Real-time Face Recognition for Enhanced Law-Enforcement Services in Cities

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Abstract—Face recognition is regarded as a critical component in the goal of monitoring and securing, particularly for wanted individuals. A Raspberry Pi facial identification will be used, with conventional face detection and recognition approaches, to demonstrate how image-based biometrics can be used with a Raspberry Pi. Agencies of law enforcement, like the police, could be outfitted by a covert and safe facial recognition system thanks to the availability of the nano-devices like the Raspberry Pi. The provided suggestion uses Raspberry Pi and OpenCV. The document builds a foundation using such aspects on systems used in a variety of further scenarios, such as face recognition in combination with low-cost machinery, and a cost-effective system for improving law-enforcement services in smart cities.

Keywords—face recognition, real-time, face detection.

1 INTRODUCTION

It is really advantageous for many individuals, like the police, to obtain devices by applying smart technological procedures. A substantial number of these items were not designed with that purpose in mind. As a result, a framework that is exceedingly safe and accurate should be outlined urgently. The open CV 'open-source PC vision library' could be described as an open library to prepare source images. Open CV needs a compiler like code squares, Dev C++, or C++. Raspberry Pi3 Model B, which is similar in size to a credit card and could be connected to a TV, along with a keyboard and a mouse [3], could be thought of as a little Mastercard-sized PC. A camera module could be thought of as a small PCB, which provides connection for the camera linked through cable for taking still images or videos in real time [4] [5].

2 RELATED WORKS

Some earlier researches connected to this study can be explained as follows:

In this study, O. Niksins etal (2015) [6] presented a system for face recognition built on a personal computer with one board quality Raspberry Pi. This technique involved localizing and recognizing faces using Haar cascade classifier, which was based on features. Face features were retrieved using a Local Binary Pattern technique that was assessed. In 110 milliseconds, the improved system analyzed a complete face. A couple of the biometric examples were compared in two milliseconds. The proposed instilled facial recognition system was tested upon FERET data and found to be accurate for EER:1% and CMC: 99.33%. In this study, I. Gupta etal (2016) [7] established face recognition and stated that it was an important part of observing and securing a goal. Their goal was to investigate the feasibility of using a Raspberry Pi to create a face recognition system based upon classic facial recognition and detection algorithms such as PCA and Haar detection. That article attempted to advance face recognition to the point where system could substitute the utilization of pass-words and RF I Cards in the systems and locations of high-security.

In this study, S. V. Deshmukh etal. (2017) [8] introduced the number of the thefts happened and how important ID forging became. A technology for recognizing faces was to be built for avoiding these problems. Faces were detected using features compared to those which used by Haar, along with HOG +SVM algorithm for face recognition. They used the OpenCV and Python libraries to get a higher level of accuracy and impact. The training and identification were carried out on a Raspberry Pi embedded device. In this study, R. Novosel etal (2017) [9] indicated how biometrics based on images may be used in an IoT environment using Raspberry Pi. have demonstrated an informational system, security through a facial recognition technique, and allows certified users to access to essential data. In this study, David Gsponer (2018) [10] advocated that the study focusses on identifying faces in the first place, along with the IoT in an academic context, succeeded by its implementation throughout the project's 5 phases, along with final product presentation. The provided project resulted in a functional system that used OpenCV to recognize a face, IoT using MQTT protocol, and Clients on Raspberry Pi. The study provided a foundation by combining the three components into a system that can be used in a variety of other scenarios involving facial recognition on low-cost machinery associated with IoT. S. F. Kak etal (2019) [11] employed the smart home application to establish control management for safeguarding homes, increasing comfort, and reducing energy consumption by applying a biometric method and cloud services. Initially, the proposed system was used to identify members by applying the way of facial recognition as some equipment for improving house security and control management. The process of recognizing a captured image of a member's face in a systematic environment using a digital camera as image for the testing. The AdaBoost technique has been utilized for the detection and extraction of members' faces for training, along with members' images for the testing. A. Munir etal. (2019) [12], the study presented homes based on both existing and emerging technology, such as facial recognition for security and speech recognition for automation. In addition, the most recent work completed was briefly considered, and it was the rationale for off-

line system being one of the vital requirements to fill in the blanks within the present technology protocols indicated within the field related to the same topic. A solution for the securing of the smart homes assured its operation by taking an image of a ringing bell and comparing it with saved collected owners' information in a convincing and strong manner using the Raspberry Pi micro-controller and Open CV.

3 Implementations and Mechanism

Principle Component Analysis, which is often known as Eigenface or PCA, is a statistical measurement approach which operates in the linear domain and could be used to reduce the image's dimensions. An image of a face can be represented as vectors or in a matrix form. The following is a diagram of the related procedure [13]:

Assume that I refers to an 1xn2 as a gray-scale image. It might then be represented by a vector, x = n1xn2, which may be shown as a point within Rn. Eigenfaces are the eigenvectors obtained from the specimen covariance matrix as a result of PCA over those vectors. The steps involved in calculating those Eigenfaces are as follows [14]:

1. Obtaining face images I1, I2,..., IM (training images of the faces).
2. Symbolizing every one of the images Ii as vector xi.
3. Getting average facial calculated.
4. Getting average face subtracted.
5. Getting co-variance matrix calculated.
6. Getting eigen-vectors ui of AAT and preserving only K eigenvectors.

4 Propose System

Authenticating biometric ID using face data is a challenging research subject that is now quite active owing to the typical and non-parasitic interactions with the authentication system. ID identifying system events should deal with two types of occurrences: an individual pretending to have a granted ID could be an individual, she or he pretends to be called client, or it might be an impostor if not at that time. The system may make a single choice in general: rejects or accepts clients, also determines whether they are impostors or not.

Face recognition is a biometric technology that goes beyond detecting face in an image. It goes a little too far in establishing who owns the face. A face recognition system works by photographing a face and predicting whether it matches a second face stored in a database. As a result, the technology was developed for precisely predicting and comparing possible matches of the captured face, regardless of the face, hair, expressions, or age.

Technology utilized in the biometrical factors:

The technology utilized in the biometrical factors is classified as low-enforcement, PCA, detection of human emotion, the mechanism of extracting features and SVM, the

detection of the faces through graduate clipping, and identifying faces via cascaded discriminant analysis. Figure 1 depicts the basic steps.

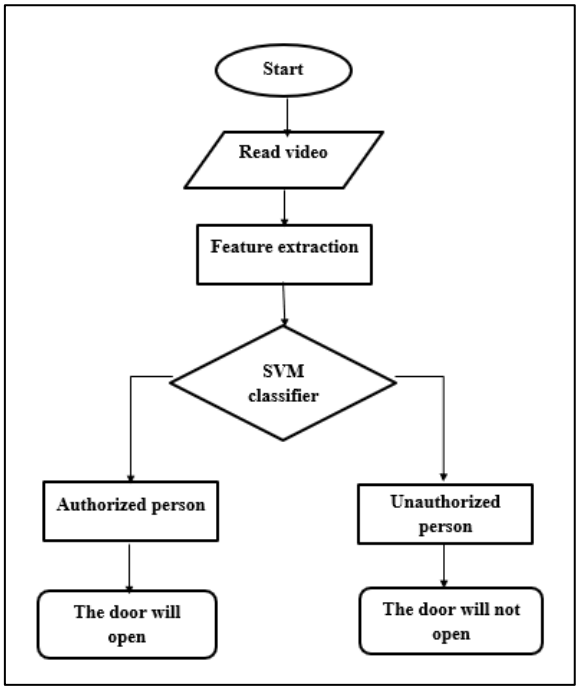

Fig. 1. Structure of facial recognition

5 Experiments and Results

Many checks were performed to estimate the performance of the recommended face detection & identification technology. And the following were the results:

Step1 – As shown in Figure 2, the camera of raspberry pi trained by a face.

Fig. 2. Trained with a Face.

Step2 – For identification, the individual stares at the camera. The next procedure, face detection, can be used to successfully detect the position of faces, as can be seen in Figure 3.

Fig. 3. Trained with a Face.

Step3 – Through the Algorithm of Face Detection and Recognition, it identifies individual whether he/she is wanted for justice.

Step 4 – The entire system is run on a Raspberry Pi3 with an attached camera.

Table1 lists the previous studies as well as their adopted methods and results.

The suggested system in this work aims to use software and hardware to create a real-time facial recognition system, with a system percentage of 90% in case where a face has been correctly detected. It must be of high-performance, low-cost, simple to use, secure, and it must be able to be utilized in any of the smart secure applications.

6 Conclusions and Futurework

To summarize, the Raspberry Pi system has been capable of distinguishing faces in real-time. Various objectives were met as a result of this study. The objectives were directly linked to the outcomes, and a determination will be made as to whether or not every one of the objectives has been effectively met. It might be inferred that all of the collected tests yielded positive results. Face recognition utilizing Raspberry Pi has also yielded positive results, with a system accuracy of 99% and the ability to be simple in a fair manner. Eventually, Python has been selected as the programming language since it was helpful to give ready and free environment, solved all of the problems faced. Another essential objective was to avoid system intrusion. As a result, this approach is comparable to the most recent facial recognition technology. As a result, it has the capability to aid the police in recognizing and identifying people. The collected data regarding device status at a given moment has been enhanced. In the future, an auto-triggered report for a theft attempt will be able to communicate the local address to the

nearest police station. This concept should be considered in order to improve the proposed system.

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