Real-time Road Conditioning Model

By:
Poorna Singh
Namrata Todkar
Samradny Ware

Introduction

- This project focuses on developing a real-time road conditioning model using advanced deep learning techniques.
- By integrating Convolutional Neural Networks (CNN) for feature extraction, OpenCV for image processing, and YOLOv8 for object detection, the model can detect road conditions such as potholes, cracks, and obstacles in real-time.
- Hyperparameter tuning is applied to optimize the model's performance, ensuring faster and more accurate detection.
- The system is designed to enhance road safety by providing real-time data for autonomous vehicles or smart traffic management systems, enabling adaptive responses to varying road conditions.

Literature Review :

AUTHOR NAME	YEAR	TITLE OF THE PAPER	METHODOLOGY	DATASET USED	MODEL USED	ACCURACY	RESEARCH GAP
Cuthbert Ruseruka , , Judith Mwakalonge , Gurcan Comert , Saidi Siuhi and Judy Perkins	2023	Road Condition Monitoring Using Vehicle Built-in Cameras and GPS Sensors: A Deep Learning Approach	The system leverages vehicle CAN data to detect road anomalies. Collected data is processed to identify issues like potholes and uneven surfaces..	The dataset consists of CAN data from vehicles which includes information such as the yaw rate, longitudinal acceleration , lateral acceleration , etc.	You Only Look Once Version 5 (YOLOv5) model	The paper does not specify the accuracy of the model directly in the extracted text. This information might be located in the results or discussion section of the paper.	The paper presents a cost-effective, real-time road monitoring approach using existing vehicle CAN data, eliminating the need for extra hardware.

Literature Review :

Mumbere Muyisa Forrest, Zhigang Chen, Shahzad Hassan, Ian Osolo Raymond, Karim Alinani	2018	Cost Effective Surface Disruption Detection System for Paved and Unpaved Roads	The paper proposes using ultrasonic sensors mounted on vehicles to detect and classify road surface disruptions on both paved and unpaved roads.	Data collected from ultrasonic sensors during tests conducted on paved and unpaved roads	The paper uses a custom algorithm for detecting road surface disruptions from sensor data.	The system achieved a 94% accuracy rate regarding pothole characteristics (size, surface, and depth) on both paved and unpaved roads, and a pothole detection rate of 62% on paved roads.	The system effectively detects RSD and potholes but struggles with lower detection rates on paved roads and variable conditions on unpaved roads. Future work should focus on enhancing detection accuracy across these environments.

Research gaps

1. Detection Challenges on Diverse Road Conditions
2. Issues with Detection Precision and Overfitting
3. Exploration of Multiclass Classification and Deep Learning

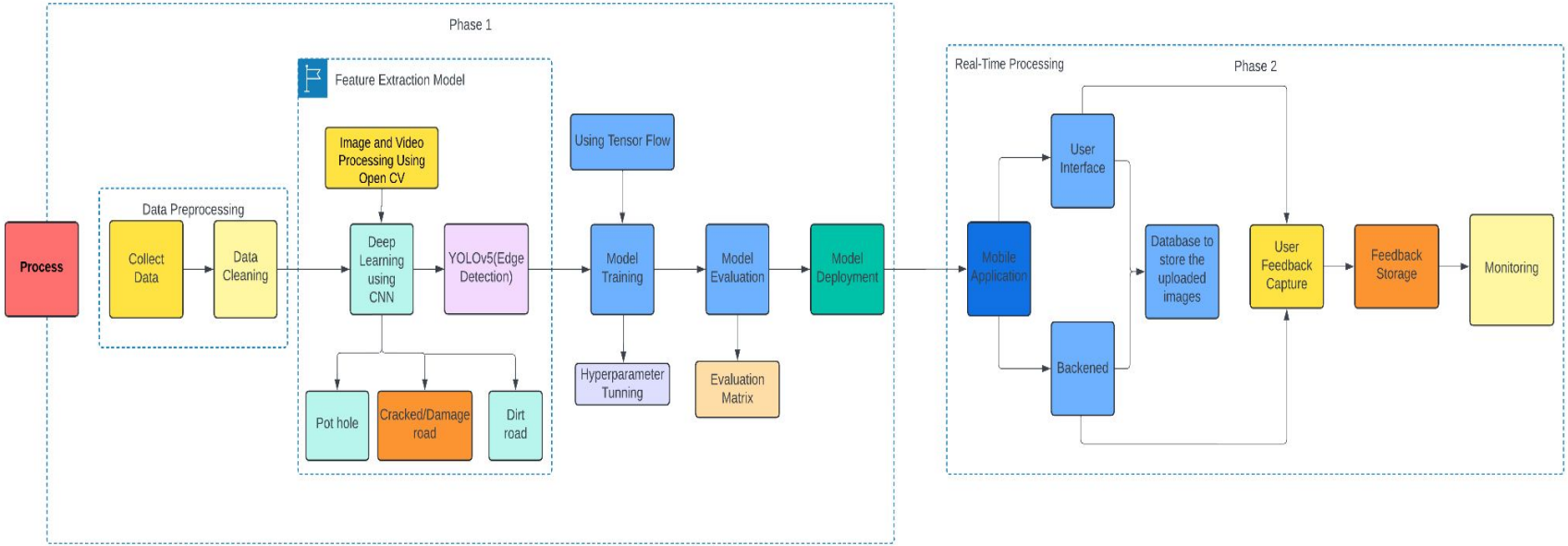
Problem Statement

1. High Costs and Inefficiencies in Current Road Monitoring Methods
2. Need for a Cost-Effective, Real-Time Monitoring Solution
3. Challenges in Detecting Road Surface Disruptions on Different Road Types
4. Limitations of Automated Systems in Specific Conditions

Objective

1. Utilize Deep Learning and Machine Learning for Pavement Distress Detection
2. Improve Detection on potholes on roads
3. Enhance Prediction Reliability and Feasibility
4. Develop Cost-Effective Real-Time Road Monitoring Systems

Refined Methodology



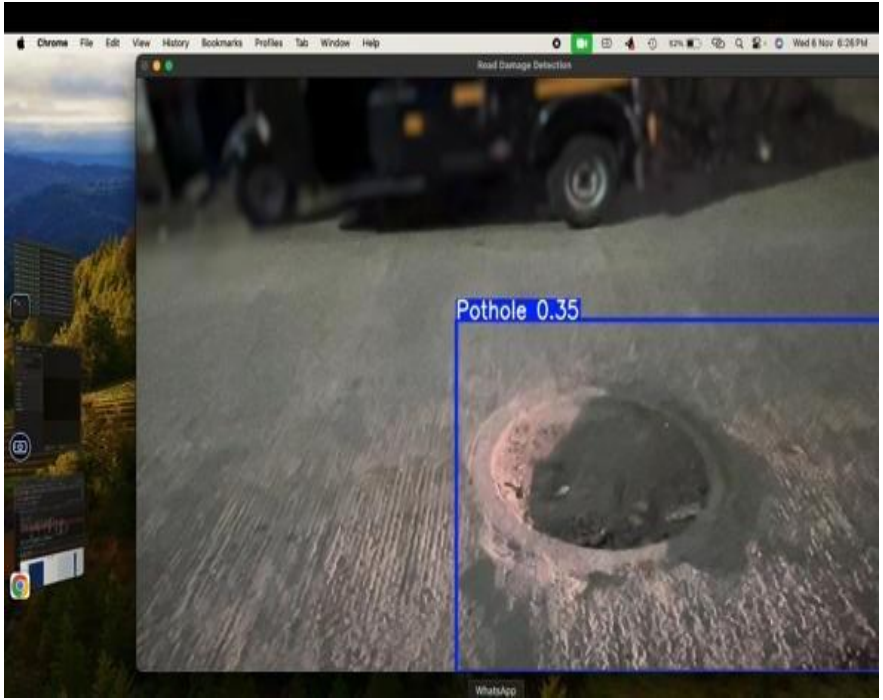
Libraries:

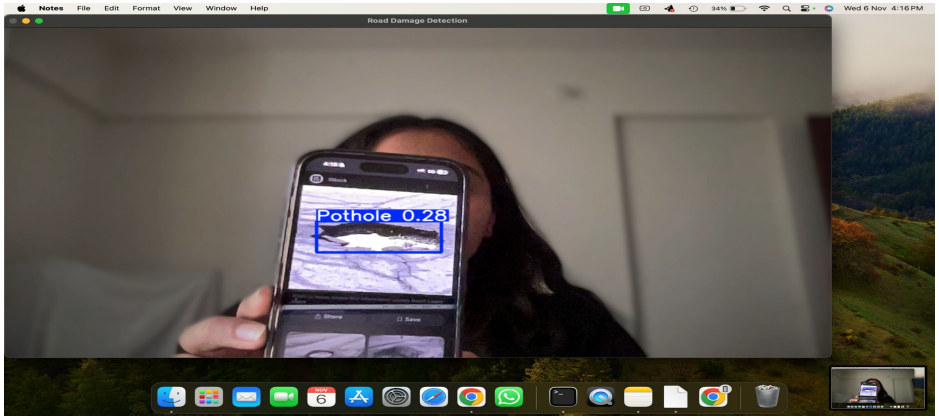
1. YOLOv8 (You Only Look Once)
2. Matplotlib & Seaborn
3. Pandas & NumPy
4. Neural Networks (including Deep Neural Networks)
5. Ultralytics
6. Pytorch

Dataset:

- https://www.kaggle.com/code/jefmenegazzo/road-surface-type-classification/input
- https://data.mendeley.com/datasets/tj2m7zz4rg/2
- https://github.com/sekilab/RoadDamageDetector/blob/master/images/installation1.png
- https://universe.roboflow.com/vg2024/pothole-detect-yolo/dataset/1

RESULT:





Mean Average Precision : 0.5:0.95

Conclusion:

This project developed a real-time road conditioning model using pytorch,OpenCV, and YOLOv8 for accurate detection of road anomalies. Hyperparameter tuning improved model performance, making it suitable for deployment in autonomous vehicles and smart traffic systems. The solution enhances road safety and supports timely maintenance, contributing to modern, adaptive transportation infrastructure.