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# Smart Attendance System using Face Recognition

Raushan Kumar
*Department of CSE*
BIHER_Chennai
rsinha203200@gmail.com

Prince Kumar Sharma
*Department of CSE*
BIHER_Chennai
code2prince@gmail.com

P. Varun Sai
*Department of CSE*
BIHER_Chennai
varunsai178@gmail.com

Dharmendra Kumar Mandal
*Department of CSE*
BIHER_Chennai
mandaldharmendra733@gmail.com

Mrs. DR. Arul Prakash
Associate Professor Department of CSE
BIHER_Chennai,Tamil Nadu-600073
Prakash875@gmail.com

***Abstract*-: Face recognition technology has come decreasingly popular in recent times and has multitudinous operations in colorful fields. One of the most important operations is attendance operation, which is pivotal in the education sector. The traditional system of taking attendance involves calling out names and manually recording attendance, which is time-consuming and prone to crimes. also, it can be fluently manipulated, allowing scholars to cheat by deputy attendance. To overcome these issues, a face recognition attendance system has been proposed. The system is designed to fete scholars by using face bio statistics grounded on high- description monitoring and other computer technologies. It aims to digitize the traditional system of taking attendance and exclude the need for homemade recording, therefore saving time and reducing crimes. The system uses colorful technologies similar as Haar classifiers, KNN, CNN, SVM, GAN, and Gabor pollutants for face recognition. Haar classifiers are used for detecting faces in an image, KNN, CNN, and SVM are machine literacy algorithms used for face recognition, GAN is a deep literacy algorithm used for generating synthetic data, and Gabor pollutants are used for point birth. Once the system recognizes a pupil's face, it generates attendance reports that are stored in Excel format. The reports can be fluently penetrated and participated with applicable authorities. The system has been tested under different conditions similar as varying illumination, head movements, and distance between the pupil and the camera. The results of the testing show that the system is effective and dependable. Overall, the proposed system is a cost-effective and easy- to- install result for attendance operation. It eliminates the need for homemade recording, saves time, and reduces crimes. The system is also robust and accurate, making it a suitable result for use in classrooms.***

## INTRODUCTION

Attendance management is a critical aspect of administrative tasks in various organizations, including schools and universities. Traditional methods of taking attendance, such as roll calls, are prone to errors and can be time-consuming, especially in classrooms with a high number of students. This is where an intelligent attendance system comes in.

An intelligent attendance system is a computerized approach to taking attendance that uses advanced technologies like bio-metrics to identify individuals. The use of face recognition technology in attendance management has proved to be productive, but the traditional techniques have limitations that make them unsuitable for tackling challenges such as variations in lighting, pose, and occlusions.

To overcome these limitations, a proposed system uses multiple cameras installed on the ceiling of the classroom to capture images of students. The images are then processed using Generative Adversarial Networks (GANs) to enhance image quality and minimize any blurred images caused by students' movements. GANs are a type of artificial intelligence technology that generates realistic-looking images from input data.

After image enhancement, the system uses face detection and feature extraction, followed by face recognition using Gabor filters, K-nearest neighbor (KNN) algorithm, Convolution neural networks (CNN), and Support Vector Machine (SVM) algorithms. The system generates the names and identification numbers of the students identified in the image, and attendance is marked in an Excel sheet with the date and subject of the lecture.

The proposed system is cost-friendly and requires minimal hardware resources, making it an efficient solution for attendance management in schools and universities. The system eliminates the need for manual recording, reduces errors, and saves time, making it an ideal solution for modern educational institutions.

Above statement can be illustrated as figure 1 below

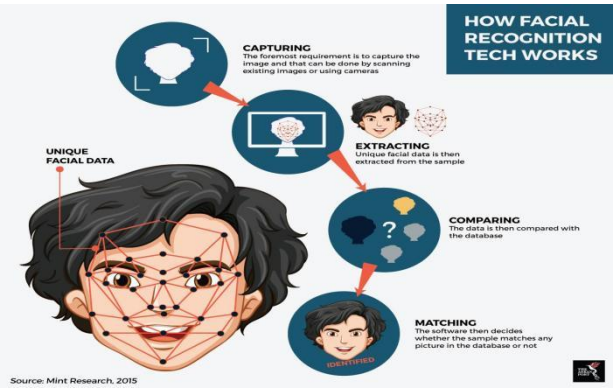



Figure 1 operating process of attendance system

LITERATURE REVIEW

This passage discusses colorful approaches proposed by different authors for developing a real- time attendance system that uses face recognition technology. The end of the paper is to compare and differ these approaches and identify the stylish result for prostrating the limitations of former styles. The first approach bandied in the passage is proposed by Yohie Kawaguchi et al( 1), who suggest a system that uses nonstop observation and face recognition. The system includes an active pupil detecting system( ASD) with two cameras, one for seeing the seat inside the class and the other for landing faces. The system estimates the actuality of scholars using background deduction and solves the direct sum assignment problem to match scholars with seats. The alternate approach( 2) uses a modified convolution neural network( CNN) and the SIFT algorithm for face recognition. The system generates attendance reports and sends them to an sanctioned person via a GSM module. The CNN is enhanced using two normalization operations to ameliorate batch normalization acceleration. The system captures images and matches them with a database, and an SMS is transferred to the authorized number as soon as the face is honored. The third approach( 3) proposes a two- stage mongrel face discovery scheme that uses a probability- grounded Face MaskPre-Filtering(PFMPF)and pixel-grounded hierarchical point announcement boosting( PBHFA) system. The system is designed with a training phase and a testing phase. The training phase involves face discovery using the Viola- Jones algorithm and point birth using the PCA algorithm. In the testing phase, the data set is partitioned into training and testing sets. The fourth approach( 4) uses a CNN to gain low-dimensional features for face discovery. The system also uses the Viola- Jones algorithm and a correlation shames
to track faces from frame to frame. The authors worked on several parameters similar as disguise estimation, sharpness, resolution, and brilliance. They also calculated a final score for face quality assessment by assigning weights to each of the regularized parameters. The fifth approach (5) uses the Eigenfaces approach for face recognition. The system includes face discovery, cropping, and background deduction for grayscale and double images. The authors chose the Eigenface system due to its simplicity, speed, and learning capability. The final approach bandied in the passage( 7) uses a skin discovery fashion for face discovery. The system detects skin pixels and makes the rest of the pixels black. The skin pixels are also used for face discovery, and two databases are used for storing faces and pupil data. Overall, these approaches suggest different styles for enforcing a real- time attendance system that uses face recognition technology. Each approach has its advantages and limitations, and the stylish result depends on the specific requirements and constraints of the situation.

PROPOSED SYSTEM

*Architecture*

The proposed attendance system is user-friendly, simple to operate, and easy to manage. It includes a database containing the images of students' faces along with their personal details such as name, enrolment number, and course. To cover the entire classroom, two or more cameras will be installed on the ceiling, which will capture images several times during a lecture. This will ensure that if a camera does not cover some students, the other cameras will capture their faces, increasing the system's efficiency. Additionally, if a student performs unfavorable poses or expressions, the system can detect their faces at another instance of image acquisition.

Once the teacher triggers the system by clicking on the start button after image acquisition, the system undergoes face detection. Detected faces in all cameras and at all given instances will be compared with stored images of the students in the database. If the system detects a match, the student's name and enrolment number will be marked as present in an excel format. Since there are multiple cameras and multiple instances, there is a possibility of redundant faces. To avoid redundancy, the system generates a single attendance record for each student by excluding duplicate faces.

Overall, this system is efficient and reliable as it can accurately take attendance of all students in a classroom. It eliminates the need for manual attendance taking, making the process faster and more streamlined for teachers.

*methodology*

Developing an intelligent attendance management system, some steps need to be followed to achieve this Successful task. The steps are definable as follows:

- Database creation
- Image amelioration
- Face detection
- Feature extraction
- Face recognition
- Redundancy removal
- Report generation

*Database creation*

During the enrollment process of students, the first step of the proposed system involves creating a database that stores essential information such as the student's name, identification number, course, semester, and subjects. Additionally, the system captures an image of the student for training purposes, which is stored in the database.

Using the images stored in the database, the proposed system can achieve facial recognition for all students attending a lecture. This means that the system can compare the facial features of each student in the classroom with the images stored in the database to identify each student accurately. By doing so, the system ensures that accurate attendance is taken for each student in the lecture, which eliminates the need for manual attendance taking.

*Image amelioration*

In a classroom setting, student movements may result in blurred images captured by the cameras. To address this, Generative Adversarial Networks (GANs) can be utilized to improve the quality of the images. GANs are well-known for their ability to retain texture information in images and generate solutions that look visually convincing.

To be more specific, in the proposed system, GANs can be used to deblur images that are affected by motion, which is represented by an unknown blur kernel, k(M). The goal is to obtain a clear and sharp latent image (denoted as z) from the blurred image (denoted as x) through the use of convolution (symbolized by *), while accounting for any additive noise (denoted as N) present in the image. By using GANs in this way, the proposed system can ensure that even if images captured by the cameras are initially blurry, they can be restored to a clearer state for more accurate facial recognition.

*Face detection*

The system uses 68 facial landmarks to detect faces, which are detected using Haar classifiers. This method involves training a cascade function on positive and negative images, which is then used to detect faces in other images. To reduce computational complexity, features are grouped into cascades of a classifier, and Ada Boost is used to select only relevant features or weak classifiers. These weak classifiers are then combined into a strong classifier using a linear combination with corresponding weights, denoted by $s_i$. The resulting strong classifier is used for face detection in the system.

*Feature extraction*

In the process of feature extraction, the system utilizes 2D Gabor filters to capture the facial features that are angled at various directions. This step is of utmost importance because it is necessary to choose a function that can effectively detect facial features while being resistant to issues like occlusion, lighting, context, and pose variance. The 2D Gabor filters help to overcome any spatial distortions that are caused by variations in position and lighting. The sinusoidal wavelet used in the Gabor filter is defined by parameters like μ, ϕ, γ, λ, and σ, while (x, y) denotes the location of a light impulse.

*Redundancy removal*

Since multiple cameras are being used in the system, there is a chance that the same student's face may appear in different images captured by different cameras. To ensure accurate attendance tracking, redundant faces are removed, and only one face per student is considered. This ensures that each student's attendance is marked only once during a lecture.

*Face recognition*

To recognize faces, three different algorithms have been used - the K-nearest neighbor algorithm, convolution neural networks, and support vector machines. The accuracy, robustness, and time complexity of these algorithms were compared to determine the most effective one for the proposed system. The K-nearest neighbor algorithm works by finding the K-nearest neighbors in the feature space and assigning the label of the majority of those neighbors to the query point. Convolution neural networks are deep learning models that use multiple layers to learn and recognize complex patterns. Support vector machines work by finding the hyperplane that separates the classes with the largest margin. The performance of these algorithms was evaluated based on their ability to accurately recognize faces, their robustness to variations in lighting and pose, and the computational time required to execute the algorithm.

*Report generation*

Attendance reports for face recognition are created by marking the attendance of each student in front of their name and enrollment number in an Excel format during a lecture.

*K-nearest neighbor algorithm*

KNN is a type of machine literacy algorithm that's appertained to as lazy literacy because it only stores the training data and doesn't produce a model. It relies on the distances between data points to classify new data. The Euclidean distance standard is frequently used to calculate the distance between two data points in KNN. The algorithm assigns a new data point to the class that's most common among its k- nearest neighbors.However, also the new data point is assigned to the class of its closest neighbor, If k is set to 1. The Euclidean distance is used by dereliction to find the nearest class in KNN.

*Convolution neural networks*

Convolution Neural Networks (CNN) are very powerful tools for extracting a wide range of features from images, which can also be applied to the task of face recognition. To achieve this, CNN uses 68 facial landmarks to generate 128-dimensional encoding, which are essentially facial features encoded in RGB format. These encoding are then compared to match faces, and the degree of similarity between them can be adjusted using a tolerance value. The use of CNN for face recognition offers a high level of accuracy and robustness, making it a popular choice for various applications.

**RESULTS**

The system was tested using three different algorithms, and it was discovered that the KNN algorithm was the most accurate with a 99.27% accuracy rate. The system was tested under various conditions such as changes in lighting, head movements, facial expressions, and distance from the camera, and it was able to recognize faces with glasses or a beard. The KNN algorithm was the most accurate with an overall accuracy of 97%, followed by CNN with 95%, and SVM with 88%. The CNN algorithm was the most time-efficient, while SVM took the most time. The system was able to accurately take attendance of up to 70 students in a classroom, indicating its reliability and robustness.

The figure below shows the result of our proposed system

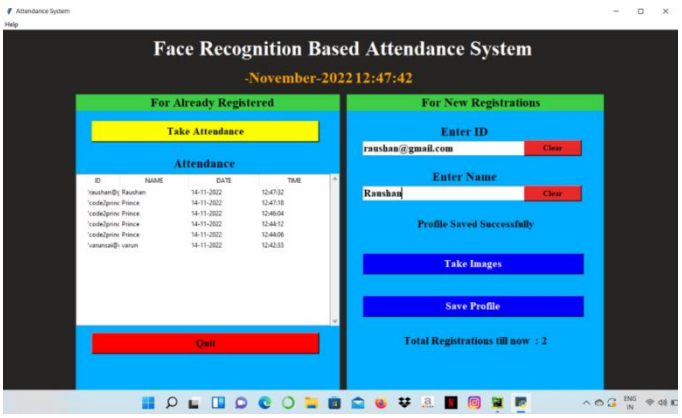



Figure 2 Proposed system

COMPARISON

Our proposed system utilizes multiple techniques for achieving accurate and efficient face recognition in a classroom setting. We use Haar cascades for detecting faces, Gabor filters for feature extraction, and generative adversarial networks for image enhancement. Additionally, we have tested and compared different face recognition algorithms such as K-nearest neighbor, convolution neural networks, and support vector machines in various conditions to determine their accuracy and time complexity. The goal of our system is to provide a cost-efficient and automated solution that reduces manual work and achieves high precision in marking attendance during lectures.

*Head movements*

During a classroom lecture, it is common for students to move their heads in different directions and angles. The head movements can be classified into three categories: pitch, yaw, and roll, which are measured along the x, y, and z-axes, respectively. To evaluate the performance of the face recognition system in different head orientations, the above-mentioned algorithms were tested with varying head angles. The graphs presented below show how the accuracy of each algorithm varies with different head angles.

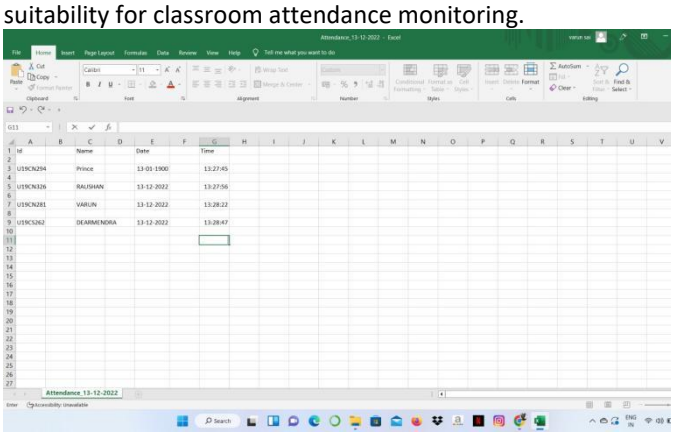
In the case of roll and yaw angles, the negative x-axis represents head movement towards the left, while the positive x-axis represents head movement towards the right. On the other hand, for the pitch angle, the negative x-axis represents head movement in a downward direction, while the positive x-axis represents head movement in an upward direction. By analyzing the accuracy of each algorithm with varying head angles, we can determine which algorithm is more suitable for accurately recognizing faces in different head orientations.

*Different camera positions*

The proposed system includes fixed cameras at the ceiling of classrooms, but due to the varying distance between students and cameras, the accuracy of face recognition may vary. To overcome this challenge, three different algorithms were tested, and their accuracy was measured under varying distances between students and cameras. The results were plotted in a graph to visualize the accuracy variation.

*Overall result*

The proposed system considers different scenarios and challenges that can occur in a classroom, such as varying head movements, distance between students and camera, and lighting conditions. To address these challenges, different algorithms are used for face detection, image enhancement, feature extraction, and face recognition. The system's performance is evaluated based on accuracy, precision, recall, F1 score, and time complexity under various conditions. This comprehensive evaluation allows us to determine the system's overall effectiveness and suitability for classroom attendance monitoring.



## CONCLUSION

The proposed system successfully achieves its objectives of high precision, low computational complexity, cost-efficiency, and less manual work. By using Gabor filters for feature extraction, the accuracy of the system is greatly improved. For face recognition, three algorithms, K-nearest neighbor, convolution neural networks, and support vector machine, were utilized and evaluated. The KNN algorithm demonstrated the highest accuracy of 99.27%, while CNN showed low computational complexity. On the other hand, SVM was found to be less efficient in this regard.

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