Classroom Attendance System based on Face Recognition

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***Abstract*—Currently, teachers have to manually take the at- tendance of students leading to wastage of lecture time and detachment from the flow of lecture. The limitations in automated attendance systems making use of clickers, ID card swiping and manually marking attendance has prompted this project to be carried out. The Classroom Attendance System aims to facilitate classroom control and attendance by detecting and recognising students' faces in a digital image or video taken by a camera. It designates the manual process of marking attendance by a lecturer to an automated system which saves time, removes paper dependency for marking attendance and ensures a more efficient mode of taking attendance. The main goal is to relieve the lecturers from taking attendance manually and automate the process. A camera is used as a source of data required for face detection. The background processing of the data is done on a remote computer wherein the complete list of students' attendance is generated. The system also provides the tools that simplify the process of making custom face recognition models for different classrooms. It uses MTCNN for face detection and a pre-trained Facenet model for face recognition. The experimental results verify that FaceNet can meet the requirements of real-time recognition of highest accuracy and can be effectively applied to face detection and recognition in the Classroom Attendance System.**

***Index Terms*—MTCNN, Facenet, Face Detection, Face Recognition, Image processing.**

I.INTRODUCTION

Taking attendance is a tedious task required to be done by the lecturers. Also taking attendance in the middle of the lecture leads to an interruption in the flow of lecture, thus the concentration breaks during the lecture for students and teachers as well. So this project aims to develop a system which automates this process of taking attendance wherein if an image or a video is submitted to the software, it will detect and recognize the faces of students present in the image. It will also generate a list of attendance of all students present in the database.

II.EXISTING SYSTEMS

A. Fingerprint based recognition system

In the Fingerprint based existing attendance system, students' fingerprint has to be configured using a portable finger-print device. Later either during the lecture hours or before, the student needs to record the fingerprint on the configured device to ensure their attendance for the day. This approach is a time consuming process where each student has to individually scan his/her fingerprint [6].

B.Webcam based Attendance Systems

In this system images will be taken through webcam and face detection and face recognition algorithms will be applied to it. It uses Viola Jones as the face detection algorithm, PCA and LDA for feature extraction and SVM for classification of images [9].

In another system, a webcam is used as a source of image to capture images and take attendance. Viola Jones is used for face detection and Haar Classifier for face recognition. This approach is only well suited for virtual lectures and might now work well in a real time environment. [3]

C.RFID based recognition system

There is a card reader where students need to place their ID card to record their presence for the day. Data is transferred from RFID cards to the reader and from there to the microcontroller. Since a lot of technology goes into making it and in case of large strength of students, tags have to be purchased for everyone and hence this is a costly approach for marking attendance [11].

D.Iris Detection based attendance system

This system provides an automatic recognition of a single person based on a unique characteristic possessed by each person. Due to its property of iris recognition, high quality images of persons' iris is required which can be a major challenge. Students' iris images with sufficient resolution and sharpness have to

be captured to support recognition [8].

E.Face Recognition based attendance systems

In one approach, a teacher sitting in the classroom will capture images manually. A combination of PCA and eigenfaces is used for face recognition and matched from a database. An SMS is sent to the absentees. The problem with this approach is that the teacher always has to manually click a picture. Also the attendance of students depends on the time at which the teacher clicks the photo. [4]

In another approach, camera setup in the office will automatically capture images and a combination of LDA, PCA and eigenfaces is used for face recognition. The problem with this approach is that the image is only captured once, so the student might leave after image is captured and his/her attendance will still be marked. [5]

An alternative system has a camera setup in the classroom which will automatically capture images. A combination of HSV and RGB is used for face detection and PCA for face recognition. Again here the Image is only captured once so student might leave after the image is captured and their attendance will still be marked. [7]

In another existing system, a camera is set up at the entrance of the classroom where Viola Jones is used for face detection and a combination of PCA, LDA and SVM will be used for face recognition again. The gap in this approach is the positioning of the camera as any student can get his/her attendance marked at the entrance and might not even sit for the lecture. [10]

III.PROPOSED SYSTEM

The flow diagram of our proposed Classroom Attendance System is shown in Fig. 1.

In our proposed system, the attendance will be marked automatically by using MTCNN for face detection and a pre- trained Facenet model for face recognition. The input can be either an image or a video.

The system is split into two parts as the GUI and backend. GUI provides the means to generate a custom face detection and recognition model.

Once the model is generated, it can be used on the input file. Image files can be provided to the model for face recognition. If the input is a video file, the system will ask to provide a number of frames to segment the video in, a threshold to determine in how many frames a particular person should be recognised in order to receive attendance and based on that all the resultant frames would be passed to the model. In the backend, the face detection process will occur and the detected faces will be matched with the already trained datasets of students' images. After completion of the face recognition process the attendance will be generated.

A. Data Acquisition

1.Image acquisition: A camera will be set up in the classroom in such a way that every student is fairly visible and the images/video will be captured throughout the lecture. This file is given as an input to the system for further processing. The cctv camera present in the classroom can be utilised for this purpose.

2.*Dataset creation:* Dataset of students is created before the recognition process to train the model and make it more efficient in giving accurate results. Initially we utilised a dataset of 5 celebrities then trained and validated the model.

Later we created a dataset of students with different poses and variations like wearing glasses, cap, different lighting conditions, etc. For better accuracy minimum 15 images of each student should be used for training and atleast 10 images of each student should be used for validation.

B. Face Recognition Process

The block diagram of the face recognition process is given in Fig. 2.

1) Model creation: When the model is created, the images from the training and validation folder as passed face detection and face recognition algorithm to generate the 128- dimensional embedding and corresponding name of each im- age. These embeddings and name/labels are passed through an SVM classifier and the labels are converted to encodings. The SVM model and the encodings are saved in the home directory of the user.

2) Image capturing: The video file of a particular lecture is given as the input to the system. The frames are captured from the video for further processing.

3) Face detection and extraction: The initial step of face recognition is face detection wherein the image file is given to the system and all the human faces present in that particular image are detected using face detection algorithm. There are a number of image processing algorithms that can be used to detect faces in an image, mark the location of detected faces,etc. We have used the MTCNN (Multitask Cascaded Convolutional Neural Networks) to detect human faces in given images or video frames. All those detected faces from the image or video file would be represented by the system as 160x160 face arrays.

4) Face encoding: Once the faces are detected in the given image, the next step is to extract the unique identifying facial features for each image. The pre-trained Facenet model is applied on the extracted face arrays. Facenet model generates a 128-dimensional representation for each image array.

5) Face matching: Our system validates the faces by con- structing 128-d embeddings for each face. The facenet model is a deep convolutional neural network trained via a triplet loss function. This model encourages vectors having the same identity to become more similar (i.e. there will be smaller distance), whereas vectors having different identities, those are expected to become less similar (i.e. there will be larger distance). It provides the Euclidean distance between faces in the detected image. This process takes place for all faces in the training datasets.

6) Face classifier: Support Vector Machine (SVM) classi- fier model generated when creating the model is used to predict the class label, hence it assigns labels to all the recognized faces as given in the training dataset. The encodings file is used to convert the SVM output label to the name of the recognised person. Once all the faces are assigned to the respective labels the process goes to the attendance marking stage.

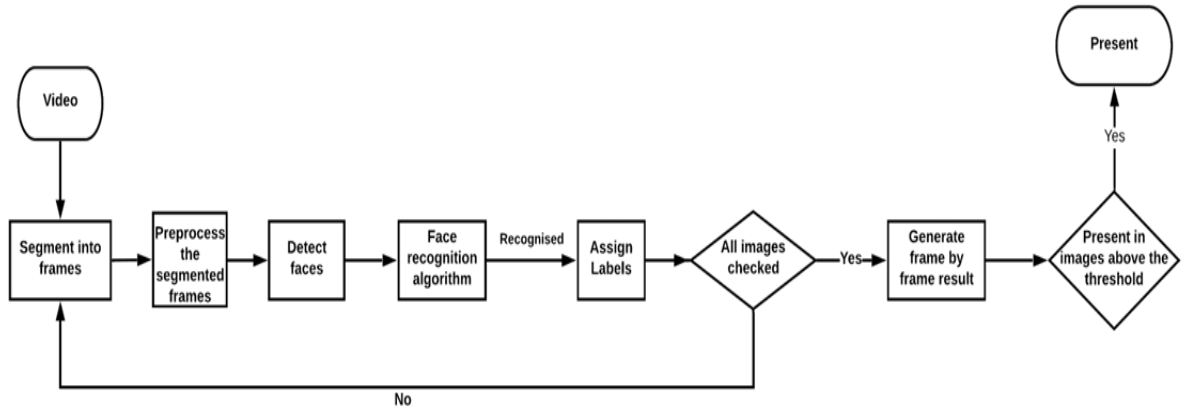

Fig. 1. Flow Diagram

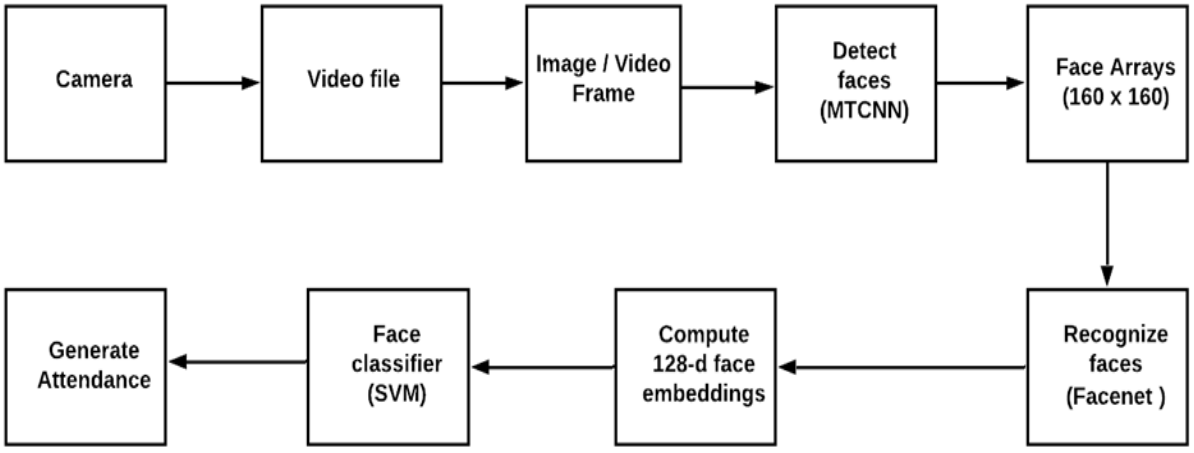

Fig. 2. Face Recognition process

7) Attendance marking: In case of an image input, once all the faces are identified, the system generates a file containing the names of recognized students. It also generates an image file containing the faces of students recognized by the system. Both the text and image files are stored into a result folder which will be saved in the destination path provided by the user.

In case of a video input, it generates two attendance text files. One file contains the frame by frame account of recognised faces and the other generates the complete attendance taking into account the provided threshold value. For example, if frame 1 recognised Person 1, Person 2 and Person 3, frame 2 recognised Person 1 and Person 3 and frame 3 recognised Person 1, Person 2 and Person 3, and if the threshold was given was 3, then the corresponding text file will have only Person 1 and Person 3.

If an unknown face is detected by the model, it labels it according to the closest person resembling that face leading to mislabelling the unknown face and granting attendance to the resembling person for that frame. In that case, the system operates under the assumption that the unknownperson in a classroom will be present only temporarily and if the resembling person is absent the threshold value will guarantee his/her absence.

The proposed system also provides the ability for the user to automate the above mentioned processes by packaging the GUI with python scripts to make the model, test image or video on the model. The scripts can run from the command line or imported as functions in other python scripts.

GUI

The GUI shown in Fig. 3 consists of following steps:

8) Creating a Face recognition model: As shown in the Fig. 4, making a custom model requires the model name, train- ing data folder and validation data folder. We have to choose the training and validation folders consisting of subfolders as shown in Fig. 5. Each subfolder consists of images to train the model with the name of each subfolder as the name of the student.

9) Test on an image: After training our model on a dataset we can test our model on an image by providing the image and destination folder to the model as shown in Fig 6. The model will detect all the faces from the image and will then recognize the faces detected based on the model trained. After faces have been recognized a list of attendance will be generated in the output directory provided.

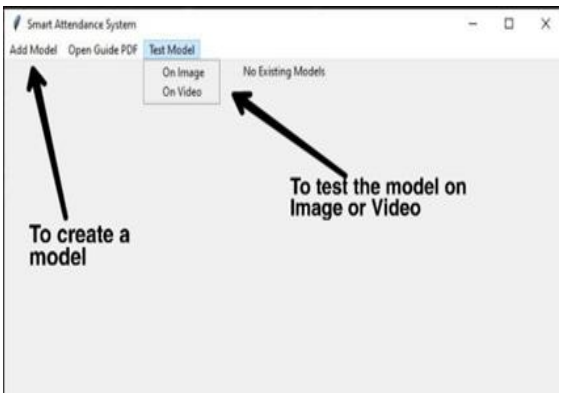

Fig. 3. GUI

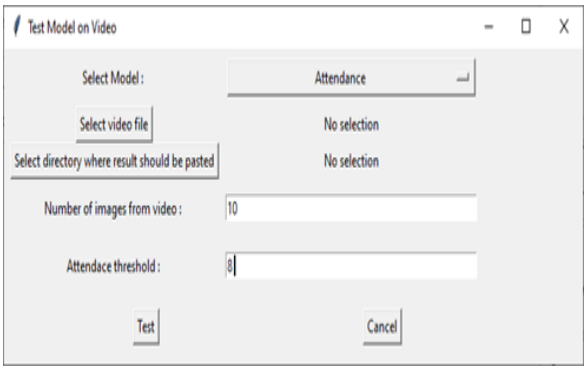

Fig. 4. GUI for making a custom face recognition model

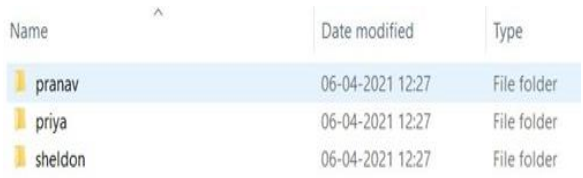

Fig. 5. Training Dataset Folders

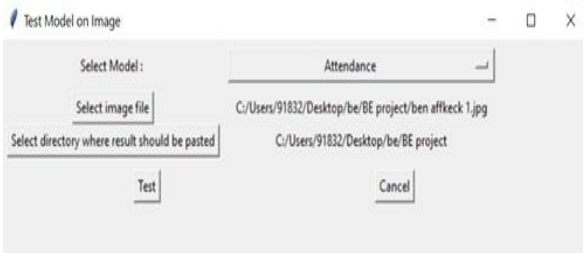

Fig. 6. Test model on Image

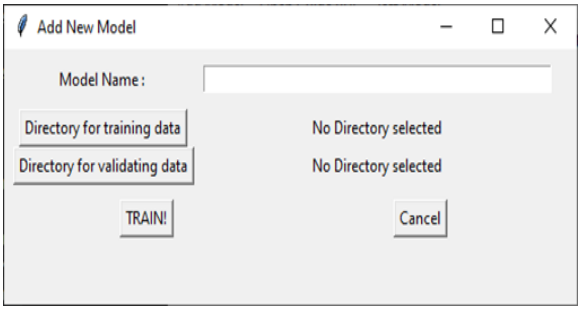

Fig. 7. Test model on Video

C. Scripts

In addition to the GUI, 3 python scripts are also provided for making the face recognition model, testing image on the model and testing video on the model namely makeModel.py, testImage.py and testVideo.py respectively.

They can be accessed from the command line or imported in a different python script.

A virtual environment is also packaged with the system which must be activated before running the scripts.

These scripts can be utilised by the user to automate their workflow or manipulate it further to better suit their infrastructure.

3) Test on a video: We can also test our model on a video by providing the video file, destination folder, number of frames to the model and threshold as shown in Fig 7. The video will be segmented into a number of frames based on user input and each frame will undergo face detection and recognition. An attendance list will be generated for all frames the video is segmented into. The threshold indicates in how many frame should any given person be recognised in, to be given the attendance. A separate attendance list is generated containing only the labels for people who pass the threshold.

IV.EXPERIMENTS & RESULTS

We created a model based on the team members as shown in Fig. 8

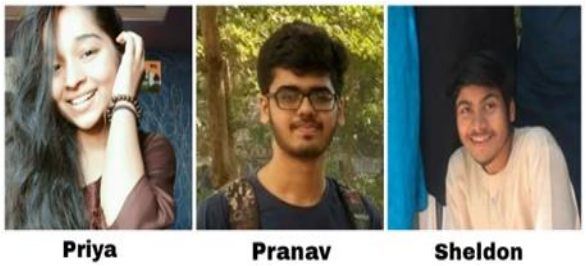

Fig. 8. Model trained on various images of 3 people

We created a video of a classroom containing the team members. In addition, we also injected unknown faces in the video at certain points.
In order to test the video, we set the number of frames at 10 and threshold at 8.

After all frames are checked and faces are recognized a message will pop up in the GUI saying ”Result is generated”. In the destination path provided as input, image files and two text files will be generated as the result shown in Fig.9. Since we passed the number of frames as 10, there will be 10 images generated in which all the faces present in the particular frame would be available and labelled as per the dataset.
The results generated for the 10 frames are shown at Fig. 10 The final attendance text file generated as shown in Fig. 12 has labels Priya, Sheldon. Although, an unknown face was mislabelled as ’Pranav’, the name didn’t appear in the final attendance since ’Pranav’ was not recognised in 8 (threshold value) or more frames as shown in Fig. 11.


Fig. 9. Result images and text file

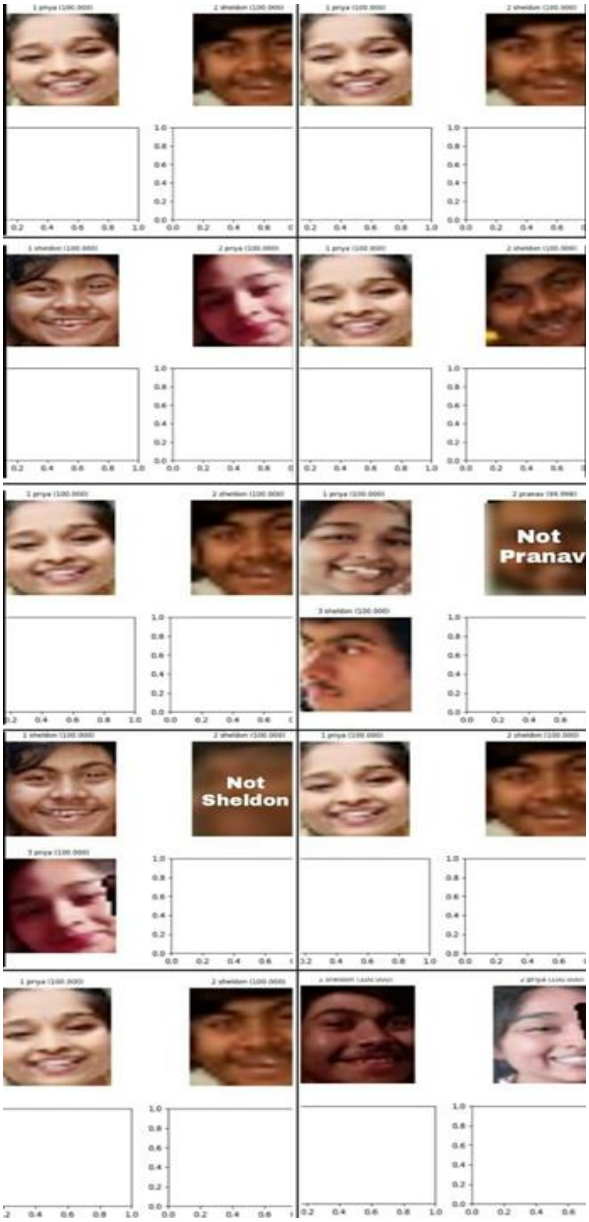

Fig. 10. Results

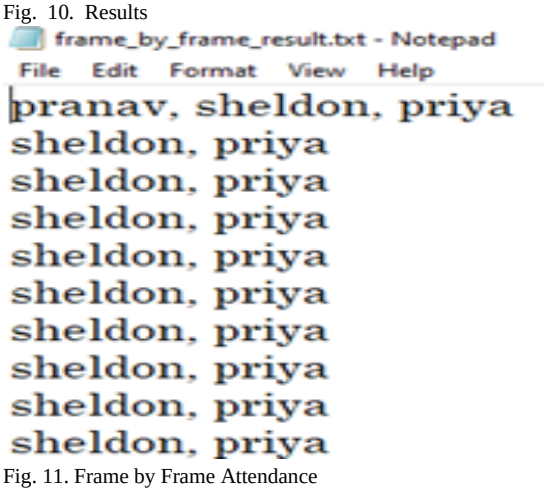

Fig. 11. Frame by Frame Attendance

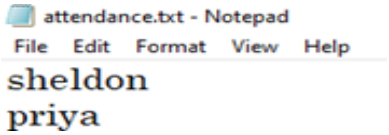

Fig. 12. Final Attendance

V.CONCLUSION

Classroom Attendance System is designed to solve the issues of existing manual systems as well as the automated systems based on iris detection, ID card swiping, etc. for taking attendance. We have used face detection and recognition concepts to mark the attendance of students and to make the system more efficient.

We have created a software which accepts input as images or videos and recognises faces from those images/videos with the help of MTCNN, SVM classifier and Facenet. The system recognises faces of students in different poses, angles, lighting conditions, etc. It can also be made useful for seminars, events or other occasions for marking attendance.

VI.AVAILABILITY OF DATA AND MATERIALS

The data that supports the findings of this study are not openly available due to reasons of sensitivity and can be made available upon reasonable request.

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