

AI-Based Attendance Monitoring System

Chhaya Sharma, Divy Shukla, Jayendra Kumar, Ayushi Verma

Department of Computer Science and Engineering,
Raj Kumar Goel Institute of Technology,
Ghaziabad, Uttar Pradesh, India.



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Abstract

An Attendance Monitoring System is essential in all organizations to track student performance. However, manually taking attendance by calling out names or register numbers and noting them in attendance registers leads to errors and is time-consuming. Some students sign in for absent classmates, making it challenging to track individual attendance accurately, especially in larger classrooms.

This article proposes a more efficient and reliable technique using facial recognition technology. A camera captures images of students entering the classroom, and the facial biometric framework compares these images to a pre-existing database of student images taken during enrollment. If there is a match, the system marks the student present and continuously monitors their performance.

Moreover, artificial intelligence concepts can further enhance attendance monitoring by capturing motion pictures of students in class to analyze attendance data, such as how much time they spend in class.

Keywords: A.I., Students Attendance Management System, Face Recognition, Students Attendance Monitoring System

1. Introduction

An innovative attendance system that uses facial recognition technology based on artificial intelligence concepts is discussed in various papers. The face is the primary feature that identifies and connects individuals globally as each person's facial features are unique. While humans can distinguish a person's face based on various factors such as color, nose, eyes, and ears, computers struggle to analyze such data. Hence, the concept of computer vision technology is employed to recognize human features.

With the availability of biometric methods, there have been remarkable changes in face recognition techniques in recent years. However, implementing the technology on a large scale is ambitious, considering variations caused by factors such as facial expressions, light, image resolution, sensing device, and viewing instance.

Several algorithmic rules have been implemented in face recognition, each with its strengths and capabilities. In our daily lives, we recognize faces and match them with data already present in the database almost instantaneously. This attendance system not only improves accuracy but also enhances efficiency by eliminating the need for manual attendance taking.

Machines that can recognise human faces have enormous potential and may be essential in practical applications like access control, defence, and domestic and international security. The two basic approaches to face identification are native face recognition and global face recognition, which both use the entire face to identify a person. Native face recognition depends on facial traits such as the eyes, nose, colour, and so on. Both strategies are put into practice using different algorithms.

Recently, A.I. applications in facial expression recognition have gained popularity among scientists, and the continuous changes in facial expressions make it a challenging yet fascinating area of research. Despite these changes, we can still easily recognize individuals. The ability of machines to recognize human faces can have a significant impact on the security and defense sectors and other areas of everyday life, making it an exciting and valuable technology to explore.

2. Existing Work

When compared to traditional authentication methods, the current biometric methods are starting to develop into one of the promising ones. The traditional authentication procedure involves writing down the person's name, address, and signature or granting them access to physical or virtual space by utilizing a password, PIN, smart card, plastic card, token, key, etc. Passwords and PINs are challenging to remember, yet they are frequently simple to steal or suspect. Face recognition is one of the biometric authentication techniques. Facial recognition is a significant biometric authentication technique that has been researched and developed over time. Jenif D'Souza W.S. et al. ^[1] identified three essential factors for object detection in machine learning: efficient image representation, selecting significant features through AdaBoost, and building a classifier using a cascade for quick background object replacement. Their earlier research in 2016 about detecting faces at a 60° angle was followed up in 2019 with promising results using a decision tree. Despite ongoing research and development, facial recognition remains a crucial technology for biometric authentication.

A study by Dhanush Gowda H.L. et al. ^[2] was based on earlier research by Jenif D'Souza W.S. et al. When they added Haar-like characteristics to the detector, they were able to reduce errors by 10% when compared to earlier studies, and by 12.5% following optimization. The intensive computing required during classifier training is one of the remaining shortcomings in the face detection methodology. By employing statistical concepts, Serign Modou Bah and Fang Ming ^[3] were able to reduce the amount of time needed for training, and solving the problem. The acquired results significantly cut down on the amount of time needed for computation.

Dulyawit Prangchumpol's ^[4] face recognition involved learning-based encoding of the face's microstructure. The research utilized unguided learning techniques to train an encoder on a sample set, achieving a better balance between discriminatory power and invariance. Additionally, a Principal Component Analysis (PCA) was employed to produce a concise face descriptor. As a result, the study's findings show a recognition rate of up to 84.45% for faces.

The proposed framework of Sujay Patole and Yatin Visput ^[5] provides a range of features, comprising facial recognition, highlight extraction, identification of removed highlights, attendance monitoring, and monthly reporting. It integrates advanced techniques such as picture contrasts, integral pictures, Ada-Boost, Haar-like features, and falling classifiers to detect facial features accurately. The system employs a comprehensive student image database to enable advanced LBP techniques to precisely recognize students' faces. Additionally, the framework delivers highly precise outcomes, while considering the evolution of the face over time.

The proposed system of Rohit Chavan et al. ^[6] utilizes a high-resolution digital camera that is strategically positioned at a gate or door to monitor classroom activity. The captured images are processed by a computer application for further analysis. The system compares the acquired images to reference images stored in the database, which depict the students. The primary aim of this framework is to provide an automated system for recording student attendance during class hours using facial recognition technology, as opposed to traditional manual methods. The research objective is to comprehensively explore the field of pattern recognition, which is crucial and widely used in various applications such as identification and detection.

The system proposed by Ravinder Pal Singh and Daljit Kaur ^[7] utilizes face detection to identify and locate human faces in the image. It employs face recognition techniques to process the detected regions of interest. A novel and robust hybrid approach is proposed, which combines a skin-color model for face detection and an indistinct neural network for recognizing the detected faces. The proposed hybrid algorithm delivers high precision and low false-positive outcomes by leveraging skin-tone models and efficient fuzzy neural networks for recognizing the detected image.

The system initiates the face detection procedure by creating a training dataset using a face detection algorithm. This involves applying a face detection algorithm to selected images from the database and storing the detected faces in the dataset. The proposed system's workflow for detecting faces includes loading pictures from the Yale database, applying pre-processing techniques such as RGB to gray transformation and histogram equalization, and applying a Haar classifier to detect faces. After the completion of the first stage, the subsequent face recognition stage begins, which utilizes the PCA method.

Another system was proposed by Riddhi A. Vyas and S.M. Shah ^[8]. The system loads an image from the Yale database, applies pre-processing techniques, and applies a Haar classifier to detect faces. The PCA method is then used to extract important facial features, which are matched to the training dataset using the Euclidean distance classifier. If the features are matched, the system recognizes the face.

The computational model proposed by Dhara Rathore et al. ^[9] contributes to both theoretical knowledge and practical applications such as motorized assembly observation, will control, design of human-computer interface (HCI), content-based image database management, criminal identification, and more. Face recognition is a common and effective process that people perform in their daily lives. The proposed methodology utilizes light normalization in a pre-processing stage to remove overexposed areas from photos. The evaluation results showed an 86.76% recognition rate on the Multi-PIE dataset, which was used to evaluate the proposed methodology using SSR+LPQ.

The system proposed by Radhey Shyam and Yogendra Narain Singh ^[10] evaluates current state-of-the-art face recognition techniques, including Eigenfaces, Fisherfaces, and Local Binary Pattern (LBP), and introduces a novel A-LBP (Augmented Local Binary Pattern) technique. The system compares the performance of these techniques on various face databases such as AT, T-ORL, Indian Face Database (IFD), Extended Yale A, Yale B, Labeled Faces in the Wild (LFW), and Own database using Receiver Operating Characteristic (ROC) curve analysis. The A-LBP technique outperforms Eigenfaces, Fisherfaces, and LBP techniques, especially for facial data sets with variations in posture and lighting. The system provides a critical evaluation of popular face recognition techniques and introduces a novel approach with superior performance on challenging data sets.

According to the researchers mentioned above, this study will provide a working prototype of a real-time face recognition system. There would be two stages to this investigation. First, the skin color detection algorithm and Haar Cascade are used to identify faces. The identification of the eye position will be completed later.

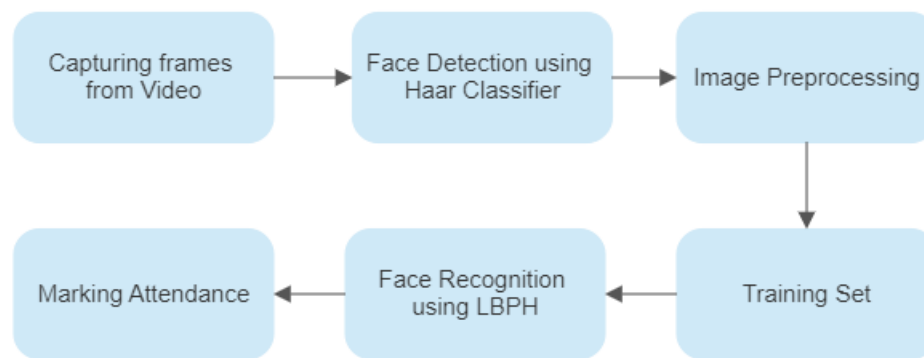
3. Proposed Work

The proposed technology that has been suggested is a highly efficient and advanced system that utilizes the power of facial recognition to mark student attendance. This innovative system works by detecting the presence of a student through the camera module. Once the student is within the range of the camera, his or her image or photo will be captured and analyzed using facial recognition technology.

The facial recognition technology used in this system is highly sophisticated and capable of accurately recognizing and validating the student's identity. The system works by comparing the captured image of the student with the images stored in the database. If the comparison is successful, the system will automatically mark the student's attendance as present. The proposed project is based on a block design where the student's presence is indicated when his face is matched. This design is highly effective as it ensures that only the students who are physically present in the classroom are marked as present. The system eliminates the possibility of proxy attendance and ensures that the attendance record is accurate and reliable.

Overall, the proposed technology is an innovative and efficient solution to the challenges faced by traditional attendance tracking systems. It offers a highly accurate and reliable way of tracking student attendance, and its implementation is likely to improve the overall attendance tracking process in educational institutions. The technology offers numerous benefits, including increased efficiency, accuracy, and convenience, making it a highly recommended solution for educational institutions looking to improve their attendance tracking systems.

Figure 1: Block Diagram Showing Working of the Proposed System



Step 1: Capturing Frames from Video

To capture accurate photographs of students' faces, a camera will be set up at the classroom door. These frames are captured by the camera at 30 frames per second and used in subsequent Processing.

Step 2: Face Detection using Haar Classifier

This phase includes face detection of the person, which aids in locating and sizing the student faces in the collected image. The Haar cascade classifier will be used to extract the copy from faces that are discovered.

Step 3: Image Preprocessing

Preprocessing is necessary for this to enhance the input image and raise the overall quality of the image. Using a color to grayscale image conversion approach, we convert the input image to grey scale.

Step 4: Training Set

The recognition method involves comparing the faces that need to be recognized with the identical face in the trained dataset. To determine to which group the person belongs, the supplied algorithm faces the training set. The training set is used by the algorithm to make facial recognition.

Step 5: Face Recognition using LBPH

The face recognition component of this technology is crucial. An automated way of recognizing and authenticating a person from photos and videos taken by the camera is face recognition.

We employed the effective face recognition method LBPH, also known as the Histogram pattern algorithm, for this.

Step 6: Marking Attendance

Attendance will only be recorded as present if a face from the particular registered folder matches. When all of the students who were present today in class are listed, the remaining students who are members of the class will be recorded as absent.

A. Face Detection using Haar Cascade Classifier

The scientific team of Paul Viola and Michael Jones has put forth the efficient Haar cascade classifier for object detection. This method is based on applied machine learning and in-depth learning. A cascade approach analyses the positive and negative images from the many cascade algorithm. After that, it will

apply to other photos to find items. Face detection algorithms will be used in this case since there are no faces to aid the classifier. In this case, the video needs a lot of both positive and negative face frames. A variety of Haar cascade features are available that examine how the present image functions. In each action, the cropped image into a 24×24 window subtracts the total number of pixels in the white and black regions from this. As a result, the output will be an integer value. It also decides how the features in it are validated.

B. Face Recognizer using LBPH

There is a face recognizer that uses LBPH (Local Binary Histogram Pattern), where the algorithm generates a fresh set of histograms for each input image and compares them to the generated histograms before returning the labels of the histograms that are connected with the input image.

A 3×3 window moves the histogram by one image as a result, allowing it to distinguish faces. Nearly every time a local region of a picture moves, the centre pixel is compared to its surrounding pixels. One is indicated when the number of neighboring pixels is less than one or when it equals the centre pixel, while 0 is used to indicate others. The image underneath the 3×3 window will then display a binary pattern and read values 0 or 1 in a clockwise sequence.

Due to its lower computational load, the LPBH algorithm was utilized for face recognition since it is relatively quick and suitable for real-time recognition. The idea behind LBPH is to just consider the local attributes of the significant objects rather than seeing the entire image as a high-dimensional vector.

The extracted object features are only of low dimensions; for instance, in the case of face recognition, it simply considers the features of the face, eyes, and mouth. The procedure was required in order to ensure that there wouldn't be a significant difference in the final results caused by the detected facial size, the different distances between the subject's face and the camera, and by variations in the environmental light intensity at the time the image was taken.

The LBPH method was used to extract the features. To find the face that is most similar to the detected face, every face in the database would be compared to every other face. To display the names and folders of the faces that are included in the database, CSV files were used for storage.

C. System Flow Diagram Algorithm

Step 1: Video frames from the input image are recorded.

Creating a grayscale version of the color image in step two

Step 3: Using the Haar Cascade classifier, faces are detected.

Step 4: LBPH is used for face recognition.

Step 5: The face is compared to the trained image.

Step 6: If the student and the database match.

Step 7: If it corresponds to the student's database attendance, "PRESENT" will be noted on the datasheet.

Step 8: The attendance is noted on the datasheet as "ABSENT" if it does not match the student database.

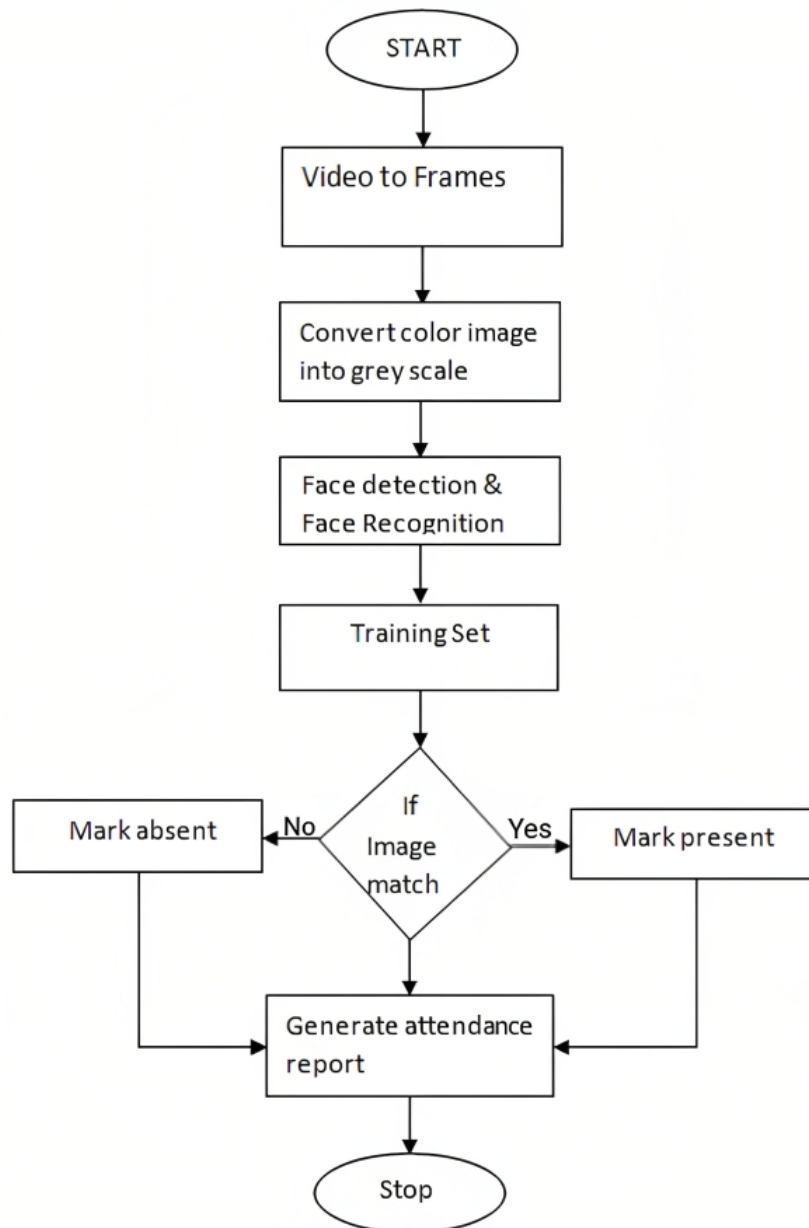
Step 9: Produce a report

Step 10: Update attendance

Step 11: Keep on with step 6

Step 12: Stop

Figure 2: Flow Chart Representing Working of the Algorithm



4. Conclusion

Face recognition technology has been used to develop an automatic attendance management system for students. It aids in minimizing staff time and effort, particularly when there are many pupils present and attendance needs to be recorded.

Python is the programming language used to implement the entire system. Various facial recognition technologies are employed in order to track students' attendance. Moreover, the student's record is correctly maintained. It can also be applied to any exam-related problems.

The attendance percentage will be communicated to the parent or guardian as part of this project's further work. We make use of the GSM module for this. So parents are the guardians who receive SMS alerts about the student's attendance.

References

1. Jenif D'Souza W.S., Jothi S., Chandrasekar A., "Automated Attendance Marking and Management System by Facial Recognition Using Histogram", ICACCS, 2019.
2. Dhanush Gowda H.L., K. Vishal, Keertiraj B.R, Neha Kumari Dubey, Pooja M.R, "Face Recognition based Attendance System", IJERT, 2020.
3. Serign Modou Bah, Fang Ming, "An improved face recognition algorithm and its application in attendance management system", Elsevier, 2019.
4. Dulyawit Prangchumpol, "Face Recognition for Attendance Management System Using Multiple Sensors", IOP, 2019.
5. Sujay Patole, Yatin Vispute, "Automatic Attendance System based on Face Recognition", IJIRSET, 2017.
6. Rohit Chavan, Baburao Phad, Sankalp Sawant, Vinayak Futak, "Attendance Management System using Face Recognition", IJIRST, 2015.
7. Ravinder Pal Singh, Daljit Kaur, "Face Detection Using Skin Colour Model and Face Recognition using ANN", IJCSMC, 2015.
8. Riddhi A. Vyas, S.M. Shah, "Comparision of PCA and LDA Techniques for Face Recognition Feature Based Extraction With Accuracy Enhancement", IRJET, 2017.
9. Dhara Rathore, Gaurav Kumar Das, Akash Saxena, "Concept of Face Recognition: A review", International Journal for Technological Research in Engineering, 2020.
10. Radhey Shyam, Yogendra Narain Singh, "Automatic Face Recognition in Digital World", ACSIT, 2015.