Automated Attendance System using Machine Learning Approach

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***Abstract*— The conventional method of taking attendance is done manually by the teacher or the administrator which requires considerable amount of time and efforts also involving errors and proxy attendance. As the number of students are increasing day by day, it is a challenging task for universities or colleges to monitor and maintain the record of the students. Automated systems involving use of biometrics like fingerprint and iris recognition are well developed in the recent years however, it is intrusive and cost required for deployment on large scale gets increased substantially. To overcome these issues, biometric feature like facial recognition can be used which involves the phases such as image acquisition, face detection, feature extraction, face classification, face recognition and eventually marking the attendance. The algorithms like Viola-Jones and HOG features along with SVM classifier are used to acquire the desired results. Various real time scenarios need to be considered such as scaling, illumination, occlusions and pose. The problem of redundancy in manual records and keeping attendance is solved by this system. Quantitative analysis is done on the basis of PSNR values.**

Keywords*— Histogram of Oriented Gradients(HOG); Support Vector Machine (SVM); Face Recognition; Peak Signal to Noise Ratio (PSNR)

I. INTRODUCTION

Checking the performance of students and maintaining the attendance is a tedious process for institute. Each institute has adopted their own method of taking attendance i.e. calling the names or by passing the sheets. Several very popular automatic attendance systems currently in use are RFID, IRIS, FINGERPRINT etc. However, making queue is essential in these cases thus requires more time and it is intrusive in nature. Any damage to RFID card can make inappropriate attendance. Apart from this deploying these systems on large scale is not cost efficient. In order to have a system both time and cost efficient with no human intervention, facial recognition is the suitable solution also face is people's preliminary scheme of person identification. With the rapid development in the fields of image processing such as pattern recognition, facial recognition and signature recognition the efficiency of this system is keep on increasing. This system is attempting to provide an automated attendance system that carries out the face recognition task through an image/video stream to record the attendance in lectures or sections and keeping the database of attendance. After creating the database of the students/ candidates, it requires almost zero efforts from the user side. Thus intrusive nature is absent in this system and makes the system effective.

II. LITERATURE SURVEY

Usually in institutes, the number of students are significant and by using conventional method of taking attendance will lead to considerable time consumption and amount of manual work gets increased significantly. The automated systems like IRIS [1], FINGERPRINT [2], RFID [3] provide better percentage of accuracy but have some limitations like intrusive nature and time inefficient. First step in automatic face recognition is face detection. In 2001, Paul Viola and Michael Jones proposed a real time object detection with very high image processing rate [4]. It is capable of detecting a variety of object classes and was greatly inspired by the problem of face detection. The local binary pattern (LBP) technique efficiently provides the image texture features. It uses background subtraction for detection of moving objects. In 1960, semi-automated system was implemented for recognition of a face by locating significant features on the photographs using the primary parameters such as eyes, ears, noses and mouths. Different algorithms for face recognition are available which are distinguishable based on the efficiency, accuracy and time consumption. Principal Component Analysis (PCA) [5] algorithm uses the eigenfaces which are created by the convolution and major features of the faces of the database. Each face is allotted a definite weight and are used at the time of comparison with the help of Euclidean distance. The Discrete Cosine Transform (DCT) [6] expresses various data points in terms of a sum of cosine functions at different frequencies. Fisherface method involving use of Linear discriminant analysis (LDA) [7] is another variation to eigenfaces being less sensitive to variation in illumination [8] while matching techniques are based on the computation of a set of geometrical features from the picture of a face. Computer vision [9] is the field that makes computer to gain high level of understanding from digital images or videos. It includes schemes of acquiring, processing, analyzing and understanding digital images and extracts high dimensional data to produce symbolic information. Machine

978-1-5090-2794-1/17/$31.00 ©2017 IEEE

learning [10] is another important area that evolved from the study of pattern recognition and computational learning theory in artificial intelligence. Computer vision and machine learning together provides excellent tool in the process of recognition. The overall configuration can be described by a vector which representing the position and size of the main facial features like eyes and eyebrows, nose, mouth, and an outline of face. In computer vision and machine learning Support Vector Machine (SVM) is a supervised learning model which classifies the data into group of binary categories based on analysis of data, thus simplifying comparison of data.

III. PROPOSED METHODOLOGY

This is a paradigmatic scheme for real time face detection and recognition. The system consists of a camera, installed in the classroom capturing the video frames followed by the detection of multiple faces. These faces are cropped and converted to grayscale causing reduction in the number of bits to be processed. These faces are then compared with the database faces and displays the result and marks the attendance.

3.1 Face Database Creation of Students

Pictures of all students are captured in different angles with variety of gestures i.e. each student has 8 to 10 pictures angled at different positions. The RGB images are cropped and converted into grayscale and resized to 112*92 pixels in order to reduce the computational time. Folder named 'Database' containing the subfolders, each subfolder contains multiple faces of single person and the corresponding name is given to the subfolder. Fig 1 shows all the faces of single person.

Fig 1. Faces of single person

Fig 2 shows single face of each student present in database.

Fig 2. All faces in the database

3.2 HOG Features

Object detection is accomplished using histogram of oriented gradients(HOG) [11] which is a feature descriptor widely used in computer vision. It is based on counting the occurrences of gradient orientation in localized portions of an image. This method has similarity with edge orientation histogram, scale-invariant feature transform descriptor, shape contexts. However, overlapping local contrast normalization is used and computed on a dense grid of uniformly spaced cells in order to improve accuracy. Implementation of the HOG descriptor algorithm [12] is as follows:

- The image must be divided into cells formed by dividing image into small connected regions and calculate histogram of gradient directions or orientation of edge within the cell.
- As per gradient orientation discretize each cell into angular bins.
- Each cell's pixel contributes weighted gradient to its corresponding angular bin.
- Blocks which are spatial regions are formed by the groups of adjacent cells. The grouping of cells into a block is the basis for grouping and normalization of histograms.
- Normalized group of histograms represents the block histogram. The set of these block histograms represents the descriptor.

Fig 3 shows the HOG feature of corresponding image.

Fig 3. HOG feature extraction

3.3 Face Detection and Eye Detection

After installing the camera in the classroom, it captures the frames containing the faces of all students sitting in the class. Viola-Jones algorithm [4] is applied on this frame, which detects the faces in the frame. To ensure that the detected object is face, each detected object is cropped and further processed for eye detection and if eyes are detected they are considered as faces else are rejected. All the cropped faces are stored in the folder named as 'Test', which is used to compare with the 'Database' folder. Features of all the faces in the test folder are extracted using HOG features.

3.4 SVM Classifier

The major process in object recognition using histogram of oriented Gradient descriptors is to feed the descriptors into some recognition system based on supervised learning. The Support Vector Machine (SVM) classifier [13] is a binary classifier where optimal hyper plane is used as decision function. The decisions can be made by SVM classifier regarding the presence of an object such as human, once trained on images containing some particular object.

3.5. Comparison / Recognition

Extracted binary features of 'Test' faces are compared with the extracted binary features of 'Database' faces, the face having the maximum amount of correlation is recognized as matched face and corresponding name of the face is extracted from the database using the classifier.

3.6. Attendance

After extracting the name of the matched face corresponding attendance is marked in the work sheet named as attendance.mat.

3.7. Experimental Results

The PSNR [14] computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image. The higher the PSNR, the better the quality of the compressed or reconstructed image. It is mathematically expressed as,

$$PSNR = 10log\frac{S^2}{MSE}$$

Where, s is a maximum possible pixel value and MSE is mean squared error and expressed as,

$$MSE = \frac{1}{NM}\sum_{m=0}^{M-1}\sum_{n=0}^{N-1} e(m,n)^2$$

Where e(m, n) is the error difference between the original and the distorted images.

Peak signal to noise ratio of each face of Test folder is calculated with respect to all the faces in the database in order to check the mathematical correlation and these results are compared with the results of recognized faces in order to yield better percentage of accuracy. Fig 4 & Fig 5 shows the comparison of PSNR with others and corresponding PSNR values respectively.

Fig 4. PSNR of each test face is calculated with all faces of database

15	13.1851	13.9245	10.6989	13.5940	15.4205	14.4415	9.9512
16	10.2527	12.5500	9.2780	11.2493	14.2736	12.2159	9.9282
17	10.2050	10.7006	10.6770	11.8717	12.4845	11.1056	12.1430
18	13.4827	11.7471	10.0529	14.6055	12.9839	12.1358	8.0532
19	13.0039	12.4595	11.9604	15.4434	15.6572	13.4822	11.3321
20	13.1235	12.4896	12.1096	15.3409	14.0609	13.7216	9.5611
21	14.3110	13.8201	11.6294	15.6858	14.3635	14.0068	9.9407
22	10.6214	11.3886	11.0690	10.0120	11.3615	11.0207	10.5217
23	16.3634	13.2864	11.6476	14.4894	14.4037	13.0619	9.8186
24	12.5346	11.6479	13.2980	12.5901	13.1782	12.5131	13.1491
25	14.8159	12.6739	11.6007	13.4393	12.3298	12.1906	8.8753
26	9.6970	10.8946	9.9018	9.2857	11.6585	11.1432	11.1319
27	9.1560	9.0303	9.6023	9.1785	10.3315	9.7005	12.8250
28	9.8262	10.8386	10.3415	9.1794	11.0586	10.5175	10.5694
29	12.2260	13.3428	10.4684	12.7692	14.1065	12.4838	10.1925
30	14.3049	11.4960	11.5039	13.9044	11.9154	11.4487	8.4624
31	'aishwarya'	'ashish'	'ganesh'	'geetanjali'	'ghutukade'	'jatin'	'karan'

Fig 5. PSNR values of each test person with respect to all others

IV. IMPLEMENTATION

4.1. Authentication

Ensures that only authenticated person is using the system. Fig 6 shows the log in windows for authentication.

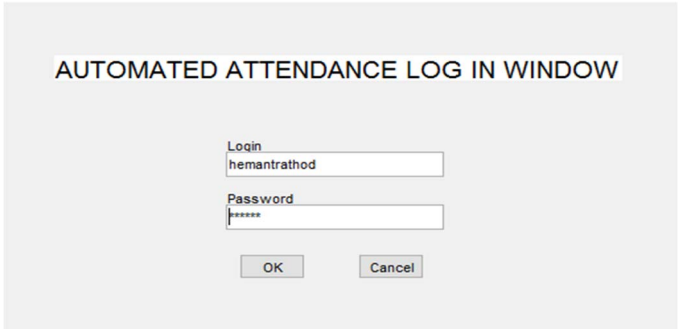

Figure 6. Log in window

4.2. User Menu

It contains list of menu items which can be accessed to have the complete view of the system. By clicking on Recognition & attendance system gets started. Fig 7 shows the user interface for various options.

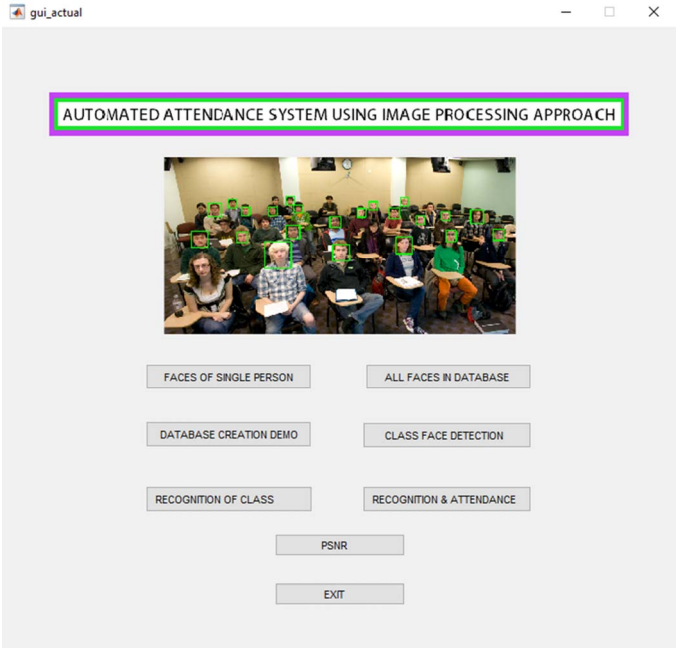

Fig 7. User interface

4.3. Face Detection

The captured frame is processed for detecting the faces of multiple students and are used for testing purpose. Fig 8 shows the detection of faces of students in the classroom.

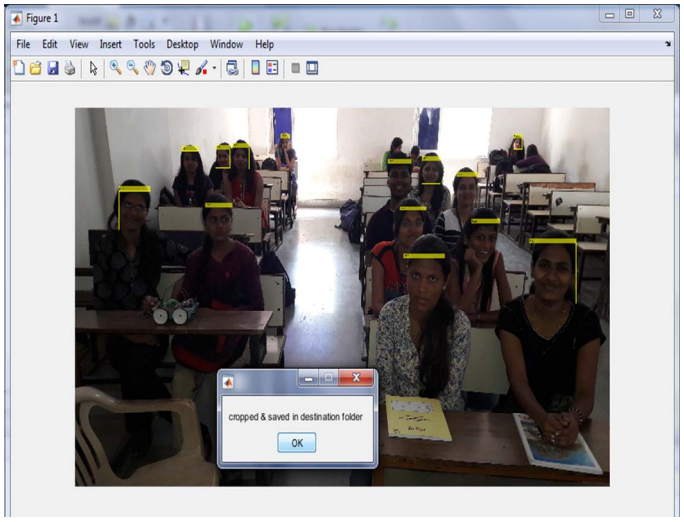

Fig 8. Face detection using Viola-Jones algorithm

4.4. Face Recognition

On carrying out the recognition process, feature comparison takes place with respect to the features stored in the database. The query face is displayed along with corresponding matched face and the name of matched face is identified and used for marking the attendance. As per the experiment most of the faces are recognized correctly. Fig 9 shows the result of recognition while corresponding attendance is shown in Fig 10.

Fig 9. Matching result

15	16	17	18	19	20
ghutukade	P	ghutukade	P	ghutukade	P
jatin	P	jatin	P	jatin	P
karan	P	karan	P	karan	P
khushboo	P	khushboo	P	khushboo	P
kirti	P	kirti	P	kirti	P
kondiba	P	kondiba	P	kondiba	P
mayuri	P	mayuri	P	mayuri	P
minal	P	minal	P	minal	P
navale	P	navale	P	navale	P
nikhil	P	nikhil	P	nikhil	P
poonam	P	poonam	P	poonam	P
pradeep	P	pradeep	P	pradeep	P
prashant	P	prashant	P	prashant	P
pratibha	P	pratibha	P	pratibha	P
rupali	P	rupali	P	rupali	P
sharad	P	sharad	P	sharad	P
shruti	P	shruti	P	shruti	P
shweta	P	shweta	P	shweta	P
snehal	P	snehal	P	snehal	P
suresh	A	suresh	A	suresh	A
tanushree	P	tanushree	P	tanushree	P
tejas	P	tejas	P	tejas	P
unmesh	P	unmesh	P	unmesh	P
vishal_chav...	P	vishal_chav...	P	vishal_chav...	P
vishal_pakh...	P	vishal_pakh...	P	vishal_pakh...	P
yudhisthir	P	yudhisthir	P	yudhisthir	P
date	20/3/2016	date	21/3/2016	date	21/3/2016

Fig 10. Record of attendance

V. FUTURE SCOPE

In order the frauds of ATM it is recommended to prepare the database of all the ATM customers with the banks and deployment of high resolutions camera and face recognition software at all.

To avoid the duplicate voters, a database of all voters of all constituencies is recommended to be prepared. Then at the time of voting resolution camera and the face recognition equipments at the voting site could help in identifications of the voters. In defense ministry and all other important places the face recognition technology can be deployed for better security.

VI. CONCLUSION

The attendance management system estimates the attendance of each student by continuous clicking of images for some time period and finds the best localized image for processing. The system allows the teacher to check student's attendance automatically without any extra cost and effort whereas the proposed system needs very elementary things such as; camera, laptop or personal computer and local network. This method is secure, reliable and easy to use. The overall system is implemented in MATLAB.

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