Advanced Facial Detection Attendance System

Linga Pravin K S[1], Lokesh Raj J[2], Ms.Tina Victoria A[3]
Department of Information Technology Sathyabama Institute of Science and Technology Chennai, India

***Abstract*—Class attendance can typically be taken and registered in a manual system which is usually time consuming and problematic. The traditional approach is rather problematic in that it is open to abuse in such matters as student proxies or even wilful manipulation. In response to such challenges, this study recommends an automation of attendance management system through facial recognition. The system immediately takes their pictures once they are in the classroom and the pictures automatically registers them as present. The A-A-LBPH algorithm of training and the Haar-Cascade classifier for face detection to make sure that the system recognizes faces effectively without the lapses. The graphical user interface, referred to as A-GUI, is implemented using the Tkinter software toolkit, which allows for user interaction, while A-Simple Mail Transfer Protocol referred to as A-SMTP provides automated forms of notification for attendance changes. It also makes a massive cut to the time taken and reliability of attendance tracking in educational institutions.**

***Index Terms*—Automated Attendance System, Facial Recognition, A-LBPH Algorithm, Haar-Cascade Classifier, Real- Time Face Detection, Tkinter GUI, SMTP Integration.**

I. INTRODUCTION

A facial recognition-based attendance management system provides us with a new and effective method of automatic attendance management. Unlike general manual or card-based identification this system employs computer vision and machine learning algorithms to identify individuals from their face hence eliminating errors that might be caused by human abruptness.

Facial identification and recognition in the system involve Eigenfaces method, Fisherfaces or deep learning methods such as CNNs. People's faces are photographed with high-quality instruments, which are then compared with image records stored in a central computer. This information can be viewed through a graphical user interface where administrators can easily update user profiles, view a record of attendance and compat reports.

At the time of registration, two or three images are taken and used to make individual account profiles. For daily attendance, it takes real-time pictures, and compares them with registered profile photos while timestamping the attendance record. It is accurate, eradicates human interference, and environmentally rids phantom or fraudulent attendance marking.

Although there are several advantages of incorporating the system to enhance accuracy and operations efficiency the potential issue includes invasion of privacy and data security.

II. LITERATURE REVIEW

The proposed system that automatically captures the attendance of the student was developed by Narkhede et al. It cuts the time spent signing in and out and eliminates chances of human error on the contractors' side. The system gives information in real-time with subsequent graphical representations to aid their decision-making process. In cases where attendance dips below a certain level, the student is notified together with all relevant parents to ensure that the ropes of responsibility are picked and that things improve. Whereas it; It is time-saving to the educators and helps in the preparation of accurate attendance lists. Its utility is rather technical and thus can be significantly impaired in the face of certain interference. Attendance is the only aspect of students' behavior or performance that the system targets, thus making the system have a very narrow focus.

Barhate and his team designed a Unique attendance tracking system using Python OpenCV. This system makes it easier to keep updates with high accuracy in recording of attendance. Students are required to check in their classes and if they miss them then the

guardians are informed hence enhancing accountability. The target attendance data is in Excel files for convenient handling, and the convenient interface makes it more intuitive. On the other hand, although the system seems capable, it initiatives its connection and workings with the internet and this may not be easy to come by all the time all over the world. Also, there might be a possibility of serveral types of bias and therefore different accuracy of such algorithms with regard to different population segments.

Tsai and Li designed an intelligent attendance tracker using TensorFlow for deep learning by integrating it into a smartphone. The above system eradicates cases of proxy attendance whilst promoting validity by supporting actual live attendance through face recognition. Registration documents are kept within a cloud-based system allowing the system to grow with needs of the colleges and providing for easy retrieval. The use of the automated system minimizes the paperwork and increases the effectiveness of the health facility. However, one gets worried when the internet connection is used and all the documents are stored in the cloud. Also, prejudices in deep learning may result in variation of the recognition accuracy of students with different backgrounds.

Here a real-time attendance system has been proposed by using four deep learning models such as VGG-FACE, Facenet, Openface and DeepFace developed by V. A et al.

The of usage of several models guarantees the high accuracy and reliable identification of human faces. This system is mainly used for recording attendance through face detection from surveillance cameras thus eliminating human errors. However, recognition based on face is not always accurate because it can be affected by environmental factors which include, lighting and angles in front of the camera. The given models might have biases that result in lower utility for certain subgroups of students, camera access needs to be reliable at different time points.

In the second project of this research, Fernando and Athauda developed an online attendance monitoring system on Haar Cascade and A-LBPH algorithms to identify the attendance accuracy of which amounted to 99.22%. Attendance is taken in an excel based system and summary can be checked through a simple GUI depicting the attendance status. As it eliminates much of the human intervention it, it lowers the chances of failure due to recurial mistakes. But using consistent video and hardware have their difficulties in areas with lacking basic services and infrastructure. The system's algorithm has pre-set biases and is very reactive to natural conditions such as light and the positioning of cameras which may need constant tweaking in appropriate conditions.

Dash et al. presented a facial recognition system that uses OpenCV and ESP32-CAM embedded with Tkinter. We have integrated options for live video streaming for monitoring of attendance, and for managing data the custom built the system uses NumPy. This acquisition eliminates chances of manual errors and at the same time, increases efficiency. Still, the system is highly dependent on stable hardware, and Internet connection and does not work effectively in regions with poor technological infrastructure. Lower recognition accuracy might be caused by differences in lighting and background of the scenes The approach is rather complex and might not attract many users.

This improved work was independently done by Rathi et al. by coming up with an automated Attendance System using Haar cascade and A-LBPH algorithms with OpenCV. It is an efficient system that offer desired updates so that the right attendance could be recorded. It supports multiple user acknowledgement; it is suitable for the classroom setting. But things such as lighting and positioning of the camera can influence the results. In essence, the system may need constant update and, at times, service to ensure it serves the intended function optimally. This restricts its scalability in areas of low resource and also depends specifically on particular hardware.

Nazri et al. (2014) proposed a prototype attendance system that employed MTCNN for detection of face and PCA for feature extraction. The system is accurate to 98.7% and is capable of processing real-time videos for purposes of attendance. Self-registration of new student captivates prospective students and system keeps records in local server to enhance security. However, unknown noise distribution may lead to system instability, and variability factors such as lighting condition are influential.

Vignesh et al had developed an electronic attendance system using CNN along with OpenCV for feature detection. The system registers attendance, and by

means of SMS,
parents receive daily attendance and grading reports. This saves time for the educators it also ensures maximum accuracy. But, CNN models are complex and may need technical attention for maintenance in comparison to other models of similar categorization. The system is also dependent on the environmental characteristics, including light intensity or camera positions.

Raj et al. proposed, implement and develop a facial recognition-based attendance system that uses SVM, Haar classifiers, CNN, and GANs to detect faces and increase the system's accuracy. This saves human effort because excel generates an automatic list of attendance for each of the schools. It was however, verified that the system could indeed run under different environments, and was hence reliable. The downside of this method includes misidentification especially if the conditions under which the identification is being done are complicated; the approach also requires constant upgrading; for it to work well in a new setting it has to be programmed anew. The aforementioned progressive algorithms of the system, in turn, enhance implementation difficulty.

Gill et al. designed an attendance system that was based on Haar Cascade and A-LBPH algorithms and was strengthened by image augmentation procedures. This also makes it easy to manage the data set since it comes in CSV format as a record of attendance is produced with a button click. It reduces cases of proxies attending the meeting and enhances the quality of the results generated. But it is tested that the system has variations depending on the lighting and intensity of environment. Algorithmic restrictions could also lead to occasional errors, such as misidentify or false negative and can be refined further.

Tirupal et al. employed RetinaFace for attendance systems needs of facial recognition. It secures an identification rate of 91% and enforce pragmatic log file maintenance. It eliminates mental mistakes and hence makes information more reliable. However, display brightness, the camera's performance, and other conditions affect the performance. The system appears to incorporate complicated equipment that raises the setup degree and requires steady servicing to perform effectively.

C. B. et al. proposed an automatic system for attendance checking deployed on the RetinaFace algorithm due to high reliability. It enhances attendance tracking and also eliminates or cuts down paperwork on the same. In essence, it relieves instructors of time consumption and record keeping burden and provides simplified administrative solutions for record management for those who employ it. But, the key flows of the implementation need lots of planning, and the performance of the system is influenced by the environment. The system also needs constant updates in order to ensure high accuracy and reliability of the results provided.

Kumar et al. put into practice YOLO-based attendance system that tracks engagement using parameters like the Eye Aspect Ratio (EAR). It also helps to automatize records on attendance and also contains information about students' attentiveness. Theleast of it is that the system is effective and reduces much hand work. However, it is limited by the environment for instance light and relies on high end techniques which can break down or give erroneous results.

Three researchers, Pande et al., pioneered the smart attendance system that worked based on facial recognition. The system helps avoid mistakes and organizing tasks related to attendance recording, as well as makes them automated. For accuracy it uses face detection algorithms. Still, it is contingent with the quality of lightings and cameras used. There are concerns about misidentification in some cases and the general need for updating any such technology which are some concerns about its scalability and sustainability.

III. PROPOSED METHODOLOGY

This work suggests a system for recording attendance of students in classrooms via facial recognition, image processing in real time and simple interactive tools. This methodology aims at increase accuracy, efficiency, and accessibility of the system; other issues that usually affect traditional attendance system includes proxy attendance and manual errors. Below is the key

1. Face Detection Module

Face detection is done by the face detection module where images or live video feeds require face detection use Haar-cascade classifiers as shown in fig:1. Efficiently, this pre-trained classifier accurately

identifies facial landmarks such as the eyes, noses and mouth by examining the image at different image scales. The detection pipeline starts with image preprocessing since the images are transformed to grayscale to minimize computational costs. The next step involves the use of the Haar-cascade classifier which identifies and locates face areas and also come up with the co-ordinates of the faces detected. These coordinates are then fed to the facial recognition module for further processing and because the process is entirely real time and accurate it well suits classrooms.

2. Facial Recognition Module

This module makes uses of the A-Local Binary Patterns Histograms (A-LBPH) algorithm to recognize and identify faces detected by the system. The A-LBPH algorithm computes local texture features by transitioning the binary patterns of the pixels identified in the face to histograms. These histograms are reflecting different facial abrasiveness, which are then matched with a database. The module then involves in training the A-LBPH model from a dataset of students with their respective IDs so as to identify faces to respective IDs. The output is facing label or ID, which helps effectively mark attendance.

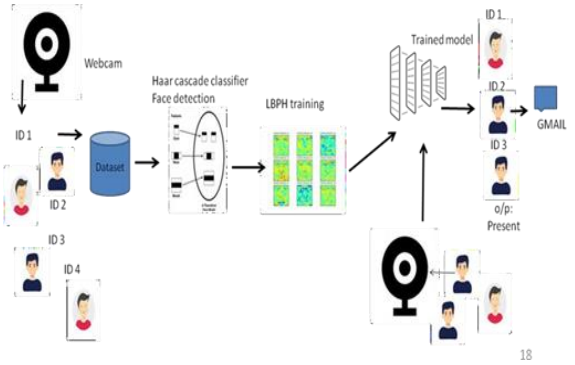


Fig:1 System architecture

3. Attendance Management Module

The attendance management module then uses the value gotten from the facial recognition module to capture and manipulate the attendance records. Upon face detection there is the ability to record the students' ID number and time stamp in a database to enhance records management. Its processing techniques eliminate duplicates by checking for repeated detection of the same student within a short time. This module also has buttons that allow the creation and storage of the database containing the students' attendance records, where the students' attendance records are safe from malicious actors, yet easily downloadable and easily managed to make their records void of errors. This module also frees the administration from more attendance record manipulation mistakes and enables efficient records management.

4. User Interface Module

The user interface module, which has been compiled through the Tkinter option, shall afford the faculty / administrators an easy tool to engage the system. We have a live monitoring dashboard that displays real-time video feed and the faces recognized by application. The elements at the interface which might interest are the attendance summary which gives a general account of class/session attendance and also the override which is a feature that might allow for a modification of the attendance checker in case one was to be made. Further, included is report generation where by the user can be able to get the attendance records of certain dates or session. To make the security mechanism strong, there is user authentication as well as role-based access control integrated in the module.

5. Notification Module

The notification module is enhanced with the Simple Mail Transfer Protocol (SMTP), through which e-mail notification concerning the attendance status of the students and faculty is delivered. The system also provides easy and fast attendance reports every after a class or a session via an email. Another example of customization of the alerts for the administrator is that the message's content and the list of recipients can be defined, for instance, the notices to the students who have many absences. This is also completed through incorporation of simple mail transfer protocol (SMTP) that helps in the secure and faster communication and also improve student and faculty responsiveness.

IV. RESULT DISCUSSISON

The system uses facial recognition technology, real-time operation and simple GUI to realize the auto-recording feature of attendee information. The following is the breakdown of the results and their analysis:

User Inputs: If you need to enter the enrollment number, name as a student, and possible subject

matter. Enrol students by taking and orienting their facial data. Data Processing: Faced recognition should be done using Haar Cascade and A-LBPH algorithms. Identify the faces matched against the stored dataset for proper attendance taking to be recorded. Attendance Logging: Saves the attendance report in a database with date and time stamp. The records can be more clearly viewed and validated with the help of "Check Sheets". Notifications: Electronic attendance reports are sent to students and students and faculty via simple mail transfer protocol –SMTP based email messages. Validation and Error Handling: Input validation trip to make certain that crucial input such as enrollment and name are not omitted. To help the user, warning messages and error prompts are displayed all through the process.

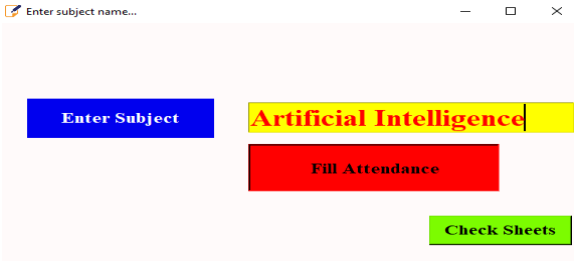
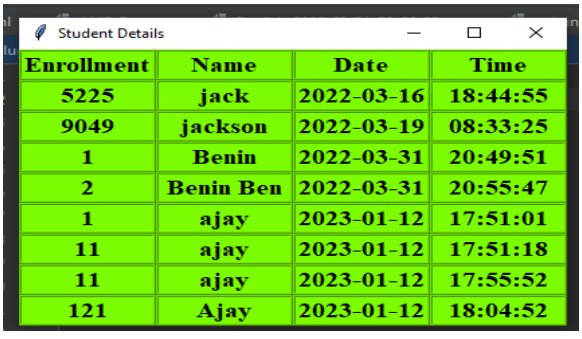


Fig:2 Subject Selection

1. Subject Selection and Attendance Management:

- Feature: The system enables the user to enter the subject name, for which they want to record attendance, as displayed in fig:2
- Fill Attendance Button: Marks the starting point of marking the attendance for the subject that was chosen.
- Check Sheets Button: Raises the attendance records of the selected subject, maintained in a neat and orderly manner in the form of a table.



Enrollment	Name	Date	Time
5225	jack	2022-03-16	18:44:55
9049	jackson	2022-03-19	08:33:25
1	Benin	2022-03-31	20:49:51
2	Benin Ben	2022-03-31	20:55:47
1	ajay	2023-01-12	17:51:01
11	ajay	2023-01-12	17:51:18
11	ajay	2023-01-12	17:55:52
121	Ajay	2023-01-12	18:04:52

Fig:3 Record Display

2. Attendance Records Display:

Enables the teacher to update and approve the attendance list of all the students concurrently shown in fig:3.

- Helps teachers review and validate attendance for each student in real time.

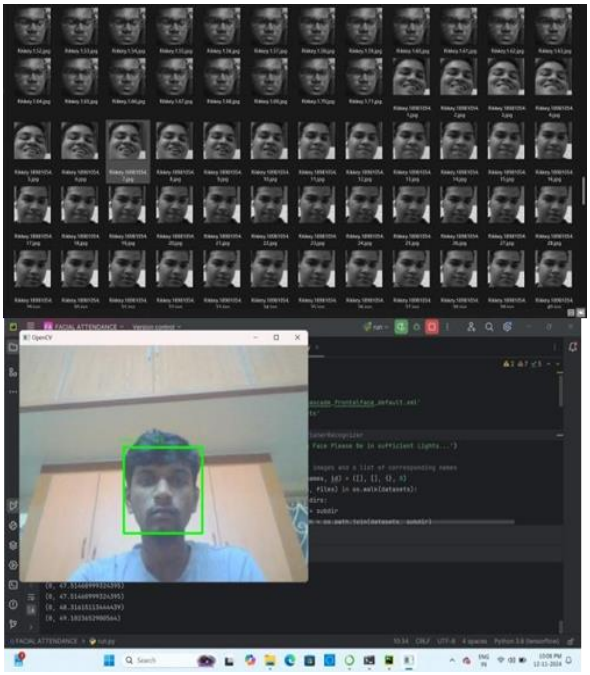


Fig:4 Captures images

3. User Dashboard for Face Recognition:

- Enter Enrollment and Name: Forms that allow a student enter his/her enrollment number and/ or name for registration.
- Take Images: Takes multiple photographs as depicted in fig:4 for face recognition training of the student.
- Train Images: Teaches the system the enroll form of the registered student.
- Automatic Attendance: Therefore, it shall mark attendance based on the facial recognition.
- Send Mail: Informs concerned personnel through email on attendance as shown in fig:5 below.
- Check Registered Students: It shows the list of students who are already captured by the system.
- Clear Buttons: Clears the input fields, for enrollment and name, from all previous entries in case of fresh entries.

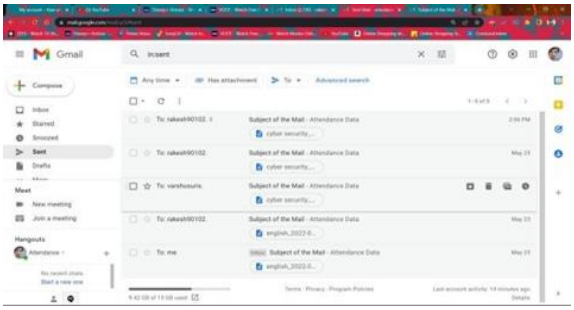


Fig:5 Mail Notification

4. Validation and Notifications:

- Ach of warning messages like “Enrollment & Name required!!!”." when users are making the registration or attending an event and fail to enter their details in the input fields
- Data accuracy is maintained and there is restriction on the registrations being half filled.!!!" if the input fields are left empty during the registration or attendance process.
- Ensures data accuracy and prevents incomplete registrations

Fig:6 Saved Images

5. Image Capture and Training:

Once enrollment and name are entered, the system confirms that images have been successfully saved and displays the message ("Images Saved for Enrollment: ...").

After training the model with the saved images as in fig:6 after that there is a confirmation sign showing that the model is trained and ready to identify the student.

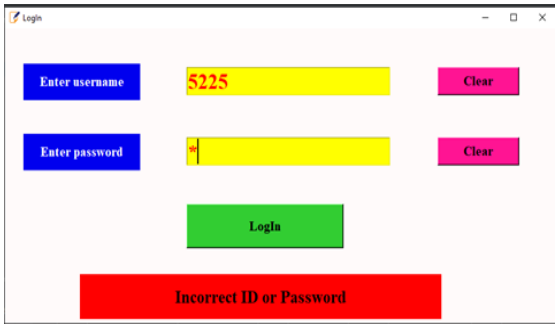


Fig:7 Displays an error message

6. Login Page:

- Invites the user to type in a user name and password to log into the system. ▪ Shows wrong ID or Password message where the ID password entered is wrong.ssage ("Incorrect ID or Password") if the login credentials are invalid.
- Ensures secure access for authorized users only as in fig:7.

V. CONCLUSION

The proposed attendance management system therefore efficiently achieves the automated process of recording the student’s attendance through use of the facial recognition that shall help minimize manual work and time, more so where there are many students. Written in Python, the system not only serves as an efficient solution to tracking student attendance, but it also presents an effective means for preserving attendance data that can be useful for all sorts of academic functions, including validating a student’s participation in an exam. Though, the framework shows a good degree of operational output, it came across certain drawbacks like vulnerability to low light conditions etc. Others include incorporating refined video processing or enhancement methods, or even enhancing algorithms that

would give the machine a consistent performance. To further enhance the applicability of the system in real life classrooms, its extension into the classrooms with camera and computer hardware integration is expected next. In addition, the applicability of the system to accommodate seminars, conferences show the potential of the system in handling attendance across various domains.

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