Indian Institute of Technology Mandi

Design Practicum IC-202P

Mid-submission Report

Pothole detection and repair using recycled plastic waste-based material

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GROUP-6

TEAM MEMBERS:

Anmol Kumar (B23246)
Jaya Pandey (B23444)
Tanishi A Gupta (B23472)
Harsh Rana (B23203)
Arpit Kumar (B23248)

Under the Supervision of:

Faculty Mentor - Dr. Radheshyam, CAIR
Dr. Dube Dheeraj Prakashchand, SMME
Dr. Neha Shukla, SMME
Dr. Ravindra Bukke, SMME

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Chapter 1

Introduction

Potholes are a persistent challenge in road infrastructure, leading to vehicular damage, increased fuel consumption, traffic congestion, and safety hazards. The deterioration of road surfaces is primarily caused by repeated traffic loads, water infiltration, freeze-thaw cycles, and inadequate maintenance. Traditional pothole repair methods, such as cold and hot mix asphalt, have limitations in terms of cost, durability, and environmental sustainability. These conventional materials require frequent reapplication, contribute to greenhouse gas emissions, and place a significant economic burden on municipalities and governments.

Simultaneously, plastic waste accumulation has emerged as a critical environmental issue, with millions of tons of non-biodegradable plastics filling landfills and polluting natural ecosystems. Recycling and repurposing plastic waste into construction materials offer a promising solution to address both road maintenance and environmental concerns. The use of recycled plastic in road repairs presents an innovative, cost-effective, and sustainable alternative to traditional asphalt-based methods.

By addressing the intersection of road infrastructure challenges, plastic waste management, and technological advancements, this study aims to present a feasible and scalable method for sustainable pothole detection and repair.

Chapter 2

Final Solution

Our system provides an end-to-end approach for detecting potholes and estimating their severity based on volume. It is divided into two key modules:

1. Pothole Detection using YOLOv8

We employed the YOLOv8 object detection model for accurate and real-time pothole detection. The model was trained on an existing annotated pothole dataset and further tested on custom images captured in real-world road scenarios to validate its robustness and generalization. YOLOv8 was chosen for its superior accuracy-speed tradeoff, making it suitable for deployment in edge devices or real-time inspection systems.

2. Pothole Volume Estimation using Time-of-Flight (ToF) Camera

To estimate the volume of detected potholes, we utilized a Time-of-Flight (ToF) camera. This camera captures depth maps and point clouds, providing depth information for every pixel in the scene.

First, a reference flat surface is calibrated using a depth map of an undisturbed road section. This establishes the base level, assuming it to be ideally flat.

When a pothole or bump is encountered, a new depth map is generated for that region.

By subtracting the depth values of the current surface from the reference base, we calculate the spatial depression or elevation.

This differential data is used to compute the volume of the pothole, enabling severity classification and aiding in prioritizing repairs.

Chapter 3

CAD/Sketch of Final Solution

Include a CAD design or sketch of the chosen solution.

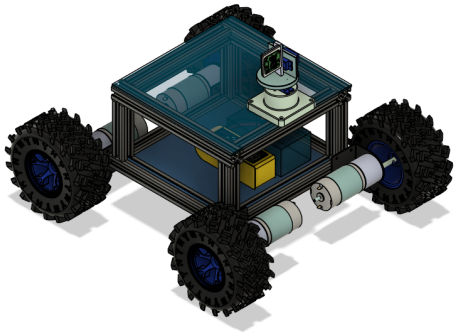

Figure 3.1: Isometric view.

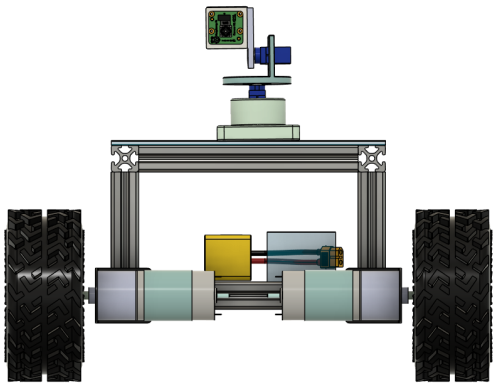

Figure 3.2: Front view.

Chapter 4

Bill of Materials (BOM)

List of all components and materials required. here