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Surface Inspection Robot

MINI PROJECT

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2ND SEM MINI PROJECT
BTECH CSE
SEC-B

Inspirobot-X: Autonomous Infrastructure Inspection Robot

Abstract

Inspirobot-X is an autonomous ground-based robotic system designed for real-time infrastructure inspection and maintenance. Equipped with air quality, smoke, and temperature sensors, it efficiently monitors hazardous environments, ensuring safety and operational efficiency. The system integrates Arduino/Raspberry Pi, ROS, OpenCV, and machine learning for seamless detection and data analysis.

Introduction

Modern infrastructure demands regular inspections to maintain safety and reliability. Inspirobot-X aims to minimize human intervention in dangerous areas through an autonomous robotic system. This project focuses on enhancing inspection accuracy and reducing risks associated with manual operations.

System Architecture

- * Microcontroller: Arduino or Raspberry Pi
- * Sensors:
 - * Air Quality Sensor (MQ-135)
 - * Smoke Sensor (MQ-2)
 - * Temperature Sensor (DHT22)
- * Communication: ROS (Robot Operating System)
- * Mobility: Chassis and Wheels for terrain navigation
- * Software Stack: Python, C++, OpenCV

Technologies Used

- * Programming Languages: Python, C++
- * Libraries: OpenCV, ROS
- * Microcontroller: Arduino/Raspberry Pi
- * Sensors: MQ-135, MQ-2, DHT22
- * Machine Learning: Data analysis and anomaly detection

Implementation

1. Sensor Integration: Real-time data collection from air quality, smoke, and temperature sensors.
2. Microcontroller Programming: Logic implementation for navigation and data processing.
3. ROS Communication: Seamless data transmission and control.
4. Data Visualization: Monitoring through real-time dashboards.

Testing and Validation

- * Conducted real-time tests for:
- * Sensor accuracy
- * Navigation stability
- * Data transmission

Challenges Faced

- * Sensor calibration for accuracy
- * Hardware integration with ROS
- * Real-time data synchronization

Conclusion

Inspirobot-X successfully demonstrated autonomous infrastructure inspection with real-time monitoring, enhancing safety and efficiency. Future improvements include expanding sensor capabilities and optimizing navigation algorithms.

References

Robots in Inspection and Monitoring of Buildings and Infrastructure: A Systematic Review

- **Authors:** Kereshmeh Afsari, Srijeet Halder
- **Published in:** *Applied Sciences*, 2023
- **Summary:** This comprehensive review analyzes 269 papers on robotic inspection and monitoring of buildings and infrastructure. It categorizes various robotic systems, including unmanned ground vehicles (UGVs), and discusses their applications in maintenance inspection, construction quality inspection, and safety inspection. The study also highlights common research areas such as autonomous navigation, sensing, and data transmission.

All-Weather Autonomous Inspection Robot for Electrical Substations

- **Authors:** [Authors not specified in the provided content]
- **Published in:** *IEEE Xplore*, 2022
- **Summary:** This paper presents the design and implementation of an all-weather autonomous inspection robot tailored for electrical substations. It details the system's components, software architecture, and the algorithms enabling autonomous navigation and inspection tasks under various environmental conditions.