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Attendance System based on Face Recognition

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Abstract
Attendance has become one of the crucial methods for monitoring the students in schools as well as employees at a workplace. Most of these places rely on the manual method or contact based methods to mark the attendance. The face of a person is what we humans use to recognize or identify a person. Manually updating the attendance is a very tedious task and also consumes a lot of time. So we have proposed a way to use face recognition to mark the attendance of students in school by using the concept of face encodings. The attendance of the students' is automatically updated at the end of the day in the database without any human intervention. There are many algorithms available to perform the task. In this proposed system we have used the concept of face encodings which are a part of face_ recognition api in python. This enables us to detect multiple faces at once and is also a very effective contactless recognition system when compared to iris or fingerprint recognition.

Keywords**:** *Face recognition, Attendance, Face Encodings.*

1. Introduction

Attendance Monitoring[1] is very important when it comes to a college or corporate office. Every college has their own set of rules to monitor the attendance of their students. Some lecturers take attendance manually, some use online tools and very few are automated[9]. By taking the attendance manually, there is some wastage of time for both the students as well as lecturers. Here we are developing a model to automate the students' attendance by using Face Recognition[4].

Face Recognition is one in which we recognize people by their facial characteristics[7]. It is one of the biometric applications which is used to uniquely identify an individual and then verify him/her by first comparing and then analyzing patterns. The main concept inface-recognition is the face which has some features[10] that the camera can capture such as distance between the eyes, nose, mouth, etc. By being able to detect a face in the frame the camera can focus on the individuals' faces.

Developing a model for facial recognition is very difficult because every individuals' faces are different, complex and multidimensional. We focused towards the development of a pattern recognition which is simple, fast, accurate and is easy to meet our objectives.We use Feature-encodings[10]that usually contain information about an object's(face) important characteristics. It represents (or embed) the face on a 128-dimensional unit hypersphere. The embedding is a generic representation for a person's face. The main use of Feature encodings is to reduce the dimension [2] by selecting only certain features which are required.

The paper consists of the following. Section 2 gives a gist of the previous work in the domain. Section 3 explains the implementation of the proposed system. Section 4 gives the observations and result obtained. Section 5 concludes that paper. Section 6 sheds light on the future implementations.

2. Literature Survey

In [4] (Rajath S Bharadwaj, Tejus S Rao), Local Binary Pattern Histogram algorithm was used. It is the easiest face recognition algorithm. It is robust against monotonic gray scale transformations. The proposed system cannot update attendance of multiple people at once, that is it cannot detect more than 5 faces at once.

In [9] (Venkata Kalyan Polamarasetty, Muralidhar Reddy Reddem), Histogram of oriented gradients (HOG) algorithm was used. The HOG algorithm enables quick computation of features. HOG can be used to detect any kind of object. It only tells about facial recognition rather than actual implementation of Face recognition for attendance - as how the attendance is being calculated per student. The system is implemented using MATLAB. It requires expensive hardware which has high computation

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power. So, it being costly, can run only on a small database.

In [1] (Akshara Jadhav, Akshay Jadhav), the implementation is that the student is supposed to stand in front of the camera for the iris to be recognized so that the system can mark attendance for the student. Daugman's Algorithm is used for iris recognition. It is very accurate compared to basic facial recognition. Better than a fingerprint reading system as there is no contact between the system and human. The system recognizes face up to 30 degrees variation in angle. Since each student has to come and stand facing the system, the entire process comes out to be slow.

In [2] (S. Sayeed, J. Hossen), The Principal Component Analysis approach was used to recognize face characteristics. Eigenface is generated and eigenface captured is compared with an image in the database. To further see how the model was working Euclidean distance is used. Attendance of the student is monitored. If the attendance falls below 80%, a message is sent to warn the student about shortage of attendance. Information loss happens since Principal Component Analysis (PCA) is a type of dimensionality reduction technique. There is no system to update the attendance of a student who was present but due to technical glitch the student was marked absent.

In the proposed system in [7] (Samuel Lukas, Aditya Rama Mitra), algorithms such as Discrete wavelength transform, Discrete cosine transform, Radial based function network and techniques such as grayscale normalization and histogram equalization are used. The system provides an accuracy upto 82%. The drawback is that this system only identified 121 out of 148 students in the class. There is no system or option to change the attendance of a student who was present but was marked absent due to an algorithm not able to recognize a person's face.

In [5] (Kennedy Okokpujie, Etinosa Noma-Osaghae), The system requires the person to stand in front of the camera for the face to be recorded. Viola-Jones algorithm was used to detect faces. Fisherfaces method was then used for creation of face templates. The system provides accuracy upto 70.33%. Attendance can be checked online which is very much helpful in today's world. The algorithm worked with different facial expressions and varying lighting conditions. It doesn't guarantee whether a student coming with or without spectacles or with or without a beard would be detected as the same person or not. This can cause issues with marking of the attendance. In the system proposed in paper [6] (Hemavati Sabu , Madhumala Sonawane), Eigenfaces method is used for facial recognition. The system provides accuracy upto 83% taking into account varying lighting conditions and angle of head. The major drawback here is that multiple faces are detected in an image even if there is only one face, meaning the algorithm which detects a face in an image is inaccurate as it detects faces in other parts of the image even if there are no faces as such.

3. Proposed Methodology

We are using face_recogniton api which makes the job a lot easier. The following tasks befall the developers of facial recognition system [Figure 1]:

• Find faces – It is the task of finding faces in frames of the video stream.

• Face detection or location – Collecting just the part of the image that contains the face.

• Feature extraction - this step analyses the face and obtains unique digital values for it.

• Identification of the face or face recognition - we compare the extracted data with the data from the database, if the data match, we will display the name of the person else we will display a message saying an unknown face.

All libraries that are used are configured in the mode of using only CPU, without a GPU (NVIDIA Cuda).The below diagram shows the flow of process in the above system.

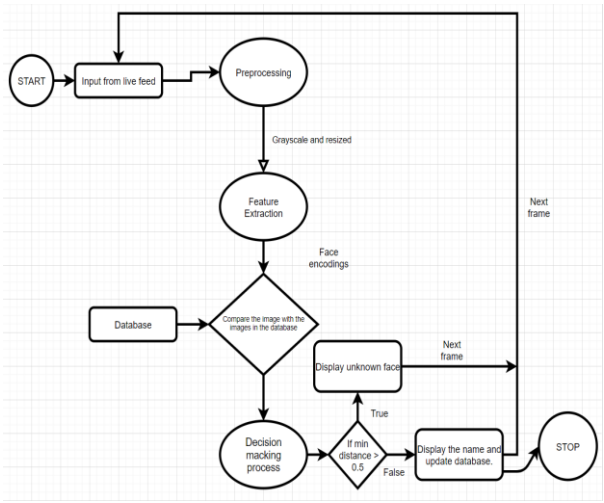

Figure 1: Diagram of the parts of the proposed method

There are two major parts in a classification process, training and recognition. Our model can be trained on static images and also with the feed from the camera. For every face its face encodings are extracted and stored along with their respective names.

Training: We first convert the image to grayscale as we don't need colour data to find faces. To find faces in an image, we use face_locations which is a part of face_recognition api. It returns the bounding coordinates of all the faces present in the image and frame. These sections of the images are extracted then fed to the face_encodings method [Figure 2a].

The method takes two arguments, one is the list of bounding values for faces returned from face_locations

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and another is the frame. It then returns a list containing the face embeddings for all the face locations in the frame.

The face encodings for the faces in the training set and collected and stored in the database which are used later for face recognition.

Figure 2a: Bounding boxes for faces detected.

Recognition: After training, the project is then used to detect and log faces in real time. Real time video feed is accessed through a camera. We use OpenCV to get the frames from the input stream. To find faces in the frame, we use face_locations which is a part of face_recognition api. It returns the bounding coordinates of all the faces present in the image and frame. This is then fed to the face_encodings method in the face_recogniton api to extract face encodings for the faces in the frame. Unlike other forms of facial feature representations, this embedding has a property that a larger euclidean distance between two face embeddings means that the faces are likely not of the same person.

For facial recognition, the algorithm observes some important metrics of the face, such as color, size and inclination of the eyes, distance between eyebrows, etc. All these elements collectively define the face, which encodes the information obtained from the image used to identify a particular face.

This property makes clustering, similarity detection, and classification tasks easier than other face recognition techniques where the Euclidean distance between features is not meaningful. [Figure 2 b]:

Figure 2 b: The above image shows face embeddings for a face.

These extracted encodings are compared with the ones that already present i.e. the encodings of the trained faces. Comparison is done by finding the faces closest to the new face. The face with the lowest distance is considered to be the actual face. If the distance is too big, then the face is classified as "Unknown".

Attendance : Once the faces are recognised in the frame, their respective registration numbers are recorded in the database. A face is detected only once within the interval of 3 seconds, as it might still be a part of the next frame and would cause the system to enter the log again. The student moving into the class and moving out are captured using two different cameras, thus giving us information about the duration of the class attended. At the end of the day the student's log details are compared with the time slots in the time table and he or she is marked present if they were present within the class for at least 75 percent of the lecture's duration.

4. Experimentation and Discussion of Result

Python 3.7 was used to build the project. The face_recognition api was used for some parts of the project like extracting face_locations and face_encodings. The OpenCV module was used to process the frames from the video stream. Augmentations were made on the image to improve the accuracy and to overcome the issues encountered during assignment of attendance.
The proposed system works well in good lighting. The model was trained to extract the face embeddings of around 60 students of the class. Consider the figure [Figure 3].

Figure 3.1: A person who's face will be detected by our model.

The project when run looks like the below figure [Figure 3.2]. The figure shows random registration numbers to maintain privacy. Also the data being updated into the database is seen in Figure 3.3 .

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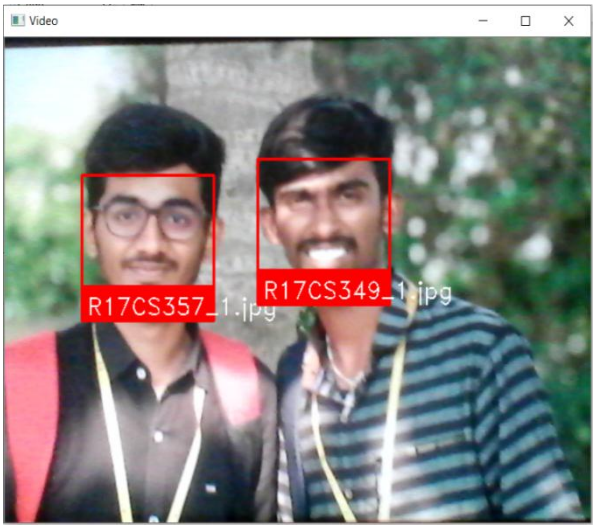

Figure 3.2: Faces being detected in real time.

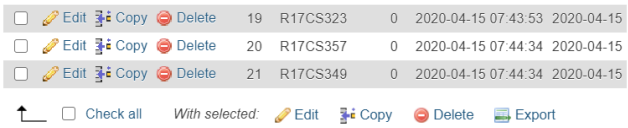

Figure 3.3: Attendance being marked in the database.

The model was given a frame which had 4 people and it detected all four 8 times out of 10 under good lighting.

The constraint for the closest distance was considered to be less than 0.5. If the face has a distance more than 0.5 with all the present encodings it is considered to be an unrecognised face. The value 0.5 was obtained based on real world trials. It might vary depending on the type of lighting and angle that the camera is positioned.

Our project overcomes the drawback of the papers *[1]* and *[4]* which cannot detect multiple faces at a time. The first paper *[1]* relies on the iris data though being comparatively accurate is time consuming. The same goes for the paper *[4]* where the model can recognise only a single face at a time.

Our project can detect and identify multiple faces at a time which drastically reduces the time needed to mark attendance. The project has also been efficient in regnising persons with facial changes over time such as wearing spectacles or growing a beard.

5. Conclusion

Attendance management system is a necessary tool for taking attendance in an environment where the contribution of people in work is very important. Most of the existing approaches are time consuming, intrusive and require manual work from the users. In this research, we eliminated the above challenges by demonstrating the use of face recognition in a student attendance management system. The system takes attendance by using a camera mounted in the door of a classroom outside and inside to acquire images of the students walking in and out. The model extracts the face encodings for the faces in the image and compares them with the encodings of the faces in the database. On identification of a registered student face on the acquired image collections, the attendance is marked as present otherwise absent.

The future scope of this system can be enhanced and used by companies to monitor the movement of their employees across the campus of the industry or indoor work environment, the data collected by the above implementation can be analysed and employees spending least time doing actual work can be penalised, the proposed system can also be used to monitor movement of unknown people coming inside an educational campus, the accuracy can be always increased by using apt amount of training data and installing cameras such that light falls on person's face to improve detection and recognition.

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