

## ABSTRACT

Gender detection from facial images plays a pivotal role in intelligent security systems, personalized digital services, and demographic analytics. This study presents an end-to-end gender detection system that combines face detection via MediaPipe-OpenCV with gender classification using a pre-trained Inception V3 Convolutional Neural Network refined through transfer learning and fine-tuning. The dataset merges the Kaggle Gender Classification Dataset with the Indonesian Muslim Student Face Dataset (IMSFD) from Mendeley. Each image undergoes preprocessing face detection, cropping, resizing to  $299 \times 299$  pixels, intensity normalization to the 0 to 1 range, and data augmentation to enhance diversity and reduce overfitting. Hyperparameter optimization of learning rate, dropout rate, and batch size is performed via grid search. The optimized model attains 96.43 % validation accuracy with high precision, recall, and F1-score for both gender classes. Deployment of the model in ONNX format, integrated with OpenCV, enables real-time inference on a standard webcam at approximately 25 fps, maintaining robustness against variations in lighting, facial expression, and pose. These results highlight the system's applicability to vision-based surveillance, adaptive digital signage, and recommendation platforms that leverage user demographics.

**Keywords** : gender detection, face detection, CNN, Inception V3, transfer learning, hyperparameter optimization, OpenCV, augmentation.