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HaarCascade and LBPH Algorithms in Face Recognition Analysis

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***Abstract* — Different face detection techniques are being used for ages. Taking a step forward, recognizing the human face from the database or getting the new face in the database by capturing in either video or by training the code with the pre-install images in the data base for face recognition has been proposed here. Human face detection is necessity for the modern Artificial Intelligence system that can recognize the face in live feeds. This can be helpful to make informative decisions for the identification of the people, by offering security related threats, and also by other means. Recognizing human faces from the images and live video feeds or videos can be insignificant task for machines and required many image processing techniques for feature landmarks. Numerous Machine Learning Algorithms and their testing on datasets is required. In this paper, HaarCascade face recognition and Local Binary Pattern Histogram are used for feature extraction which will help in identification of human face.**

Keywords—HaarCasade, LBPH, HOG, Face Recognition

I. INTRODUCTION

The primary objective of this study is to advance the state of the art in face recognition. Depending on the attendance or login system. Images used for testing and training the suggested model are restricted to the face's frontal view to maximize performance. It is recommended that both the test and training photos be captured using the same instrument. In [2] we see a universal symbol. Anyone may add their name and photo to a database for subsequent use in biometric authentication. It is only via our human nature that we are able to access and analyze information, which is crucial to the recognition process. Light is a kind of energy that can be seen by humans and is used as a visual representation of the world around us. Automated facial recognition systems that can perform at the same level as human beings are a formidable problem. Several of the facial recognition methods are discussed in [1]. Recognizing and remembering people's faces, especially when there are a lot of them (as is the case when there are numerous workers in a firm) of varying colors, genders, and positions, may be a challenging task. There are numerous defining characteristics that make each person's face unique. So, a biometric system, such as a facial recognition system, may aid in remembering important details about a person. It's also relevant right now to recognize people even if they have their faces covered [3]. By doing away with the conventional marking method, the Face Recognition System highlights its ease of use. An automated, facial-recognition-based system that can replace the need for enterprises to count their staff members many times to verify their presence would be a huge boon to productivity. Recently released research [4] shows how demographics affect commercial and open-source FR algorithms. In [6] we go into great depth on the face edition. Face detection is discussed in depth in [7–9]. Although some literature talks of various filter designs [11-13] that can be applied for processing the image but the proposed HaarCascade based training mechanism works better. For real-time applications, recognizing the face in data space with other objects is the primary challenge of face detection and recognition. The model's primary function is to identify people in a photograph or video and log them into a system or otherwise identify them. Facilitating the efficient utilization of code and applications on less capable hardware. In this article, we will look at how an automated employee login and detection system may be used to enhance face recognition. This article's intended outcomes are seeing glimpses of the characters' faces. The second step is to take the discovered faces and extract valuable characteristics from them. Thirdly, to identify a face, you must first separate its many characteristics. Finally, noting the presence of a named individual.

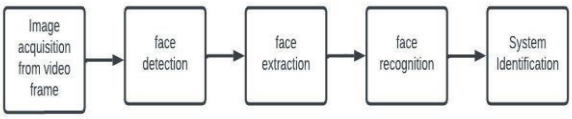

Fig. 1. Block Diagram of General Framework

There are several drawbacks associated with the use of systems such as RFID (Radio frequency Identification), fingerprint identification, and iris recognition. The RFID System was created for its simplicity, whereas the fingerprint system works very well but takes a long time to authenticate a user, so the user has to wait in a line for verification. A method for recognizing a person's iris that also stores supplementary information about that person's privacy. As a result of this, it is recommended that the application system have some kind of facial recognition software. Table 1 lists out comparison of various biometric systems.

TABLE I. DIFFERENT EXISTING BIOMETRIC SYSTEMS

System Type	Advantages	Disadvantages
RFID system	Simple	Fraudulent usage
Fingerprint System	Accurate	Time-Consuming
Voice recognition system	-	Less accurate compared to others
Iris System	Accurate	Privacy Invasion

II. METHODOLOGY

It is difficult to differentiate between face detection and recognition due to a lack of understanding. Face Detection is the process of determining the region of the face where facial characteristics are located in a picture, while Facial Recognition is the process of identifying the person whose face is in the image. There are just a few things that can contribute to face recognition and detection. To encounter hardships. These face characteristics include the backdrop, light, location, display, frames per second, frame rate, closure, rotation, and measurement in addition to a great deal of other characteristics. A feature is a collection of data that is used to represent a face feature in an image. The elimination of facial traits is a very significant step in the recognition process. Selecting which functions to use might be a challenging endeavour. In order to provide a result with a high level of accuracy, the output algorithm has to be compatible and based on a number of different factors. Figure 2 gives the detailed flowchart.

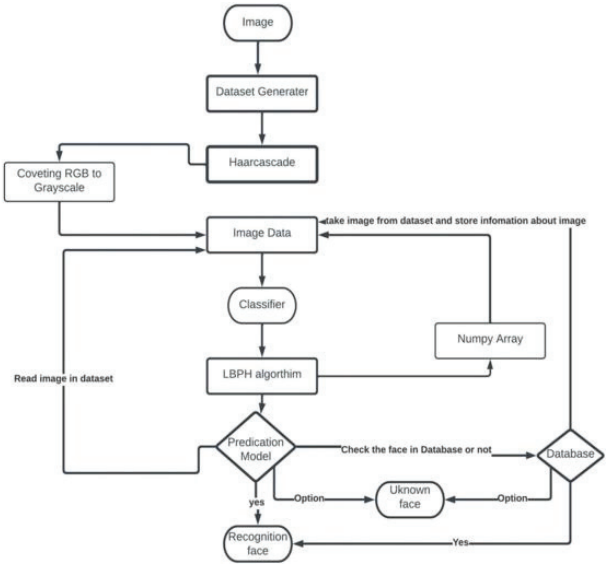

Fig. 2. Flowchart

The procedure starts with a snapshot taken using an easy-to-navigate interface, is then followed by the preprocessing of scanned photographs from a webcam, and finally ends with a comparison of the image with images stored in the database. Both the Haar-Cascade method for face recognition and the Local Binary Pattern Histogram (LBPH) algorithm for face recognition are employed, and the Haar-Cascade algorithm is explained in further depth below. The built-in webcam is used for the purpose of photographing and storing data about a person's face. There is also the possibility of using the multiclass classification in machine learning algorithms with a degree of accuracy that is lower than that which has been discussed in [5].

A. Face Detection using Haar Casade

While doing an analysis on a picture utilizing haar cascade, the scale is set to be smaller than the image that is being analyzed. When it has been included into a picture, the average number of pixels for each category will be determined. If the difference between the two numbers is greater than a certain threshold, then they are presumed to be identical. Matching a variety of a person's facial characteristics, such as their haar, is how face detection is carried out on a person's face. For instance, the forehead, the eyes, the nose, and many more. A feature-based classifier known as Haar-cascade is used in order to categorize the frontal face. It simply learns to recognize and classify the items that are now in the frame by categorizing them as they appear. It puts a positive picture on top of a group of negative photos and superimposes it.

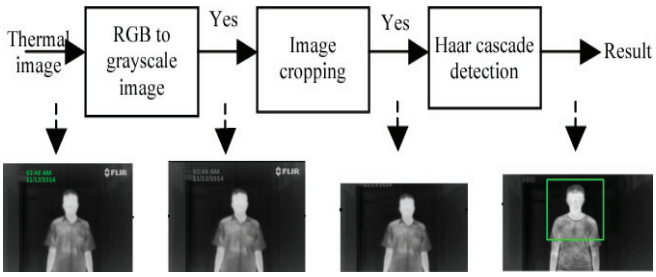

Fig. 3. Block Diagram of face detection using Haar-Cascade

B. Face recognition using LBPH (Local Binary pattern Histogram)

Several procedures are followed by the LBPH algorithm when it comes to facial recognition. One way to carry out these steps is to: The first thing you need to do is get familiar with the algorithm. In order to complete the recognition process, use a database of human faces. A one-of-a-kind id is affixed to each photograph. Photographs of the same individual are always filed under the same ID number. The initial phase in the computing process consists of the application of the LBPH operation. The creation of an intermediate picture allows for improved reorientation of the original image. Pixels are another name for the same thing as a picture. The picture is saved in a system that has a value that is directly proportional to the image's value. The picture is then saved, and the data associated with each pixel are utilized to recognize the image.

C. Modeling

Generating the dataset of faces means collecting test images of faces so that our code can learn to recognise faces. Open-CV packages can been utilized. To install the package, type: pip install opencv-python or use pip to install opencv-contrib-python.

Using the Haar-cascade frontal face default.xml file to find the coordinates of the test face so that the collected test face image can be cropped and used to make a dataset and a prediction model. Now, changing images of test faces from RGB (red, green, blue) to grayscale. RGB images have three

channels, but grayscale images only have one. This makes things like contrast, exposure, shadows, and brightness a lot simpler. Face classifier and detect multiscale method get the coordinates pass Scale Factor (refers to how much to change from the original image) and Minimum Neighbors (It tell how many faces to detect form the data we embedded). When the Value is higher, there is less detection, but the Quality is better. So, we can make changes to this value by playing with it and seeing what happens. Collect the image and stop executing when the number of images needed is reached or when a key on the keyboard is pressed.

Train the classifier that will be used for face embedding so that it can identify faces from the database. The technology is unable to determine which of the faces is correct and which is incorrect. Thus, in order to make it comprehend, it has to be converted into the numpy array format. This is done so that it can make some choice based on the data that it acquired from the producing dataset.

Be sure you create a classifier.xml file to save those pixel numpy array values, since here is where the information about the test faces will be saved.

Building a Model for Predictions Something we may detect. The process of face detection requires the development of a function to create a border around each detected face. It does this by constructing a draw boundary, function, which draws a boundary around the face and, if the person's name is in the database, displays it along with the boundary. When a face is detected but not found in the database, the status "Unknown" is shown. Xampp employs a database to store user information. Xampp is an Apache-based, multi-platform web server solution stack bundle created by the Apache Friends project. It includes the Apache HTTP Server, the MariaDE database, and PHP and Perl interpreters. Databases are used to store data, and that data includes user information.

III. Alogirthms Used

A. LBPH Algorithm

Local Binary Patterns(LBP) is a type of visual descriptor used for classification in computer vision. LBP was describe in 1994 and has been found a powerful feature for texture classification. When LBP is combined with the Histogram of oriented gradients (HOG), it improves the detection performance on datasets. As LBP is a visual descriptor it can also be used for face recognition tasks.

B. Haar Cascading

Haar Cascading object detection using Haar feature-based cascade classifiers is an object detection method proposed by Paul Viola and Michael Jones in their paper “Rapid Object Detection using a Boosted Cascade of Simple Features” in 2001 [10]. It is machine learning based where a cascade function is trained from lot of positive and negative images. It is then used to detect objects in other images.

C. Common face detection Libraries:

1) Media Pipe: Media Pipe Library is used for Face Detection. Media is newly build library which only provide Face detection. Media don’t have face recognition method.

2) OpenCV: OpenCV is open source library which support methods for face detection and recognition. OpenCV is easy to use and don’t depend on System. OpenCV has both face detection/ recognition and object detection library so easy to build for this This paper.

3) Dlib: Dlib is Machine Learning and deep learning library. Its accuracy is high. Dlib required massive amount of data to learn and get accurate result. For this data we required a large amount of space and system spec.

D. Common face recognition Algorithm

1) Eigenfaces: Eigenfaces use Principle of Components Analysis. It is based on appearance which captures the variation in a collection of face images. It uses this database to compare different face images integrated manner.

2) Fisherfaces: This methods is a improvement of Eigenface method. This uses Fisher’s Liner Discriminant Analysis (FLDA or LDA) classification method that This papers high dimensional data onto a line and performs classification in this one-dimensional space.

3) Local Binary Patterns Histograms: LBPH is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighbor of each pixel and considers the result as binary number and then visualizes the results as histograms.

IV. Results and Comparission

A. Comparison Between Haar Cascade and Other Detection Methods

For any Face Recognition system, the basic requirement is to detect a face in real time. Detection of depends on many factors like capturing refresh rate, video Quality, FPS, and much more. FPS plays a vital role in detection. FPS helps in detection of Face/Object as it can detect face much better as frame rate increases.

Fig. 4. Test Image

HaarCascade in Open-CV is used but there are many other method and algorithm in face biometric system most often used are:

i. Haar Cascade Face Detection in Open CV

ii. Deep Learning(DNN) based Face Detection in Open CV

iii. HOG Face Detection in Dlib

iv. Deep Learning(MMOD) Based face Detection in Dlib

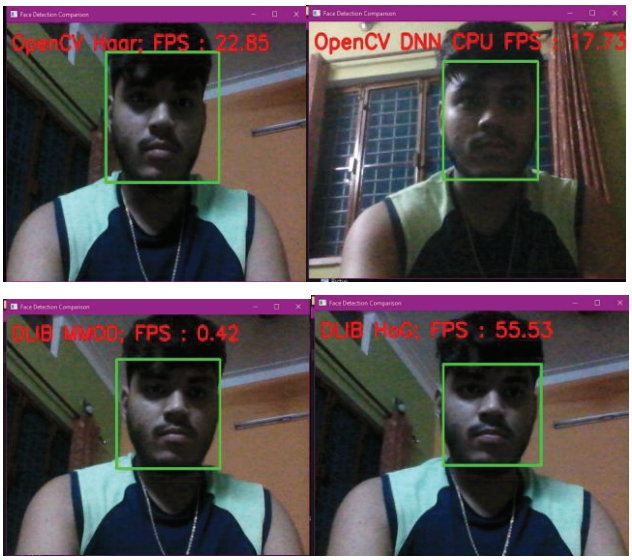

Fig. 5. FPS of different face detection libraries

1) HaarCasade: Work almost in real time on CPU. It has simple Architecture. Detects faces at different scales. The major drawback of this method is that it gives lot of false prediction. It don't work on non-frontal face.

2) Deep Neural Network: Most accurate of all methods. It also runs on Real time in CPU. The biggest merit of this method is that it works on different orientation and across various scales. It overcome all the drawback of Haar Cascade based detector, without Compromising benefits of Haar. Bit slower than Hog.

3) Histogram of oriented Gradients: It is the fastest method in GPU also it works well with frontal faces and slightly non-frontal faces. It is light weighted model than the other. The major drawback of this method is that it can't detect face size less than 80*80. The boundary excludes some parts like forehead and chin and others. Don't work on side face and extreme non-frontal faces.

4) Max-Margin Oriented Gradients (MMOD): It works for different face orientations but requires robust data. It is faster in GPU and easy to train. The biggest drawback is it to slow in CPU. The boundary box is even smaller than the HOG.

From all of this DNN is best to use as it is improved version Haar. So, it overcome the Cons of Haarcascade that is, faster detecting non-frontal faces and slight faces.

V. Conclusion

Face Recognition System was developed utilizing a face recognition technology. The proposed approach identifies individuals by comparing input photos to webcam images of real-world people. This method can identify and locate facial characteristics as well as detect and recognize faces in images. In addition, pre-processing techniques are used to enhance picture brightness and diminish the influence of light on the image. LBPH is used to eliminate facial characteristics from a picture. This suggested approach yields 100 percent for photographs of high quality and 92.31% for images of poor quality. Under a different light, erasing facial characteristics may be very difficult for analysis. The programme is executed using the LBPH algorithm. LBPH beats other algorithms with a confidence factor between 2 and 5 and offers an interface with little noise. Hence, LBPH is a realistic and competent face recognition identified in Open CV for identifying students in the university and appropriately identifies their presence by eliminating proxies. This suggested paradigm has a number of limitations. Initially, the picture should be placed at the front and have a straight face. Second, the precision may be diminished under severe illumination conditions. Third False positives might arise if the captured picture is blurry. LBP is a text-based descriptor that identifies local characteristics. For best accuracy, the test picture and the image of the train should be of identical quality when obtained by the camera. Thus, alternative algorithms may be employed in lieu of LBP, such as the Deep Learning method for face identification. CNN is an in-depth machine learning technique that performs well in low-level picture recognition when a big database is provided for recognition. But it requires a much larger database and system to boost its accuracy and speed in order to improve performance.

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