Automated Attendance Marking System Using Face Recognition

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Abstract:

A student's identity towards their attendance in class is represented by their physical presence, which in return can be validated by face tracking. We've developed an automatic student attendance system based on face recognition. Fingerprint scanning techniques are practically ubiquitous in attendance systems, although the recent epidemic has sparked worries about programs that allow physical contact. A contactless automated attendance management system eliminates any physical interaction between the human and the device. This system can be upgraded to any kind of authentication engines or other uses, which requires physical presence and with the pandemic driven world, we reduce usage of physical touch to mark attendance. Face recognition in video surveillance is another key consideration for this idea, for example, identifying suspects in real time using closed circuit footage is possible with the implemented algorithm. We have progressed this algorithm to consider video as an input to track and look for faces. Accessing the camera facilitates for framing. Through an easy-to-use interface. Thus, eliminating the hassle and improving the authenticity. Both the test and training images must be captured with the same device to ensure no differences in quality, or if possible, the owner or person with database access rights can add high-quality images captured with a high-quality camera and later add that image to the database, but as stated previously, only the administrator or person with database access rights can enroll or remove schoolchildren or academic staff data from it. In order to be recognized, students must also register in the database. The IT cellar at the admission requirements office can help you enroll.

Keywords: Automation, Face Recognition, Deep Learning, Machine Learning

I. INTRODUCTION

Traditionally school attendance systems use a simple roll and call method, where the teacher announces the students name and the student answers to mark his presence in the class. However, this system is age old and wastes quite a lot of time out of already meagre class times. This is especially the case when there are a big number of students in a class. It's also pretty hard to keep track of such a large group's attendance data. Another disadvantage of traditional methods is the potential of students reporting fraudulent attendance. In educational institutions, the necessity for simple recognition of students in diverse activities has become critical. This is to record student truancy and tardiness to class, respectively. Lecture and laboratory attendance, along with Semester Examinations, are among the most significant of these activities.

The system proposed in this paper uses multitude of technologies all combined to create an uniquely crafted attendance recognition detection engine based on face authentication. The main goal of this paper is to describe the high-level architecture and the major technologies used to build the product.

II. EXISTING SYSTEM

The oldest form of biometric authentication is fingerprints. In forensic science and biometric techniques such as citizen identification devices, current fingerprint-based identification is utilized. Despite the widespread use of fingerprints, information on the distinctiveness of fingerprint minutiae is limited [1] An imprint on a surface of composite curved segments creates a fingerprint. Iris Biometric Authentication is a biometrics way of identifying persons based on unique patterns in the ring-shaped portion of the eyeball surrounding the pupil. Because each iris is unique to a person, it's an excellent biometric verification tool. And the very fact that iris cannot be copied from imprints increases the security of the system [2] A special digital camera is being used in the Iris Recognition procedure. The camera will take a crisp, high-contrast picture of a

person's iris using both visible & near-infrared light. The camera focuses on your eye and detects the core of the pupil, the margin of the pupil, the edges of the iris, and your eyelid and eyelashes with Iris Recognition. This data is then input into Iris Recognition software, which analyses the iris' unique pattern and converts it to an iris template [3]

Specialized hardware is required to build a system to detect, store and recognize iris of students, however, this concept is out of scope of this paper [4] The major idea or the concept of the engine built in this paper can surely be modified and updated to include iris detection and this showcases the robustness of the system built [5]

III. Proposed system

By removing traditional attendance marking techniques such as calling the students' names or checking their individual ID cards, the facial recognition student's attendance framework emphasizes its simplicity [6]. As a consequence, a facial recognition-based attendance system is proposed to fully automate the marking of student attendance. Furthermore, the computerized attendance system based on facial recognition is able to overcome the challenges associated with fraudulent techniques, and faculty members do not need to record the number of students numerous times to authenticate their presence [7] The system makes sure to mark attendance of the students in the class by itself, ensuring smooth sailing of the class work and without creating a disturbance in the flow of the class. The seamless marking of attendance is one the key aspects of using this engine [8]

The main goal of the engine is face detection and recognition. On the high level, the algorithm can be described as such, the faces of the class of the students are first fed to the system [9] The engine detects the various facial features of the class and ensures that all the students are now in the database, making sure that they can now be marked present or absent based on their presence. The engine now can be implemented in each class, creating its own sheet for the class and detecting all the students present in the class video feed [10] This algorithm then detects and identifies the students in the class and compares it with the database, essentially marking present for the students present in the class and then marking absent for the students absent in the class [11]

The OpenCV library is being used in the proposed framework. It is a free Opensource Computer Vision Library that can be used for both commercial and academic purposes. It supports a wide range of platforms, including Windows, Linux, and macOS, and includes Python and PyQt interfaces. It mainly focuses on real-time applications [12] The library contains over 2500 updated algorithms that can be used to identify and recognize faces, objects, as well as other items. For face recognition, OpenCV provides a Face Recognizer class library. Faces are identified and controlled using Python or the command line [13] It's a simple library developed using deep learning and dlib's cutting-edge facial recognition. The Dlib is a multi-stage open-source software library that runs on a number of platforms. This is a simple face recognition tool that you can use from the command line to detect faces in a folder of photos [14]

IV. Architecture

The system architecture is made up of three parts:

1. **Face Detection:** the face of the student is detected and feeded into the system, to be able to mark attendance. The face detection algorithm is imported from OpenCV library, which creates a matrix of unique features to detect and identify an unique face and naming them based on the input provided by the administrator [15]

2. **Face Recognition:** The face is recognized using the face recognition library present again in the OpenCV library. The detected face is quickly scanned with the database of faces to ensure that the face is present in the class [16]

3. **Marking Attendance and Updating Database:** The recognized faces are marked present in the google sheet and by default, every missed face in the database is market absent automatically. The absent faces are anyway marked absent, however it is the unrecognized faces that create a problem, as a solution, we added a human component, where the system notifies the professor of the unknown face to be able to detect any kind of fraudulent presence or undetected face due to usage of masks or other facial coverings [17]

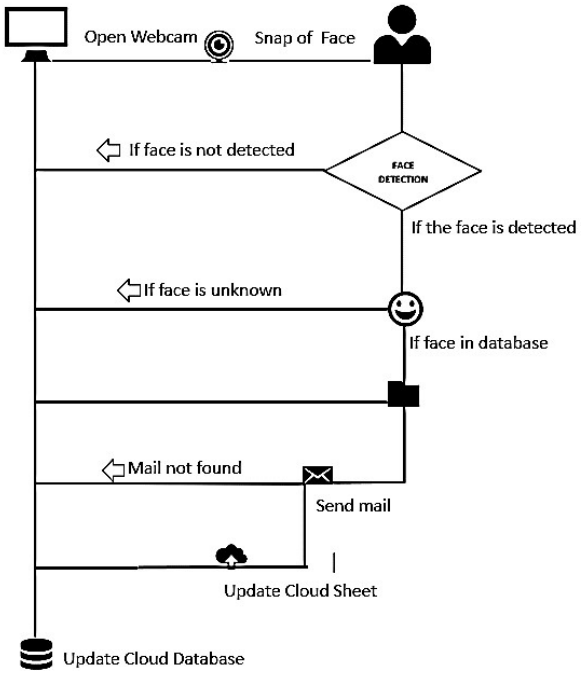


Fig 1. System Architecture

Fig 1 shows the architecture of our system which describes all the processes, methods, functions, and workflow of the proposed system. The user makes an entry of his details into the database by taking a snap [18] This image along with his mail and particulars are updated in the database. These details are further used for the recognition of the person. Firstly, the person's face is detected then the face is compared with the images present in the database. If the face is matching then the email is sent as present and all the absent students receive a mail that they are absent from the class. The same is marked in the google sheet and the database is updated [19]

V. METHODOLOGY

The data set consists of selfie pictures of students' detection would be much faster and with highest accuracy if the camera used is a 3D camera, to be able to detect depth of the various facial features. For the representation of the paper, we have used the inbuilt camera present in the laptop and as the processor we were working on was not a high-end one we have confined it to taking 15 images as a database [20] The images are stored in the folder "known_face_photos". The name of the image is the same as the name of the user enrolled in the system. This makes sure to mark attendance using names of the students in the excel sheet, essentially allowing the teachers to read the names of the students while rechecking the attendance of the students. who would like to enroll themselves in the system. The images are taken using the integrated camera under well-lit conditions. The library takes care of importing as much facial features as possible in a 2D camera [22]

Pre-Processing

The collected data set is checked in advance that is not taken in low light conditions that directly affect the accuracy of the model. The images taken need to be in well-lit conditions due the fact that the camera used is the inbuilt camera of the laptop, the camera is not built to detect the images of the people [23] Hence, taking the photos in well-lit conditions helps the algorithm to remove any kind of false positives and also helps the administrator maintain a healthy database. The images are ensured that they are taken in an upright position with the head placed in the center. The user gets to click the image by looking at the video output from the camera [24] The data set is passed on to the NumPy library, which will convert the format of height, and width to a NumPy array. This reformatting allows in easy storage of all kinds of user features that are unique to a student and helps in identification of the user. This will be further used to compare and reference the images.

Model Construction

We have used all the encodings generated to build the model to recognise the faces and make sure to record the attendance of the students present in the class. Encodings are generated first, this is where we scan the images of all the students in the class, for example, every student registered for the class is first taken a photo to register their features to be later scanned for attendance. These images are then processed using computer vision, to ensure that the encodings are stored into the array to be later scanned. The scanned encodings are stored into the "known_face_encodings" folder, where all the student's features are stored and accessed later. The encodings are stored in the Numpy array format, stored in a text file. The encodings are saved in the name of the student, which makes it easier to later reference, as the name being stored as the file name reduces the redundancy to maintain another data structure to reference the name of the student. Along with the face features, the email of the student is also stored to maintain contact with the registered student [25] The format used for encodings is in text format, however this usage is purely for research purposes. There are other better formats to store the features of the students to store, we have used text format to read easily and to cross

check the numpy arrays. However, other formats such as csv or other pre-defined formats can be used for faster reading and scanning. The custom file formats make sure the attendance is marked faster and also that the data is not tampered with or easily edited.

Another set of new encodings are generated from the video footage. The algorithm works as a two-step process, first a snapshot of the students present is taken, this ensures that all the students are in one single frame. Later, each and individual student is segregated and each temporary encoding is created. The reason to create these temporary encodings is to ensure to check with the already present encodings. The format and the process to store the encodings is quite similar and follows the same process as the one used to first create the registered students encodings. These encodings the major key, to compare all the images taken for the attendance from the class. These new images from the class are processed to create another set of temporary encodings, these temporary state encodings are compared to the already stored ones.

VI. Results

To evaluate the model accuracy, we have manually prepared a table consisting of expected outcomes and cross-verified the actual output. We have got to know that the accuracy levels are highly satisfying.

S.NO	TEST CASE	PRECONDITION	TEST STEPS	TEST DATA	EXPECTED RESULTS
1	IN-TIME(known face)	❑ All the students are successfully enrolled ❑ Database is stored and accessible for the machine	1. Change from enrolling to recognition. 2. Ensure that the room is sufficiently lit. 3. Ensure that the camera is properly oriented.	❖ known_face_encodings ❖ known_face_photos	➢ If the student is enrolled and is in time then his attendance is marked as present in the google sheet
2	LATE(known face)	❑ All the students are successfully enrolled ❑ Database is stored and accessible for the machine	1. Change from enrolling to recognition. 2. Ensure that the room is sufficiently lit. 3. Ensure that the camera is properly oriented.	❖ known_face_encodings ❖ known_face_photos	➢ If the student is enrolled and is late then his attendance is marked as absent in the google sheet
3	IN-TIME(unknown face)	❑ All the students are successfully enrolled ❑ Database is stored and accessible for the machine	1. Change from enrolling to recognition. 2. Ensure that the room is sufficiently lit. 3. Ensure that the camera is properly oriented.	❖ known_face_encodings ❖ known_face_photos	➢ If the student is not enrolled and is in time then he is identified as unknown.
4	LATE(unknown face)	❑ All the students are successfully enrolled ❑ Database is stored and accessible for the machine	1. Change from enrolling to recognition. 2. Ensure that the room is sufficiently lit. 3. Ensure that the camera is properly oriented.	❖ known_face_encodings ❖ known_face_photos	➢ If the student is not enrolled and is late then he is identified as unknown.
5	If the mail enrolled doesn't exist	❑ All the students are successfully enrolled ❑ Database is stored and accessible for the machine	1. Change from enrolling to recognition. 2. Ensure that the room is sufficiently lit. 3. Ensure that the camera is properly oriented.	❖ known_face_encodings ❖ known_face_photos	EMAIL NOT SENT
6	Nobody in the class	❑ All the students are successfully enrolled ❑ Database is stored and accessible for the machine	1. Change from enrolling to recognition. 2. Ensure that the room is sufficiently lit. 3. Ensure that the camera is properly oriented.	❖ known_face_encodings ❖ known_face_photos	NO FACE DETECTED

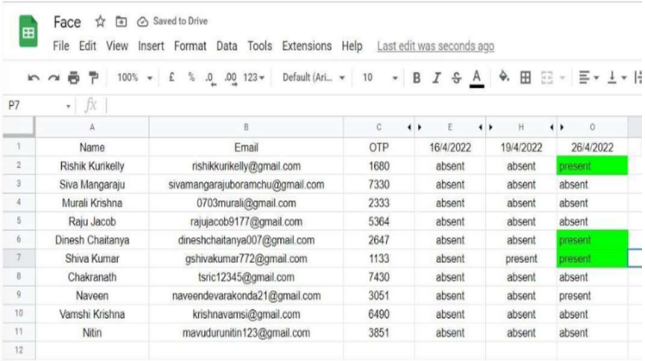
Table 1. Evaluation results of the outcome

The unique outcomes of the system are made into test cases for easy evaluation. The table depicts the actual outcome to the expected outcome. To check if the model is working properly according to the ideology of construction there are certain constraints that are added, such as if a student is late to the class and his face is known(means he has enrolled himself in the system and is present in the expected class) then and only then he is marked present else he is marked absent. The remaining test cases and their evaluation is furbished in the table above.

Image 1. The output of the working system

Here the model is taking a single frame from the video output of the integrated camera of the machine, this frame is then analyzed by the model to match with the facial encodings of the persons present in the database. It is evident that the model could recognize multiple faces at once using a single image. Their attendance is marked in the google sheet which can be accessed by anyone having the link. Then the persons are notified of their attendance by sending a mail confirming their attendance marking the class time. The unmarked or unrecognized students are marked absent and a mail is sent from the admin regarding the same.

All the faces recognized in the image are marked present and all the other persons are marked absent. The persons marked present are highlighted with green shape fill for better visibility.



	A	B	C	E	H	O
1	Name	Email	OTP	16/4/2022	19/4/2022	26/4/2022
2	Rishik Kurikelly	rishikkurikelly@gmail.com	1680	absent	absent	present
3	Siva Mangaraju	sivamangarajuboramchu@gmail.com	7330	absent	absent	absent
4	Murali Krishna	0703murali@gmail.com	2333	absent	absent	absent
5	Raju Jacob	rajujacob9177@gmail.com	5364	absent	absent	absent
6	Dinesh Chaitanya	dineshchaitanya007@gmail.com	2647	absent	absent	present
7	Shiva Kumar	gshivakumar772@gmail.com	1133	absent	present	present
8	Chakranath	tsric12345@gmail.com	7430	absent	absent	absent
9	Naveen	naveendevarakonda21@gmail.com	3051	absent	absent	present
10	Vamshi Krishna	krishnavamsi@gmail.com	6490	absent	absent	absent
11	Nitin	mavudurunitin123@gmail.com	3851	absent	absent	absent
12						

Image 2. Google Sheet Updating

VII. Conclusions

In this project we have used face recognition library which is a simple library but works at higher accuracy making it to go library for easy implementation. Our model helps in reducing the difficulties of the faculty and the students by automating the attendance system that is universally available, transparent, and foolproof. This system entirely relies on the face recognition module that is proven to provide an accuracy of 99%. Our model will also reach those heights of accuracy provided good lighting conditions and good portrait conditions. In this way the hassle of manually calling names of students which is prone to vulnerabilities is mitigated.

VIII. Future work

The implemented system can be repackaged or repurposed to be able to use as any kind of authentication or attendance marking systems, for example this engine can be used in office to make sure the employees are present at work, it can also be used by investigative services to be able to monitor or look for particular persons in thousands of closed-circuit footage. The working model can be directly made commercial and put to work immediately, as the code is production ready and is easily scalable using multiple local instances, the use cases of the project are innumerable. In this project, we have only made a prototype of the actual model that we wanted to implement. The actual model can be completely autonomous containing its own integrated camera that can be fixed to a wall such that it covers the whole class. This actual model consists of a raspberry pi connected to a high-bandwidth internet supply either ethernet or Wi-Fi, preferably WI-FI. This model independently captures images independently without any intervention with very little maintenance. This model can also be handled or supervised remotely by the admin provided with the login credentials. This model is foolproof as the images are stored and act as proof of attendance and there is no chance for proxy.

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