

An Intelligent and Automatic Attendance Tracking System: A Survey

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Abstract- Taking attendance manually in classrooms can be a laborious and inefficient process that can lead to several problems. One issue is that it can be time-consuming, especially in large classes. Teachers have to spend valuable class time collecting and recording attendance, which can disrupt the flow of the lesson. Additionally, manually recording attendance is prone to errors, as it is easy to misspell names or mis record attendance. This can lead to inaccuracies in the attendance records, which can have consequences for students and teachers. Another problem with manually taking attendance is that it is inflexible. If a student is absent and then returns to class, it can be difficult to update the attendance records accurately. This can be particularly problematic in situations where attendance is used to track student progress or participation. Manually recording attendance on paper or in a spreadsheet can also present security concerns. The records may be lost or stolen, which can compromise the privacy of the students and the accuracy of the attendance records. Overall, manually taking attendance in classrooms can be an inefficient and burdensome process that can lead to a variety of problems. It is important for schools and teachers to consider alternative methods of tracking attendance, such as electronic systems or mobile apps, that can be more efficient and accurate. A web-based real-time attendance management system is a tool that allows teachers and administrators to track and record student attendance electronically. This type of system is typically accessed through a web browser and can be used from any device with an internet connection. One of the main benefits of a web-based real-time attendance management system is that it is efficient and convenient. Teachers can easily record attendance in real-time, without the need to spend valuable class time collecting and recording the data. The attendance records are also automatically saved and can be accessed by administrators and teachers as needed. Another benefit of a web-based real-time attendance management system is that it is accurate. The system can automatically record attendance based on a variety of factors, such as the student's face. This helps to ensure that the attendance records are accurate and up-to-date. Web-based real-time attendance management systems can also provide additional features and benefits, such as the ability to send notifications to students or parents about attendance, the ability to track tardiness or absences, and overall, a web-based real-time attendance management system can be a useful tool for schools and teachers looking to streamline and improve their attendance tracking processes.

Keywords- Image Processing, Convoluted Neural Network (CNN), Deep Learning, Machine Learning.

I. INTRODUCTION

Deep learning models are a type of machine learning algorithm that is designed to learn and recognize patterns in data by training on large datasets. These models can be used for a variety of tasks, including image and video analysis, natural language processing, and speech recognition.

One specific application of deep learning models is face recognition. Face recognition algorithms use deep learning techniques to identify and distinguish between different faces in images or video. These algorithms typically analyze the unique features of a person's face, such as the shape of the eyes, nose, and mouth, to create a unique "face

signature" that can be used to identify the person in future images. Deep learning models have significantly improved the accuracy and effectiveness of face recognition algorithms in recent years. These models can learn and recognize patterns in the data more accurately and efficiently than traditional machine learning algorithms, which has led to their widespread adoption in a variety of applications, including security, surveillance, and social media.

There are several problems with conventional attendance taking systems, such as RFID (radio-frequency identification) and other methods that can impact their effectiveness and efficiency. One issue is cost. These systems can be expensive to implement and maintain, as

they often require specialized hardware and software. This can be a burden for schools and other organizations with limited budgets, especially if the system needs to be rolled out to multiple classrooms or locations.

Another problem with conventional attendance taking systems is complexity. Some of these systems can be complex and difficult to use, which can lead to confusion and frustration among teachers and students. This can make it difficult to accurately track attendance and may lead to errors in the attendance records.

Real-time CCTV (closed-circuit television) based attendance management systems can be an effective solution for addressing some of the problems associated with conventional attendance taking systems, such as RFID and other methods. One of the main benefits of real-time CCTV based attendance management systems is their accuracy. These systems use cameras to track student attendance in real-time, which can help to eliminate errors and inaccuracies that can occur with other attendance taking systems. This can be particularly useful for teachers who need to track attendance for multiple classes or who teach at different locations.

Real-time CCTV based attendance management systems can also be a time-saving tool for teachers and administrators. These systems automate the attendance tracking process, which can save time and allow teachers to focus on other important tasks, such as lesson planning and student support.

In addition to their accuracy and time-saving benefits, real-time CCTV based attendance management systems can also provide added security for attendance records. These systems store the attendance data electronically and can only be accessed by authorized users. This helps to protect the privacy of students and the accuracy of the attendance records, ensuring that the data is secure and can be trusted.

Real-time CCTV based attendance management systems are also flexible, as they can be accessed from any device with an internet connection. This allows teachers to record attendance in real-time, regardless of their location. This can be particularly useful for teachers who need to track attendance for multiple classes or who teach at different locations.

Overall, real-time CCTV based attendance management systems can be a valuable tool for schools and teachers looking to improve and streamline their attendance tracking processes. These systems can provide accurate and up-to-date attendance data, save time for teachers and administrators, offer flexibility in tracking attendance, and provide added security for attendance records.

II. LITERATURE SURVEY

In [1] the background-subtracted image is what is used to find faces in an image. Face detection uses a circle or rectangle to mark the faces in photographs. The face detected after background subtraction is more accurate when compared to the face found before background subtraction from a photograph. The detected face is then clipped. The faces of each individual are finally recognized and erased from the picture.

For picture comparison in the database, each cropped image is gathered. Facial recognition is used to identify the faces that have been detected. There are many methods for finding faces. The Eigen value method is better suited, though. This approach is superior due of its effectiveness. But it fails in terms of scalability in a university since there are more students and each of them must be trained and saved. It also has the drawback of being unable to identify varied views or angles of the person's image.

Similar techniques are applied to build a CNN model that does picture classification in [2], which is referenced below. The biggest drawback is that we will need to have a separate model saved and trained on those photographs for each class of students, which is not a good concept in real-time. The model is trained to recognize faces that are utilized during training.

In [3] They utilized the correlation tracker from the dlib library to maintain track of the face from frame to frame after applying the Viola & Jones approach to detect the face. We used the Roll, Yaw, and Pitch angles to establish the head attitude. We used the variance of an image Laplacian to calculate an image's sharpness. They estimated the location of the eye corners in a face using facial landmark detection. They need to give each of the normalized parameter's weights in order to obtain the highest quality image in the real-time video sequence (NHP, NS, NR, NB). Convolution Neural Network (CNN), also referred to as deep learning, was used.

As of [4] they offer the Multi-View Normalization (MVN) framework to normalize an arbitrary face to several desirable postures with balanced illumination and neutral expression, in contrast to the bulk of face normalization techniques that concentrate on single view frontalization. The proposed MVN turns a face into a set of multi-view faces with facial identity well preserved, enabling a better representation to handle face recognition by using the benefits of generative and adversarial learning. The MVN is made to learn how to change seven target sets from a source set. One face encoder, seven pose-specific generators, and seven sets of discriminators make up the MVN architecture. Modern face recognition network serves as both an extractor of facial features and the encoder, which is constructed from training data and is not updated.

Studies on a number of benchmark datasets show that the suggested MVN performs better for face recognition.

In [5] Adaboost cascade classifier is utilized in this paper for face detection. A classifier may be taught using the extracted facial features, and once trained; it can be used to identify the query image using the same features. The characteristic for facial recognition was adopted as Local Binary Pattern. The statistical histogram of the LBP feature spectrum is used in this paper as a feature vector for classification and recognition, following the representation strategy suggested in the literature. The Adaboost cascade classifier is utilized in the face identification procedure on the Android platform to identify the face portion.

The Student Attendance Monitoring System using Image Processing is a tool that uses a camera to detect and record the presence of students in the classroom. It is designed to recognize the front view of a student. The system's performance may be affected by the specifications of the computer it is running on, as it requires a certain number of resources to achieve accuracy, smoothness, and overall performance.

The "face coding" method works according to the essential characteristics of the human face and the beginning. This facial coding can resist changes in light, skin tone, facial hair, hairstyle, glasses, expression and posture, and has strong reliability so that it can accurately identify a person from millions of people. The face detection technology is used to locate and segment a partial face image from the image; the feature extraction technology extracts the amount of data that can characterize the face image and forms the features.

The purpose of this research is to design, implement, and test a face recognition attendance system that can transmit attendance information to authorized handheld devices via a cellular network. The system utilizes a camera as an input device, and the Viola-Jones and Fisher faces algorithms for face detection and template creation, respectively. The templates, along with other user information, are stored in a database.

During verification, the camera acquires images of detected faces, which are compared to the stored templates to determine attendance. The system will be tested to evaluate the effect of variations in face angle, facial expression, and lighting on its accuracy.

In this research, a face recognition model is developed as an attendance machine using a hybrid feature extraction method combining CNN and PCA. The model uses real-time cameras to detect and recognize human faces using a face detection and recognition framework. The facial recognition process includes data acquisition, face detection, pre-processing, feature extraction, and classification. The face detection stage involves using a

camera to capture images and search for facial features. If patterns are recognized as faces, the system marks the ROI in the image. Pre-processing is then used to prepare the detected face image for further processing.

[10] This research paper presents a method for recording attendance in a classroom or lecture setting using an automated system with audio output and facial recognition technology. The system aims to be efficient, especially in large classes, and uses facial recognition to identify students. However, the system may have difficulty accurately identifying faces that are similar or turned at certain angles. To improve the accuracy of the face detection feature, the authors suggest integrating results from the Viola Jones face detection and skin colour detection algorithms. but the system does not consider the background of the input image.

III. OBJECTIVES

An automatic web-based face recognition-based attendance management system may have the following goals:

- To increase the accuracy of attendance tracking: The accurate real-time tracking of student attendance via an automatic web-based face recognition-based attendance management system can help to reduce errors and inaccuracies that can happen with other attendance taking methods.
- Saving time Teachers and administrators can save time by using an automated web-based facial recognition-based attendance management system, which automates the attendance monitoring process. Teachers may then be able to concentrate on other crucial activities like lesson planning and student support.
- To increase security: Since the information is saved electronically and can only be accessed by authorized users, an automatic web-based facial recognition-based attendance management system can also increase security for attendance records. This can support maintaining the accuracy of attendance data and student privacy.
- An autonomous web-based facial recognition-based attendance management system can aid in improving student engagement and attendance by properly tracking attendance and promptly delivering feedback to students and parents. For the purpose of assisting data-driven decision making, teachers, administrators, and other stakeholders can employ an automatic web-based face recognition-based attendance management system to give current and correct attendance data.
- An automatic web-based facial recognition-based attendance management system's primary goals are to increase the precision of attendance tracking, save time, add security, boost student engagement and attendance, and promote data-driven decision making.

IV. PROPOSED METHODOLOGY

This Section of the paper describes our end-to-end solution for Web-based smart attendance system and what steps we are taking to implement it. We will be having several layers of technology which will be serving as backbone for our prototype. For our frontend we will be using React.js and its packages to display data and attendance metrics.

For our backend we will be using FASTAPI web-framework for developing restful API which we can query from the front end. We will have a microservice running on a server which will be running our facial recognition model and the attendance logic. This microservice will be connected to all the IP cameras which will serve as the main detection system and will detect students and give their respective attendance. For our database we will be using postgres to store all of our data in one place.

1. Frontend Service:

- Frontend services for an attendance system is being used to display data related to student attendance in classes and other academic activities. These services are being used to create user interfaces for professors and administrators to track and manage attendance data.
- Frontend services is be used to display attendance data in a clear and organized manner, such as by creating calendar views or graphs showing attendance patterns over time. This can help students and faculty to easily understand attendance patterns and identify any potential issues or trends.
- In addition, frontend services can be used to create user- friendly interfaces to track the location and time of these actions. This can help to ensure the accuracy and reliability of attendance data and can also help to facilitate contact tracing in the event of a public health emergency. Overall, frontend our services is an essential service for providing a user-friendly and effective attendance system in a university.

2. Backend Service

The backend service is a key component of a face recognition-based attendance management system, as it provides the underlying infrastructure and support for the system's features and functions. Here are some of the main roles and functions of the backend service in a face recognition-based attendance management system:

- Querying data: We ill be using this service to query for data from the database to the frontend to display data.
- Status Cheque: We will also be using this service to check the status of the systems if they are working properly.
- User authentication and authorization: The service is also responsible for managing user accounts and permissions, including verifying user identities, granting access to authorized users, and enforcing security and privacy policies.

3. Attendance And Facial Recognition Microservice:

- This microservice is responsible for a variety of tasks, including calculating face vectors during registration and performing face verification during real-time attendance tracking.
- During the registration process, the attendance and facial recognition microservice calculates face vectors for each student or teacher who is being registered in the system. Face vectors are mathematical representations of the unique features of a person's face, such as the shape of the eyes, nose, and mouth. These vectors are used to create a unique "face signature" that can be used to identify the person in future images.
- During real-time attendance tracking, the attendance and facial recognition microservice uses the face vectors to perform face verification. This involves comparing the features of a person's face in real-time images to the stored face vectors to determine whether the person is registered in the system and if their attendance should be recorded.
- Overall, the attendance and facial recognition microservice plays a crucial role in a face recognition-based attendance management system by calculating face vectors during registration and performing face verification during real-time attendance tracking. These functions enable the system to accurately track and record student and teacher attendance.

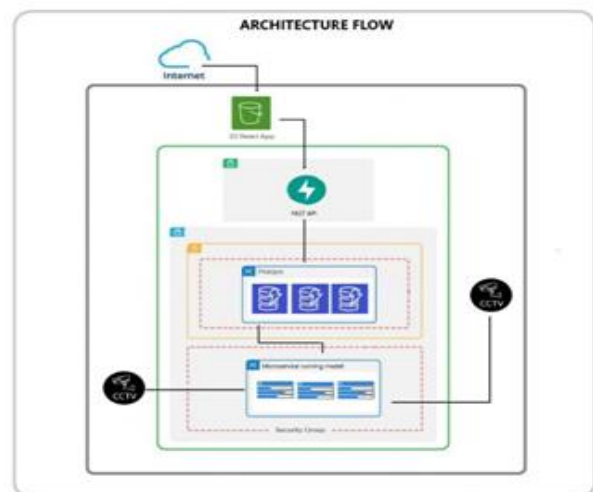


Fig 1. Architecture Flow.

4. Hardware Requirements:

The following requisites include

- Hardware: 8GB RAM (At least)
- 1TB of Hard Disk Space (At least), 6 GB of VRAM (At least)
- IP Cameras all over the campus

5. Software Requirements:

- Languages: Python 3.8 or later, Javascript (Reactjs)

- Software: Server running Ubuntu 20.04
- Libraries: OpenCV, TensorFlow, Keras
- Other Technologies used: Redis, celery, Fastapi Web service, Docker Containers
- Proposed technologies to use: Convolutional Neural Network, Tensor Flow, Keras, Google Colab, Digital Image Processing OpenCV (python library for computer vision applications), Scikit-image.

V. CONCLUSION

In conclusion, an automated face recognition-based attendance management system is a valuable tool for tracking attendance in educational or workplace settings. It provides a convenient and efficient way to record and track attendance, as well as to access and manage attendance data. By using advanced technology such as facial recognition, this system is able to accurately and reliably identify individuals and mark their attendance in real-time.

Additionally, the system can store attendance data in a database, making it easy to access and manage attendance records over time. Overall, an automated face recognition-based attendance management system offers numerous benefits and can greatly improve the efficiency and accuracy of attendance tracking.

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