

## ABSTRACT

*Damaged roads are a significant concern, contributing to traffic congestion, accidents, and tragically, fatalities. Data from the police in 2024 revealed that a minimum of three to four people died every hour due to road accidents. 30% of traffic incidents are attributed to infrastructure and environmental factors. In Indonesia, a substantial 31.9% of roads are still in disrepair, with 46.85% of these being provincial roads. To address this pressing issue and accelerate the identification of road damage, this research proposes the development of a deep learning-based road damage detection model. This model utilizes the You Only Look Once (YOLO) method, recognized for its superior speed in object recognition. The study focuses on three distinct classes of road damage: alligator cracks, linear cracks, and potholes. Two scenarios were employed for the dataset: a balanced dataset (where the difference in instances between classes ranged from 100 to 300) and an imbalanced dataset (with a difference of nearly 5,000 instances per class). The total image count between the two models varied by 3,110 (11,770 images for the balanced model versus 8,660 for the imbalanced model). The implementation of undersampling to balance the dataset allowed the model to achieve optimal performance 1.47 times faster than the imbalanced model. However, during the testing phase, the imbalanced model demonstrated a slight edge across most metrics, including precision (68.1% compared to 67.3%), mAP (64.0% compared to 63.6%), and mAP50-95 (31.7% compared to 30.9%). The sole exception was the recall metric, where the balanced model performed better (59.3% compared to 58.3%). Overall, the positive impact of undersampling on predictive capability was relatively minor. It led to an increase in True Positives (TP) and a decrease in False Positives (FP) by 10 for 'alligator cracks', 20 for 'linear cracks', and 6 for 'potholes', alongside a reduction of 16 instances in False Negatives (FN).*

**Keywords:** Road Damage, Deep Learning, Object Detection, You Only Look Once (YOLO)