ROAD MAINTENANCE BY SMART POTHOLE DETECTION AND SEVERITY ANALYSIS

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INTRODUCTION

Problem: Dangerous potholes threaten road safety, causing accidents, injuries, and vehicle damage.

- Pune: Potholes have emerged on roads at many places after spells of rain posing problems to commuters.
- Mumbai's potholes claim another life, Virar teacher falls off scooter
- Accidents in Pune have increased as water-filled potholes become nearly invisible at night, especially for two-wheeler riders

Inefficiency: Traditional methods of pothole detection and repair are often slow and reactive, leading to frustrated citizens and costly delays.

- There is a need for a system that helps not only citizens but the road contractors and government officials to make the process of road repairing fast and efficient .
- That could be done based on analyzing severitiy of area with respect to potholes.

INTRODUCTION CONTD..

Our Solution:

- **Machine Learning for Accuracy**: Advanced AI identifies and assesses pothole severity from user-submitted images along with location.
- **Community Participation:** Citizens can easily report potholes, while Government officers prioritize repairs based on severity assessment and contractors complete them efficiently.
- **User-Friendly Platform:** React-based interface empowers communities with real-time road condition data and feedback mechanisms.

Additionally it could be a great step towards few of the United Nation's sustainability goals:

- **Sustainable Cities and Communities**
- **Industry, Innovation and Infrastructure**

OBJECTIVES

01

Accurately identify potholes in user-submitted images, ensuring high precision and recall rates in detection.

02

Implement a robust scoring system to evaluate the severity of detected potholes, facilitating effective decision-making for citizens and contractors.

03

Design an intuitive web portal that allows users to easily submit images, view pothole locations on a map, and access severity information for informed decision-making.

04

Enable the collection and processing of real-time data from users and other sources to maintain an up-to-date database of road conditions, ensuring timely and accurate information

FLOWCHART

Begin
Registerd?
No
Register
Yes
Login
User-Type
Citizen
Government Official
Contractor
Explore Map
Upload Image
Review Reports
Assess priority of reports
Assign Repairs
View Assigned Repairs
Explore path
Compliant
Rate contractor
Submit Repair Completion
Assess Severity

TOOLS AND TECHNOLOGY

Machine Learning

Python

Web Frontend

HTML , CSS,
JAVASCRIPT, REACT

Web Backend

NodeJS, External APIs
MongoDB/Mongo Atlas

ADVANTAGES

A Step Towards one of the 17 UN sustainability goals - **Sustainable Cities and Communities**

Contractor Accountability and Improvement

Enhanced User Safety and Experience (specially in Rainy Seasons)

Efficient Road Maintenance Prioritization

REQUIREMENTS

User Engagement and Data Collection

Contractor Coordination and Compliance

Scalability and System Performance

Literature Review

Title	Year	Description
Real-time deep learning-based approach for pothole detection	2021	The YOLOv3 algorithm, known for its high speed and accuracy, was chosen for its capability to detect potholes in various lighting and weather conditions, using a dataset of 330 images. The system logs detected potholes along with their locations on Google Maps, offering real-time data for road maintenance authorities. The study achieved a mean Average Precision (mAP) of 65.05% and demonstrated that the model could be optimized further with a more extensive dataset and higher GPU specifications. This approach promises a scalable and efficient solution for monitoring road conditions, significantly reducing road hazard risks.
Real-time machine learning-based approach for pothole detection	2021	The authors employ a range of machine learning techniques, including Naïve Bayes, Logistic Regression, SVM, K-Nearest Neighbours (KNN), and Random Forest, to distinguish between pothole and non-pothole road events. Their methodology utilizes a binary classification system based on the features extracted from accelerometer and gyroscope sensors within the devices. The Random Forest model, particularly when optimized through random search hyperparameter tuning, demonstrated superior performance across several metrics, including accuracy, precision, recall, and F-score.
Assessing severity of road cracks using deep learning-based segmentation and detection	2022	The study addresses limitations in previous research by expanding the types of cracks detected to five (alligator crack, longitudinal crack, transverse crack, pothole, and patching) and integrating severity assessment into the system. The authors utilized a combination of deep learning models, specifically SqueezeNet, U-Net, and Mobilenet-SSD, to achieve high accuracy in detecting and classifying cracks while also assessing their severity. They trained two U-Nets separately for linear and area cracking to enhance segmentation performance, leading to improved accuracy in severity assessment—94.39% for linear cracks and 89.68% for area cracks. The overall system achieved 91.2% accuracy in both crack type classification and severity assessment.

Literature Review

Title	Year	Description
Potholes Detection Using Deep Learning and Area Estimation Using Image Processing	2021	The literature review for this paper likely examines various methodologies for pothole detection using computer vision, beginning with traditional image processing and object detection algorithms, which often struggle with accuracy and speed. It would then shift focus to deep learning approaches, particularly Convolutional Neural Networks (CNNs), which offer improved performance across diverse road and environmental conditions. The review would highlight the effectiveness of models like YOLOv5 and Faster R-CNN, noting that Faster R-CNN with ResNet50 achieved the highest accuracy at 91.9% precision, while YOLOv5 Small (Ys) provided the fastest detection speed at 0.009 seconds per image, making it suitable for real-time applications.
A Web-based Road Updates Information System using Google Maps API	2023	The literature review for this research would examine the importance of real-time road information systems in improving transportation safety and efficiency, focusing on existing methods like GPS-based apps and news outlets, which often lack accuracy and user engagement. It would explore the advantages of web-based platforms using tools like Google Maps API for providing timely and interactive road updates. Additionally, it would discuss the ISO/IEC 25010 quality model for evaluating software effectiveness, comparing the developed system's enhanced user participation and broader geographic applicability to similar platforms
Analysis and Pred. of Pothole Formation Rate using Spatial Density Meas. and Pavement Condition Data	2023	This paper investigates the relationship between various pavement conditions and the formation of potholes. It highlights that weather variations and different distress types (e.g., cracking, rutting) significantly affect the pothole formation rate. The study also considers the impact of the spatial density of potholes (PSD) on predicting the number of potholes formed annually. The literature review emphasizes the importance of considering both climatic conditions and road maintenance activities when predicting pothole formation.

THANK YOU