Face Recognition Attendance System using Python

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Abstract-

The main purpose of this project is to build a face recognition-based attendance monitoring system for educational institution to enhance and upgrade the current attendance system into more efficient and effective as compared to before. The current old system has a lot of ambiguity that caused inaccurate and inefficient of attendance taking. Many problems arise when the authority is unable to enforce the regulation that exist in the old system. The technology working behind will be the face recognition system. The human face is one of the natural traits that can uniquely identify an individual. Therefore, it is used to trace identity as the possibilities for a face to deviate or being duplicated is low. In this project, face databases will be created to pump data into the recognizer algorithm. Then, during the attendance taking session, faces will be compared against the database to seek for identity. When an individual is identified, its attendance will be taken down automatically saving necessary information into a excel sheet. At the end of the day, the excel sheet containing attendance information regarding all individuals are mailed to the respective faculty.

Keywords - Facial Recognition, Attendance System, Automation, OpenCV (Cv2),Computer Vision, Image Processing, Biometrics, Datetime Module, Group Setting, Student Attendance, Real-time Recognition, Identification, Verification

1. INTRODUCTION

This is a project about Facial Recognition-Based Attendance System for Educational Institutions. In this chapter, the problem and motivation, research objectives, project scope, project contributions and the background information of the project will be discussed in detail.

1.1 Problem Statement and Motivation

According to the previous attendance management system, the accuracy of the data collected is the biggest issue. This is because the attendance might not be recorded personally by the original person, in another word, the attendance of a particular person can be taken by a third party without the realization of the institution which violates the accuracy of the data. For example, student A is lazy to attend a particular class, so student B helped him/her to sign for the attendance which in fact student A didn‟t attend the class, but the system overlooked this matter due to no enforcement practiced. Supposing the institution establish an enforcement, it might need to waste a lot of human resource and time which in turn will not be practical at all. Thus, all the recorded attendance in the previous system is not reliable for analysis usage. The second problem of the previous system is where it is too time consuming. Assuming the time taken for a student to sign his/her attendance on a 3-4 paged name list is approximately 1 minute. In 1 hour, only approximately 60 students can sign their attendance which is obviously inefficient and time consuming. The third issue is with the accessibility of those information by the legitimate concerned party. For an example, most of the parents are very concerned to track their child‟s actual whereabouts to ensure their kid really attend the classes in college/school. However in the previous system, there are no ways for the parents to access such information. Therefore, evolution is needed to be done to the previous system to improve efficiency, data accuracy and provides accessibility to the information for those legitimate party.

1.2 Research Objectives

In order to solve the drawbacks of the previous system stated in 1.1, the existing system will need to evolve. The proposed system will reduce the paperwork where attendance will no longer involve any manual recording. The new system will also reduce the total time needed to do attendance recording. The new system will acquire individual attendance by means of facial recognition to secure data accuracy of the attendance.

The following are objectives of the project:

▪ To develop a portable Smart Attendance System which is handy and self-powered.

▪ To ensure the speed of the attendance recording process is faster than the previous system which can go as fast as approximately 3 second for each student.

▪ Have enough memory space to store the database

1.3 Project Scope and Direction

The main intention of this project is to solve the issues encountered in the old attendance system while reproducing a brand new innovative smart system that can provide

convenience to the institution. In this project, an application will be developed which is capable of recognising the identity of each individuals and eventually record down the data into a database system. Apart from that, an excel sheet is created which shows the students attendance and is directly mailed to the respected faculty

2. LITERATURE REVIEW

2.1 Attendance System Using NFC Technology with Embedded Camera on Mobile Device

According to research journal "Attendance System Using NFC (Near Field Communication) Technology with Embedded Camera on Mobile Device" (Bhise, Khichi, Korde,Lokare, 2015). The attendance system is improved by using NFCtechnology and mobile application. According to the research paper, each student is given a NFC tag that has a unique ID during their enrolment into the college. Attendance of each class will then be taken by touching or moving these tags on the lecturer mobile phone. The embedded camera on the phone will then capture the student‟s face to send all the data to the college server to do validation and verification. The advantages of this method is where the NFC is simple to use, and the speed of connection establishment is very high. It indeed speeds up the attendance taking process a lot. However, this system couldn‟t automatically spot the violation when the NFC tag is not personally tagged by the original owner. Apart from that, the convenience of the system which uses the mobile phone as the NFC reader was actually an inconvenience to the lecturer. Imagine if the lecturer had forgotten to bring their mobile phones to work, what would be the backup procedure for the attendance to be recorded? Moreover, most of the lecturer will not likely to prefer their personal smart phones to be used in this way due to privacy matter. Hence, unique information about the student like biometrics or face recognition, which is guanine for a student should be used in replacement of the NFC tag. This will ensure attendance to be taken originally by the actual student.

2.2 Face Recognition Based Attendance Marking System

The second research journals "Face Recognition Based Attendance Marking System" (SenthamilSelvi, Chitrakala, Antony Jenitha, 2014) is based on the identification of face recognition to solve the previous attendance system‟s issues. This system uses camera to capture the images of the employee to do face detection and recognition. The captured image is compared one by one with the face database to search for the worker‟s face where attendance will be marked when a result is found in the face database. The main advantage of this system is where attendance is marked on the server which is highly secure where no one can mark the attendance of other. Moreover, in this proposed system, the face detection algorithm is improved by using the skin classification technique to increase the accuracy of the detection process. Although more efforts are invested in the accuracy of the face detection algorithm, the system is yet not portable. This system requires a standalone computer which will need a constant power supply that makes it not portable. This type of system is only suitable for marking staff‟s attendance as they only need to report their presence once a day, unlike students which require to report their attendance at every class on a particular day, it will be inconvenient if the attendance marking system is not portable. Thus, to solve this issue, the whole attendance management system can be developed on an portable module so that it can be work just by executing the python program.

2.3 Fingerprint Based Attendance System Using Microcontroller and LabView

The third research journal "Fingerprint Based Attendance System Using Microcontroller and LabView" (Kumar Yadav, Singh, Pujari, Mishra, 2015) proposed a solution of using fingerprint to mark the attendance. This system is using 2 microcontrollers to deal with the fingerprint recognition process. Firstly, the fingerprint pattern will be obtained through a fingerprint sensor, then the information will be transmitted to microcontroller 1. Next microcontroller 1 will pass the information to microcontroller 2 to do the checking with the database that resides in it. After finding a student‟s match, the details are sent to the PC through serial communication to be displayed. This design is good as it accelerates development while maintaining design flexibility and simplifies testing. But again, this system is attached to a PC which make it not portable. Other than that, the database information cannot be accessible easily. Meaning that, for the parents whom are interested in knowing their child‟s attendance cannot easily or conveniently access the information. Therefore, to provide accessibility of the student‟s information to the legitimate concerned party, the information can be uploaded to a web server for easy access. While the authentication for the appropriate access can be enforced through a login screen.

2.4 RFID based Student Attendance System

According to the fourth research journal "RFID based Student Attendance System" (Hussain, Dugar, Deka, Hannan, 2014), the proposed solution is almost similar to the first research journal where RFID technology is used to improve the older attendance system. In this system, a tag and a reader is again used as a method of tracking the attendance of the students. The difference between the first journals with this is where attendance‟s information can be accessed through a web portal. It provides more convenient for information retrieval. Again, this system is imperfect in the sense that, firstly, it is not portable, as the RFID reader can only work when it is connected to a PC. Secondly, the RFID tag is not a guanine information that can uniquely identify a student, thus, resulting in the inaccuracy of the collected attendance information.

2.5 Face recognition with DNNs

In 2017, Marko Arsenovic proposed the method for face recognition tasks combining various modern approaches and the state of art crafts in deep learning. The method was divided into several important stages including obtaining the training dataset and augmentation, preparing images and training DNNs and last was integration into existing system to test the proposed method. This method was tested in IT

company where five employees were volunteered in this research. The dataset included photographs of them and this dataset was used for training DNN. The employees tooked several different positions while being photographed. In order to make this approach applicable for production usage it is very important to capture small photographs of every employee at the site. It was possible to achieve high accuracy using DNN on larger datasets. The augmentation process was splitted in two stages. The first was noising and second was blurring the image at different levels. While developing face recognition model included several different steps: face detection, image preprocessing, generating face embeddings and classification. The last step was integrating with existing system. It was determined that 95% of accuracy can be achieved by using this approach. These results are enabling further research for purpose of obtaining even higher accuracy and making this solution production ready. In 2014,

2.6 Face recognition with OpenCV

Maulahikmah presented the approach to implement and develop face recognition algorithm provided by OpenCV. The main goal was to get the best facial recognition algorithm and implement it as the main case study. Principal Component Analysis was developed to overcome expensive computation and amounts of storage of older face recognition methods such as correlation methods. This research will compare the performance of two algorithms Eigenface and Fisherface based on Receiver Operating Characteristic curve. There will be two main features created the first is Collect Face Data and second is Attendance Recognition. Collect Face Data is used to collect face images of multiple students who are going to use this application and allows preprocessing the face images to provide better performance and results. Attendance Recognition is used for training the face recognized against the training set. It also helps users to set the countdown timer where students must present their face before the countdown ends to fill the attendance. Based on the results it was found that Eigenface algorithm to be implemented in Attendance System application

3. PROPOSED METHOD

3.1 Here's a deeper dive into the proposed method, exploring each stage in more detail:

1. Libraries and Environment Setup (Deeper Dive):

OpenCV (cv2): Provides functions for image manipulation, face detection using pre-trained Haar cascades (like cv2.CascadeClassifier), and drawing bounding boxes around detected faces.

face_recognition: This library simplifies face recognition tasks. It offers functions for loading images, detecting faces using OpenCV, extracting facial encodings (feature vectors) using pre-trained models, and comparing encodings for recognition.

Deep Learning Framework (Optional): For enhanced accuracy, consider TensorFlow or PyTorch for building and training a Convolutional Neural Network (CNN). These frameworks require familiarity with deep learning concepts.

2. **Data Acquisition and Preprocessing (More Details):**

Data Collection:

Aim for a balanced dataset representing the individuals you want to recognize. Include variations in:

Pose (frontal, profile, tilted)

Lighting conditions (bright, dim, backlit)

Facial expressions (smiling, neutral, frowning)

Demographics (age, gender, ethnicity) to reduce bias.

Consider using publicly available datasets like Labeled Faces in the Wild (LFW) or MegaFace for initial development and testing.

Preprocessing:

Resize images to a standard size to ensure consistent input for the model.

Convert images to grayscale (optional) as some algorithms work well in grayscale.

Apply normalization techniques like subtracting the mean pixel intensity to improve model performance.

3. Face Detection and Feature Extraction (Breakdown):

Face Detection with OpenCV:

Load a pre-trained Haar cascade classifier for frontal face detection using

imgTestimage = face_recognition.load_image_file(‘’)

imgTestimage = cv2.cvtColor(imgTestimage, cv2.COLOR_BGR2RGB)

Apply the classifier to the image to find potential faces. It returns coordinates of bounding boxes around detected faces.

Feature Extraction: Eigenfaces (PCA): * This is a simpler approach suitable for smaller datasets. * Use scikit-learn for PCA implementation. * Extract eigenvectors that capture the most variance in the training face images. * Project new faces onto the eigenvector space to obtain a lower-dimensional representation (eigenvector). Deep Learning (CNN): * Define a CNN architecture with convolutional layers for feature extraction and fully-connected layers for classification. * Train the CNN on the preprocessed dataset to learn how to represent faces effectively. * During recognition, extract a feature vector from the final layers of the trained CNN for each detected face.

4. Model Training (Deep Learning Approach - Explained):

Data Splitting: Divide the preprocessed dataset into three sets:

Training set (majority): Used to train the CNN model.

Validation set (smaller): Used to monitor model performance during training and prevent overfitting.

Testing set (smaller): Used to evaluate the final model performance after training is complete.

Training Process:

Define an optimizer (e.g., Adam) that adjusts the CNN's weights during training to minimize the loss function

Train the CNN model on the training set in epochs (iterations).

In each epoch, the model processes batches of training data, calculates the loss, and updates its weights using the optimizer.

During training, use the validation set to monitor performance metrics like accuracy and loss.

If the validation loss starts increasing, it indicates overfitting. Techniques like dropout layers or early stopping can be used to prevent this.

Hyperparameter Tuning: Experiment with different hyperparameters like learning rate, number of layers, and filter sizes in the CNN architecture to optimize performance.

5. Recognition and Output (Enhanced):

Recognition Process:

For a new image or video frame:

Detect faces using OpenCV.

Extract facial features (eigenvector for PCA or feature vector for CNN) for each detected face.

Compare the extracted features against the database of known facial encodings (eigenvectors for PCA or feature vectors for CNN) using distance metrics:

Euclidean distance for PCA: Lower distance indicates a closer match.

Cosine similarity for CNN: Higher similarity indicates a closer match.

Implement a threshold for the distance/similarity metric to avoid misidentifications. You can only identify someone if the score is above the threshold.

Based on the closest match (within the threshold), identify.

4. RESULTS

First in all we need to register the person into the database. To do so, we need to give name and his/her registered number to store.

Now we to get the pictures of the persons from the webcam or any other cams available like we used Logitech webcam here. Select the cam from which we need to take the image and start the camera. The camera is plotted in the axes and we can capture and save the images in the folder created automatically with the registered number we have entered.

After this the data is stored in the database. Now let us capture a picture from the webcam and see the results. The camera starts and takes the image to give the results checking from the saved database.

Figure 4.1 PyCharm Interface

Figure 5.2 Webcam Face Recognition

The input image Figure 5.2 now undergoes the predict process and the name of each person are given as in Figure 5.3

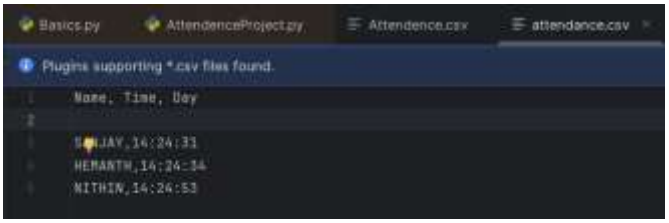

Figure 5.3 Attendance.csv

	A	B	C
1	Name	Time	
2			
3	SANJAY	14:24:31	
4	HEMANTH	14:24:34	
5	NITHIN	14:24:53	
6			

Figure 5.4 Microsoft Excel

Student Test group

The accuracy of the face recognition system was measured for two test groups (A and B) and their corresponding control groups. The control groups represent the baseline accuracy of the system, while the test groups represent the accuracy of the system with some modification.

Video Face recognition accuracy	Test Group A	Control Group A	Test Group B	Control Group B
Accuracy identification (%)	82	94	83	96

Table 5.5 Test data

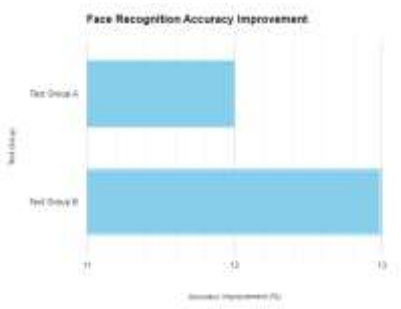

Figure 5.5.1 Accuracy

Frames per second

GPU-based configurations offer superior performance in terms of Frames Per Second for a face recognition attendance system.

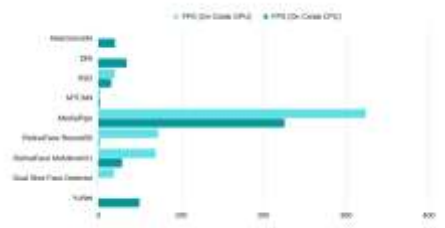

Figure 5.6 Frames per second

5. CONCLUSION

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage. Fortunately, there is such existence of micro SD that can compensate with the volume of the data. In this project, the face database is successfully built. Apart from that, the face recognizing system is also working well

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