Face Identification System and Temperature Detection as A Control to Enter the Building

Nurul Rahma Dinda[1], *Thalia* Blesky[1], *Suharjito*[1], *Immanuela Puspasari* Saputro[1*]

[1]Computer Science Program, Binus Online Learning, Bina Nusantara University, Jakarta, Indonesia, 11480

Abstract. The purpose of this study was to develop an access control system for the identification of face and body temperature during the pandemic. Access control is granted after system tests and recognizes a person's face according to the information already stored. Facial identification system developed using the CNN method as a facial recognition process. While the Euclidean distance to calculate the pattern of the face extraction point. The sensor (DS18B20) is used for temperature detection and activating the LED if the temperature criteria and face identification are correct. The access control system is written with the Python programming system and uses the OpenCV module. Based on the results of the calculations from 5 datasets, the system has an accuracy of 75.31% with an average detectable temperature of 36.21 Celsius. This access control system can operate for 24 hours so that it is more effective and efficient in controlling entry into the building.

1. Introduction

One of the applications from previous research in which the system performs facial recognition processes on chatbot applications using CNN. The drawback of this application is the absence of a temperature detection process. The temperature detection process is needed for pandemic conditions like this. Therefore, with the current condition, the idea arises to create an application that will use face recognition and a body temperature sensor using the DS18B20 to be used as building entry control, body temperature information from the DS18B20 sensor and the results of facial recognition will be sent online as the person's entry control. to enter the building.

In the process of detecting the author's face using FaceNet. It has been proven that the FaceNet system can achieve a record, which is 99.63% using the Labeled Faces in the Wild (LFW) database, Facenet: A unified embedding for face recognition and clustering[1]. The accuracy of using FaceNet is higher than DeepFace which has an accuracy of 97.35. The ability to recognize faces can be done using the Convolutional Neural Network (CNN) using the Inception-ResNet-v1 method. The development of this system will be developed using the help of the TensorFlow GPU deep learning framework. 1.12 by implementing the FaceNet system developed by Google. For prototyping the system will be developed using the Python programming language and using the Python Flask 1.0.2 web service framework. Referring to the AT&T Database which has 10 face images for each person, the System will take 100 images of faces as training images if the user has not been recognized. The purpose of taking 100 images is to ensure that the system is adequately trained so that it can more easily recognize users in various conditions. The user will be recognized when the classifier training has been completed. From previous research, Vision: a web service for face recognition [2]. The system performs the facial recognition process on the chatbot application using CNN. The drawback of this application is the absence of a temperature detection process. The temperature detection process is needed for pandemic conditions.

2. Literature review

A facial recognition system is the process of detecting and identifying a person's face. Using facial recognition technology, we obtain precise and accurate facial identification and gender information and improve time and human resource efficiency resulting in accurate reports. Many facial recognition systems have been created before, but with various objects and application programs used. The research entitled Face Recognition Method for Personnel Identification Based on Facial Imagery for the Needs of Online Attendance, Semarang State University [3], was built using Python and OpenCV programming languages. The system development cycle is in accordance with the Software Development Life Cycle (SDLC) cycle which includes the initial data retrieval stage, analyzing system requirements, creating system designs, then creating systems and testing processes in the system development environment. This system uses 1.3778 facial data that has been processed using the Haar algorithm. The results of the facial recognition system for employee attendance identification online have been able to complement and simplify the process of controlling and supervising employee

* Corresponding author: immanuela.saputro@binus.edu

attendance by the officials of each unit because it adds a facial recognition prediction score to the employee attendance recapitulation of each unit. Another study entitled Access Control System Based on Real Time Face Recognition and Gender Information [4], was built using the Principal Component Analysis (PCA) method as a facial recognition process and facial extraction point pattern recognition to produce gender information and use while the Arduino microcontroller to activate relays. This system can help the process of improving security in obtaining someone's identity information by detecting faces and assisting officers in maintaining and improving security and reducing identity fraud. The facial recognition system used as an automatic lock to open and close doors was successfully built through a study entitled Implementation of Automatic Locks Using Face Recognition and Automatic Doors Using Raspberry Pi-Based Speech Recognition [5]. Based on the test results, the system is able to open and lock the door automatically at 0.3 to 0.7 meters with an average accuracy of 67.2% and a response time of 7.87 seconds. Facial recognition systems are widely used in companies that serve as proof of the presence of their employees. This system aims to reduce fraud that may occur if there is human intervention in conducting attendance. However, most existing facial recognition systems are not optimal if there are changes in the position of the face, and changes in light. The research entitled Face Recognition System Attendance System using Raspberry Pi [6] succeeded in creating a system that combines image contrast technology, image color features, and multilevel classification of the detection features used as an attendance system that can recognize students' faces with a variety of different facial highlights. The research entitled Designing a Face Recognition Attendance System Using an Internet of Things-Based Microcomputer [7], also focuses on the presence of employees in a company. The system successfully detected facial recognition of employees who performed attendance by sending incoming data and data back into the system database for verification in advance with pretrained facial data. Face recognition is one of the biometric-based applications for identification, access control, and registration used in various organizations. This system is widely used because it provides security, cost-effective, faster and more efficient. Among several biometric techniques, facial recognition is the best scenario to prevent the spread of the Covid-19 virus as well as an attendance system. The research entitled Real-time Mask Detection and Face Recognition using Eigenfaces and Local Binary Pattern Histogram for Attendance System [8] succeeded in making a facial recognition system that was applied as a presence at Kuching Community College face without the need to remove the face mask. Facial recognition can also be used as a web service through chatbots. Like the research entitled Vision: a web service for face recognition using convolutional network [2] managed to provide web services to 100 users with the help of Jacob's voice chabot.

During the Covid-19 pandemic, body temperature measures as one of the indicators that allow whether employees can work in the office or not which is also used as an attendance system in a company. The research entitled Design and Build an Attendance System with Arduino AT mega2560 Based Body Temperature Check [9] succeeded in making a tool that detects employee body temperature by the ideal distance is 3.5 cm and the tool will sound if the temperature of a person exceeds 38^0C. Another study related to body temperature measurement entitled Temperature Detection Through Thermal Imagery of Faces Using Deep Learning [10] succeeded in detecting a person's body temperature based on thermal imagery of faces using the Tuft Face Database dataset of 109 images. The average accuracy of the system is 90% measured using mAP and the speed of time required is an average of 39.95 seconds. Body temperature is one of the indications to know a person's health. A thermometer is a device that can be used to provide information regarding the amount of body temperature. However, for the visually impaired who have limitations in vision, it is certainly difficult to use it independently. The research entitled Design and Build a DS18B20 Sensor-Based Digital Thermometer for the Blind [11] succeeded in making a prototype of a digital thermometer using the DS18B20 sensor which can measure body temperature well and make sounds so that blind people can independently measure their body temperature.

The study entitled Detection of Vehicle Types on the Road Using OpenCV [12] succeeded in detecting the type of vehicle and calculating the detected vehicle based on its type. The program will process the inserted video and generate a .txt file as output. This file contains the type of vehicle detected along with the number of vehicles detected by type. From the test results, the program has an average accuracy of 77.8% for calm road conditions, 47.5% for normal road conditions, and 28.2% for congested road conditions that in these conditions use OpenCV for real time computer vision programming for academic and commercial use.

Research uses YTF and LFW datasets. The YTF dataset is used for the SR fine-tuning process. While the LFW dataset is used for fine tuning and FaceNet evaluation. In this study, low-resolution images will be enhanced using SR. The SR methods to be used are Res-Net GAN and RRDB GAN. After that the image with an increased resolution will be recognized using Facenet. The results of the evaluation with the SR RRDB GAN dataset have the highest accuracy rate of 98.96% and the VAL rate of 96.757%. The SR Res-Net GAN dataset has an accuracy rate of 98.53% and a VAL rate of 94.667%. The accuracy rate of Facenet using SR data is better than the accuracy obtained by 0.46%, Low Resolution Face Recognition With Generative Adversarial Network [13].

Based on the studies that have been carried out on the topic of face recognition and using OpenCV, the goal to be achieved is in the face recognition process both in real time and gender. In contrast to previous studies, this research will use the Facial Landmark method with how the OpenCV library can perform face recognition and NodeMCU. As a system development that will produce a facial recognition application program with gender information, information on the use of masks using the Facial Landmark method as a facial recognition process and facial extraction point pattern recognition to generate

gender information, the use of masks and the use of NodeMCU microcontrollers and temperature sensors (ML90614).

3. Method

The research method used and the results of the design of the hypothesis using the existing statistical methods. More details will be discussed in the following sub-chapter.

3.1. System Analysis

System analysis so that the system matches the expected results, it is necessary to do a system analysis on the application that is made so that the stages and processes needed by the system are known. After analyzing data and collecting various research sources, the next step is the modeling, construction and deployment stages as described in the previous chapter. Face recognition requires hardware assistance, one of which is a webcam. Webcams are used to capture objects in real time, the webcam has several advantages, namely it can capture objects accurately and quickly. By using a webcam this system can run to detect faces precisely.
In this system, in addition to the webcam as a face detection tool, a Raspberry Pi microcontroller and NodeMCU are used as tools for relay devices and connections for access control, and this system also uses a thermistor sensor as a temperature sensor. These four devices are integrated with each other by detecting, calculating, and providing gender information using a webcam. Furthermore, the running system will detect body temperature and then send commands to the microcontroller relay for processing and the user will see the detection results on the screen. The Face Identification System and Body Temperature Detection as Access Control Entering the Office Building is implemented using the Python programming language using Inception ResNest V1.

3.2. Research Flowchart

Figure 1 illustrates the methodology of the research carried out. The research consists of 3 stages, namely:

1. Modeling stage: consist of problem identification; preliminary studies; requirements gathering; training data; program implementation; program testing.
2. Simulation stage
3. Prototype

To better understand the steps taken by researchers in conducting research, the following includes a detailed and through explanation of the systematic model of the problem-solving methodology:

- Preliminary Study
  The authors conducted a literature study by collecting reference books and looking for online journals related to the research topic. The aim is to obtain existing theories and principles that can be applied in solving the problems at hand. Based on the experience experienced by researchers when entering an office building, the process of checking temperature and employee identification is still done manually, therefore the idea arose to create an automatic face identification and temperature detection application system.
- Data Collection
  The authors collect data according to the scope of the problem that will be processed to solve the problem of face identification and temperature detection. The Casia WebFace, face dataset that the researcher uses is a database that is appropriate and relevant to this study.
- Simulation Stage
  1. Training Data
     This stage aims to conduct training on the faces in the dataset. This stage serves so that the system can recognize faces detected on the camera. At this stage, the Inception RESNET V1 method is used to conduct training in the face recognition process.
  2. Program Design
     After successfully training the facial dataset, the authors designed a website-based application program using the Python programming language. The reason author uses the prototype method because it can save time and involves the user so that the program is in accordance with the wishes of the user.
     After designing, the author implemented the design into program code using Python programming language.
  3. Testing Program
     After the program has been implemented, the author conducts testing of the program to ensure that the program runs correctly.
  4. Simulation
     The compilation results will be used for simulation. At this stage the detection results have been obtained but the truth has not been determined.
  5. Prototype
     The web-based prototype produced at this stage is built with flash as a framework.

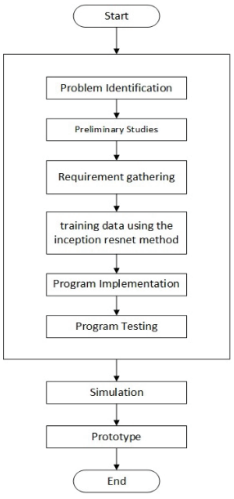


Fig.1. Research Flowchart

4. Data Collection

In this study, the researchers used the data to be used in the face recognition process using several datasets, namely the Azhari Akbar, Kareem Garudaputra, Nur Asiah, Nurul Rahma Dinda and Thalia Blesky datasets.

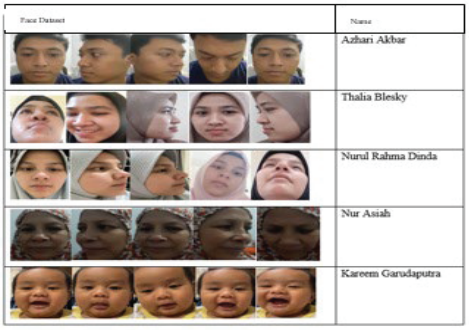


Fig.2. Characteristic Dataset

Figure 2 shows characteristics dataset where each character of the dataset has a number of images of approximately 105 images, the characteristics above use 6 faces, namely Azhari Akbar, Nurul Rahma Dinda, Nur Asiah, Kareem Garudaputra, and Thalia Blesky.

5. Results and discussion

The steps in the process of seeing faces can be seen from the following flowchart in Figure 3. The flowchart face recognition can be explained as follows: The user will get an image capture from the camera then change the color of the image to gray-scale then the application system will detect faces using the Cascade Classifier. To make face identification results more accurate, size and contrast changes are made in the image. When performing face identification using the Inception ResNet-V1 method, the resulting image from the face capture detection will be saved to be used as a dataset and a face re-mapping will be carried out on the collected dataset and then from the dataset results will be retrained on the face to get more accurate results.

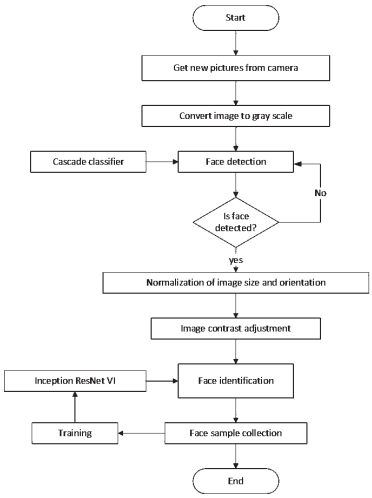


Fig.3. Flowchart Face Recognition

5.1. Flowchart Temperature

Checking the temperature using the Themistor sensor with a linearization technique to find the inverse function of the mathematical model which is a function of electronic components that change resistance to temperature called Resistance Temperature Detectors (RTD). DS18B20 Temperature Sensor [14], and Design and Build a Smart Soft Drink Dispenser System Using an Android-Based Raspberry Pi [15]. It is often used as a temperature sensor to check the temperature, for the temperature checking stage it can be seen from the flowchart Figure 4. The Flowchart Temperature showa, If the user has finished identifying the face, then the user checks body temperature, if the body temperature is >37C then the relay is On and if the body temperature is <37C then the Relay Off then the door will open (normally close on).

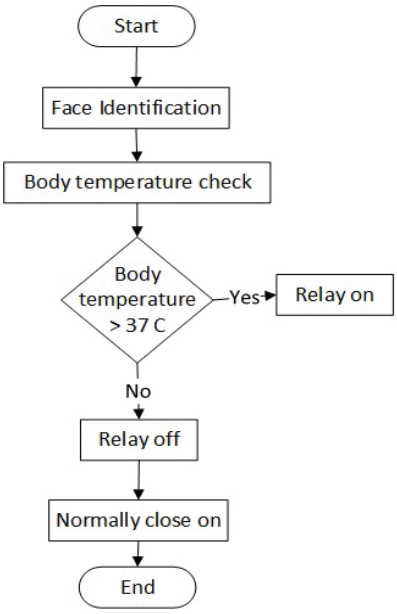


Fig.4. Flowchart Temperature

5.2. Flowchart System Application

Figure 5 shows regarding the case study in the tool we designed, namely within the scope of Bank Employees, before entering the office, the employee's face will be captured if it is not detected then the employee will repeat again to capture the face if the face has been detected then the employee will be detected body temperature if the body temperature is >37C then the relay is off if not then the relay is on and the tool will display the results of the next detection, employees are welcome to enter the office.

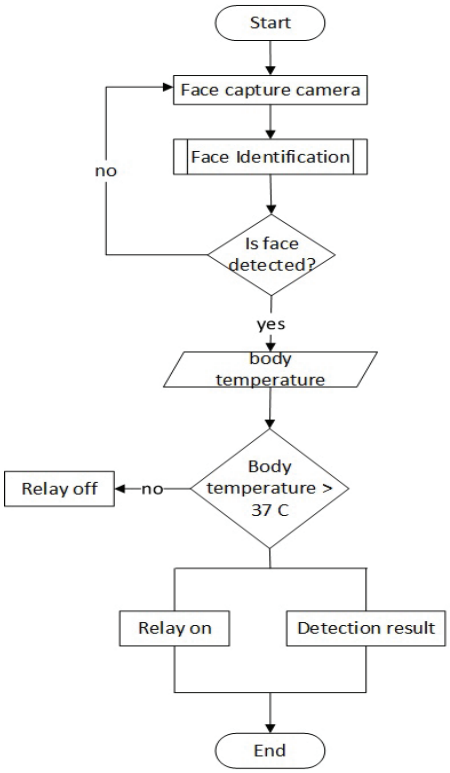


Fig.5. Flowchart System Application

5.3. Face Recognition and Temperature Result

Implementation uses the python programming language; researchers use Python version 2.7. The MTCNN process begins by creating a P-Net, R-Net, and O-net model. Then the results of the pre-trained MTCNN will be used to do cropping on the face. MTCNN will check the input image. The image will be cropped when a face is found in the image. MTCNN can simultaneously detect multiple faces and crop an image. Each image in the dataset consists of 1 face so that MTCNN will only detect 1 face. After the face is detected, the image will be cropped. So that the output image from MTCNN is a face without a background image which can affect the results during face recognition

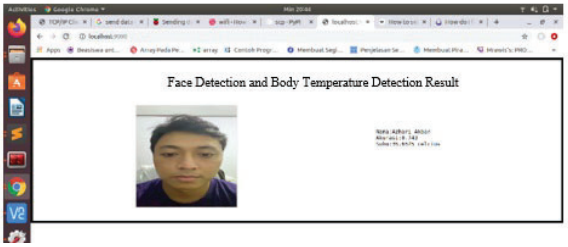


Fig.6. Azhari Akbar Identification Results

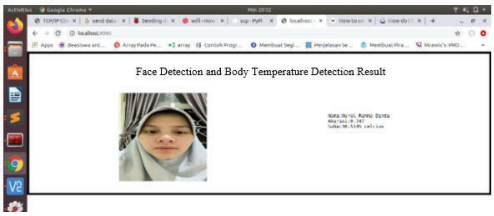


Fig.7. Nurul Rahma Dinda Identification Results

Figure 6 shows detection result of face recognition of Azhari Akbar with accuration of 0.743 and result of temperature sensor of 35.635 Celcius and Figure 7 shows detection result of face recognition of Nurul Rahma Dinda with accuration of 0.747 and result of temperature sensor of 36.5145 Celcius.

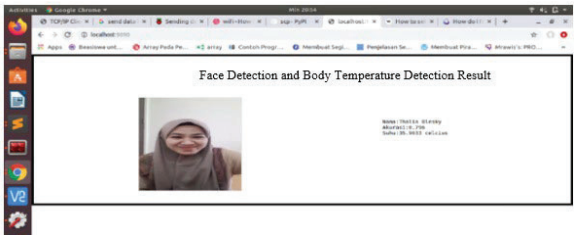
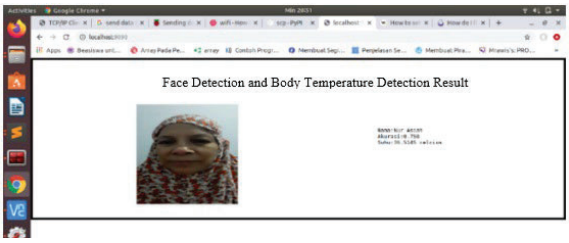


Fig.8. Nur Aisah Identification Results



Thalia Blesky Identification Results

Figure 8 shows detection result of face recognition of Nur Asiah with accuration of 0.758 and result of temperature sensor of 35.5145 Celcius and figure 9 shows detection result of face recognition of Thalia Blesky with accuration of 0.796 and result of temperature sensor of 35.9633 Celcius.

Table 1. Number of face data in Dataset

Name	Total Image	Face detection accuracy	Temperature detection
Azhari Akbar	104	0.743	35.6525 celsius
Nurul Rahma Dinda	112	0.747	36.5145 celcius
Nur Asiah	112	0.758	36.5155 celcius
Thalia Blesky	104	0.796	35.9633 celcius
Kareem Garudaputra	105	0.7126	36.4532 celcius
Average		0.7531	36,2198 celcius

6. Conclusion

From the results of the design and evaluation of program results, so the conclusions that can be given are as follows:

1. By using this system, it can help the process of increasing security during a pandemic like this in obtaining information on a person's identity by detecting face and body temperature information.
2. The results of the study show that facial recognition results are better if the dataset used only shows facial images and has high resolution.
3. The Inception Resnet – V1 method has a higher accuracy of 0.7513.

References

1. F. Schroff, D. Kalenichenko, and J. Philbin, "FaceNet: A unified embedding for face recognition and clustering," in 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Boston, MA, 2015, pp. 815-823.
2. A. Archilles and A. Wicaksana, "Vision: a web service for face recognition," J. Telkomnika, vol. 18, pp. 1389-1396, Dec. 2020.
3. L. M. Kurniawan, "Face Recognition Method for Personnel Identification Based on Facial Image for Online Presence," Scientific Journal of Informatics, vol. 1, no. 2, pp. 210-220, 2014
4. P. Nurmala, W. Gazali, and W. Budiharto, "Access Control System Based on Real Time Face Recognition and Gender Information," Jurnal ComTech: Computer, Mathematics and Engineering Applications, vol. 6, no. 2, pp. 198-207, 2015.
5. A. Ridho, E. Ariyanto, and E. Jadied, "Implementation of Automatic Lock Using Face Recognition and Automatic Door Using Speech Recognition Based on Raspberry Pi," Proceedings of Engineering, vol. 4, no. 3, pp. 1-10, 2017.
6. Evanjalin, Christy, Karthika, and Reshma, "Face recognition system attendance system using Raspberry Pi," Irish Interdiscip. J. Sci. Res., vol. 5, no. 2, pp. 84-91, Dec. 2021.
7. A. Roihan, N. Rahayu, Aji, and S. Danang, "Face recognition presence system design using microcomputer based on internet of things," Technomedia Journal, vol. 5, pp. 2620-3385, year not provided.
8. M. Suhaimin, M. Hijazi, C. Kheau, and C. On, "Real-time mask detection and face recognition using eigenfaces and local binary pattern histogram for attendance system," Bulletin of Electrical Engineering and Informatics, vol. 10, pp. 1105-1113, 2021.
9. S. Hartanto and A. D. Prabowo, "Attendance system design with Arduino ATmega2560 based body temperature check," J. Ilmiah Elektrokrisna, vol. 9, no. 3, pp. 27-40, Sep. 2021.
10. D. D. Aryasatya, N. Suciati, and A. M. Shiddiqi, "Temperature detection through facial thermal using deep learning," J. Teknik ITS, vol. 10, no. 2, pp. 189-194, Aug. 2021.
11. E. Nurazizah, Ramdhani, Mohammad, and Achmad Rizal, "Design Digital Thermometer Based on Sensor DS18B20 for Blind People," e-Proceeding of Engineering, vol. 4, pp. 3294, 2017.
12. A. Lazaro, "Detection of Vehicle Types on the Road Using OpenCV," Jurnal Teknik ITS, vol. 6, no. 2, pp. 296-299, 2017.
13. H. Martin, "Low Resolution Face Recognition Dengan Generative Adversarial Network," Magister Thesis, Bina Nusantara University, 2020.
14. M. Imam and E. Apriaskar, "Water temperature control using DS18B20," J-ENSITEC, vol. 6, no. 1, pp. 1-6, Mar. 2019.
15. P. Sandy and W. Susi, "Design and build a smart soft drink dispenser system using an android-based Raspberry Pi," Jurnal IKRA-ITH INFORMATIKA, vol. 5, no. 2, pp. 75-84, 2021.