***IoT-based Road Damage Level Detection Based on
Pavement Condition Index (PCI) Analysis***

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ABSTRACT

This research aims to develop an Internet of Things (IoT)-based road damage level detection system using Pavement Condition Index (PCI) analysis for efficient road condition assessment. The system integrates ESP8266 as the input/feedback control unit and ESP32-CAM for damage image acquisition. A Python script modeled after YOLOv8 processes the images to detect the five main types of damage and estimate their dimensions. The results are sent to a PHP/MySQL website for storage, PCI calculation (simplified method), and visualization.

The system implementation shows integrated functionality from acquisition to result presentation. Tests on 50 test image samples showed that the accuracy of damage classification by YOLOv8 reached 88%. The limited resolution of the ESP32-CAM camera and variations in environmental lighting were identified as the main factors affecting the detection accuracy. Nonetheless, the system successfully provided an initial quantitative picture of road conditions, demonstrating the potential of IoT and deep learning for the automation of road damage surveys.

Keywords: *Road Damage Detection, Internet of Things, Pavement Condition Index (PCI), YOLO, ESP32-CAM.*