Automated Attendance System using Image Processing

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***Abstract*— In today's era of technology aidedworld, image processing is gaining immense importance towards digital world. Now a days, the field of image processing has wide range applications in biometric recognition, behavioral analysis, teleconferencing and video surveillance. This paper typically puts forward idea of using image processing techniques such as detection and recognition of faces to design the system that can automatically handle the attendance of the students. Various factors that act as challenges in face recognition are illumination, orientation, size, clarity, expression and intensity of facial images. With the help of training dataset, system is trained to detect the figures representing faces (positive images) and distinguish it from background (negative images) environment. The aim is to develop the automated system for detection and recognition of faces using their images from videos and recording the attendance of the students by identifying him/her from their variant facial features. This helps to maintain and handle the attendance system automatically without any human intervention. This new system can ease the hectic attendance maintenance and handling the attendance will be more precise and efficient. The proposed system contributes to human face detection with the help of Viola Jones algorithm and face recognition with Fisher Face algorithm and achieves accuracy of 45 % to 50%.**

Keywords - video analysis, face detection, and recognition, viola-jones, fisher-face, attendance maintenance.

I. INTRODUCTION

Facial image has set out to be an important biometric feature, which easily is acquirable and doesn't require any special or physical interaction between the subject and the device. As it is observed, image recognition is very complex and challenging one affecting variety of parameters such as intensity, orientation, expression and size.

The proposed system is intended to detect and recognize the students from facial image captured in video. The entire system works autonomously and gives efficient results, in turn making attendance system effective in this growing world of technology for educational achievements. In Section II of this paper demonstrates literature survey, Section III demonstrates proposed system, Section IV experiments and results and Section V conclusion

II. LITERATURE SURVEY

Individual recognition is of most importance in today's world due to varied reasons. Real-time applications of this algorithms faces some limitations to resolve loss of important information.

Detection and recognition of faces in videos using image processing is discussed in [1]. Various steps for detection and recognition are demonstrated and details regarding what algorithms are used to implement this techniques are described.

Face detection methods can be classified based on the individuals face appearance, facial geometric structure, face colour etc. [2]. Some of the image

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processing techniques uses extraction of depth features to detect faces with respect to geometric variations and textures. Mapping of edges and skin colour thresholding is used to detect faces in [3]. Viola- Jones
[5] proposed realtime adaboost training algorithm for facial features. Yi-Qing Wang [4] used advanced haar feature classification to reimburse for variation in illumination, intensity, geometry and feature decomposition [6].
Face recognition is gaining immense importance in biometric authentication as there is no need of direct user interference. Face recognition is a part of pattern recognition. In early 1990s, Fisher faces and Eigen faces were proposed by [7]. Fisher faces has better performance than Eigenfaces [8]. Belhumeur, Hespanha, Kriegman [9] presents Eigen and Fisher face as face recognition methodology based on the features. This feature based methods helps to achieve stability towards lighting conditions and poses variations with use of non-linear feature spaces [10]. Use of algebraic and geometrical features such as facial segments, areas and perimeters helps in recognition process to increase recognition rate [11].

III. PROPOSED SYSTEM

The proposed system aims to develop an automated attendance system. To achieve the project objective, firstly, video segments are captured of the classroom lecture. Pre – Processing of video is done to remove unwanted artifacts i.e. noise and other invariants. The next stage demonstrates detection of faces from the complex backgrounds and recognition of human being. This system helps to identify students to track his/her presence in the lecture and to avoid proxy attendance caused by unauthorized students. There are four stages of operation to develop the system, they are: Video acquisition, detection of faces and cropping, extraction of features and recognition of face.
Work Flow of the system: Students will first register themselves in the system with proper details, and facial images captured from different angles and positions. On successful completion of registration process, store students data in the database. Video Acquisition is done by capturing the video of the class being conducted in a classroom. Acquired video is used to detect and recognize faces of different students and differentiate them from background using image processing techniques i.e. Viola – Jones Algorithm for face detection, Cropping of faces and Binary Face Algorithm for face recognition. Student's identity verification is done by comparing facial image of the students with the faces stored in the database. If the faces of students are matched, then their attendance is recorded and updated in the system. Also, it takes care to see that once attendance is recorded for a particular student no more update to the attendance of that student will be recorded (i.e. 1 student = 1 attendance).

The working of the system is shown in the fig 1.

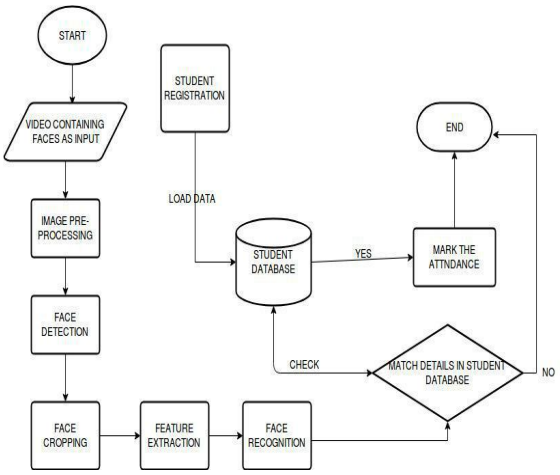


Fig 1 Model Representation of the System The

two main algorithm used are discussed here.

A. Viola Jones Algorithm

Viola Jones was the one to formulate the first ever real-time face detection algorithm which helped to detect faces from the images. In this module, a complete algorithmic description is implemented which includes feature computation using integral images, selection of features with the help of adaboost training and cascading for efficient allocation of computational resources. This algorithm provides fast and accurate detection.


Fig 2 Snapshot of face detection window

Fig 2 shows the snapshot of the face detection in image frame. To compute face detection, Viola – Jones algorithm is used. Viola Jones algorithm is divided in four phases:

1. Haar Feature Selection

In Haar feature selection, compute scalar product between the image and Haar templates. Then, calculate the difference between the number of black pixels and number of white pixels to obtain numerous features.

All the images are normalized using mean and variance to recoup the effect of different lighting conditions. Images having variance value lower than one with little information of interest are excluded.

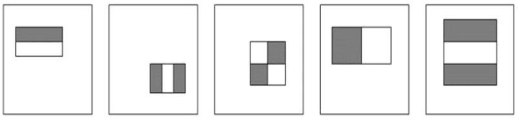


Fig 3 Haar patterns

Fig 3 shows Five Haar patterns that are used to compute various features from the facial images. These haar patterns marked with black or white pixels are moved over an image to compute all the features. These features helps to detect faces from an images with required computation.

2. Creating an Integral Image

Integral Image is an effective way of computing the summation of pixel values in a given image. It is mainly used to compute the mean intensity value within a given image.
Firstly, create an integral image which helps to compute value at each pixel (o,p) which is the addition of pixels above (o,p) and pixels to the left of (o,p) inside a rectangular window. For integral image, the value in the Summed Area Table at (o,p) is simply calculated by:

$$Q(o,p) = E(o,p) + Q(o-1,p) + Q(o,p-1) – Q(o-1,p-1)$$

where E(o,p) is the value of the pixel at (o,p), Q(o-1,p) is pixel value directly to the left of (o,p), Q(o,p-1) is pixel value directly to the right of (o,p) and Q(o-1,p-1) is the pixel value to the top – left of (o,p).

3. Adaboost Training

Adaboost training is used to select a subset of features and to construct the classifier. Adaboost refers to a particular method of training a boost classifier. In Boost classifier every weak learner takes input in a form of object and returns the value showing class of the object. This technique creates strong classifier from number of weak classifiers. To amplify the performance of the system on classification problems, adaboost training is done.

The training of the classifier is done as follows:

Each instance of training dataset is weighted. Set the initial weight as:

$$\text{weight } (wi) = 1/Z$$

where Z is the number of training instances

A weak classifier is prepared on training data using weighted samples.

Now, calculate the stage value for trained model to provide weighing using the formula given below:

$$\text{stage} = \ln((1-\text{err})/\text{err})$$

where err is misclassification rate.

Here, stage weight shows that more accurate models have more weights or much contribution to final prediction.

Update the weight of a training instance (w) using the formula:

$$w = w*\exp(\text{stage}*\text{terr})$$

where w is the weight for training instance i and terr is the prediction error for training instance i.

The strong classifier is formulated from the number of weak classifier :

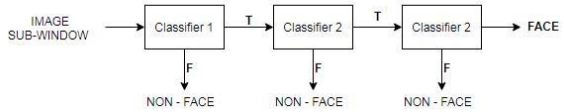
$$S(x) = m1s1(x) + m2s2(x) + m3s3(x) + \ldots\ldots$$

where S(x) is strong classifier and m1s1(x) is weak classifier.

4. Cascading Classifiers

Cascading is a peculiar case of learning which concatenates multiple classifiers. All information gathered from the output of the given classifier is used as an additional data for the next classifier in the cascade. Cascading classifiers are trained with several hundreds of "positive" sample images of face and arbitrary "negative" images (i.e. background). Both the positive and negative images must be of the same size. Once the classifier is trained it is applied to an image to detect the faces. To search for the faces from the entire image frame, the search window travels

across the image and checks every location of the classifier.



B. *Fisher Face Algorithm*

The Fisher face algorithm is used for Face Recognition in real time environment. This algorithm is used for dimensionality reduction and classification.

The Fisher face algorithm works as described below:

- Assign the number of classes and members of each class to the system.
- Calculate the mean of the training dataset (t) and the mean face value of each class (ti). The formula is given below

$$t = \frac{1}{M}\sum_{i=1}^{M} P_i \quad \ldots (1)$$

To calculate the mean value of each class used the given formula:

$$t_i = \frac{1}{M_i}\sum_{j=1, p' j \in P_i}^{M} p'_j \quad \ldots (2)$$

- Now, compute in-between class scatter matrix, S_c and inter-class scatter matrix, S_r.
- Calculate the eigen value.

$$\text{Eigen Value} = \frac{\text{Inter-class scatter matrix}}{\text{In-between class scatter matrix}}$$

- To obtain PCA projection matrix, compute total scatter matrix.
- Calculate the optimal projection matrix W_{opt}^{T}.
- Compute the value of weighted pixel of each facial image with the optimal projection matrix W_{opt}^{T}.

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- Test the facial image with the mean value of training set using the formula:

$$X_{input} = Y_{input} - t \quad \ldots (3)$$

- Calculate the normalization value of the test image and then compute the image data into the optimal projection matrix.

$$F_{test} = W_{opt}^{T} X_{input} \quad \ldots (4)$$

IV. EXPERIMENTS AND RESULTS

In the proposed system, the classroom lecture videos are captured using mobile camera with 1920 x 1088 resolution. Preprocess to capture different frames from videos. Then, detection of human face from complex background is done from frames. The algorithm are implemented using OpenCV 2.4.13 commands on Python 2.7.13 platform. Results are recorded based on accuracy of the face detection and recognition.

➢ *Dataset*

In the experiment, a dataset of positive images (facial images) and negative images (background images) is created. For training, 1248 positive images and 1052 negative images are taken. All the training images are of JPEG format and are of the size 640 x 480 pixel. Training images were used for the detection purpose.

Now, for Recognition purpose 16 students are being registered. Each students data comprising of 80 – 90 facial images are stored in the database as a test images for recognition based on the feature extracted. Each image is in JPEG format and of the size 125 x 125 pixel.

➢ *Experiment Observation*

After performing multiple trials and rigorous training of the image set, it is been observed that face recognition has been possible with near to accurate results.

In this experiments, frames are captured from the videos at the regular interval of 2 seconds. These frames are used to detect the numbers of faces present in the system. Using the registered students data, detected faces from the frames are recognized by matching the features with the database.

Fig 4 shows one of the captured frame from the classroom videos

Fig 4 Captured frame of the classroom

Fig 5 shows the number of faces detected in the frame.

Fig 5 Detection of the faces in the frame

Here, we have taken 2 image frames to evaluate experimental results based on the accuracy. Both frames are compared and it is found that based on the lightning conditions, there is the variation in the results. It is also observed that additional accessories on face do affects the results. Like if student has or hasn't wear the spectacles, caps and other accessories at the time of registration and during face recognition from the video captured in the class.

Below Table 1 shows the results obtained for the two frames and accuracy of the face recognition in each frames.

Table 1 Accuracy result of the face recognition

	Frame 1	Frame 2
No. of students	14	14
No. of students detected	12	12
No. of students recognized	8	10
False recognition	2	3
Accuracy	42%	50%

V. CONCLUSION

The results obtained from both the frames helps to conclude that the accuracy in frame 1 and frame 2 i.e. 42% and 50% respectively.

This system has been designed to automate the attendance maintenance. The main objective behind developing this system is to eradicate all the drawbacks and unconventional methods of manual attendance handling. The traditional methods lags the effectiveness of the system leading the time and paper wastage, and causes proxy attendance which is eliminated in automated system. So to overcome all such drawbacks of manual attendance, this framework would come out to be better and reliable solution with respect to both time and security. In this way, automated attendance system helps to distinguish between the faces in classroom and recognize the faces accurately to mark their attendance. The efficiency of the system can be improvised by fine tasking of the training process.

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