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REVIEW ARTICLE

ARTIFICIAL INTELLIGENCE FACE RECOGNITION: SECURITY SYSTEM

Fadhl Mohsen Sahal Mohsen[a], Nur Arzilawati Md Yunus[b]

[a]Faculty of Engineering, Built Environment and Information Technology, MAHSA University, 42610, Jenjarom, Selangor, Malaysia.
[b]Faculty of Business and Technology, University of Cyberjaya, 63000 Cyberjaya, Selangor, Malaysia.
**Corresponding Author Email: editor.gciii@gmail.com*

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ABSTRACT

Face recognition has recently been a popular study topic as a result of the growing demand for security. Security systems, identity verification, access control, surveillance systems, and social networks are just a few of the applications that can be expanded from facial recognition. However, as passwords and fingerprint scanners are supplanted by improved computer technology and more precise algorithms, facial recognition is becoming increasingly popular. Facial recognition technology is the simplest and most coherent of all the techniques. Face recognition does not necessitate an individual's active participation. Face recognition systems are theoretically capable of minimizing risk and eventually avoiding future attacks in places where identity identification is necessary, such as airports and border crossings. If there are criminals on the loose, the same justification can be made as with surveillance devices. Surveillance cameras with face recognition capabilities will aid in the identification of these individuals. Alternatively, these surveillance systems can be used to track down the whereabouts of missing persons, although this is contingent on the use of powerful facial recognition algorithms and a fully built facial database. Face detection, facial feature extraction (image normalization), face identification, and results are the major operations to be conducted for face recognition.

KEYWORDS

Face Recognition, Face Detection, Facial feature extraction, Face Identification.

1. INTRODUCTION

Nowadays the world become networked and the necessity of security to maintain information or physical property is becoming more and more necessary and complicated. Biometric access control is an automated way to verify or the identification of a person on the basis of certain physical characteristics, like a fingerprint or facial expression, and certain elements of the behavior of the person, such as their type of handwriting (Lin, 2000). Identify a person by biological features using biometric systems and because of that the forging becomes difficult. Many security techniques have been established that help to keep sensitive information secure and reduce the probability of having a security breach (Saufi, 2018). Face recognition is one of the few biometric techniques that has the merits of low intrusiveness and high accuracy. It is a programmable computer that utilizes a video source to automatically check or recognize the face of an individual from a video frame or digital image provided by the video source(Abdullah et al., 2017). This compares the image's selected facial features and a face database, or it could also be utilized via hardware to authenticate a person. This technology is a widely utilized biometrics scheme for authentication, permission, verification, and identification (Cocoran and Iancu, 2011).

2. LITERATURE REVIEW

Researchers and commercial developers have enhanced the efficiency of the algorithms of automated face recognition on a variety of difficult tasks of face recognition over the last decade. Systems of facial recognition are built to run in control environments such as access control systems and also in electronic passport gates. A relatively comparable shape can be a very difficult problem for facial recognition due to faces that have many differences between images of the same face. Image processing can be accomplished on embedded devices, which are commonly used in modern life. A face detector can be built into a compact and inexpensive system. However, because embedded systems have limited compute power and memory storage, the performance of a face detector on one can be hampered. A good face detector should be quick and reliable. In a short amount of time, a rapid system can recognize faces in an image (Ohlyan et al., 2013). A good face detector has a high true positive rate and a low rate of false positives and negatives. As a result, a face detector's performance should be evaluated in terms of speed and detection rate. The detector in video processing processes each frame of video collected. As a result, the detector must be able to process each frame quickly enough to avoid delay (Bigdeli et al., 2007). The result displayed should have high frames per second if a fast method is applied.

3. FACE RECOGNITION SYSTEM

Face recognition system is capable of performing matching comparisons of a human face in the database of face to find a match. Various methods of the face recognition systems operate are currently being developed by researchers. Each processing stage in the system must be configured to meet application specifications to reach a high-performance face recognition system, face recognition needs matching an image with a database of stored faces to recognize individuals in the input image (Jain et al., 2012).

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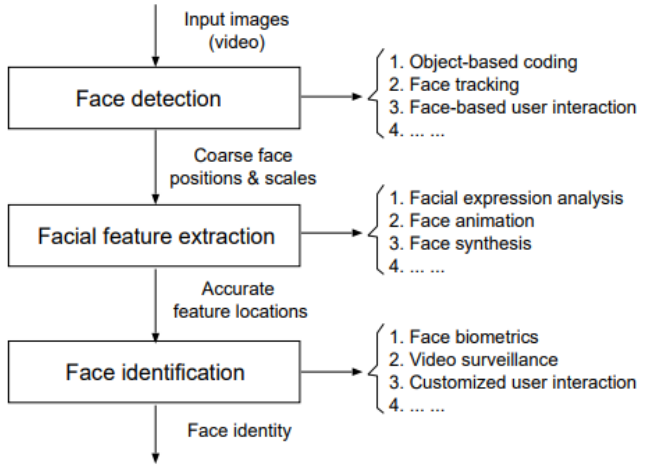

Figure 1: General framework of a face-recognition system (By et al., 1999).

A standard method of face-recognition typically consists of a series processing steps which are face recognition, facial feature extraction, and face identification are processing steps shown in Figure 1. A sub-system of general face analysis with its own characteristics forms each processing level. Let us explore in more detail these sub-systems:

i. **Face detection** - locates face areas within the input of images or video. It is a key step of facial recognition preprocessing that takes random images as input (Gurel and Erden, 2012).

ii. **Facial feature extraction (Image Normalization)** - the extraction of facial features locates essential locations of features within a detected face. The eyes, mouth, nose, and eyebrows are the most interesting characteristics. More detailed explanations of these characteristics, such as their contours, must be obtained in certain cases (see the illustration shown in the Figure.2).

iii. **Face identification** - the last stage of the complete face recognition system is creating the identity of the given image of the face, this step known as face identification. More specifically, the normalization of the image and the facial feature derived from the early stages use as the basis for an appropriate representation is created from the stated face and compared to the database of the faces. If there is a close match existed then the algorithm will display the relevant identity (Jain et al., 2012).

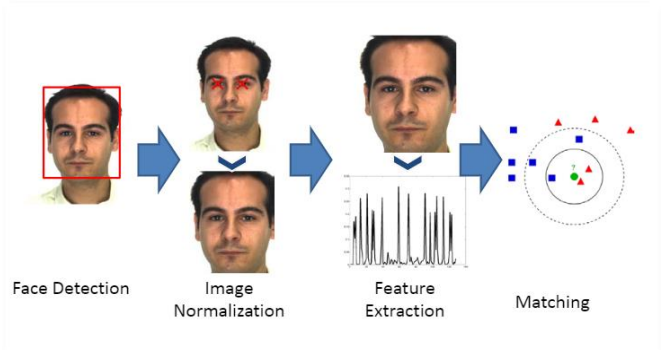

Figure 2: Visualization of the three processing stages in face recognition (Jain et al., 2012).

3.1 System Hardware and Software

The system has two main hardware parts, consist of raspberry pi 4 and Raspberry-Pi camera module. The Raspberry-Pi v2 camera module houses an 8_megapixel Sony IMX219 sensor. The system used Raspberry-Pi (Raspbian as OS) as well as Python as shown in Figure 3. Also utilizing the OpenCV, and deep learning.

The Implementation in this project is very simple which is connecting the camera pi to the CSI camera port on the raspberry pi, also the raspberry pi will be connected to the power supply and the internet, the internet is used to monitors the raspberry pi from other devices, as shown in Figure 4.

Figure 3: Raspberry PI desktop page with the Raspbian operating system.

Figure 4: Shows the raspberry PI and the camera pi are connected with each other.

4. Results and Discussion

After we know the hardware and the software of the system, now we will know about the face recognition phases. We need to work on three very distinct phases to build a full-Face Recognition project:

- Face-Detection-and-Data-Gathering
- Train-the-Recognizer
- Face-Recognition.

4.1 Face Detection and Data Gathering

The first task in face recognition of course is face detection, before anything else, as compared to a new face captured in the future, you need to capture a face to recognize it (Adrian, 2018). Before we can use face recognition, we must first create a dataset of sample photos that we want to recognize, as illustrated in Figure 5 and 6.

We can collect such photos in a variety of methods, including:

1. Using a camera and face detection to collect example faces for face enrolment.
2. Automatically downloading example faces using multiple APIs (e.g., Google, Facebook, Twitter, etc.) (Adrian, 2018).
3. Collecting the pictures by yourself.

Figure 5: Dataset for Mohsen.

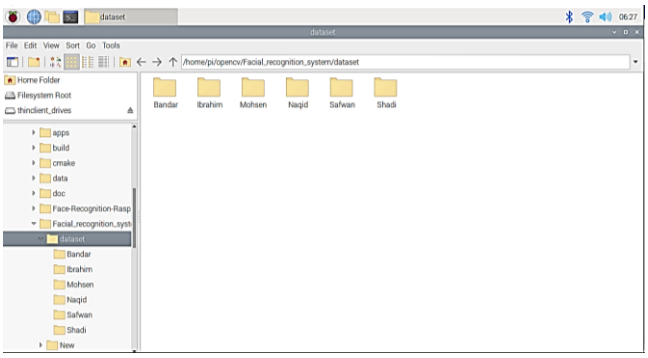

Figure 6: Dataset for Mohsen and other people (friend).

4.2 Train the Recognizer

In this second stage, all user data must be taken from the dataset and train the recognizer. A particular OpenCV feature does this directly (Marcelo, 2018). The train_model.py will parse the images inside the dataset folder in Figure 6. Organize your photos into folders by the person's name (Marcelo, 2018). For example, create a new folder named Bander and put all Bander face images in Bander folder inside dataset folder and train_model.py will create a file named Encodings. Pickle containing face identification criteria as shown in Figure 7, we use HOG (Histogram of Oriented Gradients) detection method.

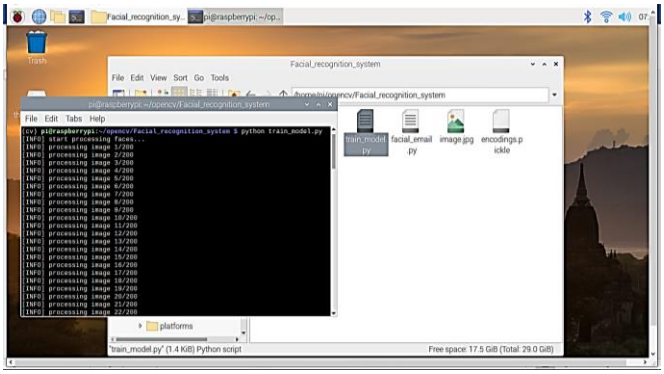

Figure 7: Train the recognizer.

4.3 Face-Recognition

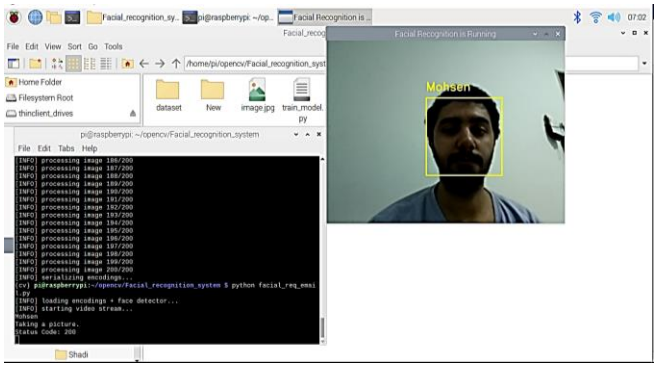

Figure 8: Face detection and recognition.

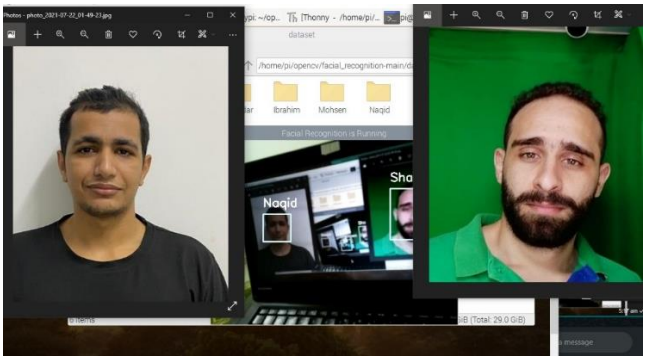

Figure 9: Face detection and recognition for more than one person.

In Figure 8 shows that the program is able to recognize the person who is in front the camera, also in Figure 9 and 10 shows that the system can detect and recognize more than one person at one time.

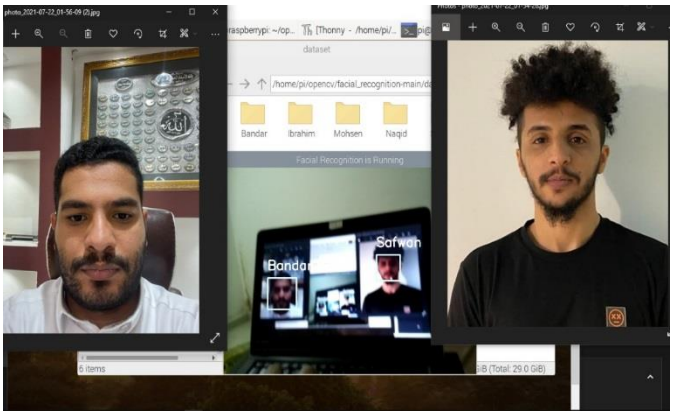

Figure 10: Face detection and recognition for multiple person.

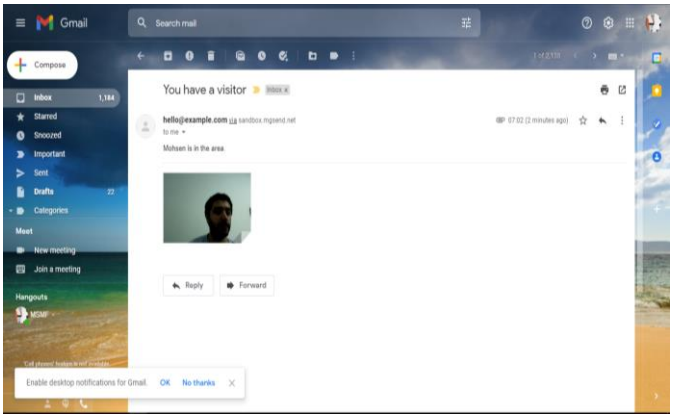

Figure 11: The face will be sent to the authorized user.

The system gives the authorized user the ability to know if there is anyone in the area by sending an email with the picture of that person to the authorized user so that he can be informed of the people in that area as shown in figure 11.

5. Conclusion

In conclusion, the face recognition systems are a component of facial image processing applications, and their importance as a research field has lately grown. Crime prevention, video monitoring, person verification, and other security tasks are among the system's applications. Face detection and recognition procedures are used to achieve the goal. Face detection algorithms based on knowledge are used to find, locate, and extract faces in obtained images. Face recognition is a difficult yet crucial recognition technique. Face recognition has one major benefit over all other biometric techniques: it is extremely user-friendly (or non-intrusiveness). Many obstacles were discovered, such as understanding the project's features, researching the restricted case study connected to this project, and considering the system's core structure and design, all of which contributed to the project's slow pace. Nonetheless, I was able to fix it in the end. During the proposal writing process, the hardware and software components are separated, and then research is conducted on the necessary component and its function in this project. Finally, with the help of the supervisor's supervision and suggestions, as well as previous product research, this job was accomplished more efficient way.

Future Works

For future work, this system was built in such a short amount of time and with such limited resources, because of that more testing and debugging will be required in the future. Also, the developers can easily add new features and improve the default functionality. Image processing can also be employed to reduce the fuzziness of the input image so that the system can distinguish faces in low-quality photographs. Aside from that, the system can use a database to store the personal information of the people in the database, so that whenever the system recognizes a face, it shows the information for that person. Some of the features that can be added like the location of the person, detecting and tracking, liveness detection, face mask detector, and social distancing detector.

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