An Approach to Real Time Facial Recognition System

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ABSTRACT

The face is one of the easiest ways to distinguish the individual identity of each other. Face recognition is a personal identification system that uses personal characteristics of a person to identify the person's identity. Human face recognition procedure basically consists of two phases, namely face detection, where this process takes place very rapidly in humans, except under conditions where the object is located at a short distance away, the next is the introduction, which recognize a face as individuals. Stage is then replicated and developed as a model for facial image recognition (face recognition) is one of the much-studied biometrics technologies and developed by experts. There are two kinds of methods that are currently popular in developed face recognition pattern namely, Eigenface method and Fisherface method. Facial image recognition Eigenface method is based on the reduction of face dimensional space using Principal Component Analysis (PCA) for facial features. The main purpose of the use of PCA on face recognition using Eigen faces was formed (face space) by finding the eigenvector corresponding to the largest eigenvalue of the face image. The area of this project face detection system with face recognition is Image processing.

Key Words: *Face, detection, recognition, system, Open CV, Eigen face.*

1. INTRODUCTION

Face detection and recognition is technology which is used to identify a person from a video or photo source. In the 1960s face recognition was introduced by Woodrow Wilson Bledsoe. Bledsoe developed a device that could classify photos of faces by hand using what's known as a RAND tablet, a device that people could use to input horizontal and vertical coordinates on a grid using a pen like stylus that emitted electromagnetic pulses [1]. Ever since then the recognition system is being improved and optimized constantly, the technology becomes gradually mature and is more and more widely used in human daily life. It has been used increasingly for forensics by law enforcement and military professionals. In fact, facial recognition system was used to help confirm the identity of Osama bin Laden after he was killed in a U.S. raid. The face recognition system is also being increasingly used in the mobiles for device security. In this paper, we propose a face detection and recognition system using python along with Open CV package. This system contains three modules which are detection, training and recognition. Basically, the detection module detects the face which gets into the field of vision of the camera and saves the face in the form of an image in JPG format. Then the training modules trains the system using Haar cascade algorithm which was proposed by Paul Viola and Michael Jones in their paper. This method consists of four steps:

1.1 Haar Feature Selection

First step is to collect the Haar Features. A Haar feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums [2].

1.2 Creating Integral Images

Integral Images are used to make this process fast. Most of the calculated features are irrelevant.

1.3 Adaboost Training

A concept called Adaboost which both selects the best features and trains the classifiers is used. This algorithm constructs a strong classifier using a linear combination of weighted simple weak classifiers.

1.4 Cascading Classifiers

The cascade classifier consists of a number of stages, where each stage is a group of weak learners. These weak learners are simple classifiers called decision stumps. Each stage is trained using a method called boosting. Boosting provides the ability to train a highly accurate classifier by taking the weighted average of decisions made by the weak learners [3].

Finally, in the recognition module the principal components of the face from the new video are extracted. Then those features get compared with the list of elements stored during training and the ones with the best match are found and name of the person recognized is displayed. This monitoring system fulfills the basic needs of face detection and recognition system, also takes the cost into consideration to ensure the pervasive mode as economical as possible. Furthermore, it can also be combined with real-time analysis algorithms.

Face detection utilizing Eigen face has been demonstrated to be precise and quick. With the guide of a normal web camera, a machine can identify and perceive an individual's face; a custom login screen with the capacity to channel client get to dependent on the clients' facial highlights will be created. The goals of this is to give a lot of location calculations that can be later bundled in an effectively compact structure among the distinctive processor designs we find in machines today. This will examine PC vision, to be specific face location based Open CV library.

2. RELATED WORK

The earliest developed face recognition algorithms used individual features on the faces, such as organs i.e. eyes, mouth or nose region to perform identification. These were purely feature set based classifiers that held a huge impact on the use of face and classifier based datasets [4]. However, such methods did not lead to good results because of the variability and the low amount of information used.

The **Viola–Jones [5]** object detection framework is the first object detection framework to provide competitive advantage. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. This algorithm is implemented in Open CV. In the domain of face detection the system yields detection rates comparable to the best previous systems. Used in real-time applications, the detector runs at 15 frames per second without resorting to image differencing or skin color detection.

From the 90s, new methods that use global features of the faces were developed. **Turk and Pentland** [8] proposed Eigenfaces that uses Principal Component Analysis (PCA). Other methods like Fisher faces or Laplacian faces extract features from face images and perform nearest neighbor identification using Euclidean distance measure.

A. Mohan et al. [6] present a general example-based framework for detecting objects in static images by components. The technique is demonstrated by developing a system that locates people in cluttered scenes. The system is structured with four distinct example-based detectors that are trained to separately find the four components of the human body: the head, legs, left arm, and right arm. After ensuring that these components are present in the proper geometric configuration, a second example-based classifier combines the results of the component detectors to classify a pattern as either a ªpersonº or a ªnonperson. We call this type of hierarchical architecture, in which learning occurs at multiple stages, an Adaptive Combination of Classifiers (ACC). We present results that show that this system performs significantly better than a similar full-body person detector. This suggests that the improvement in performance is due to the component-based approach and the ACC data classification architecture. The algorithm is also more robust than the full-body person detection method in that it is capable of locating partially occluded views of people and people whose body parts have little contrast with the background.

LBP is a visual descriptor used for classification in computer vision. LBP is the particular case of the Texture Spectrum model proposed in 1990 [8]. It has since been found to be a powerful feature for texture

classification, it has further been determined that when LBP is combined with (HOG) Histogram of oriented gradients descriptor, it improves the detection performance considerably on some datasets.

PCA algorithm [4], which is based on the Eigen faces approach, extracts relevant information in a face image, and encodes that in a suitable data structure. It was first introduced in the early 1900's and probably is the oldest algorithm. It was first introduced by Pearson (1901) and developed independently by Hotelling. The general idea of PCA is to reduce the dimensionality of the dataset in which there are large numbers of interrelated variables, while retaining much of the possible variation in the dataset.

These were the models to eliminate pose and expression variations. In the recent years, deep learning methods have been adapted to the face recognition problem. These methods achieve very good recognition rates and clearly outperform the "standard" algorithms. However, they generally require a considerable amount of data and specialized hardware to train and deploy in practice. This makes them hard to train and less suited for embedded and low power devices.

3. WORKING METHODOLOGY

Face recognition takes a photo from a video or a digital camera as input and outputs the diagnosed photo subject matter. Facial features may additionally consist of regions inside the face, variations within the face structure, face cuts and angles which have been formatted and styled. Face extraction includes grabbing of the capabilities from camera. Face detection includes the elimination of the background and focusing on the foreground eliminating some other elements apart from the face vicinity, but the device nevertheless pertains some drawbacks because it cannot come across the head be counted which can be a gift because of overlapping of faces or mistaken recognition of faces having similar facial functions.

- **Find faces** – Regardless of whether the errand of perceiving individuals in photos, or video acknowledgment, or whatever else.
- **Face positioning** - Pictures aren't regularly located on which an individual stand straightforwardly before the focus, often the face grows to become, we are facing the challenge of situating it as though the picture become taken legitimately.
- **Defining outstanding facial capabilities** - This development can be referred to as a full face acknowledgment step, it examinations the photograph and gets certainly one of a type automated estimations of the face.
- **Identification of a person** - We assessment a got information and the information efficiently accessible to us, if the statistics are similar, we will show the call of the character, if now not, in like way we've now not recognised at this point to us character. This will analyse in element each one of the means to manufacture a face acknowledgment framework and comparison their execution and the help of various libraries, simply as the velocity of crafted by way of every section in various libraries of Computer vision.

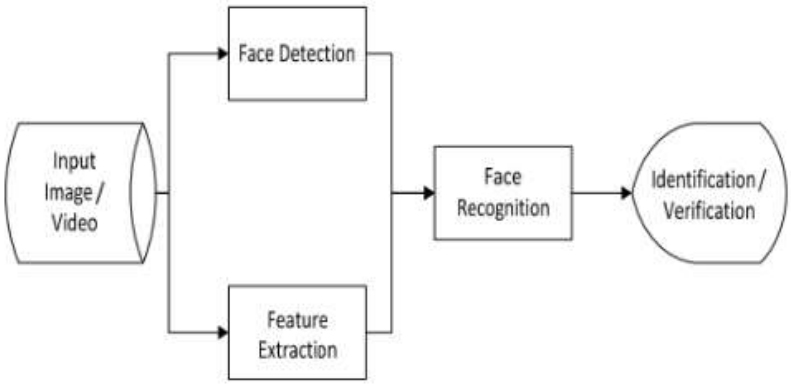

Fig.1 Block diagram for face detection

4. EXPERIMENTAL INVESTIGATIONS

The goal of our face recognition frameworks may rely upon the use of the framework. We can recognize in any event two general classes of face acknowledgment frameworks.

- We need to discover an individual inside an enormous database of countenances. These frameworks normally return a rundown of the in all likelihood individuals in the database. Regularly just one picture is accessible per individual. It is generally a bit much for acknowledgment to be done in real time.

- We need to recognize specific individuals continuously (for example in a security checking framework, banking framework, and so on.), or we need to enable access to a gathering of individuals and deny access to all others. Numerous pictures per individual are regularly accessible for preparing and constant acknowledgment is required.

In this paper, we are basically intrigued by the subsequent case. We are keen on acknowledgment with fluctuating facial detail, demeanor, present, and so on. We don't think about invariance to high degrees of turn or scaling - we accept that an insignificant pre-handling stage is accessible whenever required.

5. IMPLEMENTATION

A general face recognition framework incorporates numerous means:

- Face Detection.

- Feature extraction.

- Face recognition.

Face detection and recognition incorporates numerous correlative parts where each part is a supplement to the next. Contingent upon standard framework where each part can work separately. Face identification is a PC innovation that depends on learning calculations to designate human faces in advanced pictures. Face detection takes pictures/video successions as information and finds face zones inside these pictures. This is finished by isolating face regions from nonface foundation districts. Facial extraction finds significant highlight (eyes, mouth, nose and eye-temples) positions inside a distinguished face.

A fundamental issue in face recognizable proof is the enormous contrasts between face pictures from a similar individual when contrasted with those from various people. In this manner, it is critical to pick an appropriate face order procedure that can give a decent discrete capacity between various people. Face ID has a wide scope of utilizations. Since it offers a non-meddling route for human recognizable proof, the face is utilized as a significant biometric in security applications. Open CV-Python was begun at Intel in the year 1999 by Gary Bradsky. The principal discharge came somewhat later in the year 2000. Open CV basically represents Open Source Computer Vision Library.

Despite the fact that it is written in upgraded C/C++, it has interfaces for Python and Java alongside C++. Open CV brags of a functioning client base everywhere throughout the world with its utilization expanding step by step because of the flood in PC vision applications. Open CV-Python is the python API for Open CV. You can consider it a python wrapper around the C++ usage of Open CV.

Open CV-Python isn't just quick but on the other hand is anything but difficult to code and convey. This settles on it an extraordinary decision to perform computationally escalated projects.

A general explanation of the face recognition issue in Computer vision can be planned as pursues: given still or video pictures of a scene, recognize or check at least one people in the scene utilizing a put away database of appearances. Facial recognition by and large includes two phases: Face Detection where a photograph is looked to discover a face, at that point the picture is prepared to harvest and concentrate the individual's face for simpler recognition. Face Recognition where that recognized and handled face is contrasted with a database of known countenances, to choose who that individual. Since 2002, face recognition can be performed reasonably effectively and dependably with Intel's open source structure called Open CV. Face Detector that works in about 90-95% of clear photographs of an individual looking forward at the camera. Face detection anyway is substantially less solid

than face recognition, with a precision of 30 to 70% as a rule. Face detection has been a solid field of research since the 1990s, yet is as yet a far route away from a dependable strategy for client verification. An ever increasing number of systems are being built up every year.

6. FACE DETECTOR CLASSIFIER

A Computer program that chooses whether a picture is a positive picture (face picture) or negative picture (non-face picture) is known as a classifier. A classifier is prepared on a huge number of face and non-face pictures to figure out how to order another picture effectively. OpenCV furnishes us with two pre-prepared and fit to be utilized for face identification classifiers:

- Haar Classifier
- LBP Classifier

Both of these classifiers procedure pictures in dark scales, fundamentally on the grounds that we needn't bother with shading data to choose if an image has a face or not (we'll talk progressively about this later on). As these are preprepared in Open CV, their scholarly information documents additionally come packaged with Open CV/information/. To run a classifier, we have to stack the information documents first, as though it had no information, much the same as a recently conceived infant (idiotic children). Each record begins with the name of the classifier it has a place with.

6.1 HAAR CASCADES CLASSIFIER: The Haar Classifier is an AI based methodology, a calculation made by Paul Viola and Michael Jones; which are prepared from numerous positive pictures (with appearances) and negatives pictures (without faces).

6.1.1 Haar Feature Selection: First step is to gather the Haar Features. A Haar include considers neighbouring rectangular districts at a particular area in an identification window, summarizes the pixel powers in each area and figures the contrast between these aggregates.

6.1.2 Making Integral Images: Integral Images are utilized to make this procedure quick. A large portion of the determined highlights are superfluous.

6.1.3 Adaboost Training: An idea called Adaboost which both chooses the best highlights and prepares the classifiers is utilized. This calculation builds a solid classifier utilizing a straight blend of weighted straightforward frail classifiers.

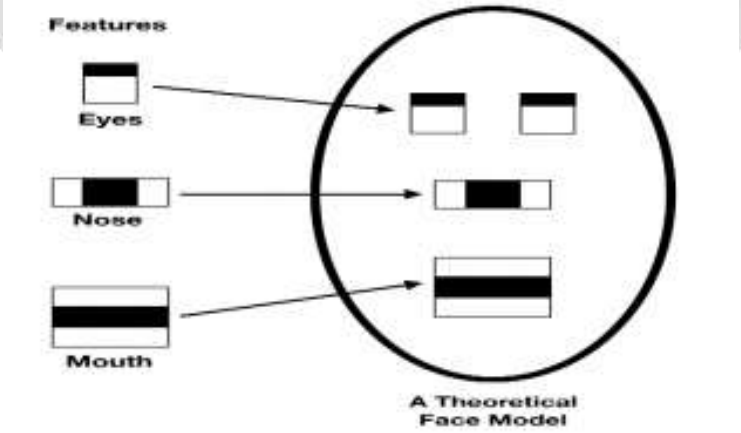

Figure 2: Detection of Theoretical Face model using Haar like features

6.2 LBP CASCADE CLASSIFIER:

As some other classifier, the Local Binary Patterns, or LBP to put it plainly, additionally should be prepared on many pictures. LBP is a visual/surface descriptor, and our countenances are likewise made out of miniaturized scale visual examples. Along these lines, LBP highlights are removed to frame an element vector that characterizes a face from a non-face. Each preparation picture is separated into certain squares. For each square, LBP takes a gander at 9 pixels (3×3 window) at once, and with a specific enthusiasm for the pixel situated in the focal point of the window. At that point, it contrasts the focal pixel esteem and each neighbour's pixel esteem under the 3×3 window. For each neighbour pixel that is more noteworthy than or equivalent to the middle pixel, it sets its incentive to 1, and for the others, it sets them to 0. From that point onward, it peruses the refreshed pixel esteems (which can be either 0 or 1) in a clockwise request and structures a twofold number. Next, it changes over the twofold number into a decimal number, and that decimal number is the new estimation of the middle pixel. We do this for each pixel in a square.

At that point it changes over each square into histogram, so we have gotten one histogram. Finally, it connects these square histograms to shape a one element vector for one picture, which contains every one of the highlights we are intrigued. Along these lines, this is the way we extricate LBP highlights from an image.

6.3 HAAR CLASSIFIER VS. LBP CLASSIFIER:

Algorithm	Advantages	Disadvantages
Haar	1. High detection accuracy 2. Low false positive rate	1. Computationally complex and slow. 2. Longer training time. 3. Less accurate on black faces. 4. Less robust to occlusion.
LBP`	1. Computationally simple and fast. 2. Shorter training time. 3. Robust to local illumination changes. 4. Robust to occlusion.	1. Less accurate. 2. High false positive rate.

6.4 FACE-RECOGNITION ALGORITHMS

6.4.1 EIGENFACE ALGORITHM:

Since we have a pre-processed facial picture, we can perform Eigenfaces (PCA) for Face Recognition. OpenCV accompanies the capacity "cvEigenDecomposite()", which plays out the PCA activity, anyway we need a database (preparing set) of pictures for it to realize how to perceive every one of your kin. Use "Head Component Analysis" to change over the preparation pictures into a lot of "Eigenfaces" that speak to the fundamental contrasts between the preparation pictures. First it will locate the "normal face picture" of your pictures by getting the mean estimation of every pixel. At that point the eigenfaces are determined in contrast with this normal face, where the first eigenface is the most prevailing face contrasts, and the second eigenface is the second most predominant face contrasts, etc., until you have around 50 eigenfaces that speak to the greater part of the distinctions in all the preparation set pictures.

In these model pictures above you can see the normal face and the first and last eigenfaces that were produced from an assortment of 30 pictures every one of 4 individuals. Notice that the normal face will show the smooth face structure of a nonexclusive individual, the initial not many eigenfaces will give some prevailing aspects of countenances, and the last eigenfaces (e.g.: Eigenface 119) are for the most part picture clamour. You can see the initial 32 eigenfaces in the picture underneath.

6.4.2 FISHERFACES ALGORITHM:

The Principal Component Analysis (PCA), which is the center of the Eigenfaces technique, finds a direct blend of highlights that expands the all-out difference in information. While this is plainly an incredible method to speak to

information, it doesn't think about any classes thus a great deal of discriminative data might be lost when discarding segments. The Fisherface strategy learns a class-explicit change grid, so they don't catch brightening as clearly as the Eigenfaces technique. The Discriminant Analysis rather finds the facial highlights to separate between the people. It's critical to make reference to, that the exhibition of the Fisherfaces intensely relies upon the info information too. For all intents and purposes stated: on the off chance that you become familiar with the Fisherfaces for well enlightened pictures just and you attempt to perceive faces in terrible lit up scenes, at that point technique is probably going to locate an inappropriate part (in light of the fact that those highlights may not be overwhelming on awful lit up pictures). This is to some degree consistent, since the technique got no opportunity to get familiar with the brightening.

7. RESULTS

The last form of the trial is a face recognition framework which depends on Open CV. The consequence of their work is given underneath which gives an interface of utilizations, wherein we see the detected face.

In light of the investigation of the submitted OpenCV, it has been set up that there is no single strategies and advancements to make a dispersed acknowledgment data framework that would join all phases of the framework development. There are an enormous number of techniques for looking, situating and as a rule for sorting out the acknowledgment procedure. By picking innovations you ought to be exceptionally cautious in light of the fact that relying upon your needs you should utilize certain strategies. Thus, work with a nitty gritty depiction of advancements for acknowledgment is very important at present, just as the improvement of new advances and an approach to take care of this squeezing issue. As referenced above, presently the innovation of PC vision and devices for face recognition are effectively creating. Worldwide innovation pioneers put resources into innovative work a great deal of cash since this issue has wide open doors for use. The course for the improvement of face acknowledgment is principally the security and expanded assurance frameworks. At present the most utilized in amusement, I accept this pattern will develop too. Proposed approach can be utilized for enormous information handling.

8. CONCLUSION

According as far as our knowledge is concerned, the OpenCV library is progressively profitable, has better execution for face location and recognition. It additionally implies that with OpenCV, it's smarter to assemble acknowledgment applications for the IOT stage. Note that lone HOG calculation has been investigated while scanning for different calculations, for example, the Haar course, it works longer, yet turns out additional in detail, if there are a lot of photographs later on for some, it is prudent to consider utilizing this strategy. Nonetheless, the structure rationale and the key purposes of making an application acknowledgment, were talked about. Haar Cascade Classifier works better which has the best exactness when contrasted with some other calculations like LBP and so on.

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