Professional Report: Autonomous Highway Paving Monitoring Simulation

December 6, 2024

Contents

1 Overview

- Overview of the *"SpaceTech for Earth"* challenge and the areas it aims to address.
- Highlighting the necessity of employing autonomous technology to monitor and update roadway infrastructure.
- The goal is to create a prototype robot that can replicate real-time highway paving monitoring and control.

2 Project Goals

- Show how a robotic device can keep an eye on highway paving activities on its own.
- Test and model real-world situations, such as monitoring development, identifying anomalies, and assessing quality.
- Use space technologies (GIS/GPS) to collect data and navigate with the highest level of accuracy possible.

3 Research and Analysis of Requirements

- Particular specifications for pavement monitoring include accuracy, data gathering, and real-time tracking.
- Technology tools include:
  - L293D motor controller for mobility.
  - Arduino Mega for control.
  - GPS unit for navigation.
- Determining the prototype's performance requirements:
  - Accuracy.
  - Data transmission.
  - Stability.

4 Architecture and Design of Systems

4.1 Hardware

- A four-wheel chassis-based robot for increased mobility.
- GPS module for tracking and location in real-tiArchitecture and Design of Systems Hardware A four-wheel chassis-based robot for increased mobility. GPS module for tracking and location in real-time. Battery pack to guarantee energy independence.

  Software An algorithm for navigating that defines and modifies routes. Features for data analysis and collecting that are specific to paving parameters. me.
- Battery pack to guarantee energy independence.

4.2 Software

- An algorithm for navigating that defines and modifies routes.
- Features for data analysis and collecting that are specific to paving parameters.

5 Execution

5.1 Steps in Development

- Assembling hardware.
- Application of GPS coordinates to the navigation code.
- Creation of a paving parameter monitoring function (e.g., speed, trajectory).

5.2 Simulation

- Constructing an environment that is meant to resemble a highway.
- Executing tests to assess system functionality.

6 Findings and Interpretation

- Simulation results include monitoring efficacy and navigation precision.
- Assessment of the concept's viability for practical uses.

7 Effects and Uses

- Contribution to the use of autonomous solutions in the upgrade of transportation infrastructure.
- Possible uses in other domains, including road upkeep and urban development site management.

8 Final Thoughts and Upcoming Projects

- An overview of the prototype's successes and lessons discovered.
- Future development suggestions include:
  - Adding more sensors.
  - Improving data analysis.

9 Appendices

- Diagrams of the system architecture and technical documentation.
- User manuals, demonstration films, and source codes.