

CNN-BASED POTHOLE DETECTION SYSTEM TO SUPPORT IMPROVED DRIVING SAFETY AND ROAD QUALITY

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ABSTRACT

Road damage, particularly potholes, is a major obstacle to mobility and increases the risk of traffic accidents, thereby creating a need for intelligent and rapid monitoring technology. This study aims to design and implement an automatic road damage detection system using a Convolutional Neural Network (CNN) algorithm with the YOLOv8 model integrated with a Geographic Information System (GIS). Using the Waterfall development method, the system was implemented on a Raspberry Pi 5 device, a Neo M8N GPS module, as well as the SiALAN website platform and SiAlan Apps mobile application. The model is capable of identifying five categories of road damage, namely potholes, alligator cracks, edge cracks, patching, and weathering/raveling. The results indicate a high level of accuracy, ranging from 88% to 93%, with the alligator cracking category achieving the best performance, recording an F1-Score of 82.1%. Further testing demonstrated that vehicle speed affects detection effectiveness, with optimal results achieved at a speed of 10 km/h, yielding an average detection success rate of 84%. Meanwhile, at a speed of 30 km/h, performance decreased significantly to 40% due to the motion blur effect. Furthermore, the User Acceptance Test (UAT) results showed a system feasibility score of 84%, which falls into the Very Good or Highly Acceptable category. Overall, the developed system provides easy access to accurate information on the location and type of road damage, thereby supporting monitoring, decision-making, and road infrastructure maintenance planning. As a result, the system serves as an effective tool for improving driving safety and road quality.

Keywords: Road Damage Detection, Convolutional Neural Network (CNN), YOLOv8, Geographic Information System (GIS), Raspberry Pi 5.