

ABSTRAK

SISTEM KEAMANAN DAN MONITORING *SAFETY BOX* DENGAN KAMERA BERBASIS *INTERNET OF THINGS*

(2025:xiii + 55 halaman + 24 gambar + 2 tabel + Daftar Pustaka + Lampiran)

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Keamanan aset pribadi seperti *safety box* menuntut sistem proteksi yang tidak hanya andal, tetapi juga adaptif terhadap perkembangan teknologi. Dalam penelitian ini, dikembangkan sistem keamanan dan monitoring *safety box* berbasis Internet of Things (IoT) yang mengandalkan autentikasi wajah dengan algoritma YOLOv5. Pemanfaatan teknologi ini dimaksudkan untuk meningkatkan keamanan fisik melalui otomatisasi serta monitoring *real-time* berbasis jaringan lokal. Dataset yang digunakan mencakup 1.100 citra wajah dengan beragam kondisi pencahayaan dan sudut pengambilan gambar, yang telah dilabeli dalam format YOLO untuk pelatihan model. Model YOLOv5 dilatih dengan konfigurasi khusus agar dapat berjalan optimal di perangkat rendah daya seperti mikrokontroler ESP32. Sistem keseluruhan terdiri dari kamera untuk akuisisi citra, ESP32 sebagai pengendali utama, motor pengunci solenoid, dan antarmuka web lokal untuk menampilkan status deteksi serta autentikasi secara visual dan interaktif. Evaluasi sistem menunjukkan performa deteksi wajah yang sangat baik, dengan nilai mean Average Precision (mAP) sebesar 0,992 dan nilai precision, recall, serta F1-Score mendekati 1,00. Sistem ini mampu mengidentifikasi wajah secara *real-time* dan mengendalikan akses ke dalam *safety box* berdasarkan nilai kepercayaan dari hasil deteksi. Temuan ini menunjukkan bahwa algoritma YOLOv5 efektif diimplementasikan dalam sistem keamanan berbasis IoT, khususnya untuk autentikasi visual dan kontrol akses fisik, dengan akurasi tinggi dan efisiensi perangkat keras yang baik.

Kata Kunci: YOLOv5, deteksi wajah, autentikasi, IoT, *safety box*, ESP32.

ABSTRACT

SECURITY AND MONITORING SYSTEM FOR A SAFETY BOX WITH CAMERA BASED ON THE INTERNET OF THINGS

(2025:xiii + 55 pages + 24 figures + 2 tables + bibliography + appendices)

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This research presents the development of a smart security and monitoring system for a safety box based on the Internet of Things (IoT), utilising face authentication through the YOLOv5 algorithm. The objective is to enhance physical asset protection by implementing an automated, real-time face recognition mechanism integrated with embedded hardware. The motivation behind this work stems from the growing need for more intelligent and reliable alternatives to conventional security systems, such as physical locks or PIN codes, which are vulnerable to breaches. The system was trained using a dataset comprising 1,100 facial images captured under varying lighting conditions and angles, annotated in the YOLO format. The YOLOv5 model was optimised for deployment on low-resource devices and embedded into a real-time hardware system, consisting of an ESP32 microcontroller, a camera module, a solenoid locking motor, and a locally hosted web interface developed with Python Flask. Experimental results demonstrate excellent model performance, achieving a mean Average Precision (mAP) of 0.992, with precision, recall, and F1-score values approaching 1.00. The system successfully performs real-time face detection and authentication, granting or denying access to the safety box based on a predefined confidence threshold. Additionally, it provides real-time visualisation and system status updates through a web-based interface accessible over a local network. The outcomes of this research confirm that the YOLOv5 algorithm can be effectively applied to IoT-based security systems, offering high accuracy, low-latency performance, and robust integration with embedded hardware platforms. This work contributes to the advancement of intelligent physical security technologies for both residential and industrial applications.

Keywords: YOLOv5, face detection, authentication, IoT, safety box, ESP32.