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The Development Face Recognition System in Home Security System

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Abstract: In this research, I had developed a Face Recognition System to choose the best security system develop by Raspberry Pi. Face Recognition is obtaining more and more fashionable and most people are already misusing it while not even realizing it. Projected during this project is an embedded face recognition device that supported the single-board Raspberry Pi. Face recognition system uses the Haar feature- based cascade classifier for face detection and face localization. Haar feature-based cascade options are digital image features employed in visual perception. Face options are extracted exploitation weighted native Binary Pattern algorithmic program. Human identification systems are needed for surveillance, monitoring, and biometric applications in real time. In Malaysia, there are numerous instances of burglary. Since last year, there have been a total of 13,567 burglary instances. Most of these incidents occur regularly as a result of a poor home security system. When they just use a key and padlock to secure the house.

Keywords: Face Recognition System, Home Security, Raspberry Pi, OpenCV Source, Haar Cascade.

1.0 INTRODUCTION

Home is a very essential place for most individuals since it is where we can keep everything safe. We live, sleep, eat, and do a lot of things at home. As a result, our house is extremely important to us. The house is also where we keep all our belongings, therefore its security is quite essential. In Foreign countries' home security systems are extremely stringent, they have already advanced to the point where their homes need access through codes and fingerprints. As a result, housebreaking is infrequent in other countries. In Malaysia, this kind of security system is still uncommon.

So, the current solution to this problem is to introduce human identification systems for real-time surveillance, monitoring, and biometric applications. This concept proposes an integrated facial recognition system that will be used to regulate magnetic door lock attraction in cars, as well as to recognize persons at the border or elsewhere. Face detection and information collecting, training the recognizer, and face recognition should all be part of this programmer. We will just create a database in which we will store photographs for each user, a collection of photos that will be utilized for face detection.

The goal of this project is to create facial recognition-based security access control systems. For face identification and localization, a face recognition system employs the Haar feature-based cascade classifier. Face ID, or facial recognition security, is a popular and commonly utilized feature in smartphones these days. This project, like Face ID on smartphones, has a maximum number of users who can access security systems. As a result, only a small number of people have access to the dwellings. In this method, an outsider will be unable to enter and depart the house

We intend to improve the accuracy of face recognition capabilities in this project. Surveillance, monitoring, and biometric applications all require real-time human identification systems. In general, in locations with restricted access, such as private residences. This project makes use of the Raspberry Pi, a system embedded device. The Raspberry Pi is a low-cost, tiny computer that may be used to teach programming through hands-on projects. It does, however, have a number of benefits and drawbacks. As a result, in order to accomplish our endeavor, we must face all of these implications.

2.0 MATERIALS AND METHODS

Face recognition is a field of study that aims to figure out how biological systems recognize faces and how this might be mimicked by computers. Biological systems employ a range of visual sensors, including as eyes and face detection, that were designed by nature to meet the agent's surroundings. Similarly, depending on the application, computer systems utilize a number of visual sensors to record, and analyses faces.

Video cameras, such as camcorders, infrared cameras, and 3D scans are examples of these sensors. The study looks at some of the most advanced facial recognition computational approaches that have been suggested so far.

2.1 Review on existing facial recognition works

To recognize an individual entity's identity, this system requires authenticity. This is done to guarantee that only authorized users and no one else has access to the services. Face recognition technology's main goal is to increase home security by creating a database of illegal visitors who enter and depart the premises. The system, on the other hand, may be of assistance to users who already have a database, making it extremely user-friendly.

Face recognition generates facial images into numerical expressions that can be compared using computer-generated filters to determine similarities. These filters are frequently created using deep "learning," which analyses data using artificial neural networks. Facial recognition technology is developing all the time, yet although algorithms may achieve exceptionally high performance in controlled situations, many systems fail in the real world. It's difficult to summarize a face recognition system's accuracy since there are no single indicator that provides a complete picture.

2.2 OpenCV

OpenCV (Open Computer Vision) is a Python module or library that allows you do a variety of activities. It was initially distributed a few years ago under the BSD license. It currently belongs to a community of over 47, 000 individuals who have downloaded over 7 million times. OpenCV is widely used by commercial businesses like as Yahoo, Google, Microsoft, Honda, IBM, Intel, Sony, and others. It creates infrastructure for real-time computer vision applications like as reconstruction, face recognition, object identification, and sensor analysis, which are developed in C++, Python, and Java and operate on Linux, Windows, Mac OS, and Android operating systems. (Abaya, 2014). The most significant aspect of OpenCV is the Core module.

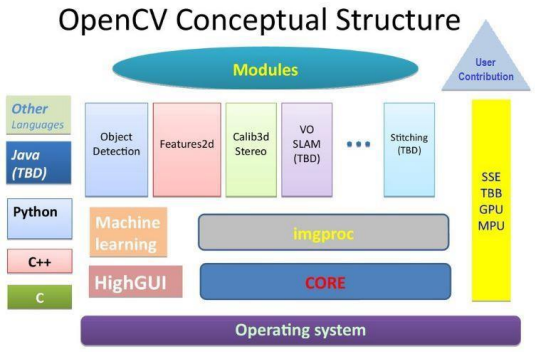


Figure 2.0 OpenCV Modular Structure

2.3 Principal Components Analysis (PCA)

In PCA, the face recognition variable is used to reduce the number of similarities in the statistical approach. As a result, each picture that is taught is represented by eigenfaces, which are a linear combination. the year 2012 (Paul and Al Sumam). The Principal Component Analysis (PCA) approach has two stages:

Phase of Preparation

In PCA, eigenvectors are formed as a result of the presence of faction's space matrices. It creates eigenspace, which is referred to as faction space by trained images. The vectors really carried data on the variance of each pixel's grey values. Because it holds the most significant information about the space, the matrix of the initial vector is used to create a new eigenfaces or space of factions at the start of the training phase. It may deal with the large drop and use the matrix to achieve their goal.

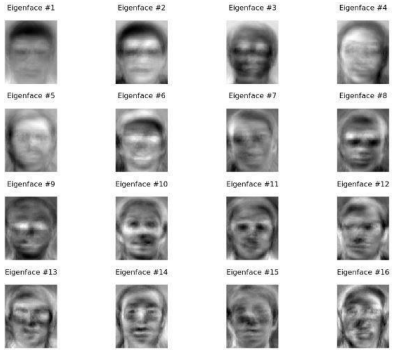


Figure 2.1 Eigenfaces representation

Classification Phase:

The Euclidean distance is used to make the face recognition more accurate. From an unknown face image, it starts compared to make accuracy which image is more similar.

LDA Relationship

The LDA subspace is concerned with the interaction between two matrices made up of known Principal Component Analysis eigenvectors. The fundamental reason for the name changes to this approach is the Fisher face, also known as eigenvectors. **Error! Reference source not found.** shows an example of Fisher face representation.

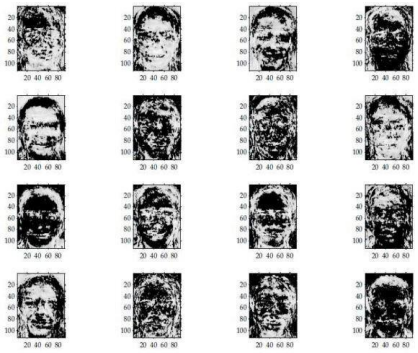


Figure 2.2 Fisher Face Representation

Face recognition technology has helped potential buyers, internet users, and market research businesses. A facial recognition system integrates the protection of all personal spaces, especially homes, into a single gadget that watches after the users implicitly. A facial recognition system's main goal is to provide the best level of home security possible. This is performed by sending data directly to the database computer using OpenCV components. If the system cannot identify the individual entering the residence, it will lock the door and transmit an alert to the administrator. The user would no longer be required to give their details every time they entered the house.

2.4 Face Algorithm

Facial recognition algorithm has several phases which is Training and Recognition phase:

Training phase:

The training step requires the creation of a database, which must be completed before moving on to the next phase. Some data, such as many images of a person needed to train the system, should already be kept in it. The extraction procedure is the final step in this phase before moving on to the picture comparison phase.

Phase of recognition or test:

As soon as the training step is completed, the extraction process' characteristics are available for identification. When a camera starts recording live video, it goes through a loop process to figure out which face belongs in the database. If a known subject is found, the name of the person specified in the python file is shown. If this is not the case, it will display an invader and send a notification.
Below shows steps by steps process of face recognition works:

- Step 1: Acquisition of image

The acquisition maybe in different type of format that is match with system like an image, video frame or other 3D image and etc.

- Step 2: Face detection

Rarely, the system may pinpoint the precise face in the dataset. Because it gives a default position and size for the face from the beginning of the picture capture process.

- Step 3: Image processing

This stage involves performing a normalization method against the picture collection. Some elements of the image, such as the distance between the pupils and the eyes, and the location of each person, were used to normalize the image. It can improve the system's performance by reducing the picture size and converting the image to grayscale. The use of a low-pass filter can also improve picture processing performance.

- Step 4: Extraction of the characteristics

The characteristic like vectors or coefficients of the image in important for the image extraction by using a certain technique.

- Step 5: Recognition

Lastly, the recognition process starts to make comparison between extracted featured with featured vectors extracted from the database. Then it displays a result whether the face is recognized or not based on similarity percentage that is compared.

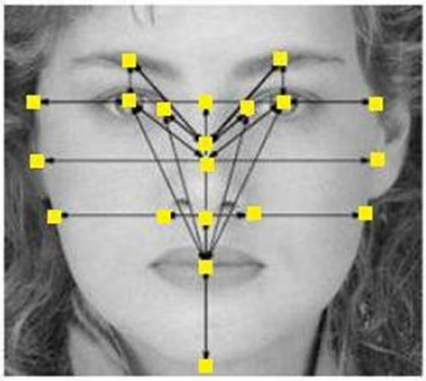


Figure 2.5 Face Algorithm

2.5 Face Detection

The most fundamental aspect of face recognition is initially detecting a face. Facial detection requires a proper algorithm that considers several face structures, as well as characteristics such as the size and shape of the face, the distance between two eyes and nose, and the kind or structure of the eyes and nose itself. Viola-Jones is an example of a face recognition algorithm that is acceptable for application since the feature offered is the most accurate.

2.6 Propose Network Design

At this stage, create a network design and assess it for architecture, software design, and hardware selection. The UI, or user interface, for each application and system path must be established and determined in order to explain how the system operates in practice. For the new design, a solution to the current network design difficulty must be presented. Both logical and physical designs are included in this phase. This stage necessitates the collection of all information about the Raspberry Pi and facial detection.

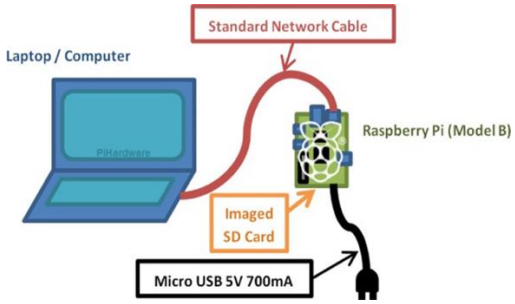


Figure 2.6 Network Design with Raspberry Pi

The Waterfall model was identified as the best method. Because each phase must be completed before going on to the next, the strategy works effectively. This paradigm was chosen because it is incredibly useful and straightforward for this project, which requires that each step be completed before going on to the next. This project approach is divided into six phases, as shown in the diagram below:

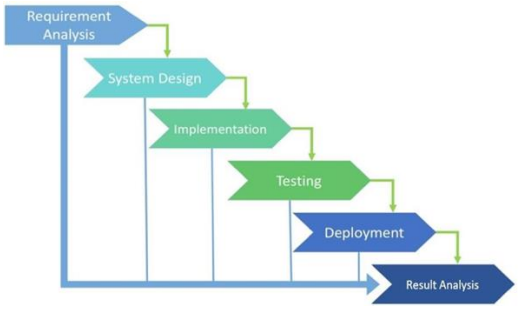


Figure 2.7 Waterfall Model

Implantation

In phase 3, it demonstrates the entire installation and configuration of Raspberry Pi-based systems, resulting in a real-world system that can be utilised by users. The hardware and software are absolutely necessary for the system to work properly. This phase includes numerous tests, such as unit testing, to confirm that the system is fully functional. The configuration of this process is accomplished in Python.

Testing

In phase 4, there should be a lot of testing done, such as user acceptability testing. All of the testing is really integrated into the system to guarantee that the produced system runs smoothly and without errors.

Deployment

Phase 5 is to set up of the system after a pilot run and testing is done. Almost final stage of the project developments.

Result Analysis

The results part in phase 6 will attempt to describe the findings without attempting to analyze or quantify them, as well as serve as a guide for the system's discussion section. The findings are disclosed, as well as the analysis. The writer describes what has been done with the data provided in the analysis section. The scale of system efficacy is determined based on the result, and there are numerous key reasons why the Waterfall Model is chosen:

- After identifying the system problem, the requirement phase focuses on characterizing the project's state.
- After planning the system framework, the design phase supports developing the components.

3.0 RESULT

This section discusses the findings of the data obtained throughout the course of the research. This part contains all of the data and an operating diagram.

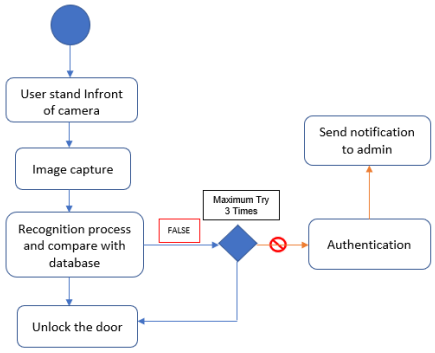


Figure 3.0 Operating Diagram

The operating diagram of the Access system is shown. After that, personnel approach the camera for face recognition, and the system verifies the user's identification. The computer captures a picture of the user's face, and the conditional statement checks to verify if the user's face and movement are right. It is now appropriate to proceed to the next step in the procedure, which is to open the door and enter the home. It's inappropriate to compare the flow to the database, which allows each user to construct database entries in the system just three times.

The Raspberry Pi 3 that was implemented in this

project is seen below. The Raspberry Pi 3 and the OpenCV open-source software are a perfect match. Two notable examples of this are OpenCV, which provides a large free resource for tackling real-time computer vision difficulties, and the Python Face Recognition Package, which computes bounding boxes around a face in real-time.

Figure 3.1 Complete circuit with Raspberry Pi

This project is represented in Figure 3.2 as it is being demonstrated. The red-light blinking comes from the Pi Camera, which was installed to scan faces and capture data that would be saved in the user's library.

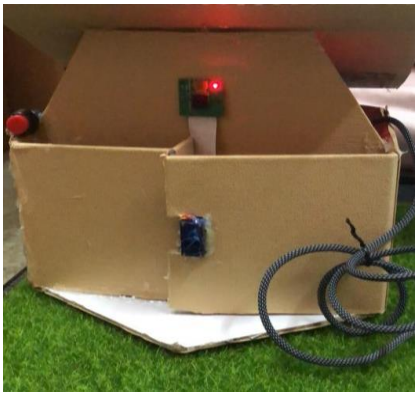


Figure 3.2 Project Demonstration

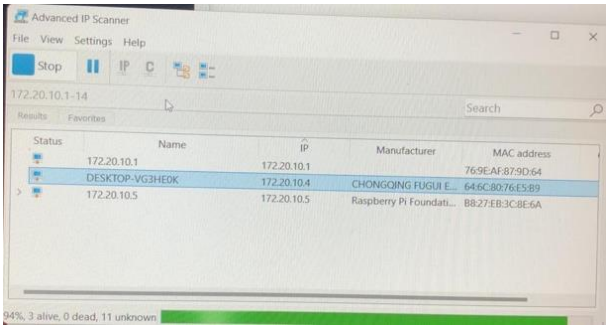
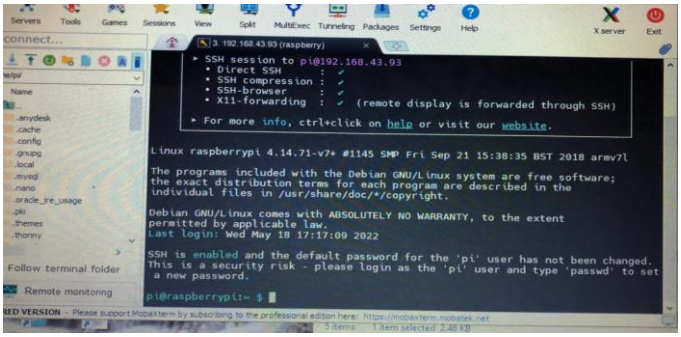


Figure 3.3 IP Scanner

IP scanning is the ongoing IT process of analyzing a network connection in order to discover Raspberry Pi IP addresses and the information connected with those IP addresses and devices. We use an IP range scanner to define a range of Raspberry Pi IP addresses and find any IP addresses inside that range. For Raspberry Pi IP address is 172.20.10.5



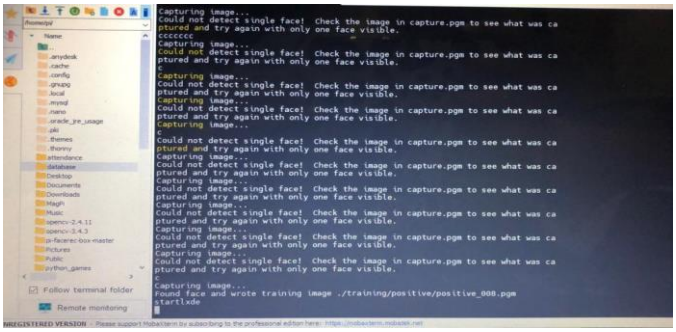


Figure 3.4 MobaXterm Terminal

In MobaXterm, this is the terminal that was used to capture the picture during the scanning phase. If the faces can be detected, the message will be shown. The picture will be saved in the /training/positive/startlxde library if it is captured.

Figure 3.5 User identified face

The image will display in the library like this because the user has access identified the face and saved it to the data base.

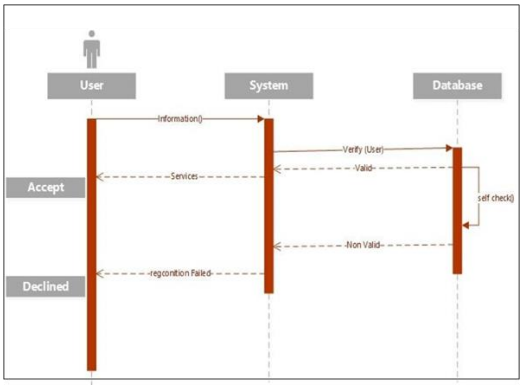


Figure 3.6 Sequence Database

Logging into the system is the initial step for the user. The user interface sends the data of the user to the system object for verification. The system object determines whether a user's status is valid or not. The user then asks for three confirmation attempts. The system continues to give services once a user is recognized in the database. The system will reject the user if the recognition fails.

4.0 DISCUSSION

In this section we will be discuss about face recognition system in home security system. The main goal of this project is to provide the most secure environment achievable in our home. The facial recognition system integrates the protection of our property into single device that also can protect the residents from any harm. We must make sure that the quality of safety systems has improved due to facial recognition technology. Face recognition is a new technology that has a lot of potential. Face recognition may help to protect and giving more secure in our safety. Face verification, also known as face authentication, is the process of authenticating an identification based on a face photograph by comparing it to a database. Face authentication entails matching an input image solely with the image associated with the person identity. In other words, the technology will just compare your face to one image from the database.

5.0 CONCLUSION

As a conclusion, the main reason I chose this issue is because of the Raspberry Pi face recognition technology, which can lock a specific location and send message if an unauthorized person enters the property. This technology will give the company with emergency backup at any time. We may also save time by adopting a digital version of the security system. The technique is to describe what each of the following message in terminal will entail. When it comes to technological devices, one of the most pressing issues is security. Most existing systems strive to make their systems secure in order to persuade its data that using this project is safe. The suggested system includes all of the elements that users need to run a reliable and user-friendly facial recognition system. While the system is being developed for the Raspberry Pi socket, efforts are being made to improve the system for the open-source version, since developers are not limited because this system does not need it. For future recommendations, I would like to add an alarm system that can capture the face of a person who try to break into the house and then it will send the image to an admin.

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