

## ABSTRAK

Pengenalan wajah dalam lingkungan kelas sering menghadapi tantangan seperti resolusi rendah akibat jarak kamera, pencahayaan tidak merata, serta keterbatasan perangkat keras pada *edge device* yang menyulitkan penerapan model *deep learning* berukuran besar secara real-time. Penelitian ini bertujuan mengembangkan sistem pengenalan wajah siswa berbasis *object detection* dengan memodifikasi arsitektur YOLOv8 agar lebih ringan dan efisien tanpa mengorbankan akurasi. Modifikasi dilakukan dengan menyederhanakan bagian *neck* dan menghapus jalur deteksi P4 dan P5, sehingga fokus pada skala kecil (P3) yang relevan untuk wajah berukuran kecil. Dataset yang digunakan terdiri dari citra 40 siswa dengan variasi posisi duduk dan pencahayaan, mewakili kondisi kelas sebenarnya. Hasil eksperimen menunjukkan bahwa model YOLOv8-*Simplified* mampu bersaing dengan YOLOv8x, varian terbaik YOLOv8, dengan ukuran model hanya 51.1 MB atau sekitar 62.7% lebih ringan. Evaluasi metrik menunjukkan performa tinggi, yakni *precision* 0.90, *recall* 0.85, mAP@50 sebesar 0.92, dan mAP@50-95 sebesar 0.70. Selain itu, kombinasi *learning rate* 0.001 dan 300 *epoch* terbukti optimal untuk keseimbangan akurasi dan efisiensi pelatihan. Dengan demikian, YOLOv8-*Simplified* menjadi solusi yang efisien, ringan, dan akurat untuk sistem pengenalan wajah berbasis AI di lingkungan pendidikan nyata, serta mendukung implementasi pada perangkat *edge* untuk analisis kelas secara *real-time*.

**Kata kunci**— *Deep Learning, Low Resolution, Face recognition, YOLOv8, Modern classroom*

## ABSTRACT

Facial recognition in classroom environments often faces challenges such as low image resolution due to camera distance, uneven lighting conditions, and hardware limitations on edge devices, which limit the real-time implementation of large deep learning models. This study aims to develop a student face recognition system using object detection by modifying the YOLOv8 architecture to make it lighter and more efficient without sacrificing accuracy. The modification involves simplifying the neck structure and removing detection paths P4 and P5, focusing only on the small scale (P3), which is more relevant for detecting small faces. The dataset used consists of 40 students with varying seating positions and lighting conditions, representing real classroom scenarios. Experimental results show that the YOLOv8-*Simplified* model performs competitively compared to YOLOv8x, the best-performing YOLOv8 variant, with a significantly smaller model size of 51.1 MB, which is approximately 62.7 percent lighter. The evaluation metrics demonstrate high performance, with a precision of 0.90, recall of 0.85, mAP@50 of 0.92, and mAP@50-95 of 0.70. Additionally, a learning rate of 0.001 and 300 *training* epochs were identified as the optimal combination for balancing accuracy and *training* efficiency. In conclusion, YOLOv8-*Simplified* offers an efficient, lightweight, and accurate solution for AI-based face recognition systems in real educational environments, making it well-suited for *edge* device implementation and real-time classroom analytics.

**Keywords**— Deep Learning, Low Resolution, Face recognition, YOLOv8, Modern classroom