



# FACE RECOGNITION-BASED SMART ATTENDANCE MONITORING AND TRACKING SYSTEM

Sumanta Chatterjee<sup>1</sup>, Diptanu Das<sup>2</sup>, Debopriya Adhikary<sup>3</sup>, Mamartha Dutta<sup>4</sup>, Ishani Mitra<sup>5</sup>, Mainak Ghosh<sup>6</sup>, Pabitra Kumar Bhunia<sup>7</sup>

<sup>1</sup>Assistant Professor, <sup>2,3,4,5,6,7</sup>UG Student  
<sup>1,2,3,4,5,6,7</sup>Department of Computer Science and Engineering  
<sup>1,2,3,4,5,6,7</sup>JIS College of Engineering, Kalyani, India

**Abstract:** The automatic Face recognition system has become one of the most popular technologies in the past few years for its applications in various fields such as security, surveillance, and identity verification. The main intention of this system is to perform an automatic system for human face recognition for an institution or organization to have the attendance of their students or employees. This paper aims to provide an extensive overview of face recognition systems including its history, methodology, working principle, and applications.

**IndexTerms – Face recognition, Automated Attendance Monitoring.**

## I. INTRODUCTION:

The automatic face recognition system is one of the most significant research attentions in recent years. Face recognition technology has become an important tool in different applications such as access control, forensic analysis, and identity verification. It can match a human face from a digital image against a database of faces. This system is employed to certify users through ID verification services. This system was started developing in the 1960s, started as a form of Computer application. Since their beginning, facial recognition has become one of the most used technologies [14]. These days, face recognition is used on smartphones, also used in industries to confirm the identity. In biometric face recognition technology uses computer algorithms to analyze and identify one's unique facial features [8]. The process of face recognition basically goes through capturing an image of a person's face, extracting unique features from the image, and comparing those features with a database of shape of the jawline, the size of nose, the contours of face etc. As technology grows, attendances are stored in a database with security. All the information concerning the students is kept within the database. So that Manual attending can be replaced by the RFID [1]. In order to beat the drawbacks of the RFID, the biometric authentication was introduced. Biometric authentication includes thumb impression, iris pattern and face detection [1]. In a classroom with a high teacher-to-student ratio, it turns into an extremely dreary and tedious process to mark the attendance physically and cumulative attendance of each student. Consequently, we can execute a viable framework which will mark the attendance of students automatically via face recognition [2].

The histogram of oriented gradients (HOG) algorithm is additionally one of the significant calculations that has been broadly utilized under the territory of Machine learning. This strategy can be to a great extent sent for different article identification just as countenances of the subject [4]. All pictures utilized are changed over to grayscale and each pixel in this picture is allocated a number. Every single pixel includes itself in a correlation method where it looks at its incentive to its neighboring pixels [8]. The inspiration is to locate the included dull district will have a white bolt pointing towards it. Every pixel is made to experience through a similar procedure. The biometric system is efficient, reliable and provides a high level of security when compared to the traditional authentication methods. However, these systems offer some disadvantages as well. Most of the devices are unable to enroll some small percentage of users, and the performance of the system can deteriorate over time [9]. To overcome these disadvantages face recognition-based authentication techniques are developed. Face recognition technology involves scanning the distinctive features of the human face to authorize the student [5]. The face recognition system works based on the values of the nodal points on the person's face. The values measured with each nodal points helps in identifying and verifying the person's face. These values captured from the face's nodal point are given to other applications or software to identify the person easily and accurately [3]. We have divided the whole work into five different sections. Section I contains the Introduction of the work, Section II contains Literature Survey, section III contains which Methodology has been used, section IV contains the Working Principle of the whole work, section V contains the Output of the Project and section VI contains Conclusion.

## II. LITERATURE SURVEY:

Face recognition attendance system has become a most popular technology in last few years for it is potential to put back all traditional attendance systems. This literature survey gives an overview of recent studies on face recognition attendance systems, which includes its advantages, challenges, and applications. Few studies have shown that face recognition attendance system has a lot of advantages over traditional attendance systems [13]. The facial detection model proposed by Kruti Goyal et al. [8], is a facial detection model which is built using different types of algorithms like AdaBoost, Haar Cascades. This model uses MATLAB and OpenCV for its implementation. Extraction of facial features is done as a localization of the face which is performed using pattern recognition [9].

In another implementation of a similar system, Kawaguchi, proposed a model in which the faces are compared to the images in a database along with the fixed seating positions. This is a method of continuous examination which uses video streaming camera to sense the presence of the students in the class. They even estimated the seating arrangements using several different types of calculations. It is a very common architecture, which implemented using two different cameras, one is used to sense and the other one is used to capture images [5]. Muthu Kalyani proposed a different approach to this, by using Android Devices to accomplish this task. This was done by the linkage of the android phone to the CCTV camera. After the picture being captured in the camera, it was then exposed to 3D modelling and canonical techniques were used on the pictures for the comparison [6].

Priyanka Wagh(2015)discussed about the various face recognition techniques like Principle Component Analysis (PCA), Eigenface, Support Vector Machines (SVM) and Neural Networks and compared them based on their success rate. The authors also wrote about system architecture, step by-step methodology and supported it with its algorithm. They have also provided a mathematical model using mathematical concepts and language [8].

Nusrat Mubin Ara(2017) in their paper have discussed about the developments in the field of technology they used, such as face detection, normalization, face recognition, and neural networks. The authors also wrote about the methodology in which face detection is done using History of Oriented Gradients, Face Alignment using face landmark estimation, extracting features using Convolutional Neural Network and lastly generating embedding. Although their system found some false predictions, they achieved an accuracy of more than 95% [15].

Abhishek Jha at his study proceeded further to a superior system for the recognition process by utilizing statistical methods PCA and LDA in addition to likewise comparing the picture taken and the saved images for marking the attendance. They suggested to the extensive and blunder inclined procedure of participation making which whenever bargained may influence the understudy definitely. They proposed a framework for figuring the pictures in a specific procedure with the goal that matches scoring should be possible. While it very well may be accomplished by utilizing certain calculations, like color detection, PCA and LDA [10]. Face recognition attendance system is massively used in educational institutions for recording student attendance. It is found that by using of face recognition attendance systems, the accuracy and efficiency of attendance system has improved. Another study by Huang et al. (2020) found that face recognition attendance systems are also used in the offices for recording employee attendance. Study has found that the use of face recognition attendance systems has brushed up the accuracy and efficiency of attendance recording, and reduced the prospect of time theft [12].

Overall, the literature survey tells that face recognition attendance system has a few advantages over traditional attendance systems, which includes higher accuracy and efficiency. But there are also challenges associated with the mechanics, such as sensitivity to environmental factors (e.g., lighting). The survey also shows that face recognition attendance systems are widely used in various places, including education and workplace settings.

## III. METHODOLOGY:

A face recognition attendance system is a system which uses facial recognition technology to identify individuals and record their attendance. The following are the steps involved in the methodology of a typical face recognition attendance system. The very first step in the face recognition attendance system is to capture the images of the individuals. This can be done using a camera or a webcam. The captured images are then pre-processed to remove distortions. This step helps to improve the accuracy of the face recognition system. The next step is to extract the features of the face. The system uses different algorithms (here we are going to use HOG) to identify the critical features of the face, such as the eyes, nose, mouth, etc. After all the features are extracted, the system compares them with the stored database of faces to identify the individual. If the system recognizes the person, the attendance is recorded in excel sheet automatically. The system updates the database when individual's face is recognized successfully. The system generates attendance reports for everyone, including the time and date of the attendance, and other relevant information.

The HOG stands for Histogram of Oriented Gradients. This algorithm is a popular approach which is used for object detection and recognition. In case of HOG algorithm, firstly the image is divided into some small square regions which are called cells. For every cell, the gradient of the image is computed by a series of filters. Those filters can detect the direction and magnitude of edges in that image. The gradient values are then accumulated into histograms based on their orientation; it results a set of histograms that capture the dominant edge orientations within every cell. Then the histograms are combined across adjacent cells to form larger blocks. Every block some cells and each histogram in the block is normalized by the total energy of the block. This normalization helps to make the algorithm more powerful. Finally, the normalized blocks are integrated to form a feature vector that represents the image. This feature vector can then be used in a machine learning algorithm, such as a support vector machine (SVM), to classify objects within the image. The HOG algorithm has been used in a different application, including pedestrian detection, face detection, and object recognition.

Overall, a face recognition attendance system uses facial recognition technology to identify individuals and record their attendance automatically. The system involves capturing images, pre-processing, feature extraction, face recognition, updating the database, and generating attendance reports.

#### IV. WORKING PRINCIPLE:

This project, Face recognition and attendance monitoring system has gone through several working processes like Face Detection, Face Alignment, Feature Extraction and comparison, Identification and authentication. Those are explained below:

1. **FACE DETECTION:** At first view the given photo and identify how many faces are present in the photo. The given photo is encoded to a simplified version of image using Histogram of Oriented Gradients Algorithm. That simplified image is used to find that image part the mostly looks like generic Histogram of Oriented Gradients encoding of a face.
2. **FACE ALIGNMENT:** As soon as the face has been detected, system will align that face to a standard size and position. This is done to ensure that the face can be compared accurately to other faces. Figure out the pose of the face by finding the main landmarks in the face. Once we find those landmarks, use them to wrap the image so that the eyes and the mouth are centered.
3. **FEATURE EXTRACTION AND COMPARISON:** The system then extract features from the face such as the position and the shape of the eyes, nose, and mouth. The features are unique to each individual and can be used to identify a person. The features extracted from the face are then compared to a database of known faces. The database contains a collection of features from known individuals along with their names and other identifying information and pass the centered face image through a neural network that knows how to measure features of the face. Save those 128 measurements.
4. **IDENTIFICATION and AUTHENTICATION:** If the features extracted from the face match those in the database, the system identifies the person. If there is no match, the system concludes that the person is not in the database. Once the person is identified, the system can then authenticate the person's identity by comparing the features extracted from the face to a stored template of the person's face. *Looking at all the faces we have measured in the past, see which person has the closest measurements to our face's measurements. That is our match!.*

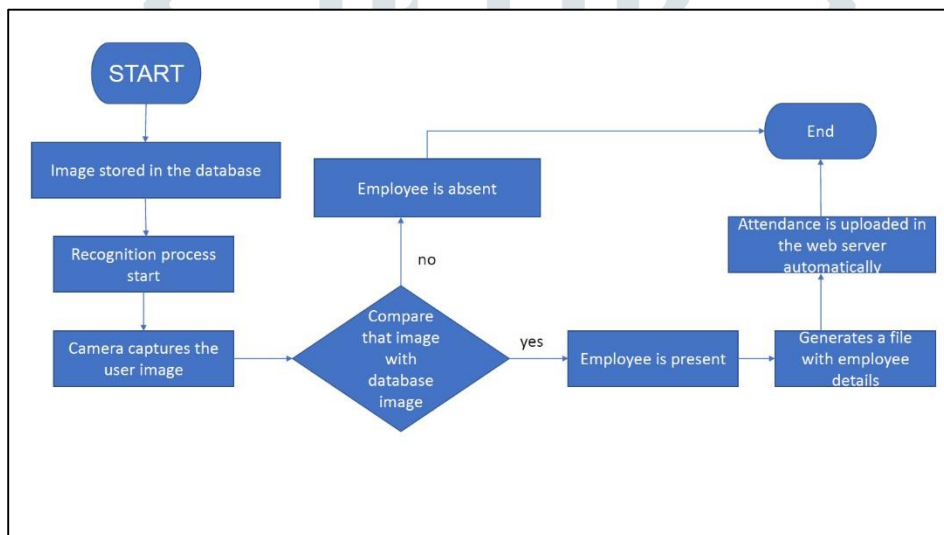


Fig I: Work flow diagram of the proposed system

Overall, the working principle of a face recognition system involves detecting and aligning a face, extracting unique features, comparing them to a database, identifying the person, and authenticating their identity. Now that you know how this all works, here's instructions from start-to-finish of how run this entire face recognition pipeline on your own computer.

#### V. OUTPUT AND EXPERIMENTAL DATA ANALYSIS:

In Fig II. The image of Diptanu Das is exactly recognized and in Fig III, the name of respective person, attendance time and date are stored successfully.

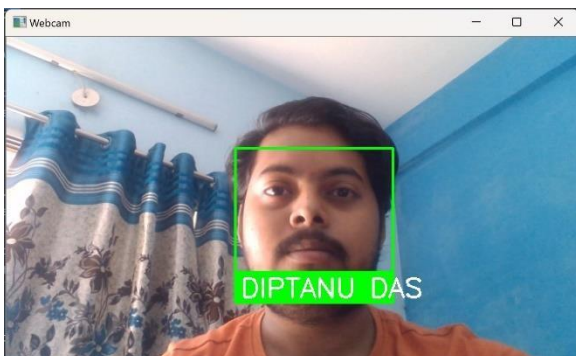


Fig II: Image after recognition with exact name

	A	B	C
1	Name	Time	Date
2	DIPTANU DAS	10:49:30	16-03-2023

Fig III: Data has been recorded in excel sheet

From the above output, we get to know this program can detect the face of employee and register the name of employee, his/her Attendance time and date will be stored in an excel file.

TABLE of Experimental Data

SAMPLE	DATE	TIME	FACE RECOGNISED (YES/NO)	DATA STORED BASED ON FACE RECOGNITION (Yes/No)
Diptanu Das	15-09-2022	10:49:00	yes	yes
Diptanu Das	15-09-2022	10:49:00	yes	yes
Diptanu Das	15-09-2022	10:49:00	yes	yes
Diptanu Das	15-09-2022	10:49:00	no	no
Diptanu Das	15-09-2022	10:49:00	no	no
Diptanu Das	15-09-2022	10:49:00	no	no
Diptanu Das	15-09-2022	10:49:00	yes	yes
Diptanu Das	15-09-2022	10:49:00	yes	yes
Diptanu Das	15-09-2022	10:49:00	no	no
Diptanu Das	15-09-2022	10:49:00	yes	yes
Ishani Mitra	15-09-2022	10:55:35	yes	yes
Ishani Mitra	15-09-2022	10:55:35	yes	yes
Ishani Mitra	15-09-2022	10:55:35	yes	yes
Ishani Mitra	15-09-2022	10:55:35	no	no
Ishani Mitra	15-09-2022	10:55:35	no	no
Ishani Mitra	15-09-2022	10:55:35	no	no
Ishani Mitra	15-09-2022	10:55:35	yes	yes
Ishani Mitra	15-09-2022	10:55:35	yes	yes
Ishani Mitra	15-09-2022	10:55:35	no	no
Ishani Mitra	15-09-2022	10:55:35	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	no	no
Mainka Ghosh	15-09-2022	11:01:30	no	no
Mainka Ghosh	15-09-2022	11:01:30	no	no
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Mainka Ghosh	15-09-2022	11:01:30	yes	yes
Debojyoti Adhikary	15-09-2022	11:10:20	yes	yes
Debojyoti Adhikary	15-09-2022	11:10:20	yes	yes
Debojyoti Adhikary	15-09-2022	11:10:20	no	no
Debojyoti Adhikary	15-09-2022	11:10:20	yes	yes
Debojyoti Adhikary	15-09-2022	11:10:20	yes	yes
Debojyoti Adhikary	15-09-2022	11:10:20	yes	yes
Debojyoti Adhikary	15-09-2022	11:10:20	yes	yes
Debojyoti Adhikary	15-09-2022	11:10:20	no	no
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	yes	yes
Mamatha Dutta	15-09-2022	11:15:20	no	no

Fig. IV: Experimental Data of employees

We have taken 500 experimental data and the system has recognized the face and stored exact details in excel sheet in 98% of cases. To access other experimental data please go through this link: [https://drive.google.com/drive/folders/1vDLr8E9HS9-Ux7\\_VgYsYaQVzuoS2USwx](https://drive.google.com/drive/folders/1vDLr8E9HS9-Ux7_VgYsYaQVzuoS2USwx)

## VI. FUTURE SCOPE and CONCLUSION:

The future scope of automatic face recognition systems is huge and holds significant potential in different domains. Here are some potential areas where face recognition systems may find applications:

- 1. SECURITY AND LAW ENFORCEMENT:** Automatic face recognition can increase security measures by identifying individuals in real-time, aiding in surveillance, and improving access control systems. It can be used in airports, public places, and government facilities to identify potential threats or suspects.
- 2. CUSTOMER SERVICE AND PERSONALIZATION:** Businesses can take advantage of face recognition systems to enhance customer experiences. By recognizing customers' faces, companies can provide personalized services, targeted marketing, and customized recommendations based on individual preferences.
- 3. HUMAN-COMPUTER INTERACTION:** Face recognition can restructure the way humans interact with computers and devices. It can enable natural user interfaces, such as facial gestures and expressions, for controlling devices, playing games, or browsing interfaces without physical contact.
- 4. HEALTHCARE MONITORING AND AGE ESTIMATION:** Face recognition algorithms can be used for monitoring patients' health conditions by analyzing facial expressions, detecting signs of pain or distress, and providing personalized care accordingly. On top of that, face recognition can estimate a person's age, aiding in age-restricted services or personalized marketing campaigns.
- 5. EDUCATION AND ATTENDANCE MANAGEMENT:** Face recognition systems can simplify attendance tracking in schools, universities reducing administrative burden and ensuring exact records. They can also be used for monitoring students' engagement during virtual classes.
- 6. SMART CITIES AND PUBLIC SERVICES:** Face recognition can come up with smart city initiatives by optimizing traffic management, public safety, and crowd control. It can also aid in identifying wanted individuals, reducing crime rates, and enhancing overall city management.

7. **SOCIAL MEDIA AND ENTERTAINMENT:** Face recognition applications has already found in social media platforms for automatically tagging individuals in photos. In the future, it could be used for more advanced features like generating personalized content, analyzing emotions, and enhancing virtual reality experiences.

It's important to bear in mind that the future of face recognition technology also raises ethical and privacy concerns, which need to be addressed to guarantee responsible use and protect individual rights.

In order to obtain the attendance of individual and to record their time of entry and exit, the authors proposed the attendance management system based on face recognition technology in the institutions/organizations. The face recognition attendance system can be fused with other systems such as HR management, access control systems etc. This will provide a comprehensive solution for organizations to manage their employees' attendance and related activities. The face recognition attendance system can be customized to suit the needs of different organizations. For example, the system can be customized to record attendance for specific departments or by adding some more feature it can record the exact time and some details of that employee. The system takes attendance of each student by continuous observation at the entry and exit points. The result of our preliminary experiment shows improved performance in the estimation of the attendance compared to the traditional black and white attendance systems. Current work is focused on the face detection algorithms from images or video frames..

## REFERENCES:

- [1] "Automated Attendance Systems Using Face Recognition by K-Means Algorithms"; N. Palanivel, S. Aswinkumar, J. Balaji, 2019 IEEE International Conference on system, computation, Automation and network(ICSAN)
- [2] "Real-Time Smart Attendance System using Face Recognition Techniques"; Shreyak Sawhney, Karan Kacher, Samyak Jain, Shailendra Narayan Singh, Rakesh Garg; 2019 9th International Conference on cloud computing, Data science & Engineering.
- [3] "Automated Attendance Marking and Management System by Facial Recognition Using Histogram"; Jenif W.S. D'Souza, S. jothi, A. Chandrasekar; 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS)
- [4] "Attendance Management System using Facial Recognition"; Ankush Kumar, Manish Sharma, Saurabh Pratap Gautam, Ranjeet Kumar, Sandeep Raj; 2020 International Conference on Decision Aid Sciences and Application(DASA).
- [5] "Face Recognition-based Lecture Attendance System.,"; KAWAGUCHI and Yohei; The 3rd AEARU Workshop on Network Education. 2005., 2005.
- [6] "Smart Application For AMS using Face Recognition,,"; MuthuKalyani.K; CSEIJ 2013, 2013
- [7] "Real Time Face Recognition Based Attendance System for University Classroom"; Hajirah sultan, Mahammad Hamza Zafar, Saba anwar, Asif Waris, Haris Ijas, Moaz Sarwar; 2022 2<sup>nd</sup> International Conference on Artificial Intelligence (ICAI).
- [8] "Attendance System based on Face Recognition using Eigen face and PCA Algorithms,,"; P. Wagh, S. Patil, J. Chaudhari and R. Thakare; 2015 International Conference on Green Computing and Internet of Things (ICGCIoT), 2015. "Image Quality assessment for fake Biometric Detection: Application to Iris, fingerprint and Face Recognition"; Javier Galbally, Sebastian Marcel, Julien Fierrez; 2014 IEEE Transactions on Image Processing's.
- [9] "Face Detection and tracking using OpenCV,,"; K. Goyal, K. Agarwal and R. Kumar; International Conference on Electronics, Communication and Aerospace Technology, ICECA 2017, 2017.
- [10] "Class Room Attendance System Using Facial Recognition System.,"; A. Jha; International journal of Mathematical science technology and management 2(3). 2007, 2007.
- [11] "Real time face recognition system (RTFRS)"; Suad Haji, Asaf Varol; 2016 4<sup>th</sup> International Symposium on Digital Forensic and Security.
- [12] "Automated Student attendance System Using Face Recognition"; E. Omer Akay, K. Oguz Kanbek, Yesim Oniz; 2020 4<sup>th</sup> International Symposium on Multidisciplinary Studies and innovative Technologies(ISMSIT).
- [13] "Real time face recognition using feature combination"; C. Nastar, M. Mitschke; 1998 Proceeding Third IEEE International Conference on Automatic Face and Gesture Recognition.
- [14] N. M. Ara, N. S. Simul and M. S. Islam, "Convolutional Neural Network Approach for Vision Based Student Recognition System," in 2017 20th International Conference of Computer and Information Technology (ICCIT), 22-24 December, 2017, Sylhet, 2017.
- [15] "Convolutional Neural Network Approach for Vision Based Student Recognition System,,"; N. M. Ara, N. S. Simul and M. S. Islam; 2017 20th International Conference of Computer and Information Technology (ICCIT), 22-24 December, 2017, Sylhet, 2017.