ABSTRACT

The increasing number of motor vehicles in Indonesia has contributed to the rising rate of traffic violations, particularly by motorcyclists who fail to wear helmets. Although the Electronic Traffic Law Enforcement (ETLE) system has been implemented, challenges such as detection errors remain a barrier to effective law enforcement. This study aims to develop an Artificial Intelligence (AI)-based traffic violation classification system integrated with the ETLE system, with a focus on the automatic detection of helmet violations. Two main algorithm are used in this research: YOLO11 for real-time motorcyclist detection, and EfficientNet-B0 to classify helmet usage based on cropped images of the rider's head area. The dataset was obtained from mobile-based surveillance cameras and then processed through manual labeling, data augmentation, and preprocessing techniques such as denoising, contrast enhancement, sharpening, resizing, and normalization to optimize image quality for model training. The system development process follows the CRISP-DM approach, which includes business understanding, data understanding, data preparation, modeling, evaluation, and deployment into an operational system. The test results show that the YOLO11 model achieved 94.11% accuracy and a mAP@50 of 98.7% in detecting motorcyclists, while the EfficientNet-B0 model achieved up to 96% validation accuracy in classifying helmet violations. The system is capable of processing video in real-time with reliable accuracy, making it a highly promising solution to enhance the effectiveness and efficiency of digital traffic law enforcement in Indonesia through an advanced and automated ETLE system.

Keywords: ***artificial intelligence, CRISP-DM, EfficientNet-B0, ETLE, YOLO11***