# Hasil revisi 156_wati_turnitin.docx

*by* By Turnitin

**Submission date:** 05-Feb-2026 11:30AM (UTC+0900)
**Submission ID:** 2866801192
**File name:** Hasil_revisi_156_wati_turnitin.docx (1.85M)
**Word count:** 1644
**Character count:** 10090

# Design Of Automatic Home Door Security Using Face Recognition With A Convolutional Neural Network (CNN) Model

**Mira Wati[1], Heri Wahyudi[2], Muhammad Syukri[3], Rizal Parghani[4]**
*[1,2,3,4] STMIK Mardira Indonesia, Bandung*
*Email: miramiw090999@gmail.com[1], herywahyudi@stmik-mi.ac.id[2], syukrie@stmik-mi.ac.id[3], rizal.parghani@stmik-mi.ac.id[4]*

## Abstract

*In Indonesia, the majority of residences continue to utilise traditional keys for door access. Keys are essential for house security; nonetheless, numerous criminals can circumvent this protection. A viable option to avert similar tragedies is to substitute the door security system with facial recognition technology. This security system employs CNN programming and an Arduino application. It utilises an ESP32 to autonomously open and close the door and engage a buzzer upon detecting a potential intruder. This research examines facial recognition technology utilised for door unlocking. The device exhibits a success rate of 71.4%, evaluated under various situations across five trials for each object.*

*Further upgrades to the gadget and system developed from this research can be achieved by incorporating more features and tools for detecting low light levels in a room. Furthermore, the system might be engineered to detect from considerable distances, such as many kilometres away.*

**Keywords:** *Face Recognition, ESP32, CNN, Arduino*

## Introduction

Technological and communicative advancements have led to an increasing demand for expedited and more efficient solutions within society. These improvements motivate individuals to persist in researching and uncovering methods to streamline daily tasks, including the exploration of technology in the realm of security.

Security denotes a state devoid of danger or threats. It is an essential component of every information system (Nabila et al., 2022; Tribuana et al., 2024). Enhancing security systems can avert criminal cases. A facial detection system for door security has been created utilising the Convolutional Neural Network (CNN) methodology. The Convolutional Neural Network, referred to in Indonesian as Jaringan Saraf Konvolusional, is a technique for advancing Multi-Layer Perceptron (MLP) machine learning to analyse two-dimensional data. Convolutional Neural Networks (CNNs) are categorised as Deep Neural Networks due to their numerous layers. Biometric systems are fast advancing, primarily employing facial traits for detection via face recognition (Rahim et al., 2023).

Face Recognition

The implementation of biometric technology is advancing swiftly. Biometric techniques typically employ facial characteristics for identification via facial recognition (Mishra et al., 2020; Radzi et al., 2020). Face recognition is a technology that utilizes computer systems to identify faces through a camera visually. The process of facial recognition parallels human visual perception. The facial detection gadget operates by correlating facial forms, textures, and other distinctive traits specific to each individual. The visual data analysed by the computer comprises pixels or picture parts. The visual display generally manifests in monochrome, grayscale, and actual colour—numerous factors affecting visual output include brightness, contrast, contour, colour, shape, and texture.

Convolutional Neural Network (CNN)

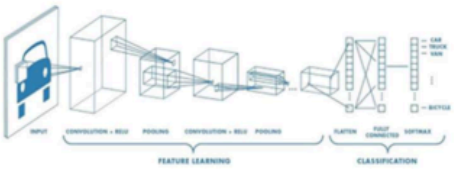


Figure 1. CNN algorithm architecture

A Convolutional Neural Network (CNN) is an algorithm classified as part of deep learning. Convolutional Neural Networks (CNNs) are frequently employed for object recognition through detection and segmentation processes. Their architecture has a significant influence on the efficacy of CNNs in detection (Mun & Lee, 2022; Phawinee et al., 2021).

A CNN comprises an input layer, an output layer, and several hidden layers. The concealed layers of a CNN consist of convolutional layers, pooling layers, fully connected layers, and normalisation layers (ReLU). Further layers may be included in the CNN to develop a more intricate model. (Rahim et al., 2022) This exemplifies a CNN architecture.

Arduino Software (IDE)

The Arduino Software (IDE) is a programming application that comprises a code editor, a text console, a message area, functioning buttons, and several additional menus. It facilitates access to the Arduino, enabling users to upload desired programmes and interact with the gadget. (Febriantono et al., 2023)




Figure 2. Arduino

The author aims to develop an automated and efficient house door lock system utilising advanced technologies, including Face Recognition through the CNN model.

**Research Method**

The research technique entailed the creation of a door security system that replaces conventional keys with facial recognition technology. The system incorporates Convolutional Neural Network (CNN) programming with an Arduino application. An ESP32 microcontroller is used to automate the door's opening and closing mechanism, while activating a buzzer upon detecting a potential intruder. The research examines the efficacy of facial recognition technology for door unlocking, conducting five trials for each object under diverse settings. The device attained a success rate of 71.4%, demonstrating its reliability in practical applications.

The research recommends integrating supplementary features and tools to augment performance in low-light conditions. This entails enhancing capabilities for remote detection, allowing the system to identify faces from several kilometres away. These developments will enhance the security system's versatility and mitigate obstacles presented by fluctuating illumination circumstances, consequently augmenting overall security efficacy.

**Result and Discussion**

**Analysis and Design**

Ongoing Analysis

The current examination involves deconstructing the existing system to identify and assess emerging issues. The ongoing analysis encompasses:



Figure 3. Analysis of the running system

System Overview

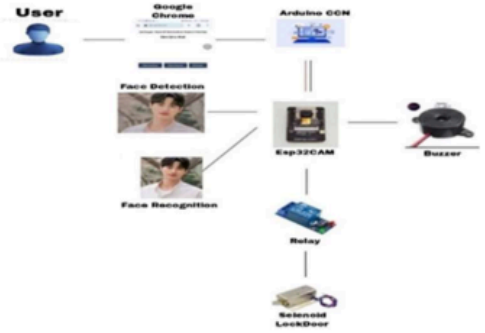



Figure 4. System Overview

Use Case Diagram Design

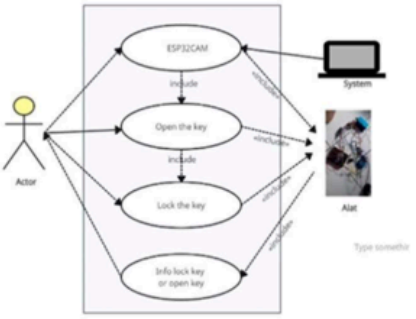



Figure 5. Use Case Diagram Design

Use Case Narrative

| *Use Case* | | *Smart door lock* | |
|---|---|---|---|
| *Actor* | | Penggguna, tamu, pengasuh rumah tangga, pencuri | |
| *Precondition* | | Esp32-cam on | |
| *Postcondition* | | Sistem sudah tersambung dengan alat | |
| *Main Flow of Event* | | | |
| *Action Actor* | | *System Response* | |
| 1 | Menyalakan stop kontak | 2 | Menampilkan alat menyala |
| 3 | Mengisi mendekatkan wajah ke Esp32-Cam | 4 | Mendeteksi wajah sudah terdaftar atau tidak |
| 5 | Buzzer berbunyi | | a. Jika salah, maka buzzer akan berbunyi |
| 6 | Selenoid | | b. Jika benar, maka solenoid akan terbuka |

Figure 6. Use Case Narrative

Activity Diagram

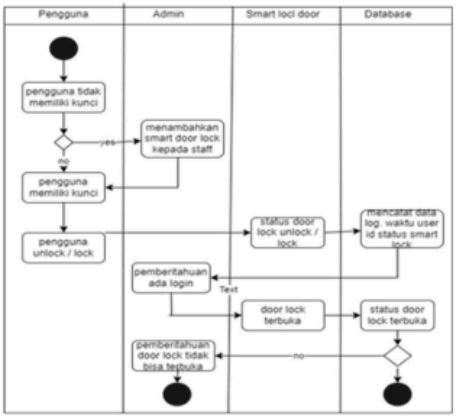



Figure 7. Activity Diagram

Sequence Diagram

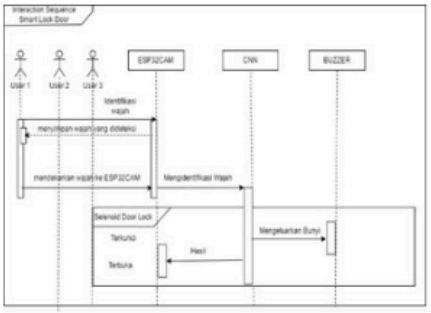



Figure 8. Sequence Diagram

Prototyping Design

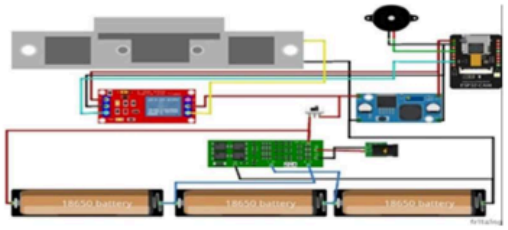



**Figure 9. Prototyping Design**

Description:

1. The ESP32-Cam is used to process the created program and to operate the existing sensors.

2. The step-down transformer is used as a communication bridge to send and receive power between devices.

3. The switch is used as an on-off button for the device to indicate or notify activity on the device while it is running.
4. The buzzer is used to indicate whether or not a face has been registered on the sensor.
5. The relay module is used to break the electrical circuit and connect the electrical current.
6. The solenoid is used as a door lock.
7. An 18650 Ultrafire battery can provide backup power.

Implementation and testing

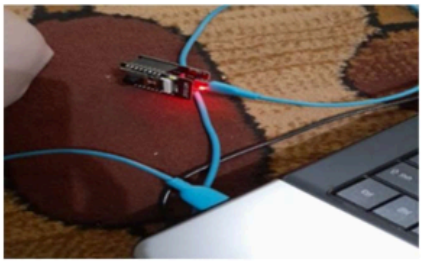


Figure 10. ESP32-Cam Connected to Laptop

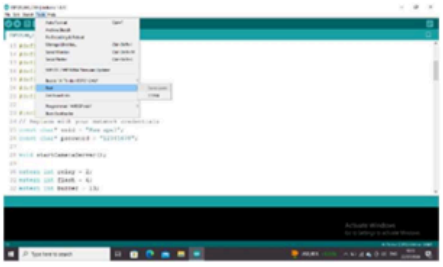


Figure 11. Enter the Program



Figure 12. ESP32-Cam is Connected To The Device

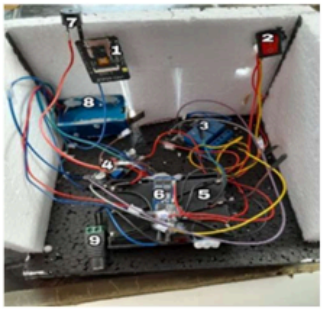



Figure 13. The Entire Set Of Tools

1. Undetected and unregistered facial data

   If the system and device do not detect facial data, the buzzer will sound, and the solenoid will not automatically open. The results are as follows:

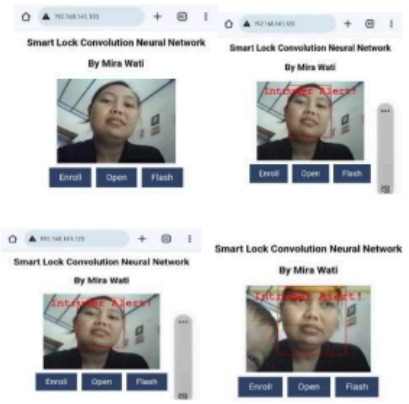



Figure 14. Undetected and unregistered facial data

Table 1. Results of testing unregistered facial samples

| No | Sempel wajah | Status | System | Doorlock | Buzzer | Ket |
|---|---|---|---|---|---|---|
| | Sempel id 0 | | | | | |
| 1 | Sempel wajah 1 | Terdaftar | Tidak di kenali | Off | On | Tidak sesuai |
| 2 | Sempel wajah 2 | Terdaftar | Tidak dikenali | Off | On | Tidak sesuai |
| 3 | Semepel wajah 3 | Terdaftar | Tidak di kenali | Off | On | Tidak berhasil |
| 4 | Sempel wajah 4 | Terdaftar | Tidak dikenali | Off | On | Tidak sesuai |

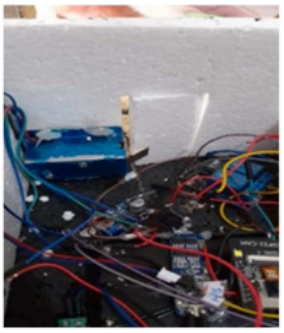
The table above represents the initial assessment of the comprehensive facial data tool, with the facial recognition accuracy for each test indicated by the formula below:

$$Akurasi\ deteksi\ wajah = \frac{Hasil\ berhasil}{Jumlah\ pengujian}\ x\ 100\%$$

$$\text{Akurasi pengujian 1} = \frac{0}{4}\ x\ 100\%$$

$$= 0\%$$

The facial sample data indicates that the face is undetectable and unregistered; hence, the solenoid will not activate, the buzzer will ring automatically, and the door will stay secured.



2. Detected and registered facial data

The system and gadget will automatically activate the solenoid upon detecting and registering facial data, and the buzzer will remain silent. The outcomes are as follows:




Figure 15. Detected and registered facial data

Table 2. Results of testing unregistered facial samples

| No | Sempel wajah | Status | System | Doorlock | Buzzer | Ket |
|---|---|---|---|---|---|---|
| | Sempel id 0 | | | | | |
| 1 | Sempel wajah 1 | Sedang mendaftar | Dikenali | Proses | Off | Sesuai |
| 2 | Sempel wajah 2 | Sedang mendaftar | Dikenali | Proses | Off | Sesuai |
| 3 | Sempel wajah 3 | Sedang mendaftar | Dikenali | Proses | Off | Sesuai |
| 4 | Sempel wajah 4 | Sedang mendaftar | Dikenali | Proses | Off | Sesuai |
| 5 | Sempel wajah 5 | Sedang Terdaftar | Dikenali | Proses | Off | Berhasil |
| 6 | Sempel wajah 4 | Sedang mendaftar | Dikenali | Proses | Off | Sesuai |
| 7 | Sempel wajah 5 | Terdaftar | Dikenali | Terbuka | Off | Berhasil |

The table above represents the initial assessment of the comprehensive facial data tool, with the facial recognition accuracy for each test indicated by the formula below:

$$Akurasi\ deteksi\ wajah = \frac{Hasil\ berhasil}{Jumlah\ pengujian}\ x\ 100\%$$

$$\text{Akurasi pengujian 2} = \frac{5}{7}\ x\ 100\%$$
$$= 71{,}4\%$$

The facial sample data indicates that facial detection and registration are successful; thus, the solenoid will activate, the buzzer will remain silent, and the door will open automatically.



**Coclusion**

This research concludes that the automatic door security system employing facial recognition technology with a Convolutional Neural Network (CNN) model is successful. This unique design addresses prevalent issues faced by landowners, particularly the challenge of vacating the premises when sure occupants have not yet arrived. This technique eliminates the need to hide the house key in locations such as vents, offering a safer and more convenient method for home access.

Additionally, the device operates as a digital key, augmenting home security with contemporary facial recognition sensors. Several proposals have been offered to future researchers to enhance this foundation. This

encompasses enhancing the program and device to align with technical progress, establishing a system for remote identification capabilities, and ensuring that the system can still identify registered faces even when the device is powered down, thereby obviating the need for re-registration.

**References**


Febriantono, M. A., Zuhair, A., & Khaeruddin. (2023). Smart Home Security System Using Face Recognition Based on IoT- CNN. 2023 International Conference on Information Technology Research and Innovation (ICITRI), 28–33. https://doi.org/10.1109/ICITRI59340.2023.10249929

Mishra, R., Ransingh, A., Behera, M. K., & Chakravarty, S. (2020). Convolutional Neural Network Based Smart Door Lock System. 2020 IEEE India Council International Subsections Conference (INDISCON), 151–156. https://doi.org/10.1109/INDISCON50162.2020.00041

Mun, H.-J., & Lee, M.-H. (2022). Design for Visitor Authentication Based on Face Recognition Technology Using CCTV. IEEE Access, 10, 124604–124618. https://doi.org/10.1109/ACCESS.2022.3223374

Nabila, L., Priharti, W., & Istiqomah. (2022). Design of Home Security System Using Face Recognition with Convolutional Neural Network Method. 2022 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT), 78–83. https://doi.org/10.1109/IAICT55358.2022.9887404

Phawinee, S., Cai, J.-F., Guo, Z.-Y., Zheng, H.-Z., & Chen, G.-C. (2021). Face recognition in an intelligent door lock with ResNet model based on deep learning. Journal of Intelligent & Fuzzy Systems, 40(4), 8021–8031. https://doi.org/10.3233/JIFS-189624

Radzi, S. A., Alif, M. K. M. F., Athirah, Y. N., Jaafar, A. S., Norihan, A. H., & Saleha, M. S. (2020). IoT based facial recognition door access control home security system using raspberry pi. International

Journal of Power Electronics and Drive Systems (IJPEDS), 11(1), 417. https://doi.org/10.11591/ijpeds.v11.i1.pp417-424

Rahim, A., Zhong, Y., & Ahmad, T. (2022). A Deep Learning-Based Intelligent Face Recognition Method in the Internet of Home Things for Security Applications. Journal of Hunan University Natural Sciences, 49(10), 39–52. https://doi.org/10.55463/issn.1674-2974.49.10.6

Rahim, A., Zhong, Y., Ahmad, T., Ahmad, S., Pławiak, P., & Hammad, M. (2023). Enhancing Smart Home Security: Anomaly Detection and Face Recognition in Smart Home IoT Devices Using Logit-Boosted CNN Models. Sensors, 23(15), 6979. https://doi.org/10.3390/s23156979

Tribuana, D., Hazriani, H., & Arda, A. L. (2024). Face recognition for smart door security access with convolutional neural network method. TELKOMNIKA (Telecommunication Computing Electronics and Control), 22(3), 702. https://doi.org/10.12928/telkomnika.v22i3.25946

.

# Hasil revisi 156_wati_turnitin.docx

ORIGINALITY REPORT

| 7% | 4% | 4% | 4% |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
|---|---|---|
| 1 | Submitted to Purdue University<br>Student Paper | 2% |
| 2 | jordanjamesbird.com<br>Internet Source | 2% |
| 3 | www.researchgate.net<br>Internet Source | 1% |
| 4 | journal.lemlit.org<br>Internet Source | 1% |
| 5 | You, Ziyang. "Thermodynamic Measurement and Control of Qubits on Superconducting Circuits", University of Macau<br>Publication | 1% |

| | | | |
|---|---|---|---|
| Exclude quotes | On | Exclude matches | Off |
| Exclude bibliography | On | | |