



University
Mohammed VI
Polytechnic



Inspection Robot for Confined Spaces – Requirements Specification

Moataz SEGHYAR

Introduction

Purpose

This document defines the functional and non-functional requirements for a tracked inspection robot designed for confined industrial environments. The robot will perform autonomous and remote inspections, monitor environmental conditions, and support modular expansion for additional functionality.

Project Overview

The inspection robot will:

- Use a tracked propulsion system for mobility.
- Navigate using LiDAR and a depth camera.
- Collect and transmit environmental data (temperature, humidity, gas concentrations).
- Operate in both manual remote control and autonomous modes.
- Feature a modular expansion port for additional components.
- Be designed to withstand harsh industrial environments (IP65-rated).

System Architecture

The robot system consists of the following key components:

- **Propulsion:** Tracked system powered by two DC motors.
- **Processing Unit:** Jetson Nano for sensor data processing.

- **Microcontroller:** STM32 for motor and sensor control.
- **Power System:** 24V battery providing at least 1.5 hours of operation.
- **Sensors:** Industrial-grade sensors for temperature, humidity, and gas levels.
- **Communication:** Wireless connectivity for real-time data transmission and remote control.
- **Safety Features:** Emergency stop function.

Requirements

Functional Requirements (FRs)

| ID | Requirement |
|-------|--|
| FR-01 | The robot shall use a tracked propulsion system powered by two DC motors. |
| FR-02 | The robot shall navigate autonomously using LiDAR and depth camera data. |
| FR-03 | The robot shall support manual remote control via a wireless interface. |
| FR-04 | The robot shall collect and transmit environmental sensor data. |
| FR-05 | The robot shall enable real-time data transmission. |
| FR-06 | The robot shall include a modular expansion bay for additional components. |
| FR-07 | The robot shall provide an emergency stop function for safety. |

Non-Functional Requirements (NFRs)

| ID | Requirement |
|--------|---|
| NFR-01 | The robot shall achieve a maximum speed of at least 20 cm/s. |
| NFR-02 | The robot shall operate continuously for a minimum of 2 hours on battery power. |
| NFR-03 | The robot shall be IP65-rated for dust and moisture resistance. |
| NFR-04 | The robot shall function in ambient temperatures between -20°C and 50°C. |
| NFR-05 | The robot's communication latency shall not exceed 500 ms. |
| NFR-06 | The battery system shall support a minimum of 500 charge cycles. |
| NFR-07 | The modular expansion bay shall enable easy integration of additional sensors or tools. |
| NFR-08 | The robot shall weigh less than 20 kg for ease of transportation. |