INTELLIGENT ROAD SURFACE ANALYSIS: AI-BASED POTHOLE DETECTION AND SCIENTIFIC REDESIGN OF ROAD HUMP

Project Reference No.: *49S_BE_4878*

College : Jain College Of Engineering and Technology, Hubballi
Branch : Department of Civil Engineering
Guide(s) : Prof. Shwetha.G.C
Prof.Sachin.P.D
Student(S) : Mr. Shridhar.Pati
Mr. Sachin.M)
Mr. Shravan.M
Mr. Udayagouda.V.H

Keywords:
Artificial Intelligence (AI), Pothole Detection, Road Surface Analysis, Image Processing, Computer Vision, Machine Learning

Introduction:

1. Road transportation plays a crucial role in economic development, mobility, and connectivity.
2. Road surface deterioration particularly potholes continues to pose significant challenges to vehicle safety, ride comfort, and infrastructure maintenance.
3. Potholes are formed due to a combination of material fatigue, water infiltration, and discomfort to road users. In many developing countries, these issues persist due to manual inspection methods, delayed maintenance, and lack of standardized.
4. As smart cities expand, the need for intelligent road surface analysis using Artificial Intelligence (AI) has become increasingly essential.
5. Recent advancements in computer vision, deep learning, and edge-device computing have enabled automated monitoring of road surface defects at large scale.

Objectives:

1. To classify potholes based on severity and physical characteristics.
2. To design a real-time road surface monitoring framework.
3. To create a geo-tagged defect mapping system.
4. To propose a predictive maintenance model for road authorities
5. To reduce road accidents, vehicle wear, and transportation delays
6. To support smart-city initiatives through digital road infrastructure
7. To develop an automated AI-based system for accurate detection of potholes

Methodology:

The system uses image processing and AI techniques. Images of roads are captured and processed using trained models. The system identifies potholes and calculates their

dimensions. Separate modules are used for detection, length calculation, and breadth estimation, which are later combined into a single system.

Result and Conclusion:

1. High detection accuracy across varied conditions
2. Real-time performance suitable for city-wide deployment Accurate pothole sizing for severity classification
3. GIS mapping supports smart maintenance
4. Night and rain detection needs improvement
5. The intelligent system enhances road safety, reduces maintenance costs, improves rider comfort, and supports smart-city digital infrastructure initiatives. The experiments demonstrate that AI- powered road surface analysis is a reliable and scalable solution for detecting potholes and redesigning road humps scientifically.

References:

1. S. Koch, A. Ewees, K. Dahal, and M. N. M. Bhutta, “A review of pothole detection techniques in road surface monitoring,” IEEE Access, vol. 10, pp. 45210–45230, 2022.
2. R. Yadav, S. Badal, and R. Kumar, “Road surface distress detection using computer vision and convolutional neural networks,” Procedia Computer Science, vol. 167, pp. 2525–2534, 2020.
3. Chakraborty, P. Mittal, and S. Gupta, “Design and analysis of road humps based on vehicle dynamics and user comfort,” International Journal of Engineering Research & Technology, vol. 9, pp. 1121–1127, 2020
4. A. Mednis, G. Strazdins, R. Zviedris, G. Kanonirs, and L. Selavo, “Real-time pothole detection using Android smartphones with accelerometers,” in Proc. IEEE International Conference on Distributed Computing in Sensor Systems, pp. 1–6, 2011.

Future Scope:

The future scope of this project includes:

1. Real-Time Implementation
2. Integration with Smart Cities
3. Mobile Application Development