INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 05 ISSUE: 07 | JULY - 2021 ISSN: 2582-3930

Face Detection Based Smart Attendance System Using Haar Cascade Algorithm

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Abstract- In this article, the student attendance management system is used to track and monitor the presence of a student in a class. The attendance system using facial-recognition is safer and saves time. This research focuses on an attendance system based on facial-recognition by obtaining a lower wrong-positive rate by using a threshold to confidence i.e., Euclidian distance value while detecting strange people and saving their pictures. The Local Binary Pattern Histogram (LBPH) algorithm is better than other Euclidean algorithms such as Eigenfaces and Fisherfaces. We used Haar cascade algorithm for facial detection based on its robustness and its LBPH algorithm for facial recognition. We have an 80% face recognition rate among students and a 28% wrong-positive rate. This system recognizes students even with glasses or beards. The Facial recognition for strange persons is almost 80% with and without applying the threshold value. Its wrong-positive ratio is 17% and 40% with and without the thresholds respectively.

Keywords – Face detection, Face recognition, LBPH algorithm, Haar Cascade.

I. INTRODUCTION

Maintaining attendance is mandatory and important in all the institutions for knowing the performance of students. In every institution the teacher or lecturer takes the attendance manually. For ex. If the duration of class of one subject is about 50 minutes and teacher take 5-10 minutes to mark the attendance. It will be time consuming. And students can get proxy easily by their friends even if they are absent. To avoid proxy, teacher has to call out the names of the student and look at the faces each time so even this consumes time. Maintaining manual attendance is not secure and it can be lost.

To overcome this problem, we used Haar cascade for facial detection based on its robustness and its LBPH algorithm for facial recognition. Every human being has a unique face and fingerprints. From these features we can easily identify a person. Our proposed system uses face as the main element to recognize the students and mark the attendance. And the attendance sheet will be generated automatically and stored in the database. Even parents will get message if the pupil is absent. It maintains a separate report of students if they are absent. The teacher can fetch the details of the students whenever they want.

The main aim of our proposed system is to create a attendance system based on face recognition with minimum wrong-positive rate in recognizing strange persons by applying a scale factor and save their images. It is robust against monotonic gray scale transformations. This attendance system will also detect and save the images of any strange person in the classroom whose student details is not present in the database.

II. PROPOSED ALGORITHM

In this proposed automatic attendance management program, we used the Haar Cascade algorithm to detect faces and the LBPH face recognition algorithm. The Graphical User Interface (GUI) screen for this program is shown in Fig. 3 was created using the Python module Tkinter package which is a quick and easy way to create a GUI system.
The program will provide functionality such as photographing students and their student id, name and phone number and stores in the database, train the photos stored in the database and begin to identify students present in the classroom. When the teacher wants to note the presence of students, the program will see the faces of the students present in the classroom from the camera and process it before identifying further. The sections of the proposed plan are shown in Figure 1. The implementation of each phase is described in detail in the next section.

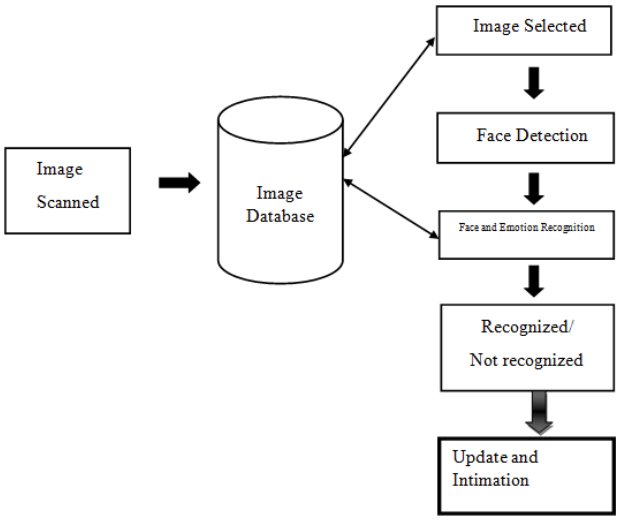

Fig. 1. System Architecture

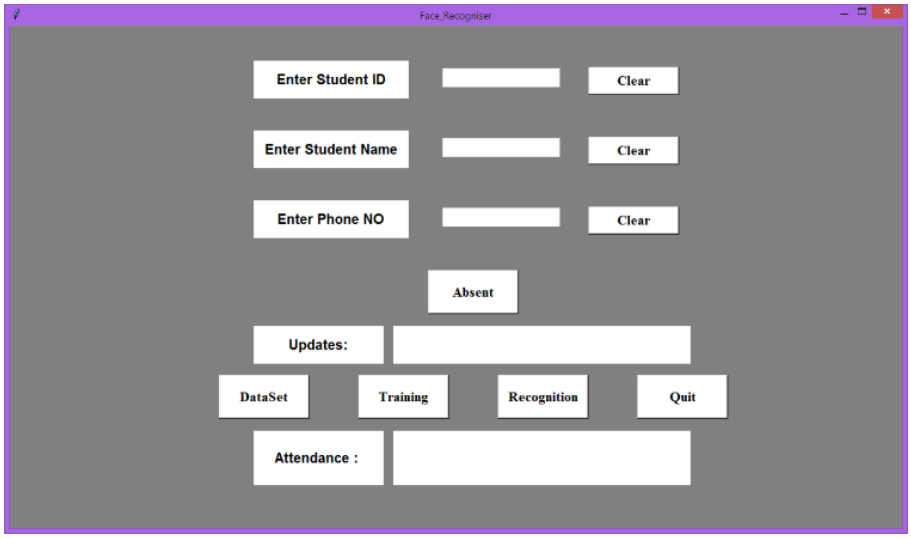

Fig. 2. System GUI

III. DATASET AND METHODOLOGY

We have created our dataset containing 20 photos of each student. Our system is tested using a real-time web camera that captures the faces of students present in the classroom in front of the camera. Fig 3 shows a few sample images after the pre-processing phase.

Fig. 3. The Extracted and Pre-Processed Faces of Students in the Dataset

Algorithm

Input: live video stream with student face visible

Output: Attendance excel sheet and SMS notification to parents

1. Convert each image frame from RGB (Red, Green, Blue) to gray scale(B/W).
2. Implement the Haar algorithm classifier for facial detection and identify the Region of Interest(ROI).
3. Then apply the LBPH algorithm on the ROI to extract the image features.
4. **if** *for enrollment* **then**
   features and details are stored in the database
   else if *for verification* **then**

do Post-processing

A. Preprocessing and Face Detection

First we need to convert the image frame from RGB color to grayscale. For face detection we used the proposed haar cascade classier [8] where the cascade function is trained in such a way that it detects and figures out the features from images. For this purpose, we use haar features such as edge, line and four-rectangle.

For a large image or a dynamic image size, many calculations and features are required and most of them will vary. However, AdaBoost will remove unwanted features of unwanted images as shown in Figure 4 [9]. After that Region Of Interest (ROI) i.e. images containing faces are extracted and sent to the next section.

B. Face Recognition

For facial recognition, we used the LBPH algorithm because of its robustness, ability to recognize the front face and side face. And the LBPH algorithm is better compared to Eigenfaces and Fisherfaces [6]. The LBPH algorithm is used as they find features that better describe the face in the image [5]. This method is simple, as it extracts features from images and inserts an image within your local dataset, in case an anonymous image creates an equal algorithm and compares the result with each image within the dataset. This algorithm works well in a variety of environments and lighting environments compared to other algorithms.

The function of Local Binary Pattern (LBP) creates an image that extracts the features and characteristics of the image in a better way. It uses the concept of scale factor, parameters such as radius and neighbors [7]. Shown in Fig. 6 [10].
First, we convert the image frame into a matrix form of 3X3 pixels. If the neighboring pixel in the matrix is larger than the center pixel of that matrix the value will be given as 1 and 0 in the correct pixel area. Now the pixel values in the queue will be converted to a binary number. Convert the binary number to the decimal number and convert it to the average pixel value of the matrix as shown in Figure 5 [10]
As the image is converted into an LBP form, we extract histograms from each image grid and sync them to create a new and larger histogram. The attached histogram will show the features of the original image. Every histogram represents a face image from the database. With the new image, we will do the above steps and get a new image histogram.

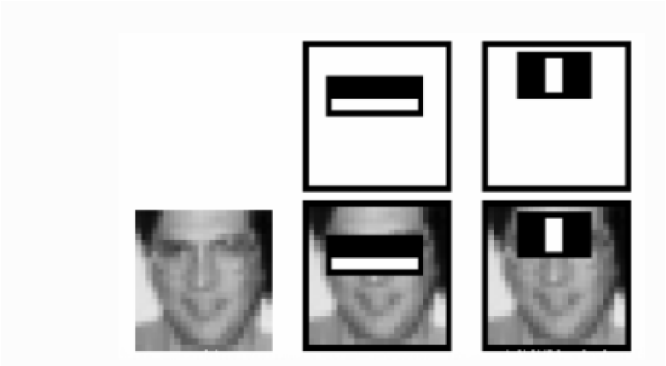

Fig.4.ExampleofRelevantHaarFeatures

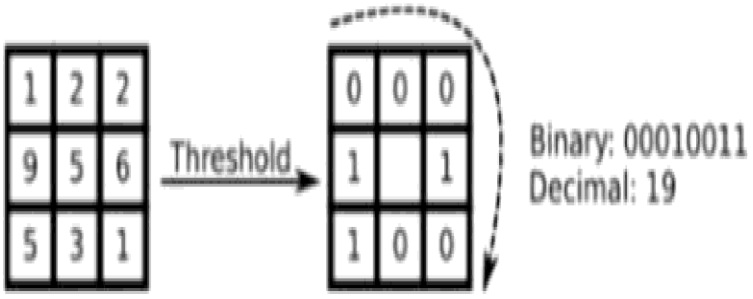

Fig.5.ProcessofLBPonan3X3matrix

C. Post Processing

Now recognize the image of student it compares with the new histogram by applying Euclidean distance with the histograms which is in the training dataset and then choose the histogram which has least confidence i.e. lowest distance, with lower confidences which is best and it also extract the ID corresponding to thathistogram.Ifconfidenceislessthan50then the details belonging to the extracted ID is shown on the frame[11]asinFig.7, the names are updated in the attendance excel sheet only if the student face is recognized as in Fig. 8. Else the "Unknown" word will be displayed on the frame and that particular student image is saved in a separate folder. This helps in identifying any other pupil in the class and reduce the wrong classification of students to an unknown person.

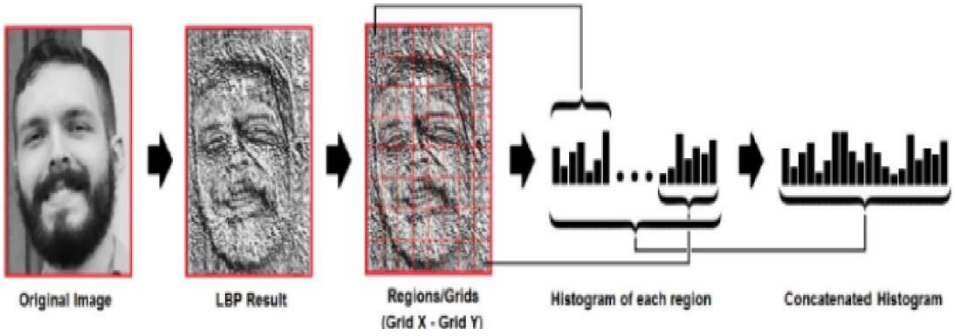

Fig.6.Process of LBPH algorithm on an image

Fig.7.Recognizing the faces

Id	Name	Date	Time
112	['Vijay']	07-07-2021	11:06:24
113	['Surya']	07-07-2021	11:06:19
114	['Arjun']	07-07-2021	11:06:24
115	['Ajith']	07-07-2021	11:06:19
116	['Sudeep']	07-07-2021	11:06:19
117	['Raksith']	07-07-2021	11:06:33
118	['Yash']	07-07-2021	11:06:24

Fig.8.Attendance sheet After completion of the program

TABLE

Table 1: Performance evaluation of the system

Performance Evaluation	percentage
Students Face detection and recognition rate(Live video)	80%
Wrong-positive rate(Students)	28%
Strange person Detection and Recognition Rate(existing model)	60%
Strange person Wrong-positive rate(exisitng model)	30%
Strange person Detection and Recognition Rate(proposed model)	85%
Strange person Wrong-positive rate(proposed model)	14%

IV. RESULTANDANALYSIS

In our system, we consider3feetasthedistanceforanimageto be recognized. As shown in the Table 1, the Facial recognition rate of students is 80% and its Wrong-positive rate is 28%. This system recognizes the students even when they are wearing glasses or grown a beard. Face Recognition of stranger in existing model is 60% and in our proposed model it is 80%. This happened mostly due to detecting random objects in the background as the face of a person by face detection algorithm. Its Wrong-positive rate is 17% and 40% for the proposed and existing model respectively. The scale factorvalueonlyaffecttheWrong-positiverateofanstrangerperson.Intheexistingsystem,itisobservedduetowhenthepersoninthevideorotate his head greater slightly then confidence value for that frame may get greater than favorable filter value then the person in the frame is considered as an strange person [13]. Favorable filter value considered as 50 [11]. But, in the proposed system, if confidence is greater than 47 and 93 then only a person is considered as an Strange person and that person's image is saved as an strange person.

V. CONCLUSION

LBPH is one of the most effective and prominent techniques used for face recognition. Our system successfully recognizes a student even with glasses or beards and also sends SMS notification to parents when the student is not present in the classroom. Here the problem in the dataset is small. In future, this system could be improved to build a better dataset, that may 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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