International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 1, pp 11-16, January-2025

https://doi.org/10.47001/IRJIET/2025.901002

Face Detection Attendance Marking Using AI: A Deep Learning Approach for Classroom Environment

[1]Kirthana Praveen, [2]Hena K Rahman, [3]D Nandakumar, [4]Shervin S, [5]Ms. Jyotsna. A

[1,2,3,4,5]Department of Computer Science and Business Systems, Rajagiri School of Engineering and Technology, Kerala, India

Authors E-mail: [1]U2209035@rajagiri.edu.in, [2]U2209027@rajagiri.edu.in, [3]U2209016@rajagiri.edu.in, [4]U2209063@rajagiri.edu.in, [5]jyotsnaa@rajagiritech.edu.in

***Abstract* - This paper presents an automated attendance mark- ing system specifically designed for a classroom environment utilizing deep learning techniques. The system employs a collection of Convolutional Neural Networks (CNN), ResNet, and Histogram of Oriented Gradients (HOG) for accurate face detection and recognition. By implementing a webcam-based face detection with AI capabilities, the system automatically identifies students and marks attendance, storing data in a secure Excel- based database accessible through different user interfaces for administrators and students. The implementation demonstrates significant advantages over traditional methods, particularly in handling varying light conditions and partial face obstruction, while maintaining high accuracy in attendance records. This solution includes a web-based interface for fast access and management of attendance data in a structured format.**

Keywords: Face Detection, Deep Learning, CNN, ResNet, HOG, Attendance System, Computer Vision.

I. INTRODUCTION

Accurate and efficient attendance tracking is an essential requirement in academic institutions. However, traditional strategies, inclusive of roll calls and signal-in sheets, are old and fraught with inefficiencies. These processes not handiest consume valuable educational time however are also liable to errors, which includes college students marking attendance for absentees or instructors inadvertently skipping names. Biometric structures, such as fingerprint and RFID-primarily based solutions, were explored as alternatives. While effective in positive contexts, those systems require bodily interaction, raising issues about hygiene and efficiency particularly in large school rooms wherein bottlenecks can arise all through peak usage. To cope with these boundaries, we present a singular AI-powered attendance marking system designed particularly for single lecture room surroundings. The system leverages contemporary computer vision and deep learning techniques, including Convolutional Neural Networks (CNN), Residual Networks (ResNet), and Histogram of Oriented Gradients (HOG), to permit real-time, contactless attendance monitoring. This solution removes bodily interaction, making it hygienic and fantastically green. Unlike traditional systems, this approach is customized to address the dynamic demanding situations of a lecture room putting, inclusive of various lights conditions, college students sitting at exceptional angles, and using accessories like mask or glasses. The integration of deep learning models guarantees correct face detection and reputation below numerous situations, permitting the machine to always perform in real-international situations. Furthermore, the gadget capabilities an intuitive web-primarily based interface that lets in teachers to take attendance with minimum effort. Attendance information is securely stored in an excel-based database, allowing administrators and teachers to quickly access detailed notes and reports. By automating attendance tracking, the system not only saves time, but also improves the accuracy and reliability of data for teachers and students all experience easily. This paper examines the design, implementation, and evaluation of the proposed framework. It highlights the system's ability to overcome the challenges of traditional manual methods, ensuring that attendance management is a seamless process in line with the evolving needs of modern classrooms

II. RELATED WORK

Several research projects have explored the development of smart attendance systems that use processing units, IoT technologies, and facial recognition. These systems are designed to improve the accuracy, performance, and comfort of attendance tracking.

Adeel Akram and Nighat Usman utilizes YOLO V3 for face detection and Microsoft Azure Face API [1] for recognition to automate attendance. Classroom cameras capture images at the start and end of sessions, ensuring accuracy. The system generates attendance reports and sends automated monthly updates to students, parents, and faculty.

Priyanka Wagh and Roshani Thakare uses face recognition to automate attendance [2] and prevent fake attendance or proxies. It addresses issues like light intensity and head pose through techniques such as illumination

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 1, pp 11-16, January-2025

https://doi.org/10.47001/IRJIET/2025.901002

invariant methods, Viola-Jones algorithm, and Principal Component Analysis (PCA). The system detects and recognizes faces, comparing them with a database to maintain accurate student attendance records.

Priya Pasumarti and P.P Sekhar uses face recognition for automating student attendance [3] with Raspberry Pi. It employs OpenCV for face detection and recognition, utilizing a modified Haar's Cascade algorithm for face detection and LBP histograms for recognition. The system is trained with a student database and uses SQLite and MySQL for updating attendance records. It also sends notifications to guardians and the Head of Department for absentee students.

R. Bairagi and R. Ahmed developed a smart attendance system [4] that uses face recognition for automated attendance leveraging the Haar Cascade classifier for face detection and LBPH for recognition. The system stores student data in a cloud database, tracks attendance by time and class schedule, and sends notifications to parents for irregular attendance, offering a secure and efficient solution for teachers.

Shizhen Huang and Haonan Luo uses real-time face recognition for video-based attendance[5], employing MTCNN for face detection and FaceNet for recognition. It incorporates face liveness detection using the ERT algorithm to detect user blinks. The system is built in Python with a Qt library user interface and uses TensorFlow for algorithm implementation.

These studies offer valuable insights into system structure, hardware setup, enrollment procedures, real-time tracking, far flung accessibility, and data protection. By referencing above contributions and considering our project time constraint and our convenience of implementation, the proposed methodology in the paper was implemented and evaluated.

III. METHODOLOGY

A) Data Collection

The proposed system relies on a custom dataset created specifically for this application. Data collection was performed using a high-resolution webcam to capture images under varied conditions, ensuring the model could generalize well across different scenarios. Multiple images were captured for each student to account for real-world variations such as:

- **Angles:** Students were asked to look straight ahead, as well as slightly to the side, to simulate typical classroom poses.
- **Lighting Conditions:** Images were taken under different lighting intensities, from bright natural light to low in-door lighting, to improve recognition robustness across changing conditions.
- **Expressions and Obstructions:** Images with varied facial expressions (neutral, smiling) and common obstructions (e.g., glasses, masks) were included to enhance the system's tolerance to these variations.

Privacy was strictly maintained by obtaining consent from each student before data collection, and all images were stored securely in organized folders labeled by student ID. This organization enabled efficient processing during training, as each folder contained a set of images corresponding to a single student, facilitating accurate labeling and streamlined feature extraction.

B) Camera Module

The module records individual pictures or video frames in real time. Both training and testing (for real recognition when in use) depend on the collected data.

C) Face Detection and Recognition Pipeline

The face detection and recognition pipeline consists of several key stages, each optimized to achieve high accuracy and real-time performance in classroom settings.

1) Face Gradient Detection using HOG: Initially, the system uses Histogram of Oriented Gradients (HOG) for efficient face detection. HOG analyzes the image to detect regions with high gradients, which typically correspond to facial features. This method provides a fast and reliable way to localize faces within each frame, reducing the computational load on the subsequent recognition steps.

2) Feature Extraction with CNN: Once a face is detected, the system employs Convolutional Neural Network (CNN) lay- ers for feature extraction. CNNs are well-suited for identifying intricate facial patterns and details. In our system:

- **Convolutional Layers** apply filters to detect edges, contours, and textures that uniquely characterize each face.
- **ReLU Activation** introduces non-linearity, allowing the network to learn complex patterns.
- **Pooling Layers** perform down-sampling, reducing the spatial dimensions of the feature maps to make the model more efficient and less sensitive to small positional changes.

This feature extraction process transforms each detected face into a set of distinctive features, making it easier for the recognition model to identify individual students accurately.

3) Face Detection with ResNet: For final detection, the system employs the Residual Network (ResNet) architecture, a

ISSN (online): 2581-3048
Volume 9, Issue 1, pp 11-16, January-2025
https://doi.org/10.47001/IRJIET/2025.901002

deep learning model known for its high performance in image detection tasks. ResNet is particularly effective in handling the "vanishing gradient" problem common in deep networks, which can hinder learning in very deep models. Key elements of the ResNet architecture used in our system include:

- Residual Connections, which allow information to skip layers, helping the model retain critical features from earlier layers.
- Deeper Layers that increase the model's capacity to capture fine details, enabling accurate differentiation between similar faces.

The ResNet model compares the features extracted by the CNN layers with stored encodings in a database, identifying each student by matching their unique facial features against the known dataset.

D) Face Recognition Module

In order to identify the individual, this module checks the collected features with a predetermined data set. It has two essential parts: A) Datasets: Images of known individuals (such as students). B) Face Recognition Module: Determine whether there is a match by comparing the features of the detected face with those in the dataset.

E) Decision-Making Process

The system verifies whether the face is recognized after facial recognition. If the system recognizes the student, after which attendance is recorded. If the person is not identified, the system does nothing more and shows them as unknown because they are not in the dataset.

F) Record Attendance

The technology records a person's attendance when it recognizes their face. This system doesn't do anything more for that person. After then, this information might be utilized for documentation.

G) Output Storage and Integration

Excel Sheet: For convenient access and offline record keeping, attendance data is kept in an Excel sheet.

Website Integration: Real-time attendance tracking and remote access by administrators or professors, are made possible by the integration of the attendance data with the website.

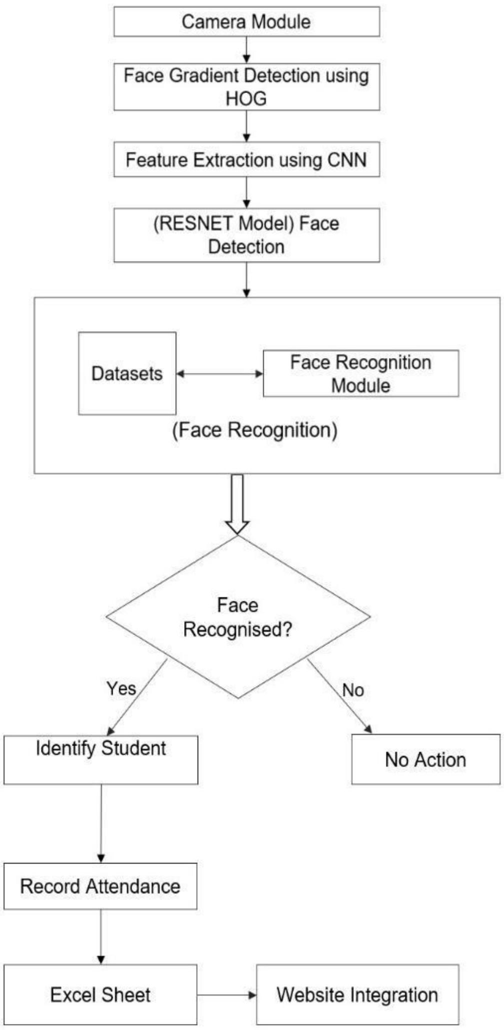

Figure 1: System Architecture

H) System Workflow

The entire workflow of the attendance marking system is automated as follows:

- **Initialization:** The system initializes the webcam and begins capturing video frames as students enter the classroom.
- **Face Detection and Recognition:** For each frame, faces are detected using HOG, followed by feature extraction through CNN and recognition via ResNet. Recognized faces are recorded as present.
- **Attendance Marking:** Identified students are marked as "present" in the database, with real-time updates in the web interface.
- **Data Storage and Retrieval:** Attendance records are saved in the Excel-based database, accessible to teachers and administrators through the web interface for daily and cumulative reporting.

Our system architecture is shown in Figure 1.

International Research Journal of Innovations in Engineering and Technology (IRJIET)

ISSN (online): 2581-3048

Volume 9, Issue 1, pp 11-16, January-2025

https://doi.org/10.47001/IRJIET/2025.901002

IV. IMPLEMENTATION

A) Technical Stack

The system was implemented using:

- Python for core programming tasks.
- OpenCV for image processing.
- Face recognition library for facial recognition.
- Pandas for data handling.
- Flask and Bootstrap for web interface.

B) User Interface

The interface includes:

- **Admin Dashboard:** Manage attendance records.
- **Student Portal:** Allows students to check their attendance.
- **Visualization Tools:** View attendance trends.

V. TESTING AND RESULTS

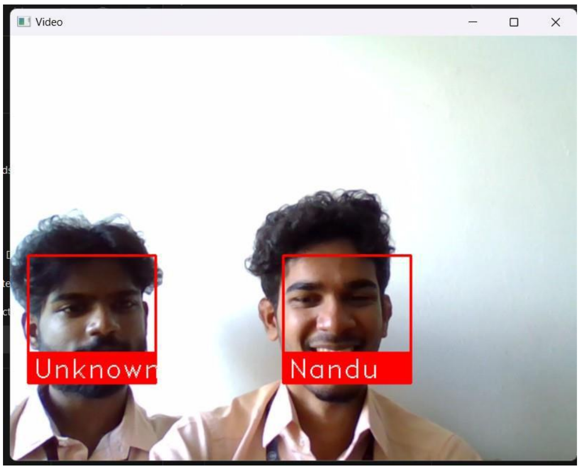

Figure 2: Face recognition

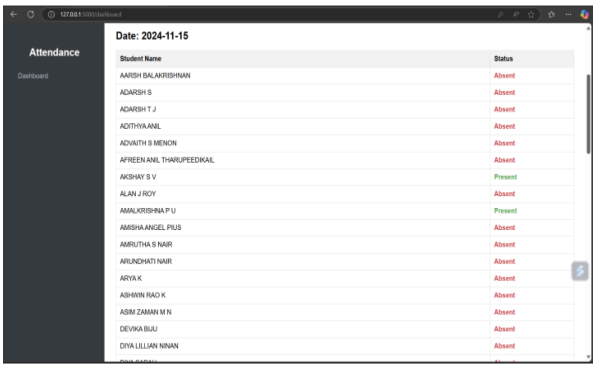

Figure 3: Attendance dashboard

Comprehensive testing was conducted to evaluate the system's accuracy, performance, and robustness under various conditions. Results are shown in Figure 2 and Figure 3.

A) Accuracy Testing

Our system achieved 93% accuracy in controlled lighting conditions and 91% in low-light scenarios. Table 1 shows the accuracy by condition

Table 1: Accuracy Testing Results

Condition	Accuracy
Controlled Lighting	93%
Low Light	91%
Varying Angles	92%

B) Stress Testing

Stress testing was performed to assess the system's performance under high load conditions, such as recognizing multiple faces simultaneously or handling crowded classrooms. Results indicated that the system maintained recognition ac- curacy and processing speed, demonstrating robustness under high-traffic conditions.

C) False Positive and False Negative Testing

False positives and false negatives were tested to measure reliability. The system exhibited a low rate of incorrect recognitions (false positives) and missed faces (false negatives) across various scenarios, indicating high reliability.

D) Usability Testing

Usability testing was conducted to verify the user-friendliness of the web interface for teachers and students. Feedback from testing sessions indicated that the interface was easy to navigate, with users finding the attendance verification process straightforward and accessible.

E) Ethical and Privacy Compliance Testing

Privacy compliance testing was carried out to ensure adherence to data privacy standards. We verified that all data handling, storage, and access control mechanisms comply with institutional and legal privacy regulations, ensuring that sensitive data is securely encrypted and accessible only to authorized personnel.

VI. CHALLENGES

A) Detection Angles Problem

The angle at which the face is photographed has a significant impact on facial recognition models. The system might not recognize a face or give false results if the subject is not directly facing the lens or facing away from the camera.

ISSN (online): 2581-3048
Volume 9, Issue 1, pp 11-16, January-2025
https://doi.org/10.47001/IRJIET/2025.901002

B) False Positives/False Negatives Problem

Occasionally, the system may misidentify a face (false positive) or fail to recognize a face at all (false negative), particularly when features are partially veiled or there is inadequate lighting. For example, recognition accuracy may be impacted by partial occlusions or low light levels.

C) Lighting Conditions Problem

Poorly captured faces that are challenging for the model to identify can be caused by inadequate lighting. Dark, hazy, or overexposed faces might cause misidentification or go undetected.

VII. CONCLUSION

The project detailed above incorporated an AI face detection attendance system utilizing deep learning CNN approach with both ResNet and HOG. This skilled facial detection machine establishes a accurate face detection attendance device. Each algorithm contributes to the sum of the elements; the power of processing from CNN and ResNet, together with the recognition capacity from HOG, creates an impressive detection system capable of handling various pressures and angles to facilitate real-time recognition. In addition, developer access to an internet application is important, as this allows teachers and administrators to quickly input or edit attendance logs while enabling students to view their attendance privately. This streamlined access reduces the administrative burden that is frequently faced through manual attendance strategies. It's a steady, non-invasive, more reliable approach to marking attendance in a classroom because with doing attendance based on manual roll call is liable to human mistakes; this device resolves that and issues of privacy and safety and it allows for live monitoring which is a increasing essential as classrooms become more technologically superior. For future tasks there may be a need to scale this project to a larger scope, whether it's a bigger classroom or an entire school district system. What will be required in the future are cloud integrations to enhance accessibility, security features such as multi-factor authentication, and analytics for trend reporting.

ACKNOWLEDGMENT

The authors would like to extend their sincere gratitude to our guide, for her invaluable guidance and support throughout this project. Her expertise in computer vision and artificial intelligence, coupled with her insights into practical implementation, were instrumental in helping us overcome technical challenges and refine our approach. Her constructive feedback during the design and development phases greatly enhanced the quality of this work. We also acknowledge the assistance provided by the Department of Computer Science and Business Systems at RSET for offering access to resources and facilities that made this research possible. Special thanks are extended to our class- mates and peers for their collaboration and feedback, which contributed to the iterative improvement of the system. This project would not have been possible without the collective support, mentorship, and encouragement we received along the way.

REFERENCES

[1] Khan, Sikandar, Adeel Akram, and Nighat Usman. "Real time automatic attendance system for face recognition using face API and OpenCV." *Wireless Personal Communications* 113.1 (2020): 469-480.

[2] Wagh, Priyanka, et al. "Attendance system based on face recognition using eigen face and PCA algorithms." *2015 International Conference on Green Computing and Internet of Things (ICGCIoT). IEEE*, 2015.

[3] Pasumarti, Priya, and P. Purna Sekhar. "Classroom attendance using face detection and Raspberry-Pi." *International Research Journal of Engineering and Technology (IRJET)* 5.03 (2018): 167-171.

[4] Bairagi, Rupak, et al. "A real-time face recognition smart attendance system with haar cascade classifiers." *2021 third International Conference on Inventive Research in Computing Applications (ICIRCA). IEEE*, 2021.

[5] Huang, Shizhen, and Haonan Luo. "Attendance system based on dynamic face recognition." *2020 International Conference on Communications, Information System and Computer Engineering (CISCE). IEEE*, 2020.

ISSN (online): 2581-3048
Volume 9, Issue 1, pp 11-16, January-2025
https://doi.org/10.47001/IRJIET/2025.901002

Citation of this Article:

Kirthana Praveen, Hena K Rahman, D Nandakumar, Shervin S, & Ms. Jyotsna. A. (2025). Face Detection Attendance Marking Using AI: A Deep Learning Approach for Classroom Environment. *International Research Journal of Innovations in Engineering and Technology - IRJIET*, 9(1), 11-16. Article DOI https://doi.org/10.47001/IRJIET/2025.901002

****