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Face Recognition based Attendance System using Haar Cascade and Local Binary Pattern Histogram Algorithm

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***Abstract*—The attendance system is used to track and monitor whether a student attends a class. There are different types of attendance systems like Biometric-based, Radiofrequency card-based, face recognition based and old paper-based attendance system. Out of them all, a Face recognition based attendance system is more secure and time-saving. There are several research papers focusing on only the recognition rate of students. This research focusing on a face recognition based attendance system with getting a less false-positive rate using a threshold to confidence i.e. euclidean distance value while detecting unknown persons and save their images. Compare to other euclidean distance-based algorithms like Eigenfaces and Fisherfaces, Local Binary Pattern Histogram (LBPH) algorithm is better [11]. We used Haar cascade for face detection because of their robustness and LBPH algorithm for face recognition. It is robust against monotonic grayscale transformations. Scenarios such as face recognition rate, false-positive rate for that and false-positive rate with and without using a threshold in detecting unknown persons are considered to evaluate our system. We got face recognition rate of students is 77% and its false-positive rate is 28%. This system is recognizing students even when students are wearing glasses or grown a beard. Face Recognition of unknown persons is nearly 60% for both with and without applying threshold value. Its false-positive rate is 14% and 30% with and without applying threshold respectively.**

***Index Terms*—Face detection, Face recognition, LBPH algorithm, Harr Cascade.**

I. Introduction

Control of machines and their process with various technologies based on computer software is called automation. In this modern age, these advancements have proven to increase accuracy and also helping us to improve our livelihood. Innovations such as these save lots of labour work. One advancement in the field of automation is the Automated Attendance system replacing the old and traditional attendance marking. The paper-based method of marking attendance is time-consuming and its complexity increases with the increase of overall strength. This case is nullified in this automated version has it saves time and an additional bonus comes with security as it also helps to prevent proxy of attendance.
The objective of our proposed system is to create a face recognition based attendance system with getting a less false-positive rate in detecting unknown persons by applying a threshold and save their images. We used Haar cascade for face detection because of their robustness and LBPH algorithm for face recognition. It is robust against monotonic grayscale transformations. Our System even detects and saves the images of any unknown person in the class whose Information is not there in the database.

II. Literature Survey

In [2] the authors proposed an attendance System using RFID cards. In this approach, The proposed RFID tag uses energy from the tag reader. The problem with this approach is that An unknown person can make use of a valid ID card and enter the University.

There are also papers involving using biometrics for attendance. In [3] fingerprint is used for marking the attendance of students. There is a biometric sensor that will take the fingerprint, feature extraction done on that data. If it is for enrollment then that data is stored in the database else if it is for authentication then that data is started matching with the data in the database. The problem with this method is that for attendance students should go to the place where

this hardware device is located or pass the hardware device around the students during class which can be a distraction to the students. And in [4] and [12] iris based attendance system is used. The problem with this approach is that it is sensitive to environmental factors.

In [1] authors proposed a face recognition based attendance system based on Eigenface recognition. Images are converted into eigenfaces, Recognition is performed by comparing eigenface got from the input image and eigenfaces in the database.The problem with this approach is that this method is very sensitive to face background, head orientations and it doesn't recognize the face of a person if the person is wearing glasses or a grown beard, etc. But in the approach proposed in this paper, our system is not sensitive to face background, head orientations and it recognizes a person's face even if he grows a beard or wears glasses, etc.

III. Proposed System

The proposed automated attendance management system is based on haar cascade for face detection and the LBPH algorithm for face recognition. Graphical User Interface(GUI) for this system shown in Fig. 2 created using python module Tkinter which is the fastest and easiest way to create a GUI application.

This system provides functionalities such as taking images of students along with their details for the database, training the images in the database and on the camera and start tracking people entering the class. when students enter the classroom this system detects the faces of students who are entering the classroom from the camera and pre-processed for further processing. The stages in the proposed system are shown in Fig. 1. The implementation of each stage is mentioned in detail in the next section.

IV. Dataset and Methodology

We created our own dataset as we didn't find any dataset online containing 60 images for each person. There are consists of 18 individuals with 60 images of each that have been taken for this project. Additional 10 individuals are considered for testing recognition of unknown persons.

We tested our system using a live real-time video in which students and unknown persons come and stand in front of the camera. Fig. 3 shows a few images after the pre-processing stage.

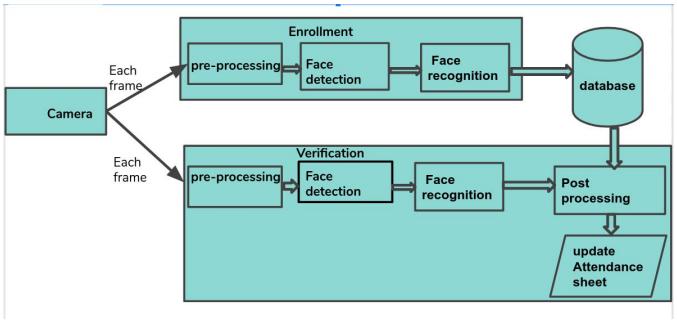

Fig. 1. System Architecture

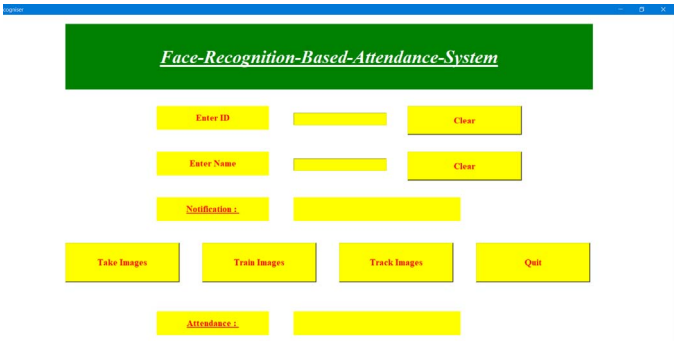

Fig. 2. System GUI

Algorithm 1
Pseudocode for the proposed system

Input: live video with student face visible

Output: attendance excel sheet

1. Transform each frame from RGB to grayscale
2. Apply the Haar Cascade classifier for face detection and get the Region Of Interest (ROI).
3. Now apply the LBPH algorithm on the ROI to get the features.
4. **if** *for enrollment* **then**
   features are stored in the database
   else if *for verification* **then**
   do Post-processing

Fig. 3. extracted and pre-processed faces of students in the dataset

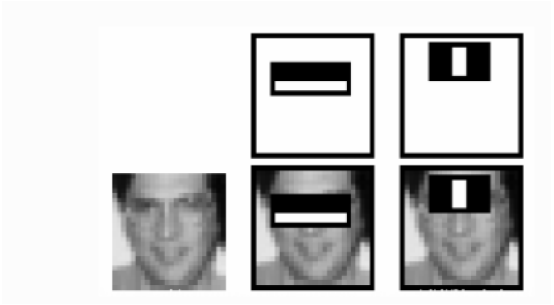

Fig. 4. example of relevant haar features

A. Pre processing and Face Detection

First we convert the frame from color to grayscale. To detect the faces we used a haar cascade classifier which is proposed in [8] where a cascade function is trained and detect features in other images. For this, we use haar features like edge, line, and four-rectangle.

For a large image or variable size of an image, it takes a lot of computations and features and most of them will be irrelevant. But AdaBoost manages to select the best out of many as shown in Fig. 4 [9]. Then Region Of Interest(ROI) i.e containing faces is extracted and sent to next stage.

B. Face Recognition

For face recognition, we decided to use the LBPH algorithm because of its robustness, the capability to recognize both front and side faces and better compared to Eigenfaces and Fisherfaces [6]. the LBPH algorithm is used as they find characteristics that best describe a face in an image [5]. They were many face recognition algorithms and the LPBH algorithm is better. This method is easier, within the sense it characterizes the image within the dataset locally and when a replacement unknown image occurs we perform an equivalent algorithm and compare the result to each of the pictures within the dataset. It works better in different environments and light conditions than other algorithms.

Local Binary Pattern(LBP) operation creates an image which highlights the characteristics of a image in a better way. It uses the concept of the sliding window and the parameters, radius and neighbours[7]. It is showed in Fig. 6 [10].

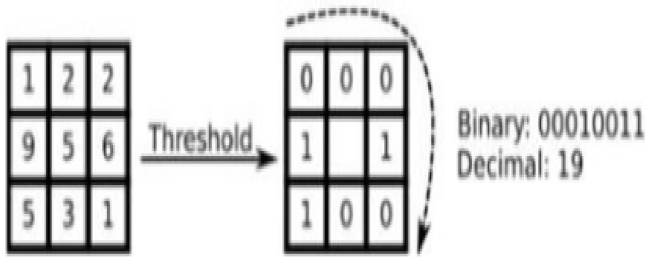

Fig. 5. process of LBP on an 3X3 matrix

First, we convert the frame into matrices of 3X3 pixels. if a neighbor pixels in a matrix is greater than the median pixel of that matrix then set value 1 else 0 in that pixel position. now note down the values of neighbour pixels in a line we get a binary number. convert that binary number to decimal number and replace it with the median pixel value of the matrix as shown in Fig. 5 [10].

As the image in now converted into LBP form, we extract histograms from each grid and concatenate to form a new and larger histogram. The concatenated histogram indicates the characteristics of the original image. Each histogram represents the facial image from the database. For the new image, it performs the above steps and gets a new histogram for the image.

C. post processing

Now to recognize the person in the image it compares (by applying Euclidean distance) the new histogram with the histograms from the training dataset and choose the histogram having lowest confidence i.e. least distance, as lower confidences are better and also extract the ID corresponding to that histogram. If confidence is less than 50 then details belong to the extracted ID is shown on the frame [11] as in Fig. 7, the names are updated into an excel sheet only if the student name is not in the excel sheet to avoid duplicate names as in Fig. 8. Else word ”Unknown” is shown on the frame and if confidence is greater than the threshold which is given value 95, then the person’s image is saved in a separate folder. This helps in identifying any intruders in the class and reduce the wrong classification of students to an unknown person.

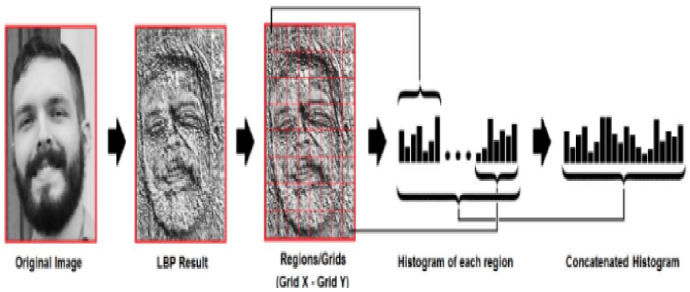

Fig. 6. process of LBPH algorithm on an image

Fig. 7. Recognizing the faces

Id	Name	Date	Time
1	['Bharath']	3/2/2020	16:23:21
16020	['sunitha']	3/2/2020	16:23:27

Fig. 8. Attendance sheet After completion of the program

TABLE I
TABLE 1 : PERFORMANCE EVALUATION OF THE SYSTEM

Performance Evaluation	percentage
Students Recognition Rate (Live video)	77%
false-positive rate (Students)	28%
Unknown person Recognition Rate (existing model)	60%
Unknown person false-positive rate (exisitng model)	30%
Unknown person Recognition Rate (proposed model)	60%
Unknown person false-positive rate (proposed model)	14%

V. RESULT AND ANALYSIS

We considered 3 feet as the distance of an object for recognition. As shown in Table 1, the Face recognition rate of students is 77% and its false-positive rate is 28%. This system is recognizing students even when students are wearing glasses or grown a beard. Face Recognition of unknown persons for both existing and proposed models is 60%. This happened mostly due to detecting random objects in the background as the face of a person by face detection algorithm. Its false-positive rate is 14% and 30% for the proposed and existing model respectively. The threshold value only affected the false positive rate of an unknown person. In the existing system, it is observed due to when the person in the video turned his head greater slightly then confidence value for that frame may get greater than favourable filter value then the person in the frame is considered as an unknown person [13].favourable filter value considered as 50 [11]. But, in the proposed system, if confidence is greater than 50 and 95 then only a person is considered as an unknown person and that person's image is saved as an unknown person.

VI. CONCLUSION

LBPH is one of the prominent technique for face recognition. Our system successfully recognizes a student with unintentional changes like wearing glasses or growing beard. Here the problem is the dataset is small. In future, An effort could be made to build a better dataset, that might practically give a more accurate result. We can Improve haar cascade classifiers through the synthesis of new training examples which can improve the recognition rate of unknown persons. A system alert(voice and visual) can be included if an intruder is detected in the class.

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