Comparison of Face Recognition Algorithms Using Opencv for Attendance System

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***Abstract*-**In this paper; we have proposed a real-time Face Recognition System for monitoring attendance of students in class rather than relying on methods that are time-consuming. The proposed implementation comprised of using the Viola-Jones algorithm for detecting the human faces from a web camera and then the detected face is resized to the required size; this resized face is further processed by using a simple Local Binary Patterns Histograms algorithm.Once recognition is done, automatically attendance will be updated in a SQLite database with the required attributes. The paper also shares the rationale for preferring OpenCVimplementation over MATLAB. The database is automatically updated by the developed system so that a remote authenticated user can access the attendance.The implementation also ensures that the attendance results are accessing to a remote authenticated user through the application GUI of attendance system.

Keywords- Face Recognition, OpenCV, PCA, LDA, Eigenface, Fisherface, LBPH

I.INTRODUCTION

Face recognition is a recognition technique used to detect faces of individuals whose images are saved in the dataset.[1] Despite the fact that other methods of identification can be more accurate, face recognition has always remained a major focus of research because of its non-meddling nature and because it is people's facile method of personal identification. Face recognition for attendance management is evolving to a ubiquitous biometric provision since it requires virtually negligible effort from the user end in contrast with other biometric options.The implementation is preferred to be done in OpenCV due to the reasons are shown by the following comparison:

OpenCV(python) vsMatlab

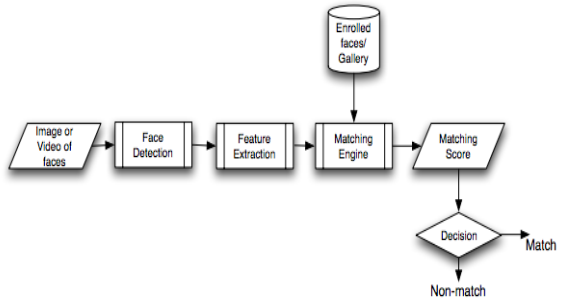
CRITERIA	OPEN CV	MATLAB
Description	Library of programming functions for real time computer-vision, cross-platform, free for use under BSD license.	Numerical computing environment, developed by Cleve Moler, allows matrix manipulation, plotting of functions, supports algorithm implementation, the creation of user interfaces.
Speed of execution	Executes much faster, examine 30 frames per second.[2]	Slower, analyze 3-4 frames per second.[3]
Operating system	Runs well on Windows, Linux, macOS, Android, iOS etc. Any device that can run 'C' can run 'OpenCV'	Runs well on Windows, Linux, macros. It can call functions written in 'C' or 'Fortran'. Matlab can be directly called from Perl,

		Java, ActiveX,NET
Cost	Free as it is BSD license	Each toolbox is purchased separately.
Resources needed	It needs less memory.	More RAM is required.

Attendance system

Traditionally this system involves taking physical attendance by utilizing participation sheet, given by the teacher or professor in class.The process of keeping track of a number of students present has always been a complex task. Over the years, various solutions have been created for tracking student attendancesuch as manual attendance marking, fingerprint scanner, and retina scanner.[4] However, the current participation stamping techniques are redundant and tedious. Physically recorded participation can be effortlessly controlled. Besides, it is exceptionally hard to confirm one by one student in a substantial classroom environment with disseminated branches whether the verified students are really reacting or not.

In this system, it uses face detection and recognition algorithms which automatically detect and registers student attending on a lecture.[5] Face detection and recognition are often referred to as, analyses characteristics of a person's face image input through a camera.[6]



The rest of the paper is organized as follows: The detailed literature survey is given in section II, the proposed model is explained in section III, the experimental results are shown in section IV, comparison of results in section V and finally conclusion and future scope are discussed in section VI.

II. LITERATURE SURVEY

Various research had already been done inface detection and feature extraction.[7] Some of the important methodsare as discussed below:

A. Face Detection Methods:

The different techniques used for face detection are classified as shown below:[8]

- Knowledge Based Method
- Feature Invariant Method
- Template Matching Method
- Appearance-Based Method

B. Face Feature Extraction Methods:

The methods used for Face Recognition can be divided into two major categories:

- Holistic Approach
- Feature-based Approach

In the holistic approach, the face is taken as input for recognition purpose.[9]

Eigen Face Recognizer

1. We can use PCA (Principal Component Analysis), for reducing the dimensionality of the data by projecting, it onto a lower dimensional subspace. [10]

Fisher Face Recognizer

2. We can go for LDA (Linear Discriminant Analysis), where the dimensionality reduction takes place such that the within-class variance is reduced and between class, variance is maximized.

Local Binary Pattern Histogram

3. We can go to LBPH where the local structure of the image is summarized by comparing each pixel with its neighborhood.
4. In Feature-based Approach, local features on the face such as eyes and nose are detected and based upon which recognition is performed.

III. PROPOSED MODEL

Face Recognition System

The proposed model for face recognition system is
The main modules used are:

1) Dataset Generation:

In this stage, face dataset of the user is created, in which 50 images of each user are taken and the attributes used are user ID and username.

2) Pre-processing:

This stage consists of 3 main steps:

a) **Face Detection:** Viola-Jones face detection algorithm is used for Face detection.[11],[12]

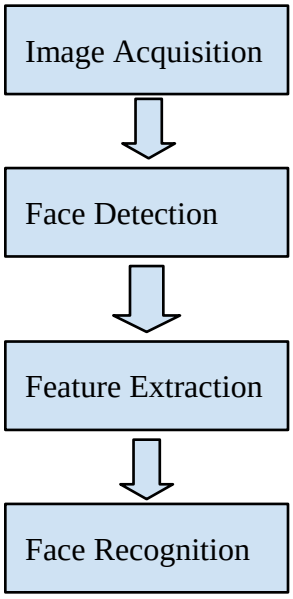
b) **Resizing:** Once face is detected, it is resized to a fixed pixel resolution

3) Feature Extraction and Recognition

For feature extraction and recognition,PCA, LDA and Histogram principle based Algorithm is used.[13] The simple LBPH algorithm is chosen for accurate real-time processing of data as it's computational complexity is less and is more efficient compared to the other face recognition algorithms.

Working of the proposed system

The working of the system is depicted as follows:



IV. IMPLEMENTATION OF ALGORITHMS

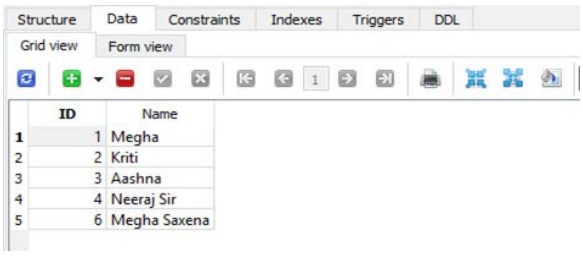
Eigen Face working:
Works on the basis of recognizing distinct features of the face like the eyes, nose, cheeks and how they differ from each other. It focuses on the areas of maximum change.[14] It assumes that all parts of the face are not equally vital or significant for face recognition.
Algorithm:
1. Select the principle component from the new image.
2. These features are now compared with the database stored during training.
3. Find the ones which are well-suited.[15]
4. 'Student' name correlated to that best match component is delivered.

Fisher Face working:
The Linear Discriminant Analysis performs a class-specific dimensionality reduction. In order to find the combination of features that separates best between-classes to within-classes scatter. Fisherfaces heavily depends on the input data.The idea is simple: same classes should cluster tightly together, while different classes are as far away as possible from each other in the lower-dimensional representation.
1. Compute the average(Euclidean distance) of all faces.
2. Compute the average of each face.
3. Subtract (2) from (1)
4. Build two scatter matrices- within the class and between classes.
5. Generate a matrix, W, that maximizes the difference between the two scatter matrices.
6. Columns of W are eigenvectors.
7. The project faces into the LDA-space.[15]

LBPH working:
The basic idea of Local Binary Patterns is to summarize the local structure in an image by comparing each pixel with its neighbourhood. Take a pixel as center and threshold its neighbours against. The main idea is to divide the LBP image into local regions and extract a histogram from each.These histograms are called Local Binary Patterns Histograms.[16]
1. Present new image to the recognizer.
2. The recognizer creates a histogram for that new image.
3. The new histogram is compared with the histogram it already has.
4. Finally, it detects the best match and returns the student name associated with that best match.[17]

V. EXPERIMENTAL RESULTS

A. Database Used
1) SQLite Database: SQLite is a C library that is used to store the name of the registered users and also to mark their attendance. It doesn't require a separate server process and allows accessing the database using a nonstandard variant of the SQL query language. Some applications can use SQLite for internal data storage.



B. Graphical User Interface (GUI):

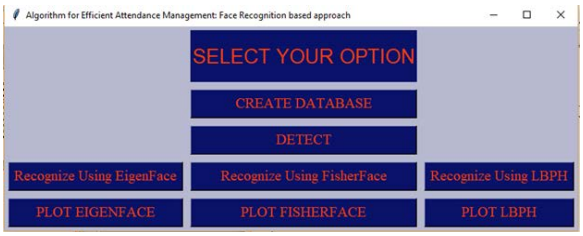


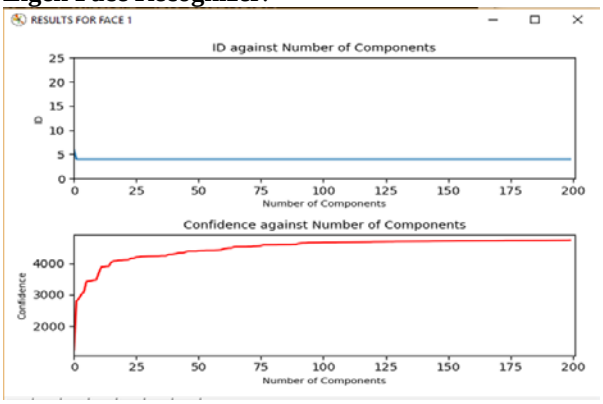
Figure shows the GUI that was made using Tkinter, as an interactive Application, using Python as a programming language and making use of OpenCV

As shown in the GUI as shown in the above figure, provisions are provided for generating the dataset, training and recognizing the user.

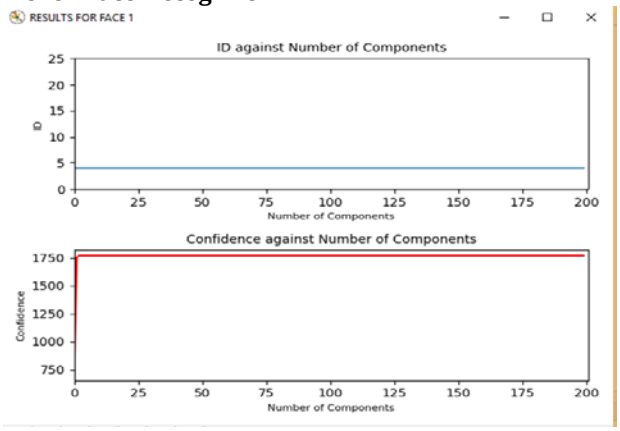
V. COMPARISON OF RESULTS

1. ANALYSIS

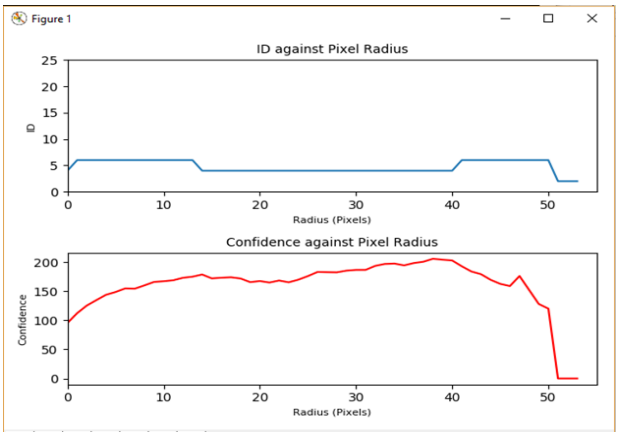
Eigen Face Recognizer.



Fisher Face Recognizer



LBPH Face Recognizer



This can be seen from the table for the efficiency and accuracy of the algorithms

CRITERIA	EIGEN FACE	FISHER FACE	LBPH
Confidence Factor(based on output)	2,000-3,000	100-400	2-5
Threshold	4,000	400	7
Principle of dataset generation	Component-Based	Component-Based	Pixel Based
Basic Principle	PCA	LDA	Histogram
Background Noise	Maximum	Medium	Minimum
Efficiency	Low	Higher than Eigenface	Highest

CONCLUSION

The paper highlights the most efficient OpenCV face recognition algorithm available for Attendance Management.We have implemented the system using Eigenface, Fisherface and Local Binary Pattern Histogram (LBPH) algorithm. LBPH outperforms other algorithms with confidence factor in range 2-5 and has minimum noise interference.The outcome derived from the implementation of attendance system shows that there exists a trade off between the correct recognition rate and the threshold value. As the threshold value increases, the number of misses begins to decrease possibly resulting in misclassifications.Hence, LBPH is the most accurate and efficient face recognition algorithm available in OpenCV to identify the students in an educational institution and mark their attendance effectively by avoiding proxies. Also, the changes in illumination didn't cause major problems to the attendance

system. In future, a neural network architecture together with a feature based approach could be implemented along with the existing system in which orientation of the faces will be determined and then the most suitable recognition method i.e. LBPH will be used

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