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Vehicle Safety System with Arduino-Based Face Detection Technique

Mira E.[1] Samsul Hadi[2], Arif R Fachrudin[3], Sugeng Hadi Susilo[4], Rilis Eka Perkasa[5]
[12345]*Politekhnik Negeri Malang, Indonesia*

Corresponding Author: mmilla20@gmail.com

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ABSTRACT

Security systems on vehicles with alarms have been widely applied to detect the presence of thieves. But the system cannot tell the difference between a vehicle owner and a thief, so the security level is very low. The aim of this study is to recognize the vehicle owner's face and distinguish it from the thief's face. Face recognition is a technology from a computer that allows us to identify or verify a person's face through a digital image. The trick is to match the texture of our facial curves with facial data stored in the database. The vehicle security system using Face Recognition is a system that is very helpful in securing the vehicle from theft when the owner leaves it. The vehicle can only be started by detecting the owner's face which has been entered in the system database. If the driver's face is not recognized and is not in the system database, this tool will automatically sound an alarm and turn off the ignition of the vehicle so that it cannot be turned on. In this study, four facial samples were included in the database which was identified as the owner of the vehicle. And four samples of faces that were not entered in the database as foreigners or non-owners of the vehicle. The result of the research is that only facial samples registered in the database can start the vehicle. While samples outside the database cannot start the vehicle.

Keywords: *Vehicle Safety System, Face Detection, Arduino-Based Face Detection*

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INTRODUCTION

Motor vehicle ownership every year always increases. Be it private cars, public transportation, goods cars, or motorbikes. This is accompanied by an increasing number of motor vehicle thefts. Security systems on vehicles with alarms have been widely applied to detect the presence of thieves. But the system cannot tell the difference between a vehicle owner and a thief, so the security level is very low. The use of face recognition in this study is to recognize the vehicle owner's face and distinguish it from the thief's face.

Face recognition is a biometric technology that has been widely applied in security systems, not only recognizing the retina of the eye, recognizing fingerprints and irises Ambadi P, Joyal Johnson (2017), Nethravati B, Sinchana SS, Anil BC (2019). In the application itself, facial recognition uses a camera to capture a person's face and

then compares it to a face that has been entered into a particular database. Face recognition is a technology from a PC that allows us to recognize or verify a person's face through a digital photo. The trick is to match the texture of our facial curves with facial information stored in the database. One of the applications is with the help of AI-Thinker on esp32-cam. The person's face is compared to the authorized person's face stored on the SD card esp32-cam ,Marella Nagendra Babu (2019)

The vehicle security system using Face Recognition is a system that is very helpful in securing the vehicle from theft when the owner leaves it. The vehicle can only be started by detecting the owner's face which has been entered in the system database. If the driver's face is not recognized and is not in the system database, this tool will automatically sound an alarm and turn off the ignition of the vehicle so that it cannot be turned on.

The final result of the study shows that the vehicle safety system with face detection can work well. For face samples entered into the database, the average voltage generated from each experiment ranges from 3.2 -3.8 Volts. This voltage range can activate the relay so that it can trigger/activate the ignition system in the vehicle. As for the face samples that were not entered into the database, the average voltage generated from each experiment ranged from 0.9 -1.6 Volts. This voltage range cannot activate the relay, so it cannot trigger/activate the ignition system in the vehicle.

METHOD

Working Principles

Figure 1. Working Principles

There are five main components in this series, namely: ESP 32 camera, laptop, Arduino, relay, and ignition system. The working principle of this tool is as follows. If a face is detected by the ESP 32 camera mounted on the steering wheel dashboard, the ESP 32 camera will send a notification signal to the Arduino. If the face of the driver has been registered in the database entered by the program from the laptop, the Arduino will send a signal 1 to activate the relay connected to the ignition system of the vehicle. If the driver's face is not in the database, it will signal 0 to the relay, so the relay will not turn on and will not be able to activate the ignition of the vehicle.

Face Detection Method on ESP 32 Cam

ESP 32 Cam can detect human faces with the MTMN model. Input is an image with 24-bit RGB format. The output is the coordinates of the human face if it is in the image. If a human face is detected through the process, it can be verified with the previously registered face. The input is the original image and the result of the face detection process. The output is a 512-d vector representing faces. Then by comparing with the existing face vectors, we can determine whether the two faces are from the

same person , esp-dl · GitHub . The steps below list the whole Face Recognition process:

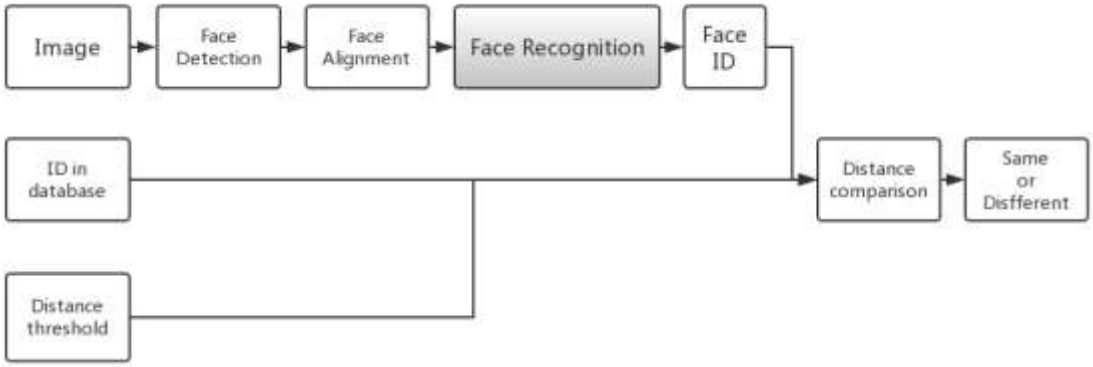

Figure 2. Block Diagram of Face Detection Method on ESP32 CAM

The working process of the box diagram is as follows:

1. Image: Get the input image with a resolution of 320x240.
2. Face Detection: Start Face Detection and get face coordinates.
3. Align Face: Align the face using the coordinates and get a face image of the desired size.
4. Face ID, Face Recognition: Enter the aligned face image into the face recognition algorithm and create Face ID. get_face_id and recognize_face
5. Compare the newly created Face ID with the existing Face ID and get the distance between these two Face IDs (usually in Euclidean distance or Cosine distance).
6. Determine if the two Face IDs are from the same person by comparing the distance between these two Face IDs and the specified threshold.

Data capture

Data from the study will be entered in a table as shown in table 1. The variables used are facial variations and the resulting output voltage. The data collection technique was carried out by recording every voltage generated from the ESP 32 when given input in the form of sample variations from faces contained in the database or those not in the database.

Tabel 1. Research data table

No	Sample	Vout 1 (volt)	Vout 2 (volt)	Vout 3 (volt)	Vout Average
1 2 3 4	A1 A2 A3 A4				

In table 1, four face samples will be entered which will be entered as vehicle owners and will be compared with four face samples that are not entered into the database. In each sample, three trials were taken, and then the average value of the output voltage from the ESP 32 was taken to compare the output voltage value of the sample data in the database and the sample data outside the database.

RESULT AND DISCUSSION

Facial sample data entered in database

As the face sample data contained in the database, four samples were taken which were included in table 2.

Table 2. Comparison of output voltages generated from face samples in the database

Face Sample	Display	V1 (volt)	V2 (volt)	V3 (volt)	V Average (volt)
A	Front	3.6	3	3.2	3.27
	Right Side	3.9	3.5	3.5	3.63
	Left Side	3.7	3.4	3.5	3.52
B	Front	3.8	3.9	3.5	3.73
	Right Side	3.7	3.6	3.9	3.73
	Left Side	3.9	3.9	3.6	3.8
C	Front	3.6	3.4	3.7	3.56
	Right Side	3.8	3.5	3.9	3.73
	Left Side	3.7	3.8	3.6	3.7
D	Front	3.6	3.7	3.5	3.6
	Right Side	3.4	3.5	3.2	3.36
	Left Side	3.7	3.8	3.9	3.8

There are 4 face samples entered in the database, each of which has three sides. That is the front view, the right side view, and the left side view. On each side, 3 trials will be carried out to get the output voltage (Vout) from the ESP 32 and connect to the Arduino to activate the ignition system on the vehicle. The graph of the average stress can be seen in Figure 2.

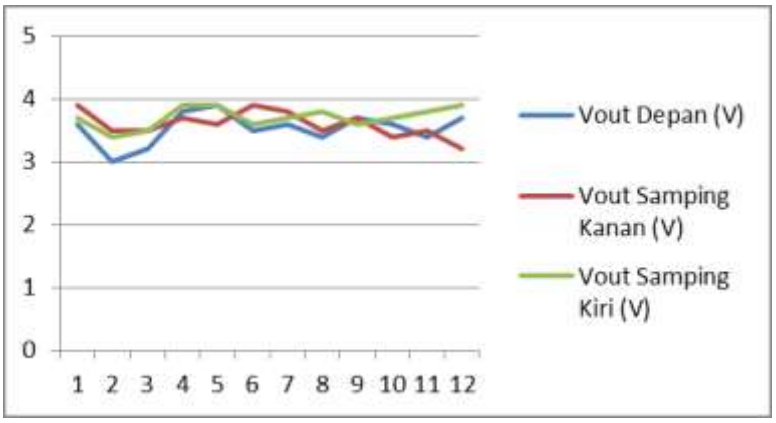

Figure 2. Comparison graph of the output voltage value on the sample in the database

For the face samples entered into the database shown in the graph in Figure 2, the average voltage generated from each experiment, namely V out for the front view, right side, and left side view, ranges from 3.2 -3, 8 Volts. This voltage range can activate the relay so that it can trigger/activate the ignition system in the vehicle.

Face sample data is not entered in the database

As facial sample data is not contained in the database, four samples are taken which are included in table 3.

Table 3. Comparison of output voltages generated from face samples outside the database

Face Sample	Display	V1 (volt)	V2 (volt)	V3 (volt)	V Average (volt)
A	Front	1.3	0.9	1.2	1.133
	Right Side	1.2	1.1	1.3	1.2
	Left Side	0.9	1.2	0.8	0.967
B	Front	1.1	0.7	0.9	0.9
	Right Side	1.2	0.8	0.7	0.9
	Left Side	1.2	1	1.2	1.134
C	Front	1.3	1.1	1.2	1.2
	Right Side	1.1	0.9	1.2	1.06
	Left Side	1.3	1.5	1.2	1.32
D	Front	0.8	0.7	0.9	0.8
	Right Side	1.5	1.3	0.9	1.24
	Left Side	1.2	1.3	1.2	1.23

There are 4 face samples that are not included in the database, each of which has three sides. That is the front view, the right side view, and the left side view. On each side, 3 trials will be carried out to get the output voltage (Vout) from the ESP 32 and connect to Arduino to activate the ignition system.

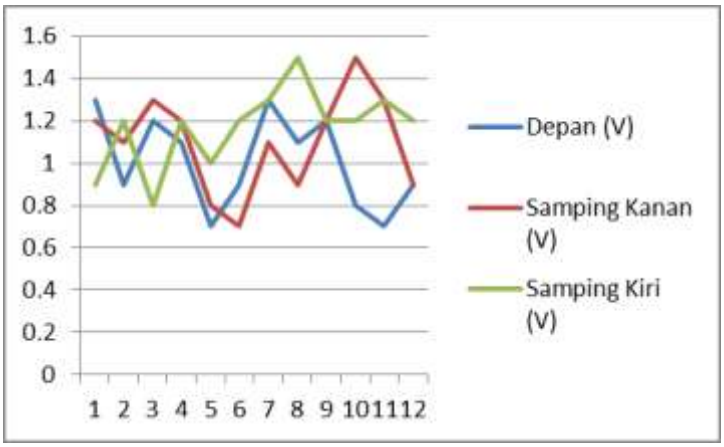

Figure 3. Graph of the comparison of the output voltage values in samples outside the database

For face samples that were not entered into the database, the average voltage generated from each experiment ranged from 0.9 -1.6 Volts.This voltage range cannot activate the relay, so it cannot trigger/activate the ignition system in the vehicle. The graph of the comparison of the output voltage values in samples outside the database can be seen in Figure 3.

CONCLUSION

The vehicle safety system can be implemented by utilizing face detection to identify the owner/driver of the vehicle. And only the owner registered in the database can activate/operate the vehicle. The circuit used consists of an Arduino, ESP 32, a laptop, and a relay connected to the vehicle's ignition system. Based on the data generated from the experiment, it can be concluded that for the voltage generated for some of the samples entered in the database, there are only a few differences in the voltage values. However, when compared with several samples that were not included in the database, there was a significant difference in the value of the voltage.The stability of the voltage on each part tends to be stable, which has a difference of only 0.5 volts.

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AUTHOR CONTRIBUTION STATMENT

All authors have worked in a shared roles in conducting and research report accordingly. As this project done in a shared portion, there is no any conflicted in managing project.

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