Method & Implementation of Real Time Face Recognition to Enhance Frame Rate

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***Abstract*—Face is important part to identify the person. It can be used as the computer visual application. Face is the important part of our body by which it is easy to identify and recognize the person. Face detection is one of the challenging tasks as there are many issues such as changes in the appearances of faces, variations in poses, noise, distortion and illumination condition. The objective of the present study is to make a real time efficient face recognition system with Open CV so as to apply it for the real time applications where we need a low recognition time but high accuracy. In this paper, the framework for efficient face detection using fusion of PCA and LBP is presented. The image features are represented as reduced features space by using PCA which is a dimensionality reduction technique. The performance of LBP is compared with ULBP algorithm. All simulations are done in OPENCV tool.**

***Keywords*- PCA, Eigen faces, Eigen space, Face Detection, Face recognition etc.**

I. INTRODUCTION

Biometric is derived from a Greek word "bio" meaning life and metrics meaning "to measure". Biometrics refers to the identification or verification of a person based on his/her physiological and behavioural characteristics. In contrast to the traditional security systems, which may be cracked or faked, current biometric technologies are based on various unique aspects of human body (such as the face, fingerprint, palm print, iris, retina, voice, and gait) [1].

Among these technologies face recognition is one of the most relevant applications of image processing. Human Face detection is the process of identifying the features of faces to detect the faces on the basis of the discriminant features. Features of faces are eyes, ears, eyebrows, nose, lips, hairs, chicks, forehead etc. Face detection can be carried out using these features of faces. Face is important part to identify the person. It can be used as the computer visual application. Face is the important part of our body by which it is easy to identify and recognize the person.

One of face recognition main goals is the understanding of the complex human visual system and the knowledge of how humans represent faces in order to discriminate different identities with high accuracy. Mainly face recognition falls into two main categories feature-based approach and holistic approach. Feature-based approach for face recognition basically relies on the detection and characterization of individual facial features and their geometrical relationships. Such features generally include the eyes, nose, and mouth. Holistic or global approaches to face recognition, on the other hand, involve encoding the entire facial image and treating the resulting facial "code" as a point in a high-dimensional space [2].

The human face is a complex, natural object that tends not to have easily identified edges and features. Because of this, it is difficult to develop a mathematical model of the face that can be used as prior knowledge when analyzing a particular image. Computational models of face recognition are interesting because they can contribute not only to theoretical knowledge but also to practical applications. According to the complexity of face detection process, many applications based on human face detection have been developed recently such as surveillance systems, digital monitoring, intelligent robots, notebooks, PC cameras, digital cameras and 3G cell phone [3].

There are several techniques for face detection like Principal Discriminant analysis (PCA), Linear Discriminant analysis (LDA) ,Hands-off distance measure for face recognition, Elastic Graph Matching (EGM), eigen space-based face recognition, a novel hybrid neural and dual eigen spaces methods, Fisher faces methods and artificial neural network.

The identification of a person by their facial image can be done in a number of different ways such as by capturing an image of the face in the visible spectrum using an inexpensive camera or by using the infrared patterns of facial heat emission.Facial recognition in visible light typically model key features from the central portion of a facial image. Using a wide assortment of cameras, the visible light systems extract features from the captured images that do not change over time while avoiding superficial features such as facial expressions or hair. Several approaches to modelling facial images in the visible spectrum are Principle Component Analysis, Local Feature Analysis, Neural Network , Elastic graph theory, and multi-resolution analysis [4].

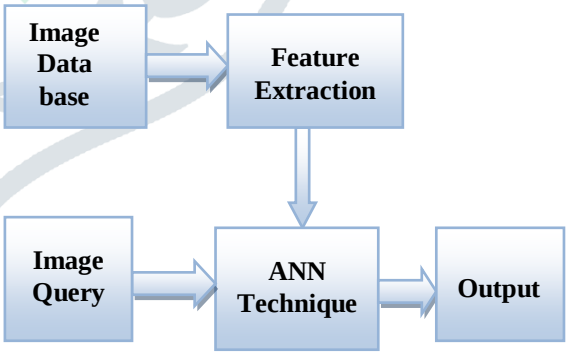

Figure 1: General Architecture of Face Recognition System

The paper is organized as follows. In Section II, It describes literature work related to system. In Section III, it describes the proposed system with some introduction of three step search and four step search algorithm. Section IV defines the results of proposed system. Finally, conclusion is given in Section V.

II. LITERATURE REVIEW

On the analysis of face recognition system some of the important studies on face recognition systems are discussed. A multi-algorithm method is based on detecting the face of the individual by combining four algorithms

namely PCA, DCT, Template Matching using Correlation and Partitioned Iterative Function System. Image quality based adaptive face recognition mainly used the multi-resolution property of wavelet transforms to extract facial features. Face detection based on features analysis and edge detection mainly consists of three phases including image pre-processing, skin color segmentation and finally the determination of face . A multi view face recognition system is based on eigen face using PCA to extract the features. This method used Cr space instead of gray level [5].

Another method for LDA based face recognition is based with selection of optimal components using E-coli bacterial foraging strategy(EBF).A GA-PCA algorithm was developed to find optimal eigen values and corresponding eigenvectors in LDA. A technique which combined weighted eigen face and BP based network divide the test face image into 9 sub blocks and then different weights were given to different parts of image according to their importance at recognition stage. A method based on Hausdorff distance which compute eigen face from edge images showed that different face regions have different degree of importance in face recognition. For multi dimensional data like 3-D images hidden markov eigen face model is proposed in which the eigen faces are integrated into separable lattice hidden markov models [6].

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III. DESCRIPTION OF PROPOSED SYSTEM

The objective of the present study is to make a real time efficient face recognition system with Open CV so as to apply it for the real time applications where we need a low recognition time but high accuracy. We do face recognition almost on a daily basis. Most of the time we look at a face and are able to recognize it instantaneously if we are already familiar with the face. This natural ability if possible imitated by machines can prove to be invaluable and may provide for very important in real life applications such as various access control, national and international security and defence etc. Presently available face detection methods mainly rely on two approaches. The first one is local face recognition system which uses facial features of a face e.g. nose, mouth, eyes etc. to associate the face with a person. The second approach or global face recognition system use the whole face to identify a person. The above two approaches have been implemented one way or another by various algorithms.

The Eigen face method for human face recognition is remarkably clean and simple. Where other face recognition methods are forced to attempt to identify features and classify relative Distances between them, the eigen face method simply evaluates the entire image as a whole. These properties make this method practical in real world implementations. This technique converts each two dimensional image into a one dimensional vector. This vector is then decomposed into orthogonal principle components

The basic concept behind the eigen face method is information reduction. In the process of decomposition, a large amount of data is discarded as not containing significant information since 90% of the total variance in the face is contained in 5-10% of the components. This means that the data needed to identify an individual is a fraction of the data presented in the image. When one evaluates even a small image, there is an incredible amount of information present. From all the possible things that could be represented in a given image, pictures of things that look like faces clearly represent a small portion of this image space. Because of this, we seek a method to break down pictures that will be better equipped to represent face images rather than images in general. To do this, we generate "base-faces" and then represent any image being analyzed by the system as a linear combination of these base faces.

Any human face can be considered to be a combination of these standard (base) faces. Thus any image being analyzed by the system is a linear combination of these base faces. If three base faces were chosen then there would be three coefficients to represent the intensity of each base face to represent any image. This technique is similar to what is done to represent colors. Base colors are chosen and then all other colors are represented in terms of the base colors. If we wanted to represent purple, we would choose coefficients so that the intensities of red and blue were approximately equal, and the coefficient of green would be zero.

1. PCA Algorithm

It assumes that M sample images are being used. Each sample image is referred to as $\mathbf{A_n}$ where n indicates that we are dealing with nth sample image (1<n< M). Each $\mathbf{A_n}$ should be a column vector. Images are made of pixels, each having (x,y) coordinates with (0,0) being at the upper left corner. Following are the steps involved in PCA:

Step 1: The size of the resulting $\mathbf{A_n}$ column vector will depend on the size of the sample images. If the sample images are x pixels across and y pixels tall, the column vector will be of size (x*y) × 1.

Step 2: Calculate the average image, Ø, as follows. This average image will be a column vector of the same size as the sample images ((x*y) × 1).

$$Ø= \sum A_L/M \quad \text{where } 1< L<M \quad (1)$$

Step 3: Calculate the difference faces by subtracting the average face from each sample image. Each will be a column vector the same size as our sample image vectors ((x*y)×1)

$$O= A_n – Ø \quad (2)$$

Step 4: Total scatter matrix or covariance matrix is calculated from Ø .The covariance matrix is defined by AA^T where A is

$$A= [O_1 O_2 O_3 \ldots O_m] \quad (3)$$

The matrix **A** will be of size (x*y) × M.

Step 5:The eigenvectors of this matrix can be found through the following formula:

$$\mathbf{u}_k = \frac{\sum_{l=1}^{M} \ddot{\mathbf{O}}_l \mathbf{X}_{lk}}{\sqrt{\lambda_k}}$$

u_k is the kth eigenface of the training data.

Step 6: For image classification this feature space can be utilized.Measure the vectors of weight which is found by multiplying the transpose of the matrix U by a vector that is found by subtracting the average face image Ø, from a sample or test image $\mathbf{A_n}$.

$w= U^T(A - Ø)$

The weights form a vector W^T = [w1,w2…..wm'] that describes the contribution of each eigenface in representing the input face image, treating the eigenface as a basis set for face images. This vector is used in a standard pattern recognition algorithm.

2. Local Binary Pattern (LBP)

LBP thresholds all pixels in a specific neighbourhood based on the value of the central pixel of that neighbourhood to compute a new value for this central

pixel. So, if the central pixel is corrupted by noise for any reason the comparison between this corrupted pixel and its neighbours will not be accurate. Also, according to LBP strategy, assigning the value 1 to all pixels greater than or equal to the central pixel value and assigning the value 0 to all pixels less than the central pixel produces inferior. The system may find a pixel with a value which is a little bit less than the central pixel value and there is another pixel which has a value significantly less than the value of the central pixel. Based on the LBP definition both of the two pixels will assign the value 0 and this is undesirable.

3. LBP Operator

The nearby binary sample operator is an image operator which transforms a photo into an array or photograph of integer labels describing the small-scale look of the photo. These labels or their information, most customarily the histogram, are then used for in addition photograph analysis. The most broadly used versions of the operator are designed for monochrome nevertheless images however it's been extended moreover for colour (multi-channel) photographs further to motion pictures and volumetric information.

4. Flow chart of Process

In the LBP technique for texture class, the occurrences of the LBP codes in a photo are gathered right into a histogram. The classification is then in keeping with-fashioned by computing easy histogram similarities. However, considering a comparable technique for facial picture illustration effects in a lack of spatial records and consequently one need to codify the feel information at the same time as preserving also their locations. One way to obtain this aim is to use the LBP texture descriptors to build numerous nearby descriptions of the face and integrate them into an international description. Such neighbourhood descriptions had been gaining interest these days that is understandable given the restrictions of the holistic representations. This nearby characteristic primarily based techniques seem to be extra robust in opposition to variations in pose or illumination than holistic techniques. The LBP process consist of 6 steps, that firstly it captures a face image then it is processed to the block of the Face image is divided into several blocks for the calculation & after this, the histogram of the image is calculated for each and every block. After this, the block histograms are concentrated into Face Image and Face Image decides the Facial recognition are represented by LBP or not.

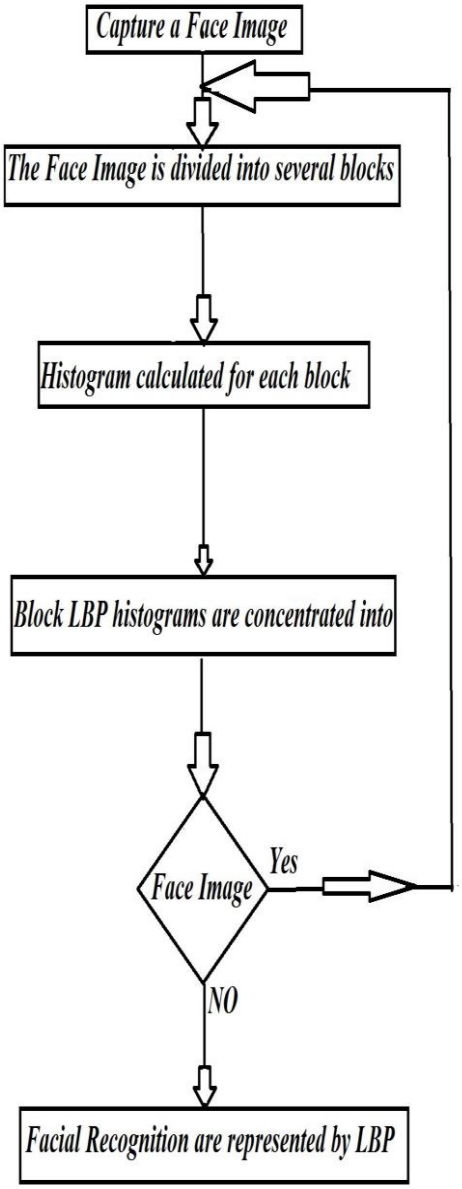

Figure 2: Flowchart of System

The fundamental methodology for LBP primarily based face description is as follows: The facial image is divided into neighbourhood regions and LBP texture descriptors are extracted from each vicinity independently. The descriptors are then concatenated to form a worldwide description of the face, as shown in Fig 2. The basic histogram that is used to acquire information approximately LBP codes in an image can be extended right into a spatially superior histogram which encodes each the advent and the spatial members of the family of facial areas.

IV. RESULTS & DISCUSSION

We have used two generally used database for face recognition i.e. ORL database and AR database. ORL database include 400 face images taken from 40 subjects, with each subjects providing ten face images. For some subjects, the images were taken at different times, with varying lighting, facial expressions (open /closed eyes, smiling/not smiling) and facial details (glasses/ no glasses). Each face image from the ORL database has been resized to a 40 × 56 matrix by using the down sampling algorithm. In this some images are used for training samples and the remaining serves as the test samples.

Figure 3: Training & Testing Database

The system proposed here first select the image from the given dataset of the face images. After the image is selected segmentation is done followed by the thresholding. Then the feature extraction is performed and finally the matching is done to obtain the desired output. The image is read using the option present in the GUI. Once the image is read segmentation of the selected image is done which basically subdivides the image into its constituent regions or colour model. Then a threshold T is selected and the segmentation is accomplished by scanning the image pixel by pixel and labelling each pixel as object or background depending on whether the gray level of that pixel is greater or less than the value of threshold. All the simulation results of the above steps are shown in this section.

The main purpose of Face Recognition system is to detect and recognize all the faces in the lowest possible time so that they can be acted upon in real time. In this chapter, we have classified the LBP entire working and results provided by self created and ORL database using the proposed algorithm.

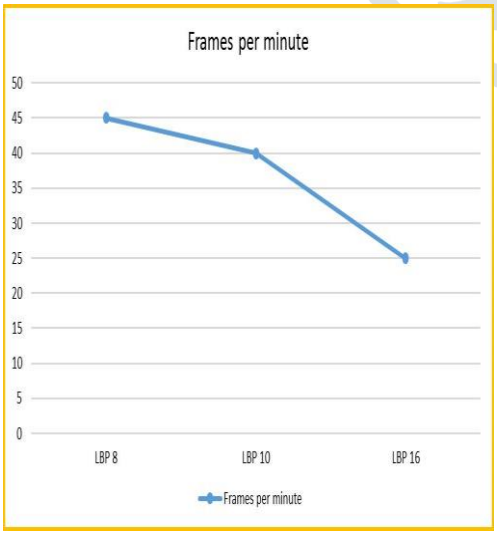

Figure 4: Frame Rate Performance with LBP

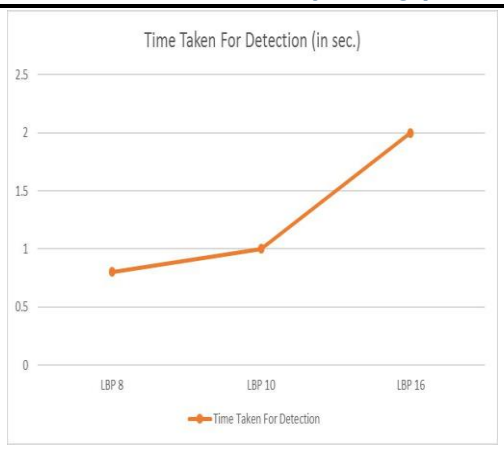

Figure 5: Detection Time with LBP

Frame rate is defined as the rate of frames received or detected in given time. In this new concept of proposed work, It tries to give the result after the 3 consecutive predicted label is same the only it display the results. So, I apply a loop, in this way the accuracy level gets increased in this way, it can be used at high-security level. In this way 3 samples of the user have been taken and give the result whether it is 100% when all three are equal and 67% if the 2 predicted label of samples matched and 33% when no predicted label is of the sampled is matched. In this way, it can be used for security systems and it helps to improve the results of our work. The performance Frame rate and time detection is shown in figure 4 & 5 resp and also comparison of LBP with different bits is shown in Table 1.

Table 1: Comparison of LBP Frames Rate

Method	Frames per Minute (%)
LBP 8	45
LBP 10	40
LBP 16	25

Table 2: Comparison of Time Detection Using LBP

Technique	Time
LBP 8	0.8 sec
LBP 10	1.0 sec
LBP 16	2.0 sec

Table 3: Performance Comparison of LBP and ULBP System

No. of training face	PCA	LDA	Basic LBP	ULBP
1	68	68	69	68
2	80	72	81	81
3	84	84	86	85
4	87	87	90	91
5	90	89	92	93
6	92	91	94	94
7	94	93	95	95
8	94	94	96	96
9	95	95	97	97

Table 3 shows the performance comparison of LBP and ULBP system. It shows that ULBP found with better results as compared to LBP system under different no. of training faces.

V. CONCLUSION

Vision is also a key component for building artificial systems that can perceive and understand their environment. The most useful and unique features of the face image are extracted in the feature extraction phase. In the classification, the face image is compared with the images from the database. This method represents the local feature of the face and matches it with the most similar face image in a database. The speed/frame or high resolution is our objective to increase for the LBP algorithm in real time application This thesis investigated a promising method of face recognition by using techniques PCA in Open CV software, which is used here for feature extraction and verification purpose. The principal component analysis method for face recognition is motivated by information theory approach that decomposes face images into a small set of characteristics features images called " eigen faces" which may be thought of as the principal components of the initial training set of face images. The simulation results shows that the proposed algorithm is very efficient in comparing the images either of the same person with variations in facial expressions or between the images of different persons.

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