Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 8, No.3, August : 2024

AUTOMATIC STUDENT ATTENDANCE SYSTEM BASED ON FACE RECOGNITION USING MTCNN

Ms. S. D. Salunkhe, Student**,** Dept. Of Computer Science and engineering, Rajarambapu Institute of Technology, Rajaramnagar (India) Affiliated to Shivaji University Kolhapur
Prof. Dr. S. S. Patil, Professor, Dept. Of Computer Science and engineering, (AI & ML) Rajarambapu Institute of Technology, Rajaramnagar (India) Affiliated to Shivaji University Kolhapur

ABSTRACT
Upholding the attendance register in the midst of everyday activities can be difficult because calling out each student's name takes time and is vulnerable to fraud or proxy. A novel method based on facial recognition has been created to safeguard student attendance records in order to address this problem. The administrator has already stored the attendance records and has arranged them according to subject. The suggested approach takes pictures at the specified subject-specific times, recognizes faces on the photos, and marks the students who are recognized as being present by adding the relevant subject ID and timestamp to their attendance records. The goal of this project is to develop an automated attendance system based on facial recognition technology. More specifically, two techniques will be applied: Face detection using MTCNN (Multi-task Cascaded Convolutional Neural Networks) CNN for facial image recognition. Additionally, feature extraction and classification are accomplished, respectively, by Face Net and SVM.
Keywords: smart farming, Artificial intelligence, Internet of Things, sensors.

I.Introduction
Each student is given a unique card with their identifying information stored on it via the RFID card system, Nonetheless, there's a possibility the card will be misplaced or used without permission. Which could lead to false attendance statistics? The traditional manual method of calling out student names is a time-consuming process. Moreover, alternative biometric methods, including voice recognition, iris, or fingerprint recognition, have limits and are not totally accurate. Organizations need a strong and reliable system in order to manage attendance records efficiently. Our suggested fix is to use face recognition technology to automate the attendance system. We have created a real-time system that can identify students' frontal faces from photos taken in the classroom, expediting the attendance process. This is because faces are an important part of human relationships and convey vital information about an individual. All humans are born with the ability to recognize faces; our system makes use of this feature to recognize faces.
An intelligent method to attendance management is the use of facial recognition technology for attendance tracking. Compared to earlier methods, facial recognition is faster and more accurate, which reduces the possibility of attendance or proxy fraud. Additionally, facial recognition offers a non-intrusive method of identification in which the subject of the identification does not need to actively confirm their identity. To do this, we use the MTCNN technique to first extract features and detect faces, and then we recognize faces. The recommended approach is broken down into five steps: preparing the training data, extracting faces from the data. Using MTCNN, embedding each face into the Face Net Keras Model, using SVM to categorize feature vectors, and then carrying out face recognition. A cascading series of convolutional neural networks (CNNs) is used by the MTCNN (Multi-Task Cascaded Convolutional Networks) algorithm, a deep learning-based face identification and alignment technique, to find and recognize faces in digital photos or videos. A neural network that recognizes faces and facial landmarks in photos is called an MTCNN, or Multi-Task Cascaded Convolutional Neural Network. Face detection and face recognition are the two primary phases in the face recognition process. To obtain precise face coordinates, MTCNN is first used for face detection. Based on the results of the previous step, Face Net is used for facial

recognition. The MTCNN processing flow is as follows: The test image is initially continuously scaled in order to obtain the image pyramid. The picture pyramid is then input to P-Net in order to obtain a large number of candidates. The candidate images that P-Net examined are refined by R-Net. After R-Net has weeded out a significant number of candidates, the images are sent into O-Net. At the conclusion, the exact box coordinates are output. FaceNet is simpler than Deep Face and uses CNN for training rather than feature extraction procedures. It also preserves face alignment. By using AdaBoost and Using Haar-like features, cascaded classifiers are trained. According to Viola and Jones, the face detector cascade they employed achieves good performance and real-time efficiency. Even with more sophisticated features and classifiers, some research suggests that this type of detector may not perform well in real-world scenarios where there is more visual diversity in human faces. Viola and Jones's proposed face detector cascade provides good performance and real-time efficiency. Even with more sophisticated features and classifiers, some research suggests that this Type of detector may not perform well in real-world scenarios where there is more visual diversity in human faces. Li et al. (Li et al. 2015) employ CNNs in a cascade for facial recognition; however, they overlook the intrinsic relationship between bounding box regression and localization of facial landmarks and necessitate bounding box calibration at extra computational expense using face detection.

MTCNN is a deep cascaded multi-task framework that increases performance by taking advantage of the correlation that exists naturally between alignment and detection. With the help of three levels of meticulously crafted deep convolutional networks, the MTCNN framework uses a cascaded architecture to make coarse-to-fine face and landmark location predictions. Furthermore, a new online hard sample mining method that further improves performance in practical applications. Using a three-stage neural network detector, the Multitask Cascaded Convolutional Neural Network (paper) is a contemporary face identification method. To identify faces of various sizes, the image is first repeatedly scaled. After that, the P-network (Proposal) carries out first detection by scanning images. It intentionally operates in this manner because of its low detection threshold, which causes it to identify a large number of false positives even after NMS (Non-Maximum Suppression).The second network, the R-network (Refine), receives the recommended regions, which are full of false positives. Refine, as its name implies, filters detections (also using NMS) to produce very accurate bounding boxes. The last step, the O-network (Output), refines the bounding boxes one last time. In this manner, bounding boxes are accurate and exact in addition to face detection. Detecting facial landmarks, such as the corners of the mouth, the nose, and the eyes, is an optional function of MTCNN. Since they are already utilized for face detection in the process, it is practically free, which is an added benefit if you require those (e.g. for face alignment)

II.Literature

This study offers a suggested automated attendance management system that automatically recognizes students as they enter the classroom and keeps track of their presence. Appropriately using face detection and recognition algorithms. The design of the paper includes a detailed description of the system and the methods employed at each level. Furthermore, a number of real-world scenarios are considered in order to evaluate the effectiveness of various face recognition systems and recommend defenses against potential security threats like spoofing. This technology replaces manual attendance tracking techniques, saving time and improving student monitoring capabilities. [1]

The complete process of creating a face recognition model is described in depth in this publication. The main goal of the model is to achieve practical application in face recognition tasks by using advanced approaches, like CNN for face detection and CNN cascade for face embedding creation. However, even if CNNs provide the best outcomes with more datasets, which might not be practical in a production setting, this study attempted to use same techniques on more compact datasets. A novel method for image augmentation in face recognition tasks was put forth in order to overcome

this difficulty. The proposed facial recognition algorithm performed well, achieving 95.02% accuracy on a small dataset of real-world employee face photos. With or without small adjustments, the model can be used as a main or auxiliary component for monitoring in another system. [2]
This study suggests an automated approach for tracking student attendance that recognizes and registers students as soon as they walk into the classroom. Using special methods for recognizing and detecting faces. The system emphasizes specific human characteristics, such as the face, eyes, and noses, and it takes into account a range of real-time scenarios to assess how well various face recognition systems perform. Additionally, the study offers methods for dealing with security issues including proxy attendance and spoofing. The enhanced student monitoring features of this system save time and enable efficient attendance management when compared to conventional or existing techniques. [3]
Time-consuming handwritten records are employed in colleges and institutions. The manual model is meant to be replaced by the suggested Students Attendance System. Context about the students is taken into account, including their facial expressions. Using facial recognition technology, it is feasible to automatically assess attendance regardless of each student's presence or absence. Our focus is on the application of facial image processing technology. Our suggested approach uses face recognition based on gray scale images to take attendance. [4].
A simple and effective method for tracking regions that are partially obscured, undergoing geometric distortion, and changing illumination. The technique is straightforward and
Effective, yet it can withstand mild alterations from the underlying motion and illumination models. For instance, the Algorithm may still follow the subject when they are altering their expression or, as demonstrated in the previous section, when they are rotating out of plane even though in our tests we have portrayed the face as a stiff entity moving in a limited way. [5]
We hypothesize that systems that identify and classify activities in extended sites can be built on top of robust, adaptive, multi-object tracking. We have already shown how to use this tracking information for multi-camera calibration, crude site modeling, object detection, and object classifiers, even though the work described here is still ongoing. It is hypothesized that systems that identify and classify activity on extended sites can be built upon the foundation of robust, adaptive, multi-object tracking. We have already shown how such tracking information may be used for multi-camera calibration, rough site modeling, item identification, and object classification, even though the work described here is still ongoing. There are two main types of RFID tags: passive and active.. Power is required for active tags, typically a small battery, but passive tags are completely passive and only become active when a reader is close by to supply power. [6]
The plan was to use a personal mobile phone to record student attendance in real time without wasting any time. The smartphone software reads the NFC chips using NFC chips placed on each seat. Encrypted data on the NFC chip includes the building and classroom numbers as well as the seat number in the event that a student uses the attendance system while taking a test. Giving teachers access to modern technology that allows them to directly obtain a student's overall attendance without using an attendance sheet that has been manipulated. No student may purposefully or inadvertently mark another person's attendance. We have collaborated to bring this design concept to reality with this goal in mind. [7]
In this research, to collect student attendance, we proposed a face detection and identification based system. The process of detection and recognition involves transforming a captured image from a camera into gray scale. The faces are identified by comparing the stored faces with the current frame that was taken by the camera. All attendance reports are generated via the proposed system. [8]
The author has demonstrated an easy and effective way to track regions that are partially occluded, undergoing geometric deformation, and changing illumination. The technique is straightforward and effective, but it can withstand acceptable departures from the underlying motion and illumination models. [9]

A better approach to gathering attendance data was put out by Zhao Pei et al. and involved the use of convolutional neural Networks (CNNs).The limitations of the traditional face recognition methods, such as Eigenface, include their sensitivity to light, motion, noise, and facial expressions. In order to reduce the impact of environmental fluctuations, it uses CNN for facial Recognition. Using this method, teachers snap pictures of the kids' faces, which are then sent to the system for additional processing. [10]

Four distinct functionalities for the vision-based attendance system were proposed by Harikrishnan J et al. [11]: face detection, training, facial recognition, and attendance management in Excel. For face identification and recognition, Haar cascade classifiers and Local Binary Patterns Histograms are employed. A security camera and a Raspberry Pi are the two main parts that make the whole system function. Because of the algorithms employed, the device can function effectively even in dimly lit environments.

Two deep learning methods were proposed by Rong Fu and others to track attendance in university classes. MTCNN face detection and Center-Face face recognition are the algorithms [12].Other advantages of this system include tracking student absences, tardiness, and early departures. The attendance of every student will be promptly recorded. This work records the attendance in 100 milliseconds and achieves an accuracy of 92.98%.

Thida Nyein et al. suggested utilizing Support Vector Machine (SVM) and FaceNet in tandem to achieve increased accuracy for multi-face recognition [13]. In this work, SVM is utilized for classification and FaceNet is used to extract features. A support vector machine is used for feature matching, or classification. This results in 99.6% facial detection accuracy.

III.EXISTING SYSTEM

3.1 Register-Based Attendance System:

A technique for keeping track of attendance, in which visitors must physically sign a logbook or register when they arrive at a designated spot. This method is frequently used in a variety of contexts, including events, businesses, schools, and any other circumstance where it's important to maintain track of whom’s there at any one time. When using a register-based attendance system, people usually sign in and indicate the time and date of their arrival. Occasionally, extra details like the reason for their visit and how long they stayed might also be noted. When the register is filled out, it acts as a record of attendance and gives information about who was present when. The main benefit of a register-based attendance system is that it is low-tech and simple to use, requiring simply a pen and paper or digital equivalent. It is also a reasonably priced option that is simple to maintain and apply. Nevertheless, there are a few disadvantages to this approach. People may find that signing the register takes a lot of time, and if the register is not kept up to date or if people sign in on behalf of others, mistakes or fraudulent activity may occur. However, the register-based method is still a common option for tracking attendance in a variety of settings.

3.2 Fingerprint-Based System for Attendance:

An increasingly popular method of tracking attendance is the fingerprint-based system, in which people must scan their fingerprints to verify that they were there at the designated spot. This technique is useful in areas like businesses and schools where maintaining precise records of attendance is essential. When using a fingerprint-based attendance system, a person places their finger on a scanner, which records and examines each fingerprint's distinct patterns. To identify the person and confirm their identity, the collected fingerprint is then compared to a database of saved fingerprints. The system logs their attendance and modifies its records in accordance with the outcome of the successful identification process (Hari et al., 1997; Onur & Bahar, 2016).An important benefit of an attendance system based on fingerprints is its high degree of accuracy and

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 8, No.3, August : 2024

IV.PROPOSED SYSTEM

This section provides a detailed explanation of the procedures followed in order to construct the attendance system. There are multiple modules that make up the development process.

4.1 Input Image:

A picture is the primary input for the model; it might be in the JPEG, PNG, or BMP formats**.**

4.2 Image Pre-Processing:

When preparing images for model training and inference, pre-processing is an essential step. In order to improve accuracy and simplify the model, formatting the photos is required. Reorienting images, changing colors, and resizing them to the right size are examples of pre-processing processes.

4.3 Face Detection:

Finding faces in the input image is the first step in the MTCNN process. Many neural networks, including P-Net, R-Net, and O-Net, are used to do this. Each network is responsible for progressively enhancing the face detection process in order to raise accuracy. Finding the bounding box coordinates of the faces found in the input image is the result of the face detection stage.

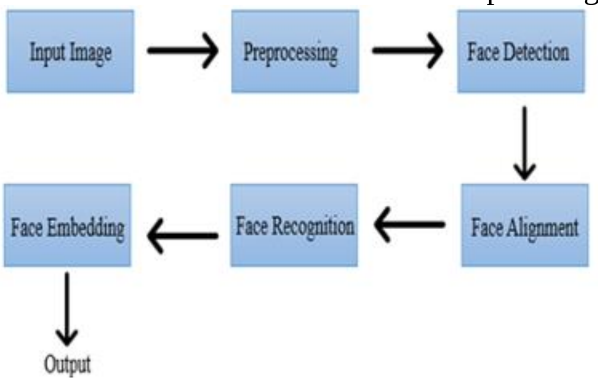

Figure.1 Flow Chart

The figure1 shows the flow chart of system

4.4 Face Alignment:

After face identification in MTCNN, The bounding box coordinates obtained in the previous phase are used to align the facial region to a standard posture. Facial landmark detection is a technique that adjusts for head tilt, rotation, or scale imbalances that may be present in the input image, improving the accuracy of the face identification phase that follows. P-Net, R-Net, and O-Net are three components of the MTCNN architecture that are used for effective facial landmark detection**.**

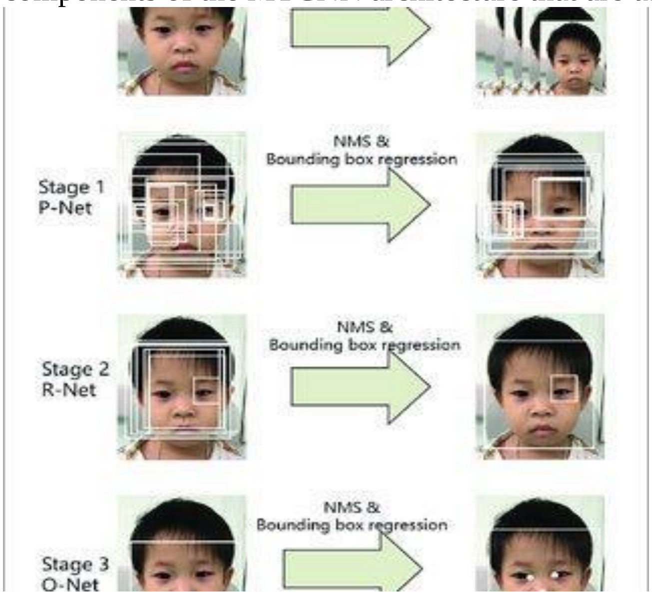

Figure. 2. Neural Network Embedding

4.5 Face Embedding:

A "face representation" or "face descriptor" is a distilled set of characteristics. Is created from the aligned facial region. By using a deep neural network. The encoded features capture the distinct qualities of the face and can be cross-referenced with other face descriptors to see should they pertain to the same person. A brief representation of the face that can be utilized for precise and effective facial recognition is what a facial descriptor essentially is.

4.6 Face Recognition:

To determine whether there is a match, the created face descriptor is compared to an existing database of face descriptors. Use a similarity measure, such as Euclidean distance or cosine similarity, this technique compares two face descriptors. The faces are recognized as belonging to the same person if the estimated similarity is less than a predetermined threshold, and the system produces the corresponding identity based on the database entry.

Algorithm

i. Take a picture of the person
ii. Use preprocessing methods to enhance the quality of the image
iii. Find and extract facial features using detection algorithms
iv. Align the landmarks on the face, then make a feature map
v. In the event that you are enrolled: Store the characteristic map in the database. Otherwise, look for a match between the feature map and those in the database. Enter the attendance information by keeping the outcome in the attendance sheet.

Rather than using several user photos as in other computer vision systems, our method uses a feature map, which results in a notable increase in precision. Our technology removes the frequent issues with existing approaches, like recognizing errors caused by poor illumination, poor image quality, or eyewear.

4.7 Workflow of MTCNN

Three stages are P-Net, R-Net, and O-Net. Of a three-stage procedure used to recognize and detect faces using the MTCNN, a sophisticated neural network structure. The initial step of the architecture, called P-Net, is in charge of producing potential face regions in an input image. Using a variety of filters, a fully convolutional network called P-Net extracts a number of potential facial areas. and the confidence scores that go along with them from the input image. R-Net is the name of the architecture's second tier. And it is in charge of improving the facial regions that P-Net first recognized. It is a fully convolutional network, similar to P-Net that uses the recognized face areas as input and increases their accuracy by removing false positives and honing the bounding box's precision**.** R-Net, the architecture's second step, is in charge of enhancing the face regions that P-Net initially identified. It is a fully convolutional network, similar to P-Net that uses the recognized face areas as input and increases their accuracy by removing false positives and honing the bounding box's precision. The last component of the design, the O-Net phase, is in charge of creating face landmarks and honing the bounding box. Using the revised candidate face regions from R Net as input, O-Net is a sophisticated deep learning network that can identify important facial landmarks like the corners of the eyes, nose, and mouth.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 8, No.3, August : 2024

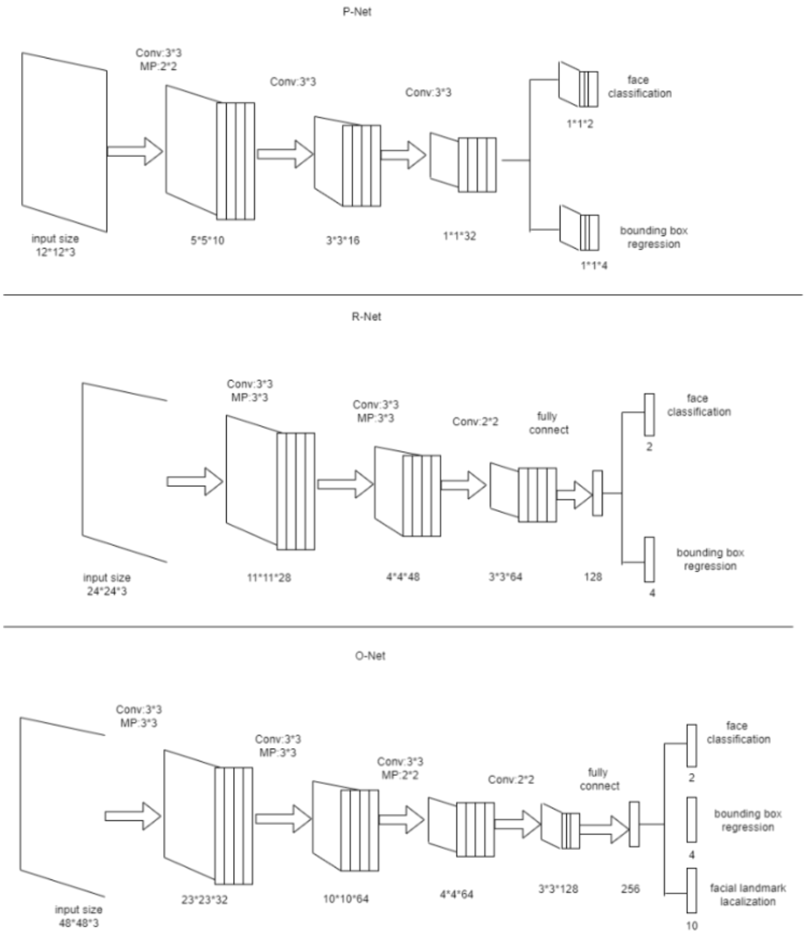

Figure3 MTCNN Architecture

The MTCNN's three steps work together to create a cascading structure that iteratively improves the face detection process. Resulting in a more accurate result in the end. A collection of bounding boxes or other related applications is the MTCNN network's output

P-Net (Proposal Network):

Given an input image patch of size, the output of the P-Net consists of:

i. Bounding box coordinates for potential face regions
ii. Confidence scores indicating the probability that the region contains a face.
iii. Mathematically, the P-Net performs the following Convolution where, denotes the convolution operation, is
iv. The convolutional filter weights, is the activation function, and is the bias term. (e.g., ReLU).
v. Bounding Box Regression: where is the predicted bounding box coordinates, and regression function.
vi. Face Classification: where is another convolutional operation followed by softmax activation to output confidence scores.

R-Net (Refinement Network):

i. The refined bounding box candidates from the P-Net, the R-Net further refines
ii. The bounding boxes and provides more accurate face classification scores.
iii. The mathematical expressions are similar to P-Net but with potentially more complex architectures and parameters.

O-Net (Output Network):

Final bounding boxes face landmarks, and confidence scores are generated by O-Net. Let be the R-Net refined bounding boxes.

O-Net's output is comprised of:

- Final bounding box coordinates.

- Facial landmark coordinates for each landmark point.
- Confidence scores indicating the probability that the region contains a face.

Mathematically, the O-Net performs similar operations as P-Net and R-Net but with additional layers and outputs.

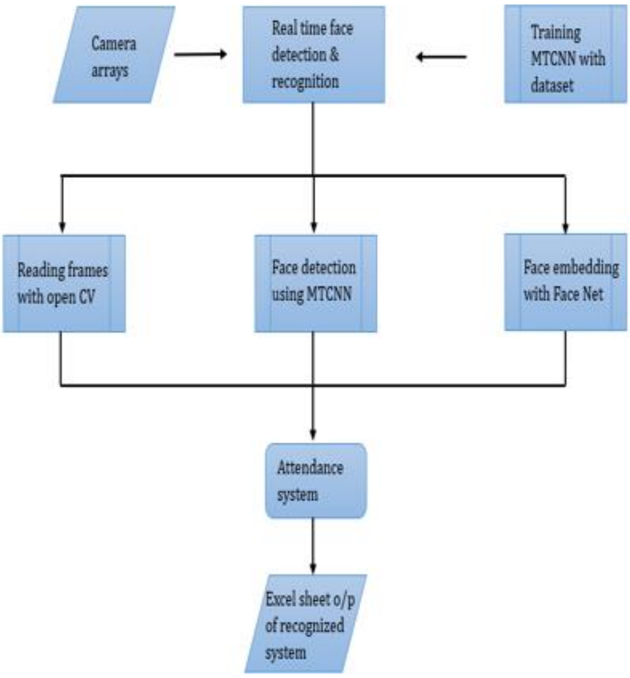

Figure 4 MTCNN Representation

Pseudocode for angle detection

if face Detected then
Calculate angle from face landmarks;
if $\{\theta1\exists\alpha1\}$ and $\{\theta2\exists\alpha2\}$ then
Detected as Frontal Face;
else if $\theta1$ > $\theta2$ then
if $\theta1$ < 45 degrees:
Detected as Slightly Right Profile;
elif $\theta1$ > 135 degrees:
Detected as Highly Right Profile;
else:
Detected as Right Profile;
else if $\theta1$ < $\theta2$ then
if $\theta2$ < 45 degrees:
Detected as Slightly Left Profile;
elif $\theta2$ > 135 degrees:
Detected as Highly Left Profile;
else:
Detected as Left Profile;
else:
Detected as Undefined Profile;
End

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 8, No.3, August : 2024

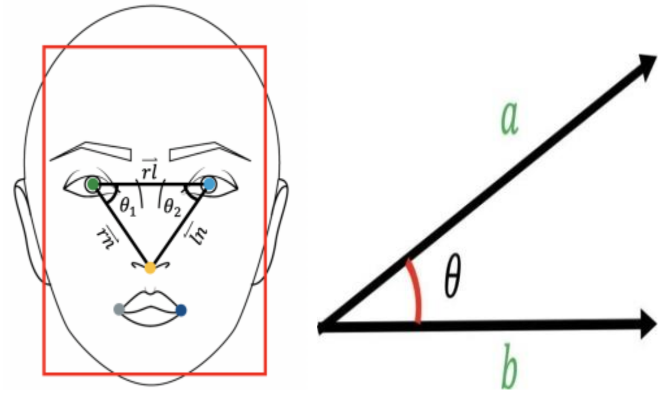

Fig. 5 Face angles and its representation [11]

We set the thresholds to α1 = [35… 57] and for α2 = [35…58], thus the prediction would be

Frontal Face, if $35 \leq \theta 1 \leq 57$ and $35 \leq \theta 2 \leq 58$Pose Prediction = Right Profile,
If $\theta 1 > \theta 2$
Left Profile, Otherwise.

Pseudo code of MTCNN Algorithm

```
def mtcnn (image):
  # Stage 1: Proposal Network (P-Net)
  # generate candidate windows and bounding box regression vectors
  pnet_boxes = pnet (image)
  # Stage 2: Refine Network (R-Net)
  # Filter the windows and unite boxes with NMS
  rnet_boxes = rnet (pnet_boxes)
  # Stage 3: Output Network (O-Net)
  # Get the final face detection boxes and positions of face feature points
  onet_boxes = onet (rnet_boxes)
     return onet_boxes
```

V.RESULT & DISCUSSION

5.1. Frontal & Left Angles

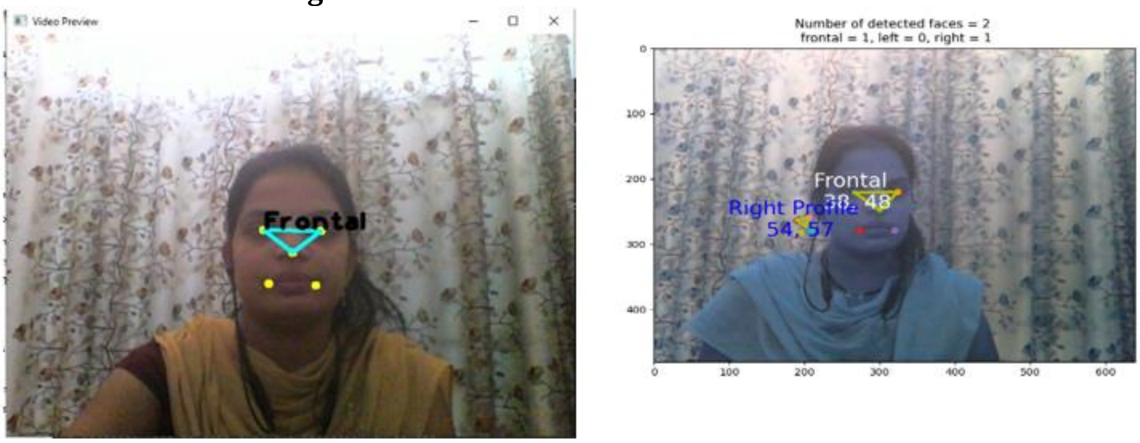

Figure 5.1.1 frontal angles representation

The figure 5 shows the frontal angle representation. The degree to which a person's face is turned away from a direct frontal position is known as the "frontal angle". It is a measurement of the angle formed by the face's axis and the camera's or observer's line of sight.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 8, No.3, August : 2024

5.2. Angles Variation Graphs

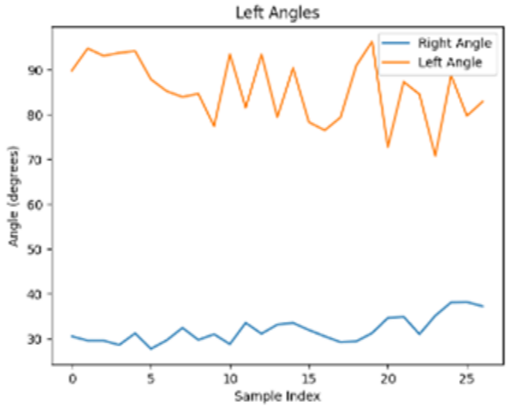

Fig 5.2.1 Left angle graph

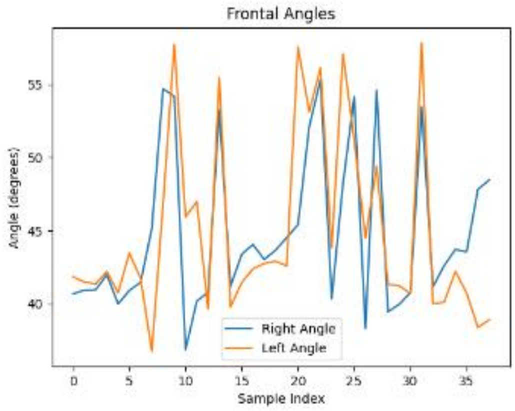

Fig 5.2.2 Frontal angle graph

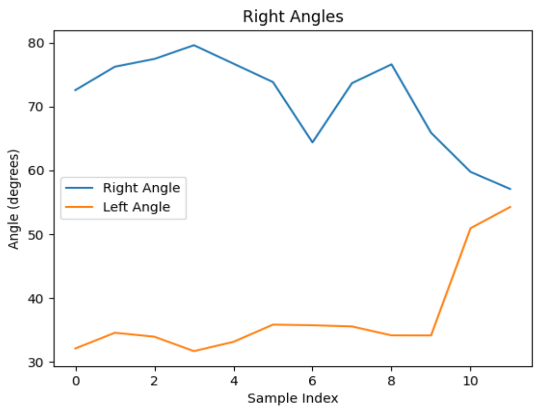

Fig 5.2.3 Right angle graph

Figure 6 angles graph representation.

The figure 6 represents the line chart-based graph representation of left right and frontal angles. When the user is moving to any side like left or right the variation in the angles is represented and it is stored in angles array.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 8, No.3, August : 2024

5.3. Accuracy of algorithm

Factor	MTCNN	Deep CNN	Cascade CNN
Accuracy	96.2 %	70 %	71 %
Handling the alignment of pose variation	High Moderation	High	High
Complexity	High	High	Moderate

Table 5.3.1.Accuracy of algorithm

5.4. ROC Curve

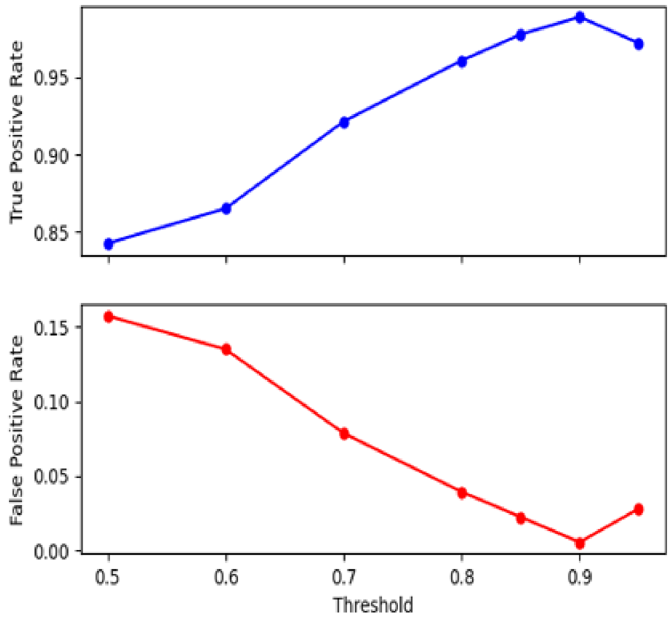

Figure 4.4.1 ROC Curve

The ROC curve with true positive and false positive rates is displayed in figure 7.

5. Confusion Matrix

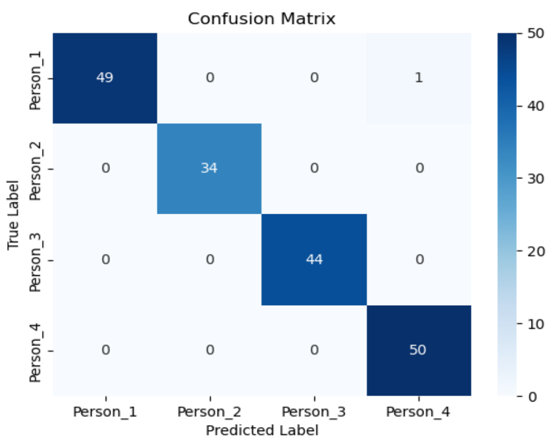

Figure 4.5.1 Confusion Matrix

The figure8 shows the confusion matrix with predicted label and true label.

VI.CONCLUSION

The research suggests that the recommended approach builds a computerized attendance system for efficient classroom management by utilizing facial recognition and detection technologies. Using a camera to identify faces, the method makes facial identification attendance marking easier by updating attendance records for those pupils. This project's main goal is to record video, break it up into individual frames, combine it with a database to check for student absences, and record attendance in real-time to ensure precise documentation. By accelerating speed and accuracy, our Automated Classroom Attendance System may accomplish the high-precision real-time attendance required for automated classroom evaluation. Thus, this article's main goal is to capture student films and create frames from them. Validate their attendance by cross-referencing them with the dataset, and mark attendance for every student independently in order to ensure precise records.

References

[1] "Automatic Attendance Management System Using Face Recognition," Jumon Joseph and K.P. Zacharia, International Journal of Science and Research, 2017.
[2] P.C. Senthil Mahesh, Shashikala, Rudra Kumar, K.P. Zacharia and Jumon Joseph, "Automatic Attendance Management System Using Face Recognition," International Journal of Science and Research, 2017.
[3] "Class attendance management system using facial recognition," International Conference on Automation, Computing, and Communication 2020, Clyde Gomes, Sagar Chanchal, Tanmay Desai, and Dipti Jadhav.
[4] Chun-Ling Lin and Yi-Huia Huang, "The Application of Adaptive Tolerance and Serialized Facial Feature Extraction to Automatic Attendance Systems," are presenting at the International Conference on Innovative Computing and Communications. published by Springer in Berlin/Heidelberg, Germany in 2021.
[5] The International Journal of Engineering Applied Sciences and Technology published an article titled "Automated attendance system with face recognition." in 2021 by Akash Singh, Shreya Bhatt, and Abhishek Gupta.
[6] "Partha Chakraborty, Mahmooda Khatun, Chowdhury Shahriar Muzammil, and Fahmida Islam, "Automated Student Attendance System Using Face Recognition," International Journal of Engineering & Advanced Technology, 2020.
[7] The article "Attendance management using face recognition" was published in the International Journal of Engineering Research & Technology in 2021 by Prajakta Kotha Wade, Sandhya Patidar, Riya Falle, and Arati Pad ula.
[8] [Ms. Shinde Shraddha, Mrs. Patil Priyanka, "Webcam Based Attendance System." 2011 Second International Conference on Applications of Computational Intelligence..
[9] Efficient zone tracking using parametric models of geometry and illumination, G. D. Hager and P. N. Belhumeur, IEEE Trans. PAMI, vol. 20
[10] Using adaptive tracking to categorize and track activities in a site, W. E. L. Grimson, C. Stauffer, R. Romano, and L. Lee, Proc. IEEE Conf. CVPR.
[11] Systems, Man, and Cybernetics Trans., Part C: Applications and Reviews, Vol. 34, No. 3, August 2004, Santa Barbara, CA.
[12] Illumination-tolerant face verification of low-bitrate JPEG2000 wavelet pictures using sophisticated correlation filters for handheld devices, Vol. 44, pp. 655-765, 2005, S. L. Wijaya, M. Savvides, and B. V. K. V. Kumar.
[13] Mahyidin, M.F. RFID-Based Student Attendance System. Available from: http://umpir.ump.edu.my; 2008–December 2012
[14] B.N. Gatsheni, F. Aghdasi, and R.B. Kuriakose. Using radio frequency identification to automate a student class attendance register in South Africa. in Mechatronics, ICM2007 4th IEEE International Conference on. 2007.
[15] Department of Computer Science and Technology, Indian Institute of Engineering Science and Technology, ZShibpur, Howrah, India, Sayan Seal, Aishee Sen, Ritodeep Mukerjee, and Asit Kumar Das, vol. 02, May 2020

[16]Department of Computer Engineering, Premier Automobiles Road, Kurla (W), Class Attendance Management System utilizing Facial Recognition, vol. o7, no. 3, Mar. 2020; Clyde Gomes, Sagar Chanchal, and Tanmay Desai

[17]"Attendance Management system using Face Recognition," International Journal of Engineering Research & Technology (IJERT), Vol. 10, Issue 08, August 2021, Sandhya Potadar, Riya Fale, and Prajakta Kothawade

[18] Yu and associates (2022) Research on face categorization using enhanced GoogleNet technology was conducted by Dong Y, Cheng J, Sun M, and Su F. 2022, 1-6; Network Security and Communication.

[19] In 2022, Vu, H. N., Pham, C., and Nguyen, M. H. Masked Convolution neural networks and local binary patterns are used for face recognition. 5497–5512 in 52(5) Applied Intelligence.

[20] Raharja, N. M., Chamim, A. N. N., & Fathansyah, M. A. (2022). Using the Eigenface algorithm, a vehicle parking security system can detect faces through facial recognition. 3(1), 78–85, Journal of Robotics and Control (JRC).

[21] Wang et al. (2020): You, J.; Li, Y.; Zou, T.; Wang, X.; Luo, Y. An innovative method for classifying images using dense-Mobile Net models. 2020: Mobile Information Systems.

[22] Areni, I. S., and Aza, V. (2019, September). Local binary pattern histogram is utilized for face identification in people with visual impairments. 2019 International Seminar on Information and Communication Technology Application (iSemantic) (pp. 241-245). IEEE.

[23] Nandhini, R., Chokkalingam, S. P., & Duraimurugan, N. (2019). Attendance system based on facial recognition. Journal of Engineering and Advanced Technology International (IJEAT), 8(3S).

[24] Rebeiro, J., & Shetty, A. B. (2021). LBP classifiers and Haar cascade are used for facial recognition. Proceedings of Global Transitions, 2(2), 330-335. Gao, J., and Yang, T. (2022)

[25]An enhanced TinyYOLOv3 and attention mechanism form the basis of the face detection system. 181, 329-337; Computer Communications.

[26] Moon, B., Kim, J., Hyun, J., Kim, Y., & Choi, C. H. (2022). Face detection with haar cascade classifiers based on vertical component calibration. Human-centered computing and information sciences, 12(11).R. Nicole, "Paper title with only initial letter capitalized," J. Name Stand. (Abridged, forthcoming).

[27] Mehdi Javed Barmon, S. K., Nowrin, I., Majumder, A., Shamrat, F. M., Antu, P. R., & Ranjan, R. (2022). Haar cascade classifier is used for human face identification. The ICPCSN 2021 Proceedings on Pervasive Computing and Social Networking (pp. 143-157). Singaporean Springer.

[28] Mitsubishi Electric Research Lab TR-20003-96, vol. 3, no. 14, p. 2, 2003; Jones, M. and Viola, P., Fast multi-view face identification.