Face Recognition based Automatic Attendance Management System

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***Abstract*:- This research focuses on an automated attendance system that uses facial recognition to identify individuals and record attendance for those individuals. The suggested approach is designed to make administrators and other stakeholders responsible for maintaining an institution's attendance more efficient. We want to reduce, not eliminate, human interactions in the process of recording attendance, which is tiresome, time-consuming, and requires a lot of resources like paper when done manually. Furthermore, the use of current technology to assist, replace, or reestablish the traditional method of recording attendance can be considered as a step toward a brighter and more well-managed future in the industry, with more efficient work done through automation. Multimedia information access has improved attributable to face recognition technology. Furthermore, using facial recognition for network access control makes it nearly difficult for hackers to obtain a user's password while simultaneously improving human-computer connection. One of the reasons why facial recognition attendance systems are becoming more popular is because of this.**

Keywords: Attendance system, face detection, face recognition, feature extraction and matching, firebase, haar cascades, Image processing, Histogram of Oriented Gradients.

I. INTRODUCTION

A person's face is a vital aspect of their head and is unique to them. Face recognition has a lengthy history, dating back to 1964 and 1965, when Woody Bledsoe, Helen Chan Wolf, and Charles Bisson used computers to recognise the human face [1]. Much of their work is thought to have stayed unreported, although it was later revealed that they focused on facial landmarks, or locations on the face such as the eye centers and the distance between the lips, among other things. Apart from that, there have been several ideas and studies on computerized facial recognition, making it one of the most advanced technologies in use today. Face recognition is used by most social networking applications such as Facebook, to identify persons in photos being posted, making it easier for app users. Face recognition is also used by mobile camera apps for face beautifying features and age determination. Augmented Reality and facial recognition are used by apps like Instagram and Snapchat to deliver a wide range of entertainment features.

On the other hand, attendance is a criterion that most institutions, such as schools, universities, and other employee-based organisations, use to determine whether students are entitled to take exams or to calculate an employee's wage based on how many days they have attended. It is commonly noticed in educational institutions that students use proxy attendance (attendance recorded even when the student is not there), which results in the student gaining an unfair advantage [2]. Furthermore, it is possible for teachers to make an inadvertent mistake when recording attendance. Now, in the case of an employee-based company, there may be a circumstance where the employee's attendance is incorrectly recorded in the ledger. To get over this limitation, you may automate the procedure by using an artificial intelligence system that recognises the individual as he passes through the door, records the attendance, and keeps the record for a long time in a database. In any scenario, this record will be useful for future reference. Face recognition is useful in this system in a number of ways, some of which are given below.

- Lessens the risk of manual mistakes.
- Time and resource savings - Administrators do not have to manually mark attendance, which saves time in the Register.
- It's simple to integrate a face recognition attendance system with any other HRMS or payroll system. The time-in, time-out, and date formats may be adjusted to be compatible with other systems in an organisation since these systems are modular and extremely adaptable.
- AI-based attendance systems are far more automated than manual attendance systems. In real time, these systems store and update daily records. Facial recognition attendance systems are configured to handle everything from daily attendance to creating very accurate timesheets for individual employees on a huge scale.

Face recognition attendance systems are contemporary conveniences that are required even in post-pandemic situations. We realise that a camera-based attendance system may be built and used to ensure that the system's attendance is maintained. These projects were the driving force behind our efforts to create a system that would make life easier for many individuals in our community.

II. BACKGROUND STUDY (LITERATURE)

The main goal of this review study was to discover solutions given by other writers and evaluate the limits of their methodologies. After examining all options, the best solution will be implemented.

In [1] the author uses the concept of marking the attendance of the student using face recognition. They proposed a methodology where they use the concept of Principal Component Analysis, local binary pattern. However, the system's effectiveness and accuracy in recognising human faces remain concerns. To tackle this difficulty in the future, researchers will adopt rapid PCA with back-propagation.

The authors of [2] developed an approach based on the Histogram of Oriented Gradients notion and utilized Firebase to store attendance data. The accuracy of the labelled faces was 99.38 percent.

The authors of [3] suggested a face recognition algorithm based on Eigenvector and Eigenvalue. Here they faced problems when the threshold value was less than the calculated value.

In [4], the planned system included a PC with the extremely useful and multi-functional machine language "MATLAB" as well as Microsoft Excel. They attached the camera to the PC and verified that the camera driver was correctly installed and compatible with MATLAB before acquiring the picture or video. Cropped faces are utilised for identification after detection. The suggested method compares these cropped faces to the face database, and after satisfactory recognition, the system records the attendance in an excel sheet.

In [5] the authors implemented a methodology where Deep neural networks (DNNs) were utilised for face recognition, and they had a unique combination of the YOLO V3 algorithm and the Azure Face API allowing our system to automatically register attendance in real time, saving time and ensuring correctness.

In [6], the authors have proposed a methodology where the attendance management system based on facial recognition offers correct attendance information to students in a simple manner and uploads the information to the server via Ethernet wire. This system is user-friendly, simple to operate, and provides enhanced security. This system provides student information, and if there are any absences, information will be communicated with the appropriate proctors and parents.

In [7] the LBPH algorithm for face recognition and the haarcascades for face detection are used in the proposed automated attendance management system. This system includes features such as photographing pupils and recording their information in a database, training the pictures in the database and on the camera, and tracking persons entering the classroom. When students enter the classroom, the system recognises their faces from the camera and pre-processes them for subsequent processing.

In [8], the authors have used a methodology where they used Viola and Jones algorithm for face bounding box generation. Principal Component Analysis was used for further processing of data and attendance was marked in the database.

The authors of [9] employs the Viola-Jones Algorithm to detect objects, Principal Component Analysis to compress data, and Local Binary Pattern Histograms to quantify texture. However, with the Viola-Jones training approach, they encountered time difficulty.

The authors of [10] classified faces using eigen faces and fisher faces, and utilised LDA to extract further distinguishing traits from them. The sole disadvantage is that they may be vulnerable to extremes in exposure (brightness).

The writers utilised the notion of the Internet of Things in [11]. The suggested technique makes use of microcontrollers and personal area networking systems. The module is built using Internet of Things components. However, the data transfer rate is sluggish, and thus can only be used for a limited distance.

The authors of [12] employed a methodology based on CNN and mathematical methods to try to extract significant information from an image, encode it, and compare it to another image stored in a database for a face recognition system. The main drawback is that it needs a large volume of data.

The authors of [13] suggested a system for estimating the number of cameras needed to capture all students' faces at a given resolution for various classroom sizes for automated attendance using face. The only drawback is that employing numerous cameras might cause image shutter speed to slow down.

In [14] the authors have used a raspberry pi and the cloud-based approach for storing the captured attendance. But the drawback is that the data cannot be fetched in offline mode as it needs an active internet connection.

In [15], The viola Jones Algorithm and Local Binary Patterns of Histogram were used to accomplish face recognition. Images of students are discovered and recognised using these techniques. They had saved student photos in the dataset. The discovered photos are compared to those in the dataset. The kids who are correctly recognised are then automatically added to our database. When any individual other than the list of photos of pupils present in the dataset is found in the classroom, these unknown faces are flagged as invaders. When an intruder is spotted, a siren sounds as a warning signal.

In [16], the system was evaluated using three different algorithms, with the KNN method proving to be the most accurate at 99.27%. The system was evaluated under a variety of situations, including lighting, head motions, expressions, and student distance from the camera. When evaluated under various conditions, KNN outperformed the competition, earning an overall accuracy of 97 percent. When evaluated under the parameters described above, CNN had an overall accuracy of 95%, whereas SVM had an accuracy of 88%. CNN was shown to have minimal time complexity when it came to time complexity. SVM was discovered to have the highest time complexity of the three methods described.

In [17], the author discusses the intelligent classroom attendance system's general design concept before improving the AlexNet convolutional neural network. Furthermore, we examine the need and efficiency of the modification from several perspectives before introducing RFID into the system. Finally, the back-end attendance management system's function and description are completed. The experiment shows that a smart classroom attendance system based on facial recognition technology is both efficient and stable, lowering classroom attendance costs significantly.

The system was implemented utilising LBPH (Local Binary Pattern Histogram) or facial recognition and detection in a specific region within the surveillance camera by the authors of this research [18]. After achieving good results from several experimental evaluations of this approach, they also have trustworthy outcomes for pose variance and lighting. This approach takes much less time to process the entire image.

In [19], the authors have implemented the system using Dlib library. Face detection was done using YOLO model and was stored to the database. In the later part they used Amazon Web Services face recognition API for detecting the faces in real time. When comparing the recognition accuracy of the face recognition library with the LBPH classifier, AWS performs better. The Face recognition library is equally simple to use and does its objective with 99.38 percent accuracy using Dlib. Even a person wearing a mask may be detected using the AWS recognition API, which can function in low-light conditions. However, the other two approaches all require resolution augmentation algorithms to function in low light, and they will be unable to distinguish someone wearing a mask on their face. The Flask framework was used to deploy the various models for real-time testing.

III. METHODOLOGY

The approach described here is to create an automatic attendance system that recognises people by their faces and records their attendance. This technique may be used in educational institutions as well as organisations where employees must keep track of their attendance. The benefits of the system may be offered to administrators as well as stakeholders in the institution's attendance. Additionally, the system attempts to reduce the number of resources necessary to maintain attendance by minimising human mistakes that may occur while recording attendance, such as proxy attendance in educational institutions.

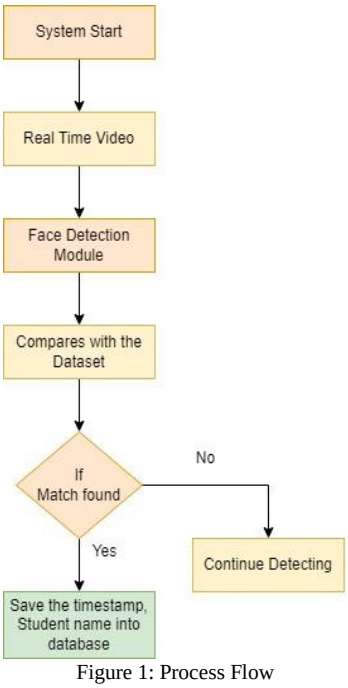

Figure 1: Process Flow

As a feasible solution for the application, the proposed approach uses a histogram of oriented gradients. This system will have a high-definition camera positioned outside the classroom for the purpose of marking attendance. By scanning their faces in that camera, students will get entry to the classroom. Another camera will be placed inside the classroom in such a manner that the lens of the camera can see every student in the room. Both cameras will be equipped with facial identification and recognition technologies that will examine the faces and record their attendance.

When a person goes through the front door, his face is turned toward the camera, which creates 128-d encodings. We then compare these 128-d encodings to the known encodings created when we trained the system with our gathered data. If the matches are detected, we add the person's name to our database, which is organised by the date and time of his entry into the premises. This helps us to keep track of attendance in a manageable and organised manner. If no match is discovered, which means the individual's photo has not been trained into the system, the system will just continue scanning for the next person entering the premises. This goes on until the system is turned off. The administrator may access the database by going to the configured webpage and clicking a button to be redirected to the Firebase console. To obtain access to the console, he must first input his credentials (username and password). Users are advised to include an extra recovery email address when creating a Google account so that they may change their password if they forget it or if their account is stolen. We recognize that Google accounts are highly secure and hence trustworthy. The database not only includes an online access, but we are also updating the attendance in real time into a local excel sheet which can be viewed even when we do not have access to internet.

IV. IMPLEMENTATION

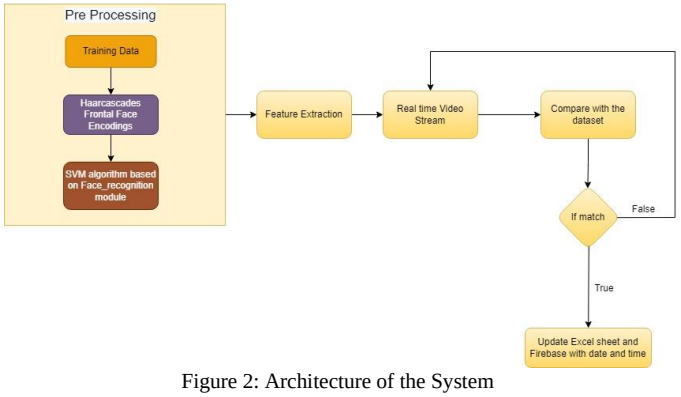

Figure 2: Architecture of the System

There are three main phases in the implementation.

1. Pre-Processing
2. Feature Extraction
3. Face Recognition in real time

Pre-Processing and Feature Extraction: The goal of applying preprocessing stages in a face identification system is to reduce false positives and speed up the detection process. We have our dataset present in our local system as we can see in figure3. Preprocessing should reject a sufficient number of

non-face windows. For preprocessing we are using Haar cascades frontalface encodings. It's an Object Detection Algorithm that detects faces in images and real-time videos. Viola and Jones introduced edge or line detection features in their research article "Rapid Object Detection using a Boosted Cascade of Simple Features," published in 2001. To train on, the algorithm is given a large number of positive photos with faces and a large number of negative images with no facesIt's made with dlib's cutting-edge facial recognition and SVM. On the Labeled Faces in the Wild benchmark, the model is 99.38 percent accurate.

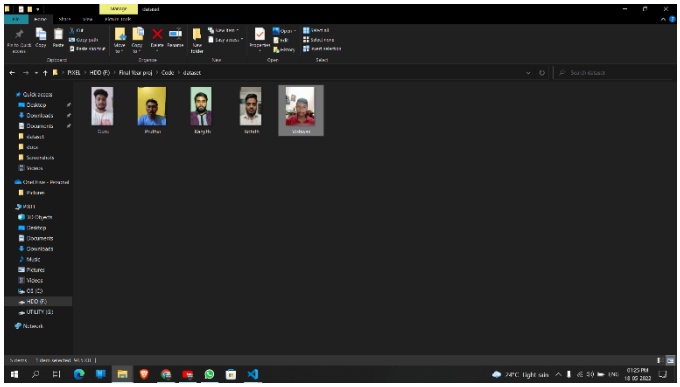

Figure 3: Dataset

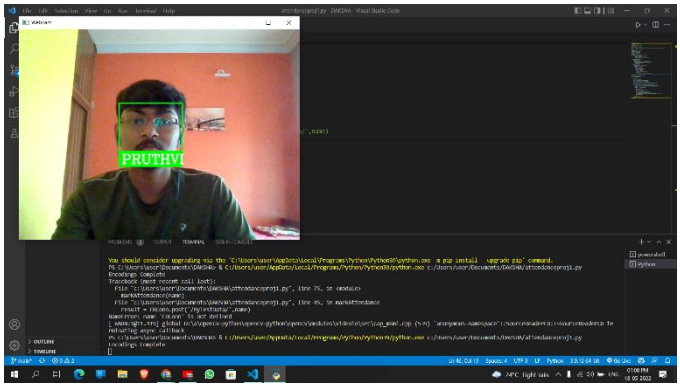

Figure 4: Face recognition in real time

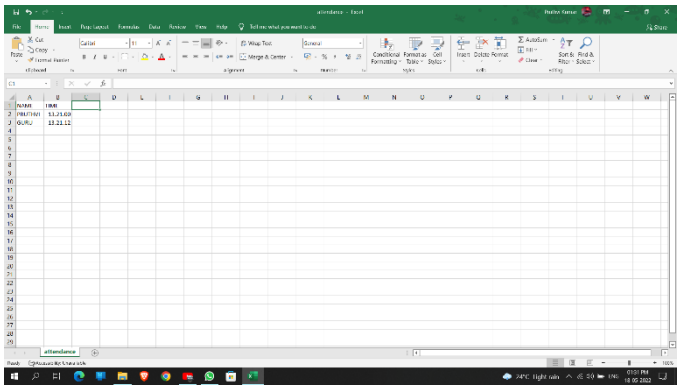

Figure 5: Attendance being written to a CSV file in real time

After all the features are extracted, the model is now ready for run. So, when we run this, the real time video capture is on and based on the dataset the student is identified as seen in figure 4 and the attendance is marked with his name with the time stamp in the csv file as we can see in figure 5.

IV. CONCLUSION

This system was proposed for recording, storing, and maintaining attendance records. We developed this method primarily to eliminate the amount of problems connected with traditional preexisting attendance solutions. At the educational institute level, the disadvantages, which varied from time, paper, and ink waste to proxy difficulties that may develop in a classroom, can be reduced. The suggested approach is just for student attendance in the classroom. However, this system may be expanded and enhanced to the point that it can be utilised in multinational corporations to monitor a much bigger database.

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