Automated Attendance System using Facial Recognition

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Abstract – **This paper gives the explanation of the implementation of the automated attendance system using image processing techniques/methods. The system helps to detect and recognize automatically the faces of the students in classrooms to reduce the manual work of taking attendance which is time consuming and tedious job by using HAAR classifier and LBP classifier. The System uses the support vector clasification algorithm and gradient boost clasification on the LBP facial features, to detect the face of the user and mark its attendance. The LBP features of face are provided to support vector machine algorithm that are extracted from the face images for the face classification. The experiment is performed on about 200 images with good precision.**

Keywords: Automated Attendance System, Support Vector Machine, HAAR Classifier, Gradient Boost, Face Recognition, LBP classifier.

I. INTRODUCTION

Image processing is a technique to carry out some procedure on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

• Importing the image via image acquisition tools;

• Analyzing and manipulating the image;

• Output in which result can be altered image or report that is based on image analysis.

Face recognition is the biometric method in which accuracy and low intrusiveness is a major issue. For this reason, the early face recognition has drawn the attention of researchers in fields from security and image processing to computer vision [1].

Automated Attendance System is the advancement in the field of automation that replaces traditional attendance marking activity, which avoids the issues like fake attendance, time consumption, and manipulation of attendance. Again maintaining an attendance record is major issues when the strength of students is large.

Face recognition is an application of image processing which performs two major tasks of identifying and verifying a person from an image by picking faces from the group of the students, obtaining the measurements and comparing it to the images already present in the database. This will help for verifying and maintaining the attendance record on a regular basis. Here the facial features are extracted from the captured image using LBP classifier [5][7] and by applying support vector machine [6] [7][8] and gradient boost the face is recognized and the attendance is marked.

II. LITERATURE REVIEW

Mashhood Sajid et al. [2] proposed a conceptual model using an integral validation process for an automated attendance system through facial recognition. Here the Gabor filters or Jets applied on preprocessed image and calculate Fiducial points. The measurements of the facial features are calculated and matched to the image information stored in the storage database.

E. Rekha et al.[3] implemented a system i.e. automate the attendance system by integrating the face recognition technology using Eigen Face database and PCA algorithm with Matlab GUI. This system updates the attendance automatically after comparing the detected face with original Eigen database in Ex eel sheet integrated with Matlab GUI.

Md. Sajid Akbar et al.[4] implements a model that recognizes face using Radio Frequency Identification (RFID). The system detects the authorized students and counts as they get in and get out from the classroom to keep the data of every student registered for a particular course in the attendance log and provides the necessary information.

Omar Abdul Rahman Salim et al.[5] use Raspberry Pi which is programmed to handle the face recognition by implementing the Local Binary Patterns algorithm LBPs. If the student's input image matches with the trained dataset image the prototype door will open using Servo Motor, then the attendance results will be stored in the MySQL database. The system gives the 95% accuracy with the dataset of 11 person images.

Hemantkumar Rathod et al.[6] presented an Automated Attendance System using Viola- Jones and HOG features along with SVM classifier. The system involves the process such as image acquisition, face detection, feature extraction, face classification, face recognition and eventually marking the attendance. Viola-Jones algorithm is used for face detection and Support vector machine (SVM) is used for classification.

Shireesha Chintalapati, M.V. Raghunadh et al. [7] proposed a system to identify an unknown person. The face detection is done using the Viola-Jones algorithm. LBPH is used for feature extraction and face classification can be done using SVM.

Atuegwu Charity et al. [8] use the face and fingerprint to take students' attendance. After preprocessing a captured image, Principal Component Analysis (PCA) algorithm was used for facial feature extraction while the Support Vector Machine (SVM) was used for classification. Fingerprints were captured using a fingerprint reader. A thinning algorithm digitized and extracted the minutiae from the scanned fingerprints. The logical technique (OR) was used to fuse the two biometric data at the decision level.

Xiang-Yu Li and Zhen- Xian Lin et al.[9] proposed Face Recognition Based on HOG and Fast PCA Algorithm. In this paper, a new method was proposed to solve the problem of low accuracy of face recognition under non - restrictive conditions. Firstly, the Haar feature classifier is used to extract the background interference data in the original data preprocessing stage. Then, the feature data of the face is extracted by the method of HOG feature extraction. Then the PCA dimensioned reduction is processed and the SVM algorithm is used to recognize the face.

III. PROPOSED SYSTEM

Here, an application is developed that can be used in educational institutes, societies and companies for attendance or maintaining Daily Visitor log for the apartment or for keeping the records for in and out the timing of the employees. The application has features like capturing an image and based on facial features, the system is able to detect the face of the user and mark its attendance. The main purpose of the system is to avoid attendance proxy and gives easy attendance maintenance without manual work. Figure 1 shows the architecture of the proposed system.

1. **Frame Extraction / Live Camera:**
   User uploads a video / grabs images using live camera on the application, application then extracts frames from the video. These frames are saved on local machine. Frames are usually 640x480 formats.
2. **Face Detection :**
   Apply the Haar cascade Classifier for the face detection in images.

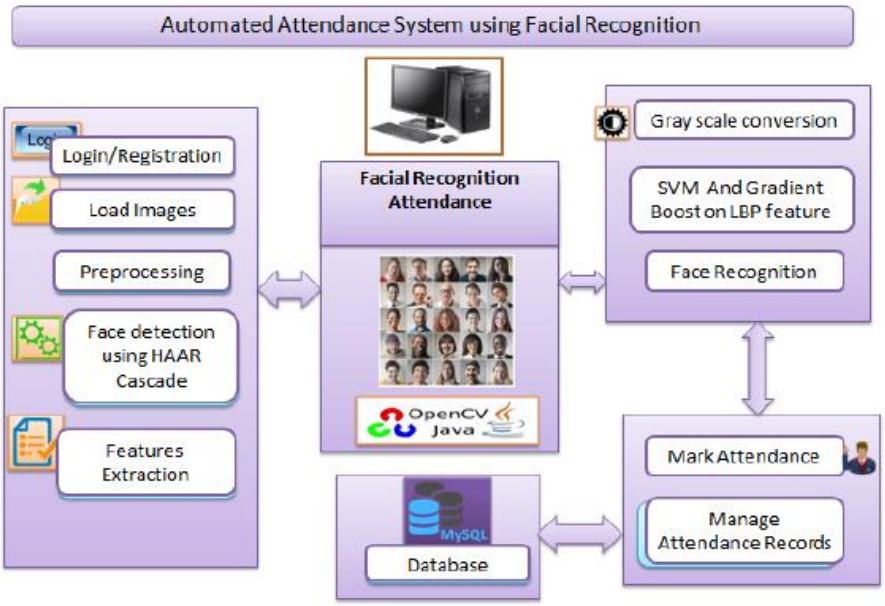

Figure 1: System Architecture

3. **Pre-Processing on images :**

Once we get the faces apply the preprocessing on images like noise removal, normalization etc. In this, it also converts the image into Gray scale by taking the average of the each pixel RGB.

4. **Feature Extraction by Local Binary Patterns Histograms:**

1. Divide the examined window into cells (e.g. 16x16 pixels for each cell).
   For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter-clockwise.
2. Where the center pixel's value is greater than the neighbor's value, write "0". Otherwise, write "1". This gives an 8-digit binary number (which is usually converted to decimal for convenience).
3. Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination of which pixels are smaller and which are greater than the center). This histogram can be seen as a 256-dimensional feature vector.
   a) Optionally normalize the histogram.
   b) Concatenate (normalized) histograms of all cells. This gives a feature vector for the entire window.
4. Feature set is then saved to a model for later matching process.

5. **Face Recognition and attendance marking:**

Using Support Vector Classification algorithm and gradient boost algorithm, the faces are recognized and their attendance is marked.

IV. ALGORITHM USED

A. Haar cascade Classifier for Face Detection

- In this system Haar classifier algorithm is used for face detection when one of the features like eyes, nose, mouth, etc. are found. Then the algorithm allows the face candidate to pass to the next stage of detection.
- A Haar-feature classifier makes use of the rectangle integral to work out the value of a feature.
- The Haar-feature classifier multiplies the weight of every rectangle by its region and the results are added collectively. Several Haar feature classifiers compose a stage.
- A stage comparator adds all the Haar-feature classifier results in a stage and compares this summation with a stage threshold. All the stage does not have a set number of Haar features. Based on the factors of the training data every stage can have a varying number of Haar features.

B. **Local Binary Patterns Histograms**

The LBP feature vector, in its simplest form, is created in the following manner:

1. Divide the examined window into cells (e.g. 16x16 pixels for each cell).
2. For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.).
3. Follow the pixels along a circle, i.e. clockwise or counter-clockwise.
4. Where the center pixel's value is greater than the neighbor's value, write"0". Otherwise, write"1". This gives an 8-digit binary number (which is usually converted to decimal for convenience).
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6. Optionally normalize the histogram.
7. Concatenate (normalized) histograms of all cells. This gives a feature vector for the entire window.

C. **Gradient Boosting Algorithm**

Gradient boosting is a machine learning technique for regression and classification problems, which produces a prediction model in the form of an ensemble of weak prediction models, typically decision trees.

• Gradient boosting builds an ensemble of trees one-by-one, then the predictions of the individual trees are summed:

$$D(x) = dtree1(x) + dtree2(x) + \ ...$$

• The next decision tree tries to cover the discrepancy between the target function F(x) and the current ensemble prediction by reconstructing the residual. For example, if an ensemble has 3 trees the prediction of that ensemble is:

$$D(x) = dtree1(x) + dtree2(x) + dtree3(x)$$

• The next tree tree 4 in the ensemble should complement well the existing trees and minimize the training error of the ensemble. In the ideal case we'd be have:

$$D(x) = dtree4(x) = f(x)$$

• To get a bit closer to the destination, we train a tree to reconstruct the difference between the target function and the current predictions of an ensemble, which is called the residual:

$$R(x) = f(x) - D(x)$$

• If decision tree completely reconstructs R(x) , the whole ensemble gives predictions without errors.

D. **Support Vector Classification Algorithm**

- SVM is a powerful classifier that is able to distinguish two classes. SVM classifies the test image into the class with highest distance up to the neighboring point in the training.
- SVM training algorithm built a model that predict whether the test image fall into this class or another.
- SVM necessitate a vast training data to decide a decision boundary and computing cost which is very high although we are using single pose (frontal) detection.
- The SVM is a learning algorithm for classification which attempt to discover the finest distinguishing hyper plane which minimize the error for unseen patterns.

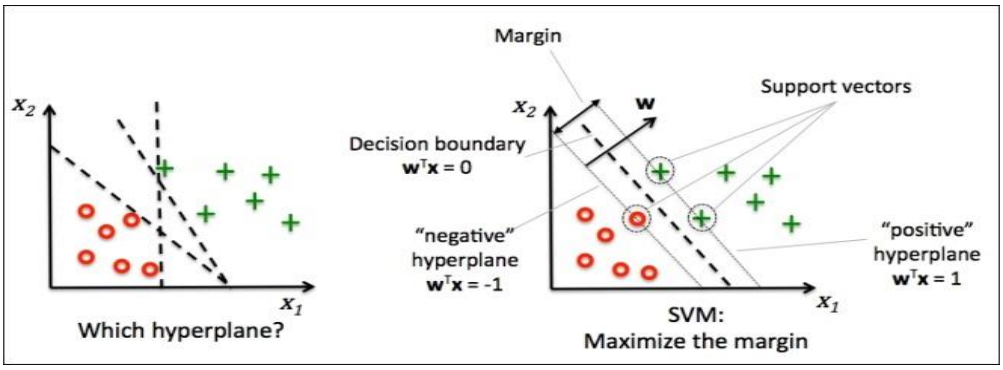

Figure 2: Distinguishing hyper plane to minimize the error

- The data which cannot be distinguished the input is mapped to high-dimensional attribute space where they can be separated by a hyper plane. This projection is well performed by means of kernels.

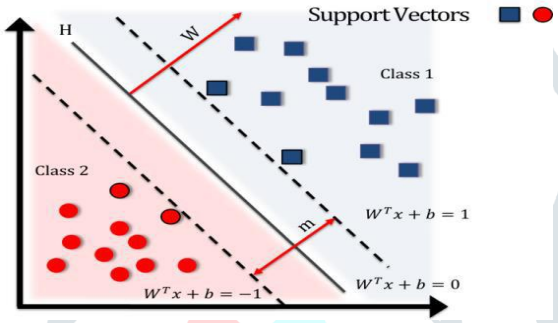

Figure3: Separating Hyper Plane by Equation

If training set of samples and the equivalent resultant values are {-1, 1}, then SVM intend to get the best separating hyper plane specified by the equation W^Tx+b that make use of the distance between the two classes as shown in above figure 3.

V.EXPERIMENTAL RESULTS

Here the real time dataset of about 200 images is used. C1, C2, C3, C4 are the classes, in which 200 images of each class for face recognition are considered. The confusion matrix is generated using WEKA tool for different classes are given in Table I.

TABLE I: CONFUSION MATRIX

	C1	C2	C3	C4
C1	161	0	0	0
C2	90	193	0	0
C3	0	0	195	0
C4	0	0	0	198

The accuracy and precision is calculated based on TP, TN, FP and FN i.e. True Positive, True Negative, False Positive and False Negative images. False positives, which are items incorrectly labeled as belonging to the class and false negatives, which are items which were not labeled as belonging to the positive class. The true positive, true negative, false positive and false negative images from each class are given in table II.

TABLE II: TP, TN, FP and FN

	TP	TN	FP	FN
c1	161	39	90	0
c2	193	7	0	90
c3	195	5	0	0
c4	198	2	0	0

The precision is calculated using the formula

Precision = TP / (TP + FP)

Accuracy = (TN + TP) / (TN+TP+FN+FP)

The Class wise distribution of the all images used in the system is given in below figure.

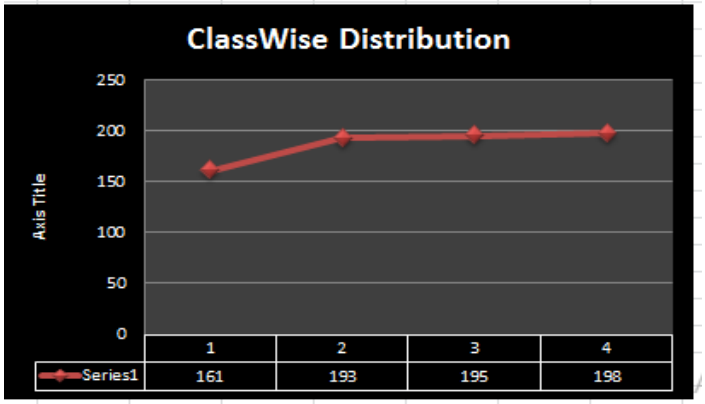

Figure 4: Plot for Class wise Distribution

VI. CONCLUSION

The automated attendance system is designed for educational or commercial organizations that can be used for monitoring student's attendance in a lecture, section or laboratory by detecting the faces of the student. It saves time and effort, particularly if students are huge in number. Haar Feature Algorithm is used for face detection. Support Vector Machines (SVM) is used for the classification of the faces. By using gradient boost technique the accuracy of the system is improved. From the results it can be concluded that the average precision given by this system is about 93%.

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