Chapter 10

Vehicle-Mounted Real-Time Road Damage Detection System Using YOLOv8 and Edge Computing

L. Churchill
http://orcid.org/0009-0009-5186-3854
M. Kumarasamy College of Engineering, India

A. Selvi
M. Kumarasamy College of Engineering, India

S. Akshaykumar
M. Kumarasamy College of Engineering, India

G. Kaviyarasan
M. Kumarasamy College of Engineering, India

A. S. Shivapriyan
M. Kumarasamy College of Engineering, India

ABSTRACT

This paper presents a real-time road health monitoring system that overcomes the limitations of manual road inspections. The system uses cameras and GPS modules mounted on public vehicles to capture live road images, which are processed on edge devices using a YOLOv8-based deep learning model. It automatically detects

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potholes, cracks, and surface irregularities, assigns severity scores, and tags each defect with precise GPS coordinates. The data is sent to a centralized PostgreSQL database with PostGIS for spatial mapping. A React-based administrative dashboard helps authorities assess road conditions and prioritize repairs, while a public React web portal allows citizens to report issues. Automated and public reports are cross-verified to avoid duplication, making the system cost-effective, scalable, and reliable.

1. INTRODUCTION

Infrastructure of road transportation is at thconnectivity,economic growth, social connectivity and mobility services in both developed and developing areas. Constant load exchanges caused by the environment and aging of materials cause gradual degradation of the pavement to producpotholes andthe form of cracks and potholes, and surface deformations, which deteriorate road safety and ride quality (Shakhovska et al., 2024). The high rate of urbaexacerbated high vehicular density exacerbates the mechanicoad on road networkexceedsmoting the wear and tear that exceed the possible scope of traditional maintenance regimes (Duan and Nazri, 2024). Poor and late recognition of pavement defects leads to the risk of accidents, additional spending on upkeep procedures, and the shorter life of infrastructure (Abbas et al., 2025). The need to ensure that the conditions of the road surface are known in time has thus been a major demand of a sustainable transport management system (Mishra and Kamal, 2024).

The conventional methods of road inspection are based on the periodic manual surveys and visual observations, which are carried out by the qualified staff. Although these approaches are still popular, they have limited coverage of space and frequency of inspection that limit them in terms of capturing quickly changing damages due to environmental changes and traffic overloads (Liu et al., 2025). Rural road systems are further complicated by the lack of resources and the lack of monitoring intensity; this leads to the fact that the routes are often underutilized, which leads to their long-term decay (Davuluri, 2024). This is because of a lack of ongoing monitoring provisions, which results in reactive instead of proactive maintenance efforts, which adds to the overall operational costs in the long run (Abdelkader et al., 2025). These restintoctions have prompted the research to intelligent and automated road-condition monitoring systems that can operate in real-time (Uppukonda et al., 2025).

The development of intelligent transportation systems has provided the possibility to combine computer vision and deep learning to analImagingoad surface automatically. Imagining platforms on vehicles and airlift can produce vast amounts of visual data that can be used to capture pavement texture, geometry, and defect features when used in real-world conditions (Britto et al., 2025). Trained deep learn-

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