

Abstract

Conventional parking management at *Telkom University Surabaya*, which relies on manual recording, has several drawbacks, such as inefficiency and low security. This study develops a parking automation system based on *computer vision* to improve efficiency and accuracy. The system consists of two main modules: *License Plate Recognition* (LPR) using *YOLOv11* and *EasyOCR*, and *Face Detection* (FD) using *Haar Cascade* and *ArcFace*. Verification is performed using *Fuzzy Matching* for license plates and *Cosine Similarity* for faces. The YOLOv11 model, fine-tuned for 35 *epochs*, achieved a *mAP@50* of 0.945 and *mAP@50-95* of 0.697 on validation data. Testing on 10 sample images demonstrated perfect *precision* and *recall* (1.0000). EasyOCR, after resolution enhancement, achieved an average accuracy of 80.32% based on the *fuzzy matching score*. The FD module showed significant improvement after *tuning*, eliminating false positives entirely and increasing the *F1-Score* from 0.3462 to 0.8889. Face identification using ArcFace and *Cosine Similarity* (threshold 0.70) yielded an F1-Score of 0.6667 on the original image, which improved to 0.8025 after *image enhancement*. Integration of face and plate detection was carried out in parallel and synchronized with a 5-second queue to ensure data alignment. *White box* testing confirmed that all features worked as expected. Most processes ran in under 1 second, except for face embedding, which required an average of 4.96 seconds. The total inference time for one complete cycle reached 447.26 seconds, yet the system remains efficient and feasible for lightweight parking automation in a campus environment.

Keywords: *Parking Automation, Face Detection, License Plate Recognition, Haar Cascade, YOLOv11, ArcFace, EasyOCR*