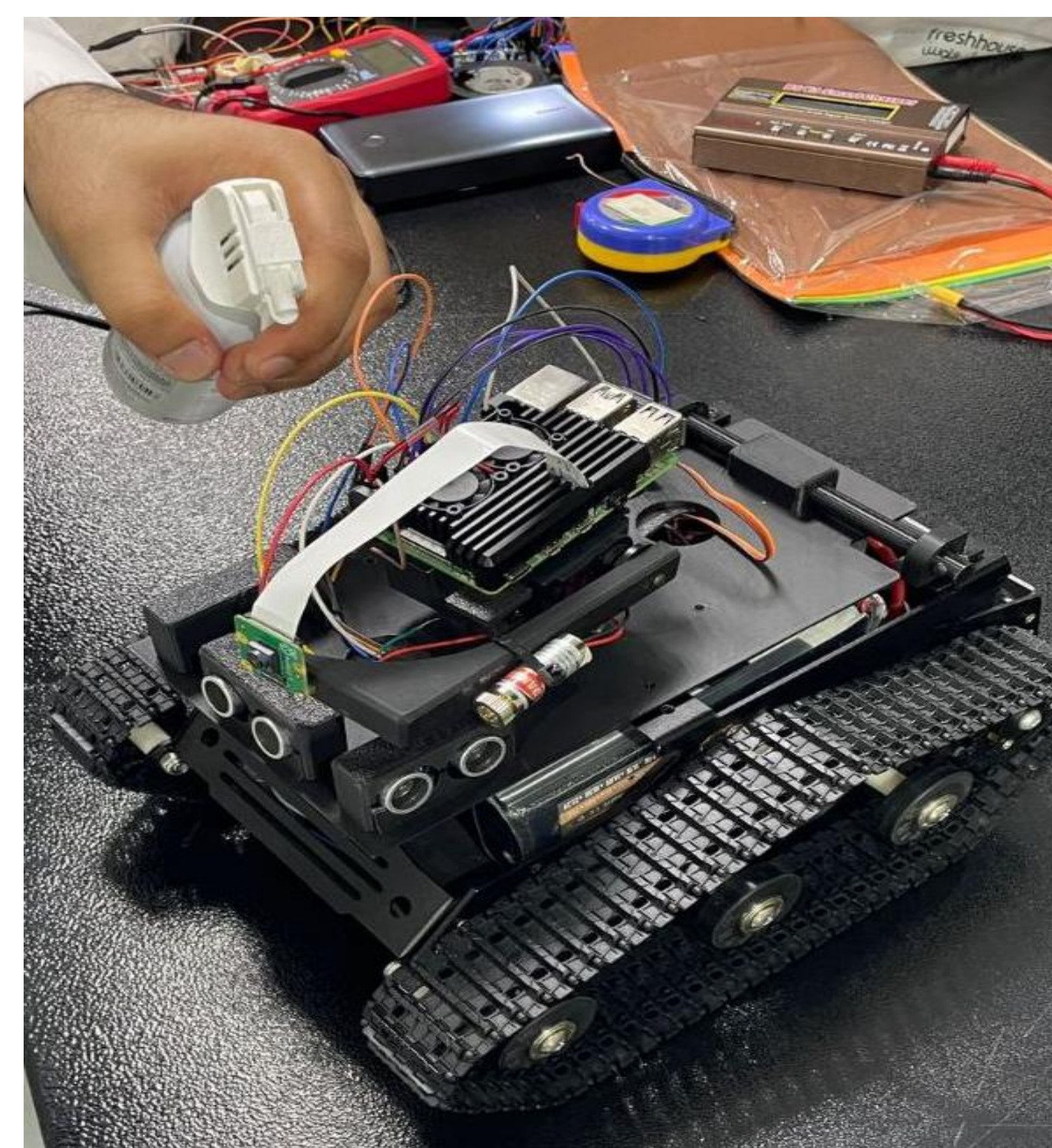


Prototype Design



Testing & Validation

IP54 test



Laser aligned to the receiver



Data received



Constraints Specifications

Constraints	Specifications
Weight ≤ 14 kg	Laser communication range ≥ 5 m
Fits within 60 × 60 × 60 cm	Data rate ≥ 1 kbps
Optical communication only (no RF)	BER ≤ 10 ⁻³
Safe operation around humans	Robot speed ≥ 0.2 m/s
Off-the-shelf components for motors, battery, sensors	Runtime ≥ 20 minutes
Budget limit as per course rules	Alignment tolerance ≥ ±10°
30° incline navigation capability	Autonomous path following using sensor
Operation in indoor lighting conditions	Integrated prototype combining ME, EE, and CS subsystems

Conclusion

The prototype successfully demonstrated safe, reliable laser communication and autonomous inspection, meeting all major constraints and specifications.