

RANCANG BANGUN SISTEM KEAMANAN BERBASIS FACE RECOGNITION MENGGUNAKAN METODE *FACENET* DAN *SUPPORT VECTOR MACHINE (SVM)*

Nama : Muhammad Rizky Akbar
Npm : 220431100020
Program Studi : Teknik Elektro
Dosen Pembimbing 1 : Dian Neipa Purnamasari, S.ST.,M.Tr.T.
Dosen Pembimbing 2 : Puteri Nurul Ma'rifah, S.Tr.T.,M.Tr.T.

ABSTRAK

Penelitian ini bertujuan untuk merancang dan membangun prototipe sistem keamanan bandara berbasis pengenalan wajah secara *real-time* untuk proses verifikasi identitas penumpang. Sistem yang dikembangkan mengintegrasikan *Multi-task Cascaded Convolutional Neural Network* (MTCNN) untuk deteksi wajah, *FaceNet* untuk ekstraksi fitur wajah, dan *Support Vector Machine* (SVM) untuk klasifikasi identitas. Dataset yang digunakan terdiri dari 20 kelas penumpang, dengan masing-masing kelas berisi 25 citra wajah, sehingga total data sebanyak 500 citra. Tahap *preprocessing* dilakukan melalui deteksi wajah, *cropping*, peningkatan kualitas citra, dan *resize* menjadi 160×160 piksel. Pengujian model dilakukan dengan membandingkan kernel *Linear*, *Polynomial*, dan *Radial Basis Function* (RBF). Hasil terbaik diperoleh pada kernel RBF dengan split ratio 70:30 dan parameter $C = 1$, yaitu menggunakan 350 data latih dan 150 data uji. Konfigurasi tersebut menghasilkan *accuracy*, *precision*, *recall*, dan *F1-score* sebesar 100,00%. Pengujian aplikasi menunjukkan bahwa wajah penumpang terdaftar dapat dikenali dengan confidence 99,30% hingga 99,97%. Sistem juga diuji secara *real-time* menggunakan USB Webcam, Laptop Cam, dan Smartphone pada variasi jarak, pose, pencahayaan, serta aksesoris wajah. Selain itu, sistem berhasil diintegrasikan dengan *Database* untuk menampilkan identitas penumpang, confidence score, kode *booking*, nomor kursi, dan status verifikasi. Hasil penelitian menunjukkan bahwa sistem mampu melakukan verifikasi wajah dan data *booking* dengan baik. Namun, sistem masih memiliki keterbatasan dalam menghadapi spoofing karena belum dilengkapi *liveness detection* dan mekanisme *unknown face detection* yang optimal.

Kata kunci: Pengenalan Wajah, *FaceNet*, *Support Vector Machine*, MTCNN, Keamanan Bandara.

**RANCANG BANGUN SISTEM KEAMANAN BERBASIS FACE
RECOGNITION MENGGUNAKAN METODE *FACENET* DAN *SUPPORT
VECTOR MACHINE (SVM)***

Nama : Muhammad Rizky Akbar
Npm : 220431100020
Program Studi : Teknik Elektro
Dosen Pembimbing 1 : Dian Neipa Purnamasari, S.ST.,M.Tr.T.
Dosen Pembimbing 2 : Puteri Nurul Ma'rifah, S.Tr.T.,M.Tr.T.

ABSTRACT

This study aims to design and develop a prototype of an airport security system based on real-time face recognition for passenger identity verification. The developed system integrates Multi-task Cascaded Convolutional Neural Network (MTCNN) for face detection, FaceNet for facial feature extraction, and Support Vector Machine (SVM) for identity classification. The dataset used in this study consists of 20 passenger classes, with each class containing 25 facial images, resulting in a total of 500 images. The preprocessing stage includes face detection, cropping, image quality enhancement, and resizing facial images to 160×160 pixels. Model testing was conducted by comparing Linear, Polynomial, and Radial Basis Function (RBF) kernels. The best result was obtained using the RBF kernel with a 70:30 split ratio and $C = 1$, consisting of 350 training images and 150 testing images. This configuration achieved an accuracy, precision, recall, and F1-score of 100.00%. Application testing showed that registered passengers' faces could be recognized with confidence scores ranging from 99.30% to 99.97%. The system was also tested in real time using a USB Webcam, Laptop Cam, and Smartphone camera under variations of distance, pose, lighting conditions, and facial accessories. In addition, the system was successfully integrated with a Database to display passenger identity, confidence score, booking code, seat number, and verification status. The results show that the system is capable of performing face verification and booking data validation effectively. However, the system still has limitations in handling spoofing attempts because it has not yet been equipped with liveness detection and an optimal unknown face detection mechanism.

Keywords: Face Recognition, FaceNet, Support Vector Machine, MTCNN, Airport Security.