Integration of opencv raspberry pi 3b+ and camera sensor in access control of vehicle ignition key system

Lukman Medriavin Silalahi\textsuperscript{1,2,3,4,5}, Imelda Uli Vistalina Simanjuntak\textsuperscript{2}, Freddy Artdima Silaban\textsuperscript{3}, Setiyono Budiyanto\textsuperscript{4}, Heryanto\textsuperscript{5}, Muhammad Ikhsan\textsuperscript{6}

\textsuperscript{1,2,3,4,5} Department of Electrical Engineering, Universitas Mercu Buana, Jl. Raya Meruya Selatan, Kembangan, Jakarta 11650.
\textsuperscript{6} Department of BaliFiber, PT Bali Towerindo Sentra, Tbk, Jl. Jenderal Sudirman Kav. 3., Tanah Abang, Jakarta 10250.

\textsuperset{*}Email : lukman.medriavin@mercubuana.ac.id

Abstract. The use of sensors for safety and comfort in vehicles has increased, as in several studies that are being discussed, including the use of pressure sensors for applications in the TPMS system or face recognition system security. The purpose of this research is to reduce vehicle theft that is happening right now. This system consists of a face recognition system. This reason is based on the ineffectiveness of the vehicle handlebar / steering lock. But in this study, a vehicle safety prototype was designed with a face recognition method in the hope that this prototype was designed to provide a sense of comfort, security and also the vehicle becomes a privacy vehicle. The method used is the Local Binary Path Histogram method to detect image objects and a small camera to capture images of the face, using the Raspberry Pi as a tool control center (in which the process occurs: Scanning, Extracting, Comparing, Matching, and all have been incorporated in OpenCV). The output of this study is the face that has been recorded in the database as access to open access to vehicle security. The conclusion of this research is the process of facial recognition in real time activating the vehicle ignition lock system.

1. Introduction
At present many prototypes have been developed for a system in driving comfort and safety. In this research, we propose a prototype design of a face recognition system for safety in vehicles. Which in previous research have conducted research on tire pressure systems for driving comfort. [1]

Vehicle theft is the impact of the lack of vigilance of the vehicle owner and the security of the vehicle system which is influenced by several factors, namely security in the double lock of the vehicle or the intention to steal the vehicle. But in this research, we designed a prototype for a vehicle safety system by identifying faces using motorized vehicles. [1-3]

The development of digital technology today has influence in various fields. Among them are on computer technology, and application development from a microcontroller. Digital image processing is one type of technology to solve problems in image processing. Images will be processed in such a way that they are easier to process and convert into information. Face recognition is an example application of image processing. In this research, a face recognition and face detection application in...
the field of computer vision was created through image processing. The method used is the Local Binary Pattern Histogram method. This method was chosen to get fast, accurate, and efficient results in face detection on images. One of the benefits is the application of the Raspberry Pi microcontroller by using face recognition techniques as an automatic lock system that uses face detection. The sensor used in this module is a mini camera. [2-13]

The purpose of the Face Recognition System in this research is to identify and verify a person's face through a digital image. The process is to do the process of matching the texture of our facial curves to the face data stored in the database. This system is committed to developing a process of recognizing individuals who can be trusted. At present, there are several digital image processing techniques that are quite well known and can be used to identify the identity of the owner of face images such as the Eigen Classifier, Fisher Classifier, and Local Binary Pattern Histogram classifier. So in this study, the Local Binary Pattern Histogram method is used.

By using computer vision technology it is hoped that other advantages will be possible to enable communication between movements with a mini camera. So that when the vehicle wants to be used, the mini camera will take pictures. Then, if the captured image matches the dataset stored in the database, the ignition will automatically ON and the engine will start. By using a face recognition system it is expected to maintain the safety of motorbikes from the perpetrators of crime.

2. Research Model

2.1. Related research

Research conducted by Ajinkya Patil, Mrudang Shukla, 2014. “Implementation Of Classroom Attendance System Based On Face Recognition In Class”. The research that was produced was a facial recognition system for the attendance of students in class to avoid wasting time in class so that the attendance process was automated based on image processing and face detection and facial recognition systems. The results of the research he has done is that the process of detecting faces to distinguish faces from non-faces has been successful by carrying out a number of scenarios that involve the process of facial recognition, namely marking the attendance of students based on existing databases in the collected student databases. The contents in the database are the student's name, student photo dataset and roll number. [4].

Research conducted by Ishita Gupta, Varsha Patil, Chaitali Kadam, Shreya Dumbre, 2016. “Face Detection and Recognition Using Raspberry Pi”. The research produced is a face recognition system with the aim of security and surveillance by exploring the application of Raspberry Pi-based face recognition systems using conventional face detection and recognition techniques such as Haar Detection and PCA (Principal Component Analysis), so that this system can replace the use of passwords and RFID for high security access. [5]

Research conducted by Suchitra, Suja, dan Shikha Tripathi, 2016. “Real-Time Emotion Recognition From Facial Images Using Raspberry Pi II”. The research produced is a method for direct recognition of emotions from facial images in order to identify human emotions. The method uses three steps of face detection including face detection using Haar-Cascade, feature extraction using ASM (Active Shape Model) of 26 extracted face points, and Adaboost classifier for the classification of five emotions including anger, disgust, happiness, neutral, to a surprise. So that the resulting interaction between humans - machines to improve work efficiency. Emotions that can be understood through the expression of text, voice and face. [6]

2.2. Method

In this research, facial images obtained came from the appearance of facial objects that have been captured until the face has been identified. The proposed method consists of several main process stages, namely:
So in this research, a prototype was designed that integrates OpenCV, Raspberry Pi 3B+ and a camera to control access to the vehicle ignition lock system. In Figure 1 above it can be explained that:

1. Raspberry Pi is a Single Board Computer (SBC) developed by the Raspberry Pi foundation in the United Kingdom (UK). Raspberry pi can work like a computer but mini-size that can create documents, process data with spreadsheets, watch movies, play games and of course coding. Raspberry Pi has two models, namely Model A and Model B, and in this study used
Model B which has a memory capacity of 512MB besides that Model B is also equipped with an Ethernet port. The Raspberry Pi design is based around the Broadcom BCM2835 SoC (System-on-Chip) which has embedded an ARM1176JZF-S processor with a frequency of 700MHz. Data storage is designed using an SD card for long-term boot and storage processes.

2. The security system to be achieved, namely confidentiality (a key must be given security by using computer vision technology so that it is not easily opened by anyone), availability (computer-based information system which is a quality data processing center and the raspberry pi is used to a decision-making tool with the aim that the data and information is available to those who are authorized to use it), and integrity (all subsystems must provide an accurate picture of the physical system it represents). [2]

3. Face recognition is a computer application that runs automatically to identify or verify someone from digital images sourced from video. Face recognition technology is based on the principles of neural computing, which analyzes facial characteristics that have been inputted in the form of images through the camera and can be broadly classified into static and dynamic matching. [2]

4. The method used in this study consists of machine vision and knowledge-based methods. The machine vision method consists of a training phase and a testing phase in which images are input. Image pre-processing which includes histogram equalization and median filtering enhances images in feature extraction preparation. Like the features: Haar, and Local Binary Patterns (LBP), then extracted from the image used to set the machine vision classifier. [7][8]

5. OpenCV is an abbreviation of Open Computer Vision, which is open source libraries that are specialized for image processing. The aim is for computers to have abilities similar to those in visual processing in humans. This library is made for the C / C ++ language as an application realtime optimization, has API (Application Programming Interface) for high level and low level, there are functions that are ready to use for loading, saving, image and video acquisition. This OpenCV library has features including structural analysis, camera calibration, motion detection, object recognition, etc. [3]

So for the block diagram in this design consists of two block diagrams, namely a software application that will be used for Python and Linux-based control systems that are on Raspberry Pi and a hardware system that plays a role in the mechanism of the relay system. Software applications are made using the Python programming language that allows users to be able to access buttons and webcams that are used to recognize and identify faces that have been created in the database, so that if a face is recognized then the system will work to activate the ignition key automatically. The hardware system uses several important components, namely a PC / Laptop, Raspberry Pi 3, webcam, Monitor Screen, LED as indicator, and relay.

For input using a webcam camera connected to the Raspberry Pi 3B +, then processed by Raspberry Pi 3B + and the output is a relay that works connecting several cables in the ignition socket as a switch so that it can turn on electricity on the motorcycle. There are LED indicators, which means that the ignition lock process is accepted and welcome to start the vehicle engine. And to illustrate the diagram in Figure 2.
3. Result And Analysis

3.1. Dataset program and face training program

In this section we will begin the first phase of the face recognition project using Raspberry Pi and OpenCV, which will start from the face detection step. In the first step, will create a dataset folder, where the folder will store for each id and some photos with a part that is used to detect faces. The results are as follows (Figure 3):

![Figure 3. Dataset collection](image)

Analysis and discussion for the face dataset program:

The face dataset command script has successfully run and outputs a total of 30 photos in 3 seconds. The results of the collection of photos in this dataset then we run the face_training command so that the dataset has been registered (recognize) into an algorithm where the file name is "trainer.yml", and both of these commands have a function as a predict recognizer. Predictive recognition is a comparison if the face does not match the dataset, the system will not recognize (unknown) and the ignition is inactive.
3.2. Face recognition program

In this section we will start the second phase of this research, which starts from running the command below:

```python
names = ['None', 'Lukman']

# Check if confidence is less them 100 ==> "0" is perfect match
if confidence < 100:
    id = names[id]
    confidence = " {0:.2f}".format(round(100 - confidence))
else:
    id = "unknown"
    confidence = " {0:.2f}".format(round(100 - confidence))

cv2.putText(img, str(id), (x=3,y=3), font, 1, (255,255,255), 2)

cv2.imshow('camera', img)

k = cv2.waitKey(10) & 0xff  # Press 'ESC' for exiting video
if k == 27:
    break

# Do a bit of cleanup
print("[INFO] Exiting Program and cleanup stuff")
cam.release()
cv2.destroyAllWindows()
```

Analysis and discussion for the face recognition program:
The face recognition command script has been successfully executed and every face detected by the camera will be identified (recognize predict) with the face dataset that has been recognized.

3.3. Running system program

In this section we will start the third phase of this research, where we get the following results:

1. The face dataset is recognized

   In this experiment it can be explained that the condition of the room is in a state of bright lighting when running the face recognition process. Then when the face recognition program is run, then the face recognition process is active, the camera sensor will turn on automatically and detect faces that are photographed on the camera and the results are displayed on the monitor as shown in Figure 5 below.
Analysis and discussion for the system program:
The system program has successfully been run against recognized face datasets. A percentage of >51% is required for the process of predicting faces to be detected, and if a face is not recognized then the known percentage is <50%. And the distance of the camera captures the image as far as 1 meter. And in Figure 5 above we get 59% of the matching face photos stored in the face dataset directory stored in the system, then the system works with the ignition key turned on.

2. The face dataset is not recognized
In this experiment it can be explained that the condition of the room is in a state of bright lighting when running the face recognition process. Then when the face recognition program is run, then the face recognition process is active, the camera sensor will turn on automatically and detect faces that are photographed on the camera and the results are displayed on the monitor as shown in Figure 6 below.

Analysis and discussion for the system program:
The system program has successfully been run against recognized face datasets. A percentage of >51% is required for the process of predicting faces to be detected, and if a face is not recognized then the known percentage is <50%. And the distance of the camera captures the image as far as 1 meter. In Figure 6 above the results obtained are 34% and 37% of the matching face photos stored in the face dataset directory stored in the system. So that the results are obtained that the system is not running well which results in ignition key still in the off state.

3. The face dataset that distinguishes between recognizable and not recognized
In this experiment it can be explained that the condition of the room is in a state of bright lighting when running the face recognition process. Then when the face recognition program
is run, then the face recognition process is active, the camera sensor will turn on automatically and detect faces that are photographed on the camera and the results are displayed on the monitor as shown in Figure 7 below.

![Figure 7](image)

**Figure 7.** The difference between faces is not recognized and faces are recognized

Analysis and discussion for the system program:
The system program has successfully been run against recognized face datasets. A percentage of >51% is required for the process of predicting faces to be detected, and if a face is not recognized then the known percentage is <50%. And the distance of the camera captures the image as far as 1 meter. In the picture 7 above we get the results of 54% and 38% of the matching face photos stored in the face dataset directory stored in the system. So that the results are obtained that the system is not running well even though one of the object images meets the standard face recognition criteria. This happens because the system is designed only for the process of recognizing one object, resulting in the ignition key still in the off state.

3.4. Design result
This section displays the results of the prototype display device before it is installed in the vehicle and after it is installed on the vehicle as follows:

1. Final prototype result
   In this experiment it can be explained that the prototype has not been installed to the vehicle as shown in Figure 8 below.

   ![Figure 8](image)

   **Figure 8.** Display prototype before installed on vehicle

2. Prototype after being installed to the vehicle
   In this experiment it can be explained that the prototype has been successfully installed to the vehicle by jumping a CDI (Capacitor Discharge Ignition) jumper to the prototype as shown in Figure 9 below.
Figure 9. Display prototype after mounted to vehicle.

4. Conclusion
The purpose of this research is to design a prototype of a motorbike safety lock using raspberry pi with face recognition method. The existence of this prototype provides vehicle safety. For this reason, in-depth analysis has been carried out and its performance has been compared, so that the following conclusions can be drawn:

1. Optimal system capability of taking pictures up to 1 meter.
2. The ability of the camera to recognize the user's face is at a percentage > 51% and an unknown face is at a percentage < 50%.
3. This prototype works with a face recognition system with the local binary pattern histogram method.
4. This prototype can set the contents of the dataset to increase vehicle ownership, and if there are unknown faces, the system will not work.

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