Contactless Attendance System in COVID-19 scenario

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Abstract: - In the COVID-19 situation, the physical interaction of humans with common devices for attendance can be life-threatening. In this situation, taking attendance in a classroom, Lecture Hall, Library or at the exam centre, for attendance of workers, employees at workplace are very difficult and time-consuming task, if recorded manually or by using any physical interactive biometric devices. Moreover, handling record is itself a tough task. Smart and automated attendance is managed by using various biometric systems like Thumb Recognition, Face Recognition, etc. In a computer vision system, authentication is a major issue. In most systems, the Human face is important for recognition and is widely used in many applications like human monitoring, attention analysis, human-machine interaction, etc. Here we tried to introduce a system that takes automatic attendance in a classroom, workplaces, etc by using a Face recognition system. The proposed system mainly is categorized into two steps i.e., Face detection and Face recognition. Viola-Jones algorithm is used to detect the faces from the current frame. This algorithm is used to differentiate the pattern of face and non-face. It will locate the faces in a frame. After detection of face, we used a face recognition concept to recognize the students/employees, where the Local Binary Pattern feature descriptor is used to identify the student/employee texture to recognize the ID. Using Face Recognition, the record of student/employee is updated in the database. Student/Employee records are stored in a database. When the face of the individual student/employee matches with one of the faces stored in the database then the attendance is recorded.

Keywords – ***Face Detection, Face Recognition, Viola-Jones algorithm , Local Binary Pattern (LBP)***

I. Introduction

To succeed in any field like education, industries, or competitive exams, punctuality plays an important role. In many educational systems like school, college, and university attendance is mandatory for appearing in the exam. Hence the conventional approach is used to record the student attendance by asking every student one by one with his/her name or roll number. Such conventional methods are time-consuming and can lead to manipulation especially in a huge strength class. Also, the attendance of the staff members, employees of any organization is important. To maintain the proper mechanism of attendance of students, faculty staff, and employees there should be accurate and proper management. To avoid all the issues, a modern automated attendance system is used. Many automated attendance systems use biometric recognition, such as fingerprint recognition, palm vein recognition to recognize the presence of students/employees and maintain the record accordingly. Similarly, there are many more attendance systems available that do not depend on human interaction or biometrics. Those systems use QRcode, Barcode, RFID, and Near Field Communication (NFC) mobile devices to update the presence of student/employee attendance. Portable devices like smartphones, tablets, laptops are also used for attendance systems. However, in this present Covid-19 pandemic situation, automated human face detection without the physical interaction with the common devices seems to be a fast, effective and safe system of monitoring attendance of students at educational places or employees at their respective workplaces.

II. Literature Survey

The attendance system has been evolving from time to time as per the requirement. A worker attendance administration system using fingerprint recognition was introduced where the portable device is used for scanning. A proposed system was developed to count the working hours of an employee. Hence this system needs every check-in/check-out, finger scanning of an employee to record the working hours. This system is cheaper and easy to use, but this system is not useful for a huge number of classes/workplaces with huge strength. Hence this system will be cost-consuming as well as time-consuming. After that, a system that is developed on a portable device connected with GPS was proposed from where the user's smartphone fingerprint and GPS location are tracked. In this manner, the location and the presence of the employee/student inside the campus can be tracked. Using this system, many fraud cases reduced. However, in this system, it will not track the exact location of the student/employee but it will be true in all cases whenever a student/employee is present in a campus location. Moreover, many smartphones are not having a fingerprint sensor and accurate GPS tracking system which can be one drawback in this system. All the above-mentioned methods are mostly fingerprint-based. If a finger is wet, dirty, or broken then most of the fingerprint systems fail and then it becomes one of the major shortcomings of the fingerprint recognition system. Another way to record attendance system is used by using barcode QR code, RFID, and NFC. These methods are very simple and easy. Here, the student/employee needs to scan the unique ID generated separately for each student/employee. This ID (QR code, RFID, NFC, etc.) needs to scan for attendance. But similarly, as discussed in the fingerprint system, it leads to a long queue to scan the ID. It takes much more time and the IDs can exchange by students/employees and fraud cases may increase. To overcome these problems, a palm vein attendance system is developed. But again, when the palm is wet and dirty, that time the system will not work properly. Therefore, face recognition technology is an alternative for student/employee attendance systems to cater to the above-mentioned problems. These systems use a camera to capture the faces of all

students/employees one by one. These methods are divided into two steps i.e., one for detecting the face and the other is to recognize the face. This provides a contactless system of attendance which becomes extremely important in the Covid-19 like pandemic situations from the safety point of view.

- **Face Detection and Recognition**

Face detection is the first and foremost task for an automatic attendance system. This process detects faces from a captured frame or video irrespective of their scale, position, illumination, orientation, age, and expression. It then finds the region of a face from the whole image by using various algorithms like viola jones, local binary pattern, neural network, etc. the system should be robust and should properly detect the frontal as well as side faces. After extracting the region of the face there are many more applications on face recognition like facial expression recognition, human attention analysis, etc.

Face recognition is a technology that matches the human face with the existing human face dataset. It has various applications like student/employee attendance system, employee attendance, smartphone access in security. Although the recognition accuracy of the face recognition system is less as compared to another fingerprint or iris recognition. But it is widely used because of contactless recognition. Automated human face recognition was firstly developed in 1960. Initially face recognition system was developed by mapping the human face image with real-time humans. After that, it was developed by using key points or features human recognition system. In the Face recognition system, LBP, histogram, PCA, LDA like feature extraction techniques are used to record the face.

III. Challenges

Attendance systems like Biometric fingerprints, RFID have their issues and shortcomings and need more time to take attendance of each student/employee. In today's COVID-19 pandemic situation, human-machine physical interaction is very much risky which can lead to the chain of COVID-19 infections. Keeping all these problems in mind, a group automatic attendance system using Face recognition can be used. For this, there is a need to develop a real-time operating student/employee attendance system which means the identification process must be done within defined time constraints to prevent omission. The extracted features from facial images which represent the identity of the students/employees have to be consistent towards a change in background, illumination, pose, and expression. High accuracy and fast computation time will be the evaluation points of the performance.

IV. Summary of Contribution

Many problems arose due to the COVID-19 pandemic situation and hence to ensure the safety of the students/employees marking the attendance, a Face recognition attendance system is developed. The summary of the contribution is given below.

- Proposed a Contactless Attendance Face Recognition system using Python.
- Database of every eight students/employee is created by capturing a total of 4000 frames with different varying conditions such as blur, side face view, bright light, etc from a video.
- For Face Detection and Face Recognition, Haar Classifier and (Local Binary Pattern) LBP Classifier are used.
- Detail experiment is done on a self-created dataset and the result is verified.
- The Attendance system with CSV file is generated.

V. Proposed System

If we consider the ongoing COVID-19 pandemic situation, physical interaction with any device is very much risky and can be life-threatening. Hence most of the automated services are developed which did not interact directly with a human. Taking this into mind, the automatic student/employee attendance system is developed. The student/employee Attendance system is divided into two categories i.e., Biometric based and the second one is QR code-based. There are different advantages as well as disadvantages for both methods. The Face recognition system is mainly divided into two processes are Face Detection and Face Recognition. For this Face Recognition system, an input image is captured from a camera and processed with image processing tools to enhance the input image for accurate detection of the face. We used the histogram equalization technique to enhance and balance the histogram of an image. After that, we used a face detection algorithm to detect the face. For Detection, we used the Ada-boost algorithm which uses Haar-cascade features to find the pattern of the face and detects the face. The detected face is passed to a face recognition algorithm which identifies the student/employee and updates his/her attendance. LBP Classifier is used to recognize the student/employee Face. There are four main steps to update the attendance system i.e.

1. Image Enhancement
2. Face Detection
3. Face Recognition
4. Update/Registering Attendance

The complete Architecture and Flowchart of a Proposed System are shown in Fig.1. and Fig.2 respectively.

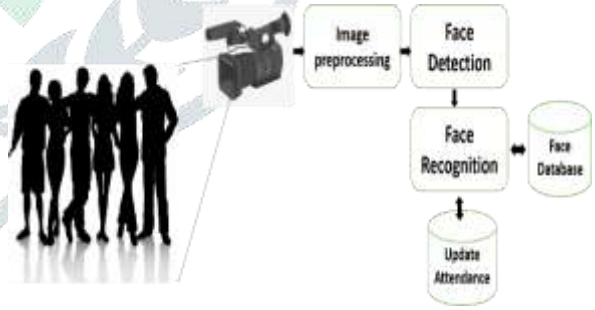


Fig.1: Complete Architecture of a Proposed System

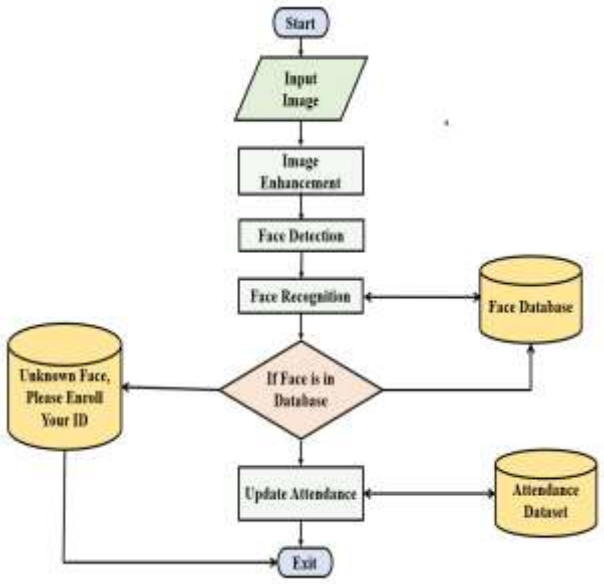


Fig.2: Flowchart of a Proposed System

1. Image Enhancement: Pre-processing

The image Enhancement technique is widely used in many computer vision applications like noise removal, deblurring, Image segmentation, Image retrieval. The main motive of this technique is to enhance the object quality according to the human perspective. There are many more techniques for image enhancement like median filtering, mean filtering, histogram equalization, logarithmic enhancement, exponential enhancement, etc. Here, we use median filtering and histogram equalization to enhance the image quality. Using median filtering we will remove the paper and salt noise and after that, we pass this processed image for histogram equalization which balances the contrast of an image.

2. Face Detection using Haar Cascade based Algorithm

- **Viola-Jones algorithm**

Viola-Jones algorithm first presented by P. Viola, M. J. Jones (2001) which is based on the Haar-cascade facial feature extractor. This algorithm is very much popular for finding an object like a face in an image. Haar-cascade is an ML algorithm in which a cascade classifier gets trained from numerous positive and negative examples. It is a very useful algorithm to detect faces in an image. The algorithm comprises four stages.

(1) Haar feature selection
(2) creating integral images
(3) AdaBoost training
(4) cascading classifiers

3. Face Recognition using Local Binary Pattern (LBP)

Human face recognition is a crucial task in the field of computer-human interaction. Face recognition computational models are interesting because they can help in both hypothetical learning and practical applications.

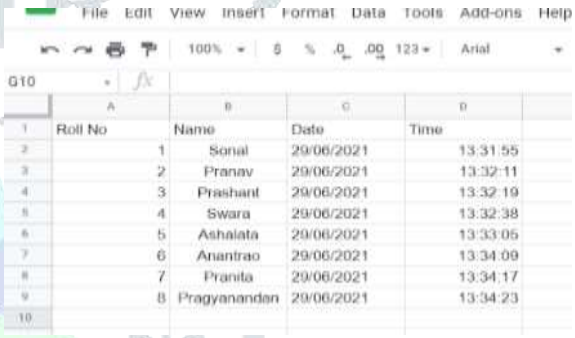
For Face Recognition, Principal Component Analysis (PCA) and Local Binary Patterns (LBP) are the most popular Algorithms for the recognition of face in a real-time environment.

- **Local Binary Pattern (LBP)**

Ojala et.al. proposed a Local Binary pattern in 1994 for texture recognition. After that, it booms the area of computer vision with different applications, content-based image retrieval, face recognition, facial expression. It is very powerful in computer vision because of its local thresholding algorithm. LBP is one type of visual descriptor used for classification. LBP operator analyzes the images in a challenging real-time environment.

4. Registering Attendance

This system maintains the attendance sheet based on input facial attributes for all the individuals who marked their attendance. For attendance generation, a separate attendance sheet is maintained, containing all the student's/employee' names. A cell array stores the attendance of all the students for a particular day. Fig. 4. shows the generated Attendance CSV file which illustrates that there are 8 students/employees in the database.



Roll No	Name	Date	Time
1	Sonal	29/06/2021	13:31:55
2	Pranav	29/06/2021	13:32:11
3	Prashant	29/06/2021	13:32:19
4	Swara	29/06/2021	13:32:38
5	Ashalata	29/06/2021	13:33:05
6	Anantrao	29/06/2021	13:34:09
7	Pranita	29/06/2021	13:34:17
8	Pragyanandan	29/06/2021	13:34:23

Fig. 4: Attendance generated in CSV file Screenshot

When the face of a student is recognized with the stored face in the database, the attendance for that student is marked else nothing is stored there. We have entries for 8 different students/employees. The first column is reserved for Roll Number/ID, the second column for Name of the students/employees, the third column is for the date and the fourth column is for the system time at when the students/employees present.

VI. Results and Dataset

This proposed system is implemented using Python 3.7 and OpenCV library. The experimental environment was the windows 10 system with 8 GB RAM, intel i5 generation. Model executed in Spyder integrated development environment (IDE). For image acquisition, the webcam specification as a 5 MP camera with a resolution of 1024 x 1024 is used.

The images of eight students/employees as a sample study are taken from a webcam with varying conditions such as an image with blur face, front face, brightness variation with low high brightness, left side face view, and right face view, including up and down face position. Sample images from the dataset are shown below in Fig.5.

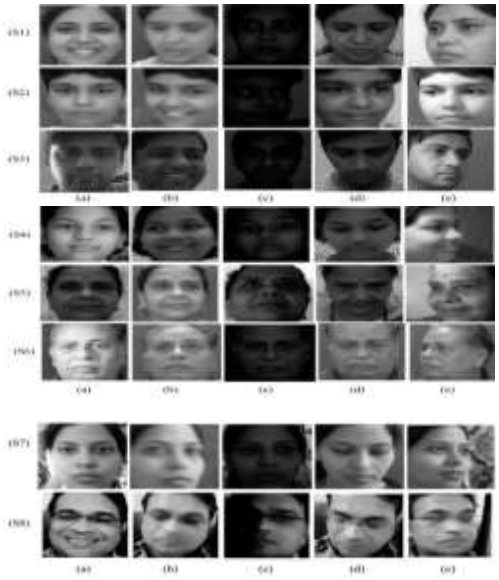


Fig.5: (S1) FaceId-1 Sonal, (S2) FaceId-2 Pranav, (S3) FaceId-3 Prashant, (S4) FaceId-4 Swara, (S5) FaceId-5 Ashalata, (S6) FaceId-6 Anantrao (S7) FaceId-7 Pranita (S8) FaceId-8 Pragyanandan and (a). Front face, (b) Blur face, (c) Low brightness, (d) Down face, (e) Side view.

Dataset is further divided into training and testing. LBP model trains using train dataset and results on test dataset are shown in Fig.6 given below where the accuracy of face recognition for each student/employee is shown. The overall accuracy of 79 % accuracy for face detection is achieved. Fig.7 shows the Recognized faces of Students/Employees with accuracy.

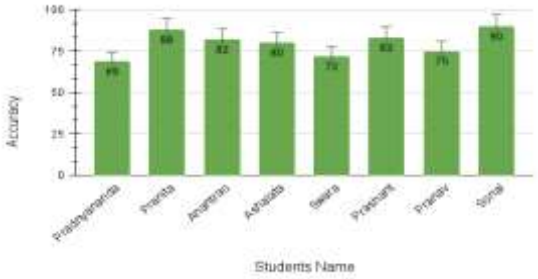


Fig.6: Results on a test dataset of students/employees with accuracy

Fig.7: Recognised faces of students/employees with accuracy.

- **Result and Discussion:**

The development of contactless attendance systems using face recognition is divided into main three parts 1. Data creation 2. Model training 3. Testing for the first task an eight student's/employee's dataset is created with identical real field conditions. The model is trained with LBP available in the OpenCV library to extract features from the face. In total, approximately 4,000 images are collected and the further dataset is split into train and test. Model train with training dataset and performance evaluated on test dataset we achieved 79% accuracy on test data. In the future, more data will help to achieve higher accuracy.

VII. Conclusion:

In the COVID-19 situation, the physical interaction of a human machine is very risky and can be life-threatening. In this situation taking attendance in the classroom, Lecture Hall, Library, or exam centre taking attendance or the attendance of the employees at the workplace is a very difficult and time-consuming task, if recorded manually or by using any physical interactive biometric task. Hence, the contactless attendance system using face recognition is developed. In this system, the input image is taken and pre-processed with a basic enhancement algorithm by reducing noise and adjusting contrast. After finding the region of a face using a face detection algorithm, the face is recognized using an LBP classifier. Attendance of the recognized student/employee is updated. This system can be used in real-time work quite well.

Future work can be extended to this project towards student attentiveness by checking student's attention towards the lecture being delivered in the classroom. The application can further be extended using the GSM module to make an automatic call or SMS system for feedback attendance to student parent or guardian. This scope is also applicable for monitoring the employees of any organization. Security and safety get improved in all public places and workplaces. Airport authorities can use facial recognition at security check-ins for international flights. Contactless facial recognition brings the ease of management of human activities without much physical involvement. This makes the system safe and less time-consuming for humans considering the Covid-19 pandemic situation.

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