Face Recognition based Class Management and Attendance System

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***Abstract*— Conducting attendance manually is indeed a tedious task, it consumes a lot of the lecture hours which leads to less productivity and waste of time. To get over such dissipation of time, there is a dire need of an automated attendance system which is reliable, efficient, and which saves time. In recent times, machine learning is enhancing and making human life smart and hence following or using the same old traditional approaches in daily chores and tasks is like wasting the time, energy, and efforts for no reason. This paper concentrates on the implementation of an automated attendance system which uses the face recognition algorithms to record the attendance of the class and manage the class database. The system seeks for its application in every classroom to record the attendance of the students smartly and take over the traditional attendance approaches.**

Keywords—Face Recognition, Class Attendance, Haar Cascade, LBPH, PDBC, OpenCV

I. INTRODUCTION

The technology is evolving and is becoming a very essential part of our life. People love and enjoy our new way of life which is supposedly called “The Smart Life” as it reduces human efforts and saves ample amount of time. Using the technology in the tiniest thing, say for toasting the bread is what people are used to. The question arises when you’re in the school or college and you find your professors struggling with management of class attendance. The question arises when you see the professors wasting their time, energy, and efforts just to record the list of present students.

The traditional approach of calling out students' names, passing the attendance sheet is not only limited to being time-consuming but also gives rise to malpractices like manipulation in the attendance, proxy, etc. There are a few attendance systems which use technology like sensors and biometrics like fingerprint, iris scanning (which at times can be unreliable). However, the system proposed in this conference stands out as it is a one-stop system to manage and record the class attendance.

The system follows four steps of working. Firstly, the record of each student is added (Roll Number and Name) and a video is captured, the images are taken from the frames of the video. In the training process - the second step, the images of the student are trained using LBPH and Haar Cascade and saved in the form of a YML file. In the tracking process - the third step, the database of trained images is compared with the student’s face to track the student’s face. Lastly, the attendance is marked in the CSV file for the tracked student with respective time and date. The block diagram of the system is as shown in Fig. 1. In this system, the list of students in the class can be viewed, and the record of the particular student can be deleted as well. The efforts put and the skills used for this project will transform and smarten the classrooms.

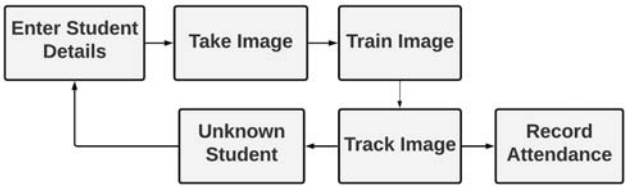


Fig. 1. Illustrative flow of the system

Few of the terms used in the paper are explained in brief:

A. Local Binary Patterns Histogram (LBPH)

The local Binary Patterns Histogram or simply, LBPH is used widely for face recognition because of the computational simplicity offered by this algorithm. This algorithm is OpenCV’s part and it follows a few steps to recognise the face. It first creates the database, performs face acquisition, extracts the features from the face, and classifies the database to check if it matches with the input or not.

B. Haar Cascade Algorithm

Haar Cascade is a face detection algorithm. To train the classifier, this algorithm needs a few images, it extracts the features from the image and calculates it. The irrelevant features calculated are removed by the Adaboost - a training process where the facial and non-facial features are classified. Since the non-facial regions are more in the image, the cascade classifier removes it in a single shot and hence the algorithm gets facial regions for detection. The OpenCV has both - the trainer as well as the detector and it also contains a lot of pre-trained classifiers which are available in the form of XML file.

C. Python Database Connectivity using sqlite3

Python has a sqlite3 module which enables access to SQLite Database. The Python Database Connectivity or PDBC follows the following steps: Firstly, the sqlite3 module needs to be imported and then connect to the database. The SQL is performed which can either be DDL or DML. DDL consists of the Create or Drop and the DML consists of Insert, Update, Delete, and Select. And lastly, the connection is closed.

II. LITERATURE SURVEY

There have been many people who understood the need for the automated attendance management system in education technology. There are many projects and researches made regarding automated attendance systems. A few of the systems are closely related to the system which I'm proposing in this paper. Here is a literature survey for getting a clear idea about the related work done in the past and for analysing these systems.

Shubhobrata Bhattacharya et al [1] designed a system which needs a video sequence as an input, the face is detected using the Viola-Jones algorithm and the facial features are extracted. The facial features are then normalized for which they used parameters like pose detection, sharpness, image size or resolution, and brightness. Lastly, a final quality score is displayed.

Whereas, the authors in [2] proposed a system which captures the face, carries out a face detection process in which the skin colour and face motion is detected and tracked. It also localizes the position of eyes, lips, and face borders. Further, the face is aligned, normalized and then the features are extracted to be used in the matching process.

In [3] the authors made a system which captures a video and converts it into frames. The face is detected using the CNN algorithm. These detected faces in the database are then matched with the input to recognise the face. On completion of this process, the name of students is updated in the CSV file - on a weekly or monthly basis.

On a similar lines, in the paper [4] developed a system which captures video, convert it into frames which are further used as the student image, detects the face using Viola-Jones algorithm, recognises the face using LBPH algorithm, and lastly, once the face is matched with the database, the student attendance is marked in the CSV file.

Mayank Srivastava et al [5] developed a system which consists of three steps - Firstly, the face image is detected, extracted, and stored in a YML file such that it can be used in the future. In the second step, the image is trained and thus the Eigenvector and Eigenvalue of the image is computed. Finally, the images stored in the YML format are used to compare and recognize the face.

In the paper [6], the authors used a two-dimensional face recognition by implementing LBP. This system also controls the door for allowing the students in the class, It is an online web server and hence is accessible to any individual who is an authenticated web client.

Kennedy Okokpujie et al [7] served the camera as an input device. The camera acquires the detected face for which the Viola-Jones algorithm is used. To create the templates of the captured images, Fisherfaces algorithm is used. The verified face images form the basis for the attendance. The attendance recorded is relayed to the authorized handheld devices via cellular network. The database capacity is up to twenty persons with twenty to fifty image databases per person.

There are a lot of insightful papers regarding attendance using face recognition. These systems have recorded some or other drawbacks which the proposed system tries to overcome. A few of the observed drawbacks are - limited database capacity, expensive systems, lack of accuracy, cumbersome process, attendance on a weekly or monthly basis. Mentioned below are a few attendance systems other than face recognition and also a few existing face recognition algorithms are discussed:

A. Attendance using pen and paper

In this method, there are two types. One in which the teacher calls out the name of the students to mark their attendance. And the other in which the sheet is passed in the class and the students mark their attendance by entering the required details. This approach not only takes up time and disturbs the class but also leads to malpractices like manipulation in attendance and proxy and hence is not a reliable option.

B. Attendance using physiological biometrics

- To automate the attendance system, there are several fingerprint and hand sensing attendance systems. For example, Mohamed Basheer K P and Raghu CV [8] proposed a system in which a handheld device (LCD Display) can be used in the classroom to mark the attendance using the fingerprint sensor. This device is managed by the faculty using a host computer. The student data can be added, and attendance data can be imported or exported.

Considering the current Covid-19 pandemic situation, using a fingerprint or hand scanner is indeed not a reliable system since it contains contact of every student with the device and hence can be dangerous.

- The attendance can also be recorded automatically using iris recognition. Amena Khatun et al [9] proposed a system in which an image of a person is taken through a web-cam and sent to a computer for further processing. The transfer of data is through a USB connection between the webcam and computer. In the image acquisition process, the iris is localized, the image is adjusted, and the iris is checked. If the required conditions are matched, the iris is extracted and is saved as an iris template database. This iris when matched with the person, is then authenticated else the above steps are repeated. This system can be reliable but there is a probability of lack of accuracy.

C. Attendance using physiological biometrics

Biometrics like voice can be used for attendance management. Benfano Soewito et al [10] made a research in which they used a smartphone for fingerprint and voice recognition. For voice recognition, the recorded electronics signal is converted into a spectrogram or voiceprint. The next voiceprint is stored in the form of a sequence of numbers and each dominant frequency in each segment is expressed as a binary number. Thus, they get a sound template which can be used to match for the authentication process.

D. Existing face recognition algorithms

There are several types of face recognition algorithms. The Eigenfaces, LBPH, Fisherfaces, SIFT, and SURF are few of the most known face recognition algorithms. These algorithms are compared in Table No. 1 based on the approximate standard maximum accuracy which each algorithm offers.

Face Recognition Algorithm	Accuracy
Eigenfaces	≈ 93%
Local Binary Patterns Histograms (LBPH)	≈ 96.88%
Fisher faces	≈ 96%
Scale Invariant Feature Transform (SIFT)	≈ 98.44%
Speed Up Robust Features (SURF)	≈ 90.2%

Table No. 1. Face recognition algorithms

III. DESIGN METHODOLOGY

This section deals with the methodology of the proposed system. The system is developed using Python: GUI, PDBC using sqlite3, and OpenCV. The important stages in the working of the system and a detailed description of the project right from the input process of the system to how to record the attendance successfully is as below. The flowchart of the system can be viewed in Fig. 4.

A. Creation of the database

The record of the student is to be added by clicking on the "Add Details" button. The GUI of the window will take the user input of the Roll Number and Name of the student. On saving, this student detail is added in the table "student" (roll number is a primary key and name is a text) with PDBC using sqlite3 (refer Fig. 2.) To one-stop the image of the student for the respective name click on "Take Images" button. Using OpenCV, a real-time live video of the student will be recorded and split into sixty frames. These sixty frames are converted into grayscale and stored as student's face images. The "Status" label gives an update on the successful execution of database creation and image training process.

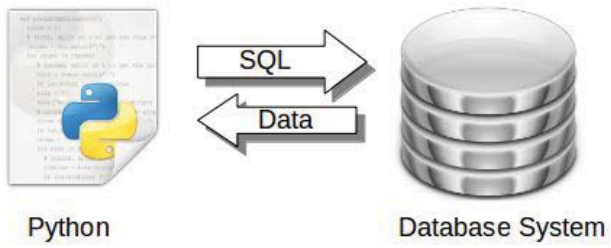


Fig. 2. Explaining PDBC

B. Image Training

To train the image, the database is already constructed which consists of an image and the image name. The Haar Cascade algorithm is used to calculate the histogram value of each image stored in the database. The database created by the image training process is saved as "trainer.yml" i.e in the form of a YML file such that it can be used in the future. Fig. 3. Explains the feature extraction process of Haar Cascade algorithm.

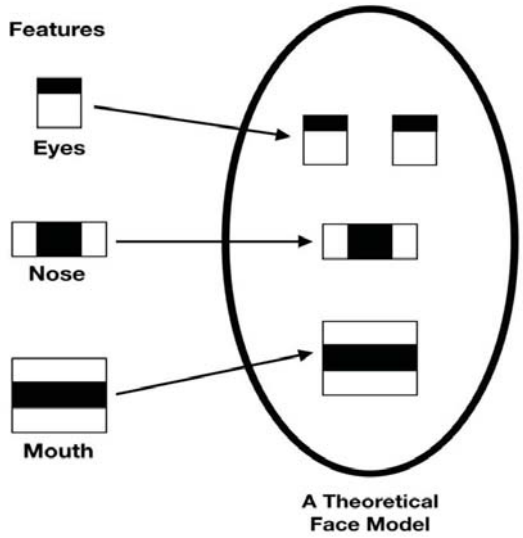


Fig. 3. Haar Cascade: Extraction of features

C. Image Tracking

The LBPH compares the histogram of the existing images in the database with the current real-time video of the student. The histogram of the current student video when matched with the existing database will display the student detail as "*roll number: name*" on the detected face. In case the student is not recognised it will label the student as "Unknown". The database of unknown images is saved in the respective folder.

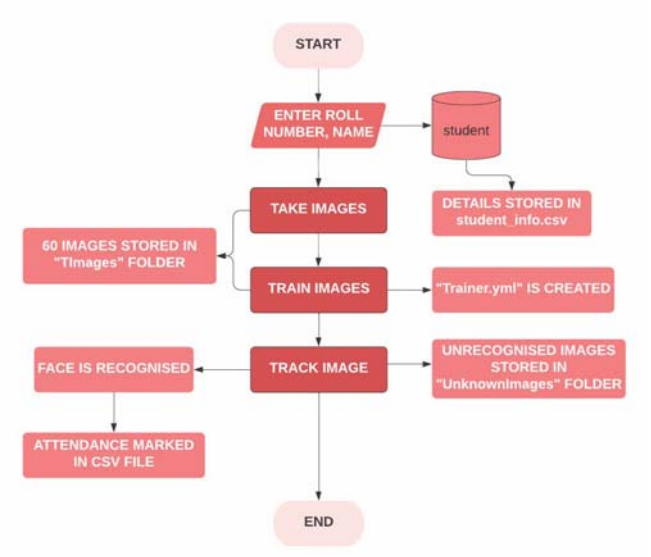


Fig. 4. Flowchart of the system

D. Attendance Record

Once the image of the student is detected among the existing database, the attendance of the student is marked. The date and time of the attendance is recorded and a CSV file is created which consists of the list of present students.

The "Attendance Report" label gives an update of the attendance record. These four steps are to be used only during adding a new student in the database. For recording the attendance of the existing student the professor only needs to click on the "Track Images" using a laptop and the

attendance for the respective student along with the time and date will be recorded.

E. Class Management Feature

This is a part of this system where it is possible to keep a track of students whose database has already been created. The professors can view the list of students clicking "View List". It also happens at times when a student changes the batch or due to any reason a student which used to be in the class is no longer a part of the same class. In this case, the professor can simply delete the database of the student by clicking on "Delete" and entering the roll number of the same student. This process uses PDBC to view and delete the record of the student from the table "student."

IV. RESULT AND DISCUSSION

The developed project is a face recognition based class management and attendance system which is expected to take the student details and images as input. The image is trained using Haar Cascade algorithm and a YML file is created out of these trained images. The trained image data is compared with the tracked image and the LBPH algorithm recognises the face and the attendance is marked for the student whose face matches with the existing database. The project also views the list of students in the classroom and deletes the student record for the student whose roll number is entered.

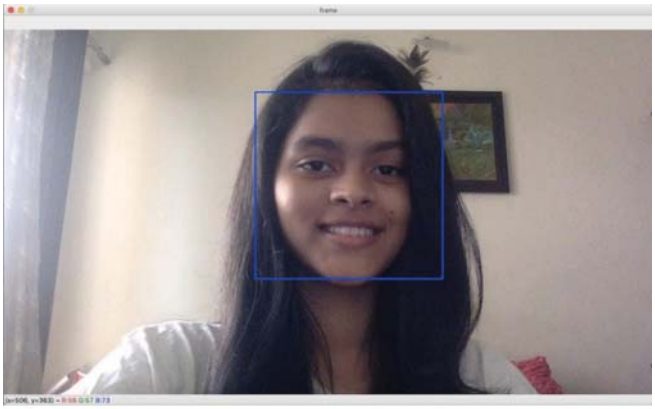
A. Add Details

Fig. 5. Student Detail Input

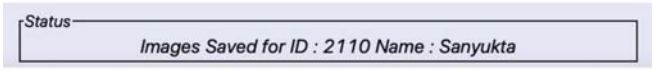
The details of the student - Roll number and Name are added in the table created namely "student." The roll number is a primary key and the name is a text. Fig. 5 shows the GUI of Add Details page.

B. Take Image

On clicking "Take Image," the webcam opens up and records a real-time video and converts it in frames to be used as an image of the student. On images being taken, the status will be updated as "Images taken for ID: *roll no* Name: *name.*"



a. Images Captured



b. Status Updated

Fig. 6. Image Capturing Process

C. Train Image

The image is trained using the haar cascade algorithm. The label to the image is assigned as the name and roll number of the student. This trained data set is saved as "trainer.yml." The status is updated to "Image trained" (refer Fig. 7) once the image training process is completed. The Histogram of the trained images can be viewed in Fig. 8.

Fig. 7. Status Update

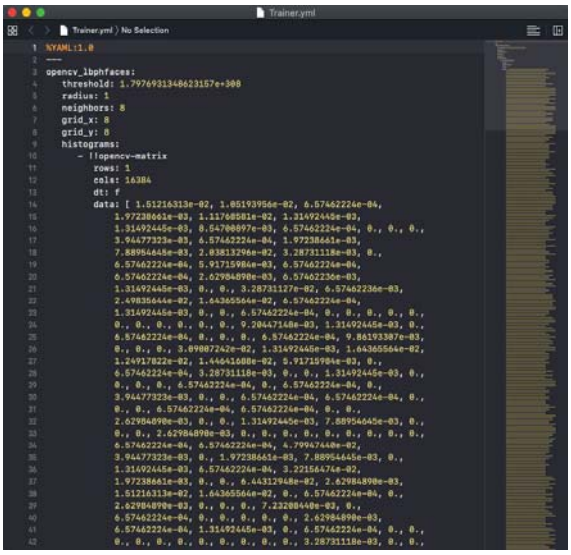


Fig. 8. Trained Image Histogram

D. Track Image

On clicking "Track Image," the webcam will be opened to record a real-time video of the students, the LBPH algorithm compares the input image with the existing database and once the database is matched for a student, the attendance is marked. The attendance report is then updated and the roll number, name, date, time is displayed and meanwhile the attendance is also marked in the CSV file.

The Fig. 9 shows the tracking process of the system. The system in the following case has successfully tracked four faces and the attendance is marked respectively.

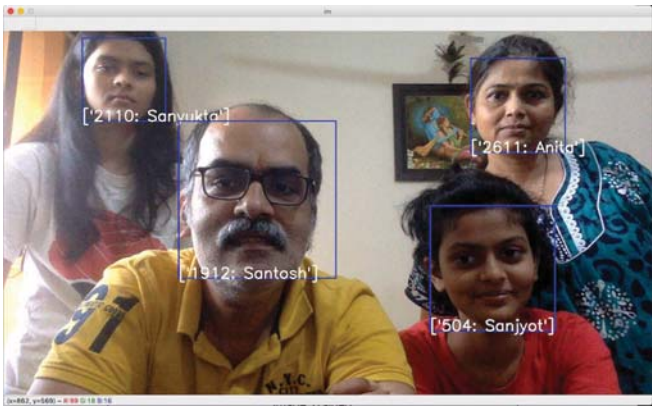


Fig. 9. Image Tracking Process

E. Unknown Image

During the tracking process, if the system shows "unknown" on a student's face, the faculty can check if the student's details are already recorded in the system or not using the "View List". The UnknownImages folder has a record of all the images which are not recognised by the system, it can either be a student's face or the objects in the nearby surroundings as seen in Fig. 10.

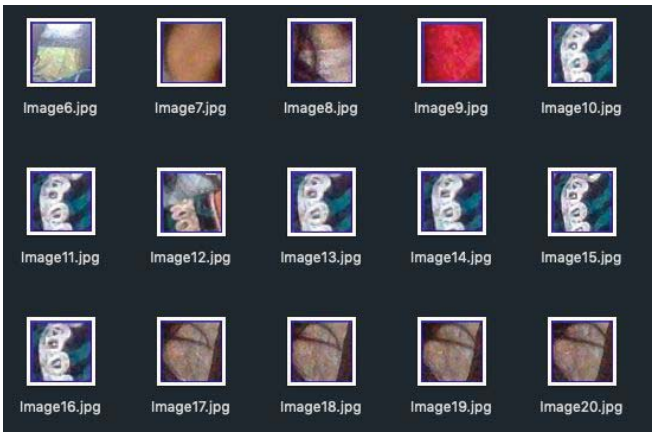


Fig. 10. Unidentified and Unknown Images

F. Attendance Record

Attendance_2020-09-13_15-15-32

Rno	Name	Date	Time
2611	['Anita']	2020-09-13	15:06:26
1912	['Santosh']	2020-09-13	15:06:26
504	['Sanjyot']	2020-09-13	15:06:42
2110	['Sanyukta']	2020-09-13	15:06:44

Fig. 11. Attendance marked in the CSV file

The attendance is marked in the CSV file for the students whose face matches with the existing database. Fig. 11 shows how the attendance is marked in the sheet in "Attendance_date_hour-minute-second" format.

G. View List

On clicking the "View List," the list of students in the class whose database has been recorded can be viewed. In case a student is not recognised by the system, the faculty can view the list and make sure if the database of the student has been added or not. GUI of the View List can be viewed in Fig. 12.

H. Delete

The delete option deletes the record of a particular student whose roll number is entered. The Fig. 12 shows the GUI of Delete student option.

Fig. 12. View and Delete Student

V. CONCLUSION

The process of conducting attendance automatically by using the face recognition and detection algorithms like LBPH and Haar Cascade is a reliable and efficient system. The Haar Cascade provides a high accuracy level irrespective of the illumination. The system can give an accuracy of about 96.88%. To get better results and accuracy, the class should be well illuminated. This system improves the productivity of the class since there is no longer any source of disturbance caused by taking attendance manually and also an ample amount of time is saved.

This project stands out from the existing systems as it is a one stop system where the faculty can manage the class data and also keep a record of the attendance. The face recognition based class management and attendance system will make every classroom a smart class. The faculty can simply use a laptop having a webcam to track the attendance of the class. There is no need for other fancy equipment and hence this system is also cost-efficient.

VI. FUTURE SCOPE

1. The newer version of the system can be updated where this system will not only be limited to a classroom. This system can be made available for any place where attendance is a need. For example - in an office, in the hospital.

2. This system can be developed as a product. It can be made available on the webserver so that it can be accessible to anyone, anywhere across the globe.

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