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Face Recognition based Automated Attendance Management System using Hybrid Classifier

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Abstract - *In now a day's academic performance is affected by staff taking attendance during the lecture hours. There is more number of existing manual attendance tracking systems that work to ensure that students attend the lectures without fail. The human being always tries to develop a system that minimizes manual human efforts by implementing automation. So, here we implemented an Automated Attendance Management System (AAMS) that will change attendance of student if he/she will come in a class room after periodic time. In this project a new hybrid classifier by modified Viola-Jones algorithm with PCA and LBP is developed for more accurate performance. After identification and recognition of a student, the system will update the entries in college/school attendance entry software or in data server.*

Key Words: **Face Detection, Face Recognition, Automated Attendance Management System, AAMS, Viola-Jones algorithm, PCA and LBP classifier.**

1. INTRODUCTION

In traditional face-to-face (F2F) class setting, student attendance record is one of the important issues dealt with any college or university from time to time. To keep the student attendance record valid and correct, the faculty member should have a proper mechanism for verifying and maintaining or managing that attendance record on regular basis. In general, there are two types of student attendance system, i.e. Manual Attendance System (MAS) and Automatic Attendance System (AAS). By practicing manual recording, faculty may experience difficulty in both verifying and maintaining each student's record in classroom environment on regular basis, especially in classes attended by a large number of students.

In practice, the manual system also needs more time for recording and calculating the average attendance of each enrolled student. On the other hand, the AAS is used to reduce the manual attendance work and also reduce the time used for maintaining attendance records [9]. In this type AAS, the higher resolution surveillance camera is used for capturing the video in a classroom. By using this video the attendance of students is marked and also, this system is generating the attendance reports as needs of academics [11]. Several ways were used before to take automatic attendance of students in a classroom.

1.1 LITERATURE SURVEY

Rashid et al. [6] proposed the fingerprint based attendance system in which a portable device capable of taking students fingerprint is moved inside the classroom. The advantage of this approach is that attendance will take at lecture time without the instructor's intervention and this system guarantees the marking of full proof attendance. But the problem with the approach is that if we pass the device during lecture time, then there may be distracting of attention of both teacher and student.

Another approach for automated attendance is T.Lim et al. [5] proposed Radio Frequency Identification (RFID) based attendance system in which each student has one unique identity card. That card will be swapped in a machine to put attendance. Swap machine is directly connected to a system that stores attendance related details. The limitation of the RFID approach is that unauthorized person also can put the attendance.

Another approach is Jun Iio [12] proposed Mobile device and web application based system. While the lecture is going on, a mobile device running the application which has been developed in this study for registration of students is passed around among participants, one by one. When the participants of lecture get the device, he or she fined his/her ID and name from the screen of the device by clicking the item which is found by the user, a screen for each person is appeared. But the problem with the approach is that if we pass the device during lecture time, then there may be distracting of the classes.

Another approach is Nazare Kanchan Jayant et al. [4] face recognition based attendance system. The drawback with fingerprint based attendance system is that the fingerprints of students are difficult to scan and time progresses; there may be difference in the fingerprints that may not be suitable for fingerprint based attendance system. So the solution to above drawback is face recognition based attendance system because the face is most protected part of the body and does not go through much over a complete life of a human being. However, face recognition can be done automatically from a camera placed somewhere in the classroom. Face Recognition System hasn't required active participation from students

to put the attendance. With the help of the camera when we capture a face that face will be stored in a device with minimum dimensions, hence the space required for storage is also less.

2. Proposed Work

In the proposed work, a high definition camera is placed on the top center of the classroom as shown in Fig-1. We capture the student data and the different orientation of student's face that will be stored in the server system.

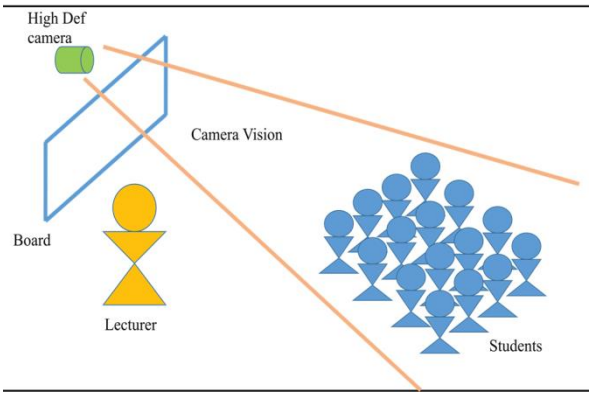


Fig -1: Camera arrangement in class

2.1 Face Detection

The new hybrid classifier based AAMS helps to put attendance of the student when the face is recognized using surveillance camera as shown in the Fig- 2. In order to detect the student faces, we used Viola-Jones Face detection algorithm [1]. As compared with other face detection algorithms available [1][2] this method is much faster. Viola-Jones face detection algorithm takes less computation time, but has high accuracy.

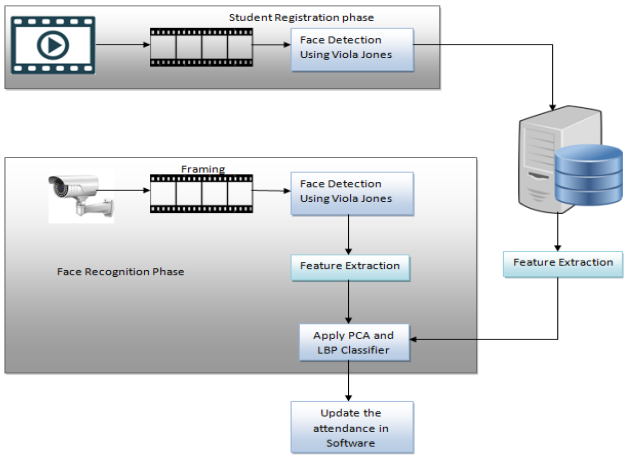


Fig -2: The System Architecture of Automated Attendance System

(i)Video Surveillance Data

We collect the data from a video surveillance camera. In this project we used high definition camera and 15TB Hard Disk Drive for video storage.

(ii)Framing

The purpose of framing is to remove unwanted data from videos that don't have a human as an object in it. it helps to reduce the time required to detect the human face as frames containing only human objects are available.

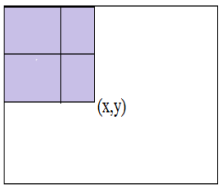
(iii) The Modified Viola Jones Algorithm

The face detection method proposed by the Modified Viola-Jones algorithm [1] is used due to it produces the high accuracy and low false detection. The basic principle of the modified Viola Jones algorithm to scan a sub-window capable of detecting faces across a given input image. The standard image processing approach would be to rescale the input image to different size and then run the fixed size detector through these images. This approach is time consuming due to calculation of different size images.

The modified Viola Jones algorithm [1] uses the integral image representation as well as modified AdaBoost algorithm and it will produce better performance in different lighting conditions. The details of Modified Viola Jones algorithm are as follows [1]: Four steps carried out during implementation of Modified Viola-Jones face detection algorithm.

Step1. Integral image representation

The first step of the Viola Jones face detection algorithm is to turn the input image into an integral image. The conversion of original input image into integral image representation is shown in the figure 3. This is done by making each pixel equal to the entire sum of all pixels above and to left of the concerned pixel.



1	1	1
1	1	1
1	1	1

1	2	3
2	4	6
3	6	9

Fig -3: Integral representation of an image

If the image is dimension of 24*24 then that have near about 160000 features available to identify a human face. If we perform computation using all these features on the image then it will take too much time for computation.

So to have a high-speed image is represented as an integral image. The integral image at location (x, y) is in Eqn.1

$$ii(x,y) = \sum i(x',y') \qquad (1)$$
$$x' \le x, y' \le y$$

Step2. Selection of Haar features

Haar features are digital image features used in face detection process. These features are moved over an image to detect the object. The Haar features have two regions one is called white and another one is called black. The computation carried out during haar feature selection is as follows Eqn. 2. In order to detect human faces the below features are applied on human faces and then threshold value is calculated by using below mentioned formula.

$$Val = \sum(pixels\ in\ black\ region) - \sum(pixels\ in\ white\ region) \qquad (2)$$

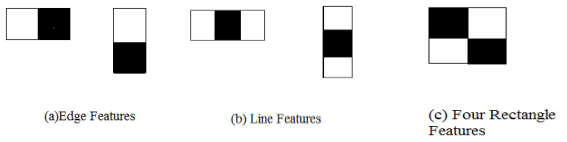
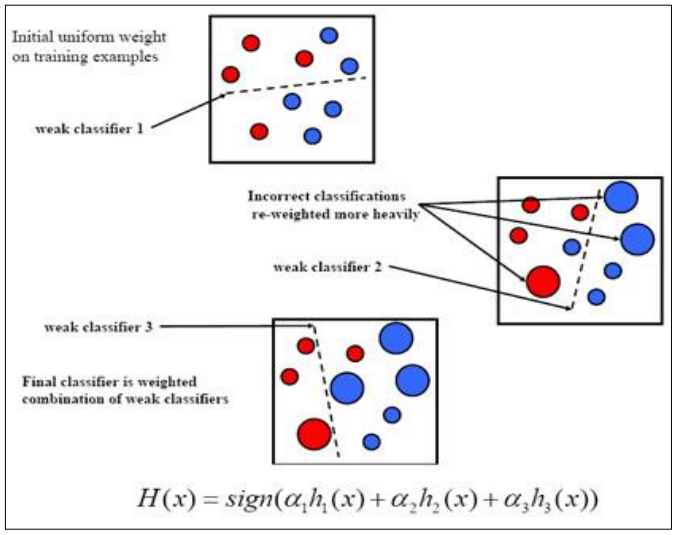


Fig -4: Different types of Haar Features

Several types of haar features applied on an image is shown in the Fig-4. These features are developed by considering human face characteristics so that it will help us to detect the human face with great accuracy. The features are selected based some of the properties associated with human faces. Such as region of the eyes has been often darker than region of the nose and cheeks. The second property is that eyes are darker than the bridge of the nose. But the same windows applying on the cheeks or any other place are irrelevant. So, among the 160000 features available appropriate features are selected using Modified AdaBoost. In Modified AdaBoost each feature is applied on all the training images. After that it finds the threshold value for each feature based on that faces are classified either as positive or negative. At the time of feature selection there will be errors or misclassification but we select the features with the minimum error rate.

Step3. Modified AdaBoost Training

As stated above there can be calculated approximately 160000 feature values within a detector at base resolution. Among all these features some few are expected to give almost consistently high values when on top of a face. In order to find these features Viola-Jones uses a modified version of the AdaBoost algorithm developed by freund and Schapire.



AdaBoost is a machine learning boosting algorithm capable of constructing a strong classifier through a weighted combination of weak classifiers. A weak classifier classifies correctly in only a little bit more than the half cases. The weak classifier process is shown in the Fig. 5.

Fig -5: The modified AdaBoost classification process

To match this terminology to the presented theory each feature is considered to be a potential weak classifier. A weak classifier is mathematically described as:

$$h(x,f,p,\theta) = \begin{cases} 1 & if\ \ pf(x) > p\theta \\ 0 & otherwise \end{cases} \qquad (3)$$

Where in Eqn.3 x is a 24*24 pixel sub-window, f is the applied feature; p is the polarity and θ is the threshold that decides whether x should be classified as a positive (face) or a negative (a non-face).The Viola Jones modified AdaBoost algorithm presented in Pseudo Code in Fig. 6.

1. Given example images (x1,y1),....(xn,yn) where y1=0,1 for negative and positive examples.
2. Initialize weights $w_{1,i}$=1/2m,1/2l for y1=0,1 where m and l are the numbers of positive and negative examples. For t=1,....T:
3. Normalize the weights, $w_{t,i} \leftarrow \frac{w_{t,i}}{\sum_{j=1}^{n} w_{t,j}}$
4. Select the best weak classifier with respect to the weighted error:
$$\epsilon_t = min_{f,p,\theta} \sum w_i |h(x_i,f,p,\theta) - y_i|$$
5. Define $h_t(x) = h(x, f_t, p_t, \theta_t)$ where f_t, p_t, θ_t are the minimizers of w_t
6. Update the weights :

$$w_{i+1,i} = w_{t,i}\beta^{1-e_i}$$

Where e_i=0 if example x_i is classified correctly and e_i=1 otherwise, and $\beta_t = \frac{\varepsilon_t}{1-\varepsilon_t}$

7. The final strong classifier is:

$$C(x) = \begin{cases} 1 \; if \; \sum_{t=1}^{T} \alpha_t h_t(x) \geq \frac{1}{2}\sum_{t=1}^{T} \alpha_t \\ 0 \qquad\qquad otherwise \end{cases}$$

Where $\alpha_t = log\frac{1}{\beta_t}$

Fig -6: The modified AdaBoost algorithm

Step 4. Cascading classifier

The basic principle of the Viola-Jones face detection algorithm is to scan the detector many times through the image- each time with a new size. Even if an image contain one or more faces it is obvious that an excessive large amount of the evaluated sub-windows would still be negatives (non-faces). Instead of finding faces, the algorithm should discard non-faces. The cascaded classifier is composed of stages each containing a strong classifier. The job of each stage is to determine whether a given sub-window is definitely not a face or maybe a face. When a sub-window is classified to be a non-face means it will discard immediately. The cascading classifier process is shown in the Fig-7 Conversely a sub-window classified as a maybe face is passed on to the next stage in the cascade. It follow that the more stages a given sub-window passes, the higher chance the sub-window actually contains a face. In a single stage classifier one would normally accept false negatives in order to reduce the false positive rates.

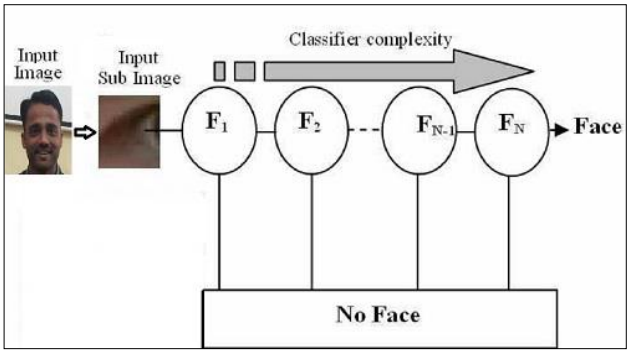


Fig -7: The cascade classifier process

Database of faces

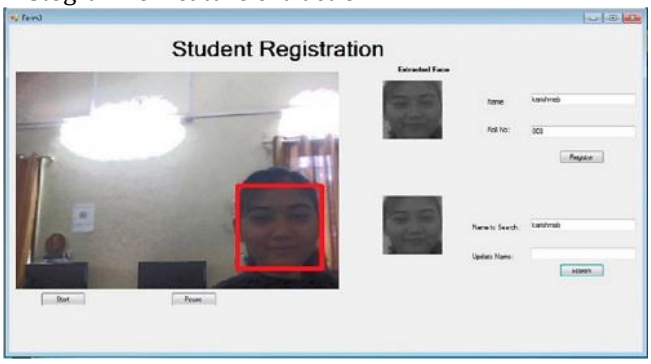
We store several photos of a human with different orientation inside the database. Along with the faces, details such as name and roll number is also saved. This database is used at the time of recognizing the human face. The accuracy of this algorithm depends on the way we trained the system.

2.2 Face recognition

Student recognition is the process of identifying the students from database. To recognize the human face we need to extract the features from the faces that are available in the frames and compared that features with the features of faces present in a database.

Video Surveillance Data

There are two ways to use the video surveillance data, first either we use the live video from surveillance camera for recognition or another way we may use the offline video which is already recorded and available in a system. Framing, Face Detection, and feature extraction are similar to that of student registration process [7][8]. For recognizing a human face we used PCA [3] and LBP classifier the detailed operation of these algorithms is as follows. The face recognition process carried out using LBP is as follows Thresholding is performed on input image such as if intensity value of the value of neighboring pixel is less then it is set to 0 else to 1 after that decimal value is formed by combing all neighboring values and put at center pixel. Image is subdivided into several parts and above operation is carried on each subpart and from each subpart local feature is extracted. Based on obtained intensity values histogram of each part is calculated. All these histograms combined together to obtain resultant histogram for feature extraction.



3. Experimental Results

Fig -8: Student registration process

A set of experiments carried out on surveillance data obtained from cameras on the college campus. The performance evaluation of the system is performing using

this dataset. The screenshots of various phases of attendance system are as follows:

Fig- 8 presets the registration process carried out in front of the webcam of the laptop. At the time of registration process, student's faces with different orientation are

saved inside the database.

Fig -9: Video captured in lab session

Fig.-9 illustrates the face recognition process carried out in a lab session with unregistered faces.

Fig -10: Face detection in the Database

Fig -11: Face Recognition

Hence, even though face is detected not a single face mapped from database. Fig- 11 shows the recognized faces at the time of attendance in a class.

4. CONCLUSION

To eliminate the manual labor involved in recording attendance, an automated Attendance Management System (AAMS) based on hybrid classifier face detection and face recognition techniques is proposed. The modified Viola-Jones algorithm and PCA and LDB classifier technique together are used for face detection and recognition. We Experiments carried out set of experiments in the classroom by varying number of students, and then we got following results Table 1 False face detection rate with varying number of students.

Table -1: False face detection rate

No. of Students	False Face Detection
0-10	0
11-40	1
41-70	3

The table shows that as the number of students inside the frame is increased then false face detection rate occurs. The Face Detection rate is 100% till the frame containing 40 students but above that face detection rate reduced slightly to 3%.

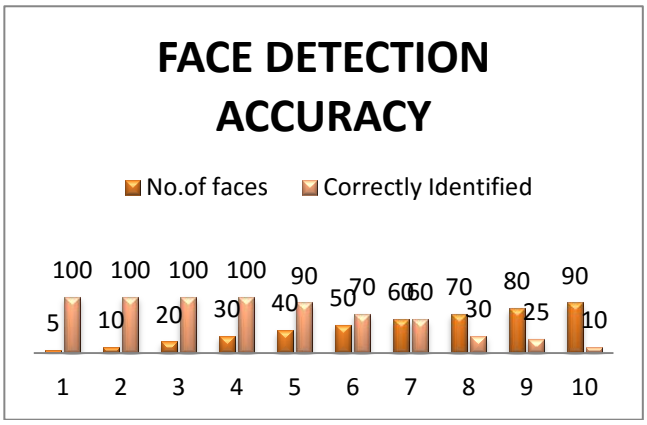


Chart -1: Face Detection accuracy comparison

Fig- 12 is graph plotted between face orientations in degree against face recognition rate. It shows that as face orientation goes beyond 350 face recognition rate decreases continuously. The conclusion comes out of our system is that the already existing systems support attendance of students only when individual student will come in front of camera but our system allows group of student .

The proposed system improves the performance of existing attendance management systems in the following ways:

i) Automatic tracking of the records of the students

ii) Minimizing the manual labor and pressure on the lecturers for accurate marking of the attendance

iii) Minimizing the time required for marking attendance and maximizing the time required for actual teaching process

iv) Increase the efficiency of the overall system

v) Improving the security

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BIOGRAPHIES

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