Python-Based Facial Recognition Attendance System with OpenCV

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***Abstract*—This project's main objective is to create a facial recognition-based attendance tracking system for educational institutions. By doing so, it hopes to update and modernize the current system and increase its effectiveness and efficiency throughout the years. The prior, outdated method's many ambiguities resulted in inaccurate and inefficient attendance recording. Numerous problems arise when the authorities are unable to uphold the rules that were established under the prior system. The technology that underpins this will be the facial recognition system. A person's face is one of their natural features that can be utilized to uniquely identify them. Faces are used to trace identification since they are unlikely to deviate or be copied. The aim of this project is to build face databases that will supply the recognizer algorithm with data. Faces will then be matched to the database during the attendance-taking session to determine identification. When someone is identified, their attendance is noted right away, and the pertinent information is stored in an Excel file. At the end of the day, an excel document containing each student's attendance information is sent to the appropriate professors.**

***Index Terms*—Smart Attendance System, RFID, NFC, OpenCV, Numpy etc**

I. INTRODUCTION

Attendance maintenance is a key job in all the institutions to monitor the performance of the students. Every institute has a unique method for doing this. While some of these institutions have implemented tactics for automatic attendance using biometric approaches, others still rely on antiquated paper- or file-based systems. A face recognition system is a type of computerized biometric software that compares patterns based on a person's facial appearance to determine or validate that person. The management of face recognition systems has significantly improved in recent years, and this technology is now widely employed for a variety of purposes, including security and commercial operations. Face recognition, a computer-based digital technology, is a major subject of study.

An inventive use of the attendance system is face recognition for attendance tracking. It is comparable to other biometrics like fingerprint or eye iris recognition systems and is frequently utilized in security systems. The demands on lecturers and the organization itself grow with the number of students enrolled in educational programs or staff working there, which further complicates attendance monitoring. This project could be useful in explaining these kinds of issues. A lecture hall's student population is counted, each participant is identified, and the data regarding the number of students in attendance is then kept up to date.

II. LITERATURE REVIEW

Bhise, Khichi, Korde,Lokare, “Attendance System Using NFC Technology and Embedded Camera Device on Mobile Phone ” [1], NFC technologies and mobile applications are used to enhance the attendance system. As per the research paper, upon their enrollment in the college, every student receives an NFC tag featuring a distinct ID. Next, each class will have its attendance recorded by the lecturer using their cell phone to touch or move these tags. After the

student's face is captured by the phone's inbuilt camera, all the data is sent to the college server for validation and verification. This approach has the advantage of being very fast connection establishment and having an easy-to-use NFC. It does really greatly expedite the process of taking attendance. When the original owner does not manually tag the NFC tag, the system is unable to immediately detect the infraction. Aside from that, the instructor found the system's convenience—using the phone as an NFC reader—to be inconvenient. What would happen if the professor failed to bring their cell phones to work? How would the attendance be documented in that scenario? Furthermore, given privacy concerns, the majority of lecturers are unlikely to favor using their own smartphones in this manner. Therefore, the NFC tag should be replaced with unique student information such as biometrics or face recognition, which is guanine for a student. This will guarantee that the real student took the attendance in the first place.

SenthamilSelvi, Chitrakala, Antony Jenitha, "Face Recognition Based Attendance Marking System" [2], This is predicated on the discovery of facial recognition to address the problems with the prior attendance system. This system takes pictures of the employees with a camera in order to perform face detection and recognition. Once a match is found in the face database, the captured image is compared one by one with the database to find the worker's face. At that point, attendance is recorded. The primary benefit of this approach is that attendance is tracked on a highly secure server, so that nobody else can track another person's attendance. Furthermore, the skin classification technique is used in this proposed system to enhance the face detection algorithm and raise the detection process' accuracy. Even though the face identification algorithm's accuracy is being improved, the system is still not portable. This approach necessitates an independent computer that requires a continuous power source, rendering it non-portable. Staff members only need to report their presence once a day, therefore this type of system is only appropriate for recording their attendance. Students must register their attendance at every class on a specific day, which makes it problematic if the attendance marking system is not portable. In order to address this problem, the attendance management system as a whole can be created as a portable module that can be operated simply by running a Python application.

Kumar Yadav, Singh, Pujari, Mishra, "Fingerprint Based Attendance System Using Microcontroller and LabView" [3], suggested utilizing a fingerprint to record attendance as a solution. Two microcontrollers are used in this system to handle the fingerprint recognition procedure. A fingerprint sensor will first be used to capture the fingerprint pattern, and microcontroller 1 will receive the data. After that, microcontroller 1 will send the data to microcontroller 2, which will use it to validate the information in the database. Following the identification of a student's match, the information is transmitted via serial communication to the PC for display. This architecture works well because it makes testing easier and keeps design flexibility while speeding up development. However, this system isn't portable because it's connected to a PC. Other than that, it is difficult to readily access the database information. This means that parents who are curious about their child's attendance will find it difficult or inconvenient to obtain the information. Thus, the data can be uploaded to a web server for convenient access in order to make the student's information accessible to the rightful concerned party. However, a login screen can be used to ensure authentication for the proper access.

Hussain, Dugar, Deka, Hannan, "RFID based Student Attendance System" [4], The suggested remedy is nearly identical to the first study publication, which employs RFID technology to enhance the antiquated attendance system. Again, a tag and reader are utilized in this technique to keep track of pupils' attendance. The web portal provides access to attendance information, which sets this journal apart from the previous ones. It makes information retrieval more convenient. Once more, there are two shortcomings to this system: the RFID reader can only function when it is attached to a PC, so it is not portable. Second, the acquired attendance data is inaccurate as the RFID tag is not a guanine information that can uniquely identify a pupil.

III. PROBLEM STATEMENT AND MOTIVATION

The accuracy of the data collected was the main issue with the previous attendance management system. This could be because the original person did not record each attendance individually; in other words,

the accuracy of the data may be compromised if a third party collected a particular person's attendance without the institution's knowledge. For example, student B can help student A sign up for a class even though student A actually missed it since student A is too lazy to go. But the system overlooks this reality since there is no enforcement mechanism in existence. The organization may need to invest a significant amount of time and human resources, which is completely unfeasible, even if it chooses to adopt enforcement. Therefore, it is not reliable to use the whole attendance log from the previous system for analysis. The previous system's significant time consumption was its second problem. estimating that signing a three- to four-page name list takes a pupil about a minute. Given that only roughly 60 students can sign their attendance in an hour, it is obviously inefficient and takes a lot of time. The third issue is making the data available to the legitimate party who is concerned. For example, most parents are highly concerned about tracking their child's actual whereabouts to make sure they attend school or college. All the same, under the old system, parents could not get this information. As such, the previous system needs to be improved in order to be more efficient, the data must be accurate, and authorized parties can access it.

IV. OBJECTIVE

- To create a self-powered, portable, intelligent attendance system.
- To guarantee that the previous system, which could record attendance for each student in as little as three seconds, is not surpassed in speed.
- Possess sufficient RAM to accommodate the database.
- Capable of accurately identifying a person's face using the face database.
- Permit parents to monitor their children's presence.
- Create the attendance management system's database.
- Offer an easy-to-use interface so that administrators can view the attendance database and parents, who are not administrators, can verify their child's attendance by mailing the attendance.
- Permit new employees or students to use a graphical user interface (GUI) to store their faces in the database.
- Able to display to the user a message indicating the success or failure of the face-recognition process.

V. DESIGN METHODOLOGIES

The attendance management system cannot operate until a basic set of data is entered into it. The person's ID and visage make up the majority of this data. Taking a camera image of the subject's face is the first step towards obtaining a portrait. The system will initially search the captured image for a face in this process. In the event that no face is detected, the system will prompt the user to take another photo until the necessary quantity of portraits—ten for every student involved in this project—is obtained. Given the Raspberry Pi's low storage capacity and the university's relatively big student body, the decision was taken to store only ten photographs per student. The images must first go through a variety of pre-processing procedures to produce a grayscale image and cropped faces of similar size images before they can be used with the EigenFaces Recognizer. Both of the aforementioned procedures are depicted in the diagram below.

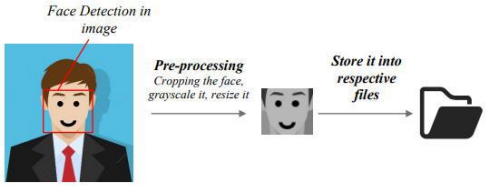


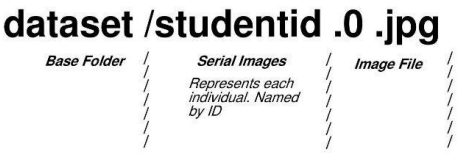
Fig.1- Block Diagram

Image Acquisition and Pre-processing procedures Following processing, the photos are organized hierarchically into a file. All of the faces in this project will be kept in a hierarchical file under the "database" folder. As you navigate around the database folder, you will see a number of sub-folders, each of which will represent a different person and contain several facial portraits of that person. Each individual's sub-folder will be named according to their unique ID number, which is specific to each and every person within the organization. The script create_database.py handles the entire image retrieval, pre-processing, and storing method process.

Hierarchy manner of the face database

Following the successful extraction of facial photos into the appropriate folder, a CSV file was generated to facilitate the subsequent step of feeding the faces

into the recognizer for training. A script called create_csv.py will be used to create the CSV file. The CSV file content for this project will have the following format:



Structure of the content in the csv file

Once the database contains a sufficient number of photographs, the images will be added to a training process. In OpenCV 3.4, three primary training mechanisms are available: EigenFaces, FisherFaces, and Local Binary Patterns Histograms (LBPH). The EigenFaces recognizer is the one on which this research will concentrate. The idea behind EigenFaces is straightforward: it detects a specific face by identifying the greatest variance in a face, then converts those variations into data that can be compared when a new face appears. The path to each image will be obtained during the training phase by reading the CSV file, after which the labels and images will be loaded into a list variable.

After then, the list will be sent to the training function, where it will take a certain amount of time to complete the training. The time required to train those images will increase with the size of the face database.

VI. RESULTS

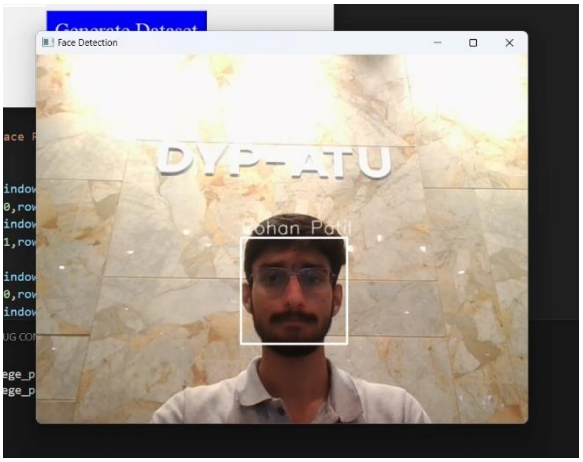


Fig.2- Face Detection

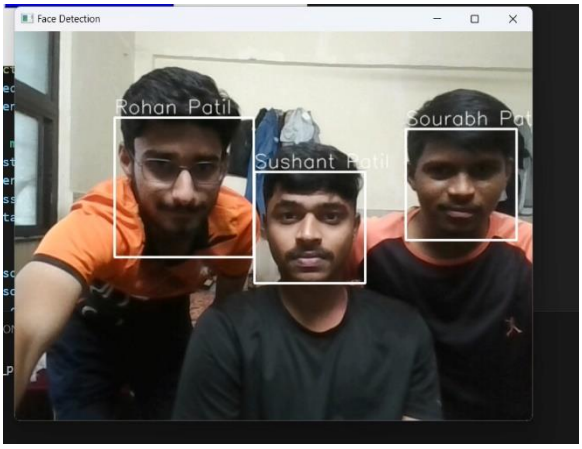


Fig.3- Face Detection

VII. CONCLUSION

Before the creation of this project. Many issues plagued most of the institutions with the old system of taking attendance, which had numerous inadequacies. Consequently, the face recognition feature of the attendance monitoring system can ensure precise attendance taking in addition to resolving the issues with the previous configuration. Technology can reduce the need for human intervention throughout the defect-fixing process while also saving resources by delegating all complex jobs to the machine. A large enough database storage to accommodate all of the faces is the only cost involved in this technique. Fortunately, data volume compensation micro-SD cards are available.

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