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Face recognition-based smart attendance management system using Dlib (CNN)

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Abstract

After a long period of online classes, students are finally returning to traditional classrooms. In online classes, the process of marking attendance was simple, straightforward, and automated. We hope to propose a system in this paper that will automate the attendance marking system in both online and offline classes. This would eliminate the time-consuming process of manually marking attendance one by one. The project's heart is deep learning facial recognition, which has a staggering accuracy of 99.38%. Students must take a photo of themselves for face encoding. This encoding is saved and later matched during live class to mark their attendance. The live stream of the classroom is used to record and save student attendance in a CSV file. The CSV file contains all past and current attendance records.

Keywords- *Attendance management system, CNN, Face Recognition, Automation*

1. INTRODUCTION

The academic achievement of children and teens in schools and institutions is highly influenced by attendance. Due to their regular attendance, the students are shown to be less prone to act rebelliously or destructively [1], [2]. The chance of failing a class or leaving school early grows with repeated absences. [3], [4]. The manual or traditional techniques of ensuring attendance are inefficient for the following reasons:

- The upkeep of a massive database of records is laborious. The number of records keeps expanding as and when the class strength does. Continuing to maintain it over time gets even more difficult.
- It requires lots of time. The responsible instructor must leave the classroom each time to take attendance, which takes away from the class's teaching time.
- It is fallible; it is not impenetrable. A teacher might overlook a student's attendance due to a variety of student misbehaviours, or they might even have the propensity to report someone's absence wrongly.
- It wastes resources because there is a lot of paperwork involved. Big records demand a lot of maintenance. There is also a chance that the documents will get damaged, stolen, or misplaced.

Several universities have begun adopting a number of techniques for tracking attendance, including Radio Frequency Identification (RFID) [3], iris recognition [4], fingerprint recognition, and others, in an effort to

automate the process. But because these technologies work in a queue, they might take longer and be more intrusive.

An essential biometric characteristic that is non-intrusive and simple to acquire is face recognition. Systems that use face recognition are generally unaware of different facial expressions.

Facial recognition has become quite important in today's digital, post-covid society. Although it is less accurate than iris and fingerprint identification, it is nonetheless frequently utilized since it is a non-invasive, contactless technique. From schools to huge corporate offices, facial recognition employing machine learning algorithms has a wide range of applications.

Given how time-consuming and difficult to maintain the existing manual attendance system is, this system aims to develop a class attendance system that takes use of the concept of facial recognition. Therefore, the purpose of our recommended solution is to employ facial recognition to record attendance automatically.

2. LITERATURE REVIEW

Face recognition is not the same as face detection. We were able to recognize faces in the face identification challenge while only being able to locate human faces in the face detection task. There are several algorithms for face recognition. There are conventional facial recognition methods in OpenCV.

- Eigenfaces
- Scale Invariant Feature Transform (SIFT)
- Fisher faces
- Local Binary Patterns Histograms (LBPH)

Traditional face recognition algorithms fall short of the requirements for facial recognition in today's society. They were produced with antiquated, conventional facial recognition techniques. The methods used by these algorithms to extract picture data and match input and output photos are different.

The LBPH algorithm is a basic but extremely successful approach that is still in use, however, it is slow in contrast to more contemporary algorithms.

Deep learning is used by modern facial recognition systems. Deep learning-based facial recognition algorithms are widely used.

- DeepFace [13]
- DeepID series of systems,
- FaceNet
- VGGFace [14]

We will build an automated facial recognition-based attendance tracking system using Python and the face recognition module.[8] The face recognition library in dlib was developed using contemporary deep learning-powered facial recognition. The model's accuracy on the dataset of Labeled Faces in the Wild [12] benchmark is 99.38%.

The face recognition library recognizes faces based on facial landmarks [9]. It scans facial images for distinguishing features like the lips, brows, corners of the mouth, eyes, and nose. More than 60 points are

present. The facial recognition library in Python is better than all other algorithms like OpenFace and VGG_Face as it provides an accuracy rate of a staggering 99.38%.

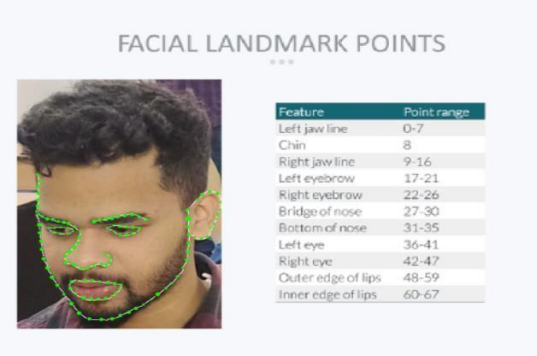

Figure 1: *Facial Landmark Points*

3. STEPS INVOLVED IN FACIAL RECOGNITION

1. **Face detection**: To detect faces, locate each one, record their coordinates, and draw a box around them. The pre-processed pictures are utilised to find faces using the Viola Jones approach. [10]
2. **Facial symmetry**: To make training more efficient, normalise the faces.
3. **Feature extraction**: Many different algorithms are used to extract local features from facial photos for training.
4. **Identification of faces:** Identify the input face to compare it to one or more faces in our database.

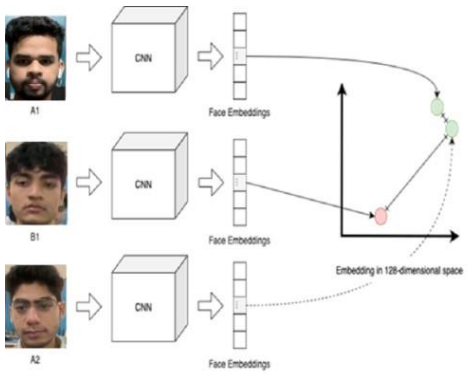

Figure 2: *Face* Embedding using CNN

a. HARDWARE REQUIREMENTS

- The camera must be positioned in the classroom
- Resolution: 1200 by 1200 pixels
- Secondary memory to store all the images and database
- 4GB RAM
- Intel i5 or above / AMDRyzen
- 1GB of HDD/SSD

b. SOFTWARE REQUIREMENTS

- Microsoft Windows 10/ Ubuntu 15.0 LTS or later/ MacOS 12.0 or later

- Python
- Excel

4. PROPOSEDMETHODOLOGY

The following key steps form the foundation of

The following steps form the foundation of this system:

1) **Image acquisition**: The first stage in recording attendance is image acquisition. Images are acquired in two steps.

a) Registration: The pupils must first sign up for the system on their own. Their front-facing profile is taken in order to use face recognition technology afterwards.

b) Attendance: Photographs of the pupils seated in a classroom are taken at the moment attendance is recorded. Students must sit so that no two are seated behind each other. Figure 4 displays one such sample photo.

2) **Face detection and recognition**: The next stages are further broken down into this step.

a) Face detection method: Find each face, record its coordinates, and then draw a box around each one. The Viola Jones method is used to detect faces from preprocessed photos. [10]

b) Face Alignments: To enable rapid training, normalize the faces.

c) Feature extraction: Local feature extraction from facial images is done by various algorithms.

Face recognition: Identifying the input face and comparing it to one or more faces from our database.

3) The faces that were recognized during the facial recognition process will be noted as present on the excel sheet, while the remaining faces will be marked as absent.

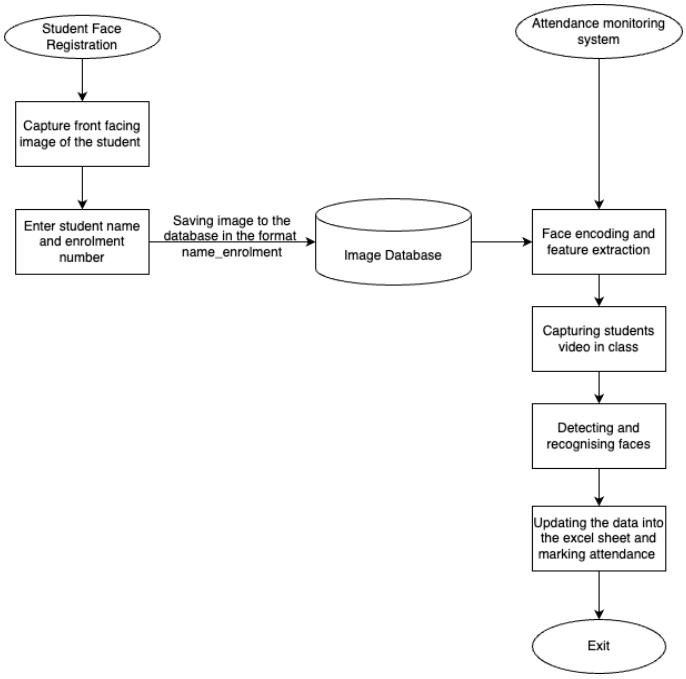

Figure 3: Flowchart of the proposed algorithm

5. RESULT AND DISCUSSION

i. Student Registration:

A GUI allows users to communicate with the system. Users will ARE given two options here, including student registration and attendance marking.

The webcam and window in Figure 10 appearinstantly after hitting the register button. The names and enrollment numbers of the students must be entered. Next, press the capture button to take a photo of the student's face. The photograph must clearly show the subject's face. If the student's face is not clearly visible in the image, click "Try Again" to try again to capture their image. Following pre-processing, these photos will be saved in the database with the filename type "StudentName_EnrollmentNumber.png."

ii. *Encoding all the student's faces in the database*

The face recognition library encodes the faces using facial landmarks.[11] It searches through facial images for distinctive characteristics like the lips, brows, corners of the mouth, eyes, nose, etc. and encodes that information as numerical data.

iii. *Face recognition*

You can select "Start Video Capture" once every student has registered. This will activate the webcam or any other camera that is connected and set up to record video and begin identifying and recognising the faces of the students.

iv. *Attendance recorded into excel sheet*.

The pupils' names, enrolment numbers, and time stamps are recorded in the excel sheet to indicate their attendance for those whose faces have been discovered and recognised.

Figure 4: Facial detection during live class

C15

	A	B	C	D	E
1	Name	Time			
2	['MAYONK'	'KUMAR'	'BEHERA'	'A2305219032']	1:06:41
3	['RAHUL'	'SINGH'		'A2305219062']	1:06:41 AM
4	['ADITYA'	'RAJ'	'SINGH'	'A2305219812']	1:06:41
5	['VAIBHAV'	'RAJ'		'A2305219046']	1:06:41
6	['ASHUTOSH'	'NAHAK'		'A2345565777']	1:06:41 AM
7	['HIMANSHU'	'JAKHMOLA'		'A2305219052']	1:06:41
8	['AKULL'	'NAINWAL'		'A2305219052']	1:06:41
9	['SHRUTI'	'PRIYA'		'A2305219052']	1:06:41
10					
11					
12					

Figure 5:Attendance recorded in a CSV file

6. COMPARATIVE ANALYSIS

The attendance was marked with an accuracy of 99.38 %. To overcome the false negatives which would arise due to the 0.62% error rate, we have recorded attendance during fixed intervals during the entire duration of the class, and only if the student has been recognised more than a threshold amount of times, they will be marked present. The comparison of various facial recognition models is summarized in the bar chart in figure 12.

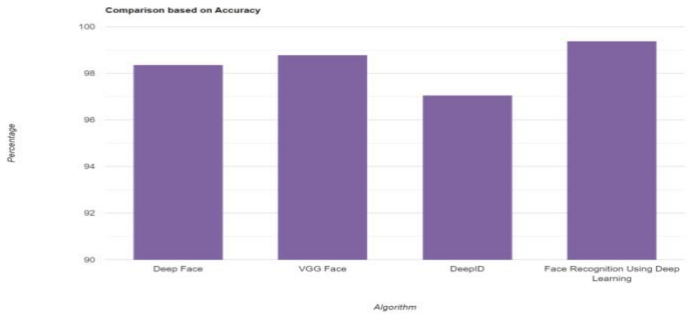

***Figure 6*:** Comparison Based on Accuracy

7. CONCLUSION AND FUTURE WORK

Currently, the system gives false negatives 5% of the time, i.e., the student is present in the class but the system fails to recognise the student and is marked absent. One way to make the system robust is to add a text-to-voice feature into the system which would announce the list of absent students. This would allow the students to ensure they have been marked present and also should any present student be marked absent, this false negation could be reversed.

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