Class Attendance Management System Using Face Recognition

Mr.P.Madhavan [1], P.kathiravan [2] ,P.kavi Kumar [2] ,S.vishwa [2]
AssistantProfessor [1],UG Student [2] Department of Electronics and Communication Engineering
MuthayammalEngineeringCollege–Rasipuram,Namakkal(D.t),TamilNadu-INDIA

Abstract- Technological developments in the fields of artificial intelligence (AI) and the Internet of Things (IoT) have produced creative solutions for a range of applications in recent years. Automation of attendance tracking systems in businesses and educational institutions is one such use. Conventional approaches to measuring attendance are frequently laborious, prone to mistakes, and unable to monitor in real time. This study suggests a Smart Attendance Tracker system that uses the ESP32 camera module and AI approaches to overcome these issues. The suggested solution makes use of AI-powered computer vision algorithms to instantly identify and distinguish faces in photos taken by the ESP32 camera. With the use of facial recognition technology, people can be accurately identified without the use of biometrics or manual entry. The AI algorithms and camera module are seamlessly integrated by the ESP32 microcontroller, which guarantees minimal latency and effective processing. Face detection, face recognition, and attendance logging modules are some of the system's essential parts. The system recognises a face and verifies who it is by comparing it to the pre-registered database. Administrators can then view attendance data in real-time as attendance records are automatically updated in a centralised database.

Keywords-Smart Attendance Tracker, Artificial Intelligence, ESP32 Camera, Computer Vision, Face Recognition, Attendance Management.

I. INTRODUCTION

Effective attendance tracking is essential for effective organisational management in today's corporate and educational settings. However, when it comes to precision, dependability, and the use of cutting-edge technology, traditional approaches frequently fall short. Presenting the Smart Attendance Tracker, a revolutionary solution that combines the adaptability of ESP32 camera technology with the power of Artificial Intelligence (AI) via Neural Networks. The combination of ESP32 camera technology and AI, specifically Neural Networks, signifies a paradigm change in attendance tracking. This novel approach improves accuracy, security, and adaptability to various contexts in addition to streamlining the procedure. The solution reduces error margin and eliminates manual intervention by autonomously identifying and recording attendance through the utilisation of Neural Networks. The ESP32 camera's quick and effective high-resolution picture capturing is utilised by the Smart Attendance Tracker. The Neural Network, which is taught to identify and categorise people based on face traits and patterns, uses these photographs as its input data. The Neural Network improves its accuracy through iterative learning, guaranteeing accurate identification even with different facial expressions and ambient situations. This system's adaptability is one of its main features. The Smart Attendance Tracker is a customised attendance tracking solution that can be easily adjusted to many settings, whether it is used in workplaces, classrooms, or events. Furthermore, immediate attendance updates are made possible by its real-time processing capabilities, which help with resource allocation and decision-making in a timely manner. AI integration also improves security protocols in addition to automating the attendance tracking procedure. The technology ensures accountability and integrity inside the organization by mitigating the dangers associated with proxy attendance using features like facial recognition. Apart from its operational effectiveness, the Smart Attendance Tracker highlights a dedication to sustainability by diminishing the amount of paper waste and energy used in comparison to conventional attendance techniques.

II. RELATEDWORK

Relevant research on smart attendance tracking systems provides important information about the conception, application, and efficiency of these technologies. Swarnajit Bhattacharya, et.al shows the use of the Open CV Python package, which handles images. It performs the task using PC Vision computation. Face acknowledgment is the process of recognising a person's face coupled with the client's approved name. The PC vision process known as "object discovery" helps us identify and locate items in images or videos. Sanyukta Santosh Pawaskar, et.alsuggested the installation of an automated attendance system that maintains the class database and records attendance using facial recognition techniques. The system aims to replace conventional attendance methods by being implemented in every classroom and intelligently recording student attendance. Shreyak Sawhney, et.alprovides a model that uses Eigenface values, Principle Component Analysis (PCA), and Convolutional Neural Networks (CNN) to construct an automatic attendance management system for students in a class. Following this, a comparison with the database holding the faces

of the students should make the connection between the recognised faces possible. This model will be an effective way to keep track of kids' attendance and records. Rudy Hartanto, et.al presents the process of developing and implementing a face recognition system involves four stages. The four stages of the method were: feature extraction, normalisation of facial features, alignment with the help of the Haar Cascade algorithm, skin colour detection, and classification with the help of the LBPH algorithm. Additionally, the process would be carried out to replace the current system with the constructed system. Jian P. Li, et.al demonstrates a fingerprint- based solution for improved attendance control in a university setting. Using the waterfall process, it was developed. There are two steps in this system: enrollment and identification. A person's fingerprint is taken upon enrollment, its distinctive traits are retrieved, and both the user's data and the fingerprint are kept in the database as a template for the topic. Before an attendance record is created, the fingerprint of the subject is taken once again during identification, and the extracted feature is compared in a ratio of 1: N-templates with the template in the database to find a match (a user). Java programming was used to develop the improved attendance management system on a Net Beans IDE framework.

III. SYSTEM COMPONENTS

A. ESP32 Camera Module

The ESP32 camera module is a small and adaptable gadget that combines a camera and an ESP32 microcontroller. This allows developers to design a wide range of Internet of Things applications that need computer vision and image processing. Usually, this module comes with an OV2640 camera sensor, which can capture images with up to 2 megapixels of resolution. It offers smooth integration for taking, analysing, and sending pictures by communicating serially with the ESP32 microcontroller. The camera module can wirelessly communicate data to other devices or a centralised database thanks to the ESP32 module. Its dual-core processor has the processing ability to handle images in real time.

Fig 1 ESP 32 Camera

A. Register Phase

The act of combining disparate data sources into a single coordinate system is known as face registration. Labels are used to store facial traits. There are two types of picture alignment or registration algorithms: intensity-based and feature-based. Facial photos are used by facial recognition systems to identify individuals. Face recognition systems do more than only verify that a legitimate identity (ID) or key is being used; they also confirm the presence of an authorised individual. The database in this module contains student information. A real-time camera records the student's face. The faces have names attached to them and are trained. Admin is in charge of maintaining the details. Only newly registered student faces are allowed to enter the attendance process; otherwise, the system prevents it. The database and student attendance records are kept up to date by the admin.

B. Face Capture

Artificial intelligence (AI) that replicates human facial recognition is known as face recognition. Facial recognition software collects facial features and builds a pattern of those elements, just like a human does, which it uses to identify or classify faces. This module uses an ESP32 camera to take pictures of the faces of the students. Bounding boxes are used to detect the faces that were captured. The camera module is used to take attendance and photograph the faces of new users. The faces that are captured are used in the detecting procedure.

C. Face Detection

In biometrics research, face recognition from picture or video is a hot topic. An intriguing and effective use of pattern recognition and image analysis is face recognition. Intelligent vision-based human-computer interaction requires facial images. Face processing is predicated on the ability to extract identifying

information from photographs and programme computers to respond appropriately. Surveillance cameras are commonly installed in public areas to record videos, and they are very valuable for security purposes. Acceptance and distinctiveness are the real benefits of face-based identification over other biometrics. Because the human face is a dynamic object with a significant degree of diversity in appearance, face identification in computer vision is a challenging challenge. Accuracy and speed of identification are critical factors in this field. The administrator can train several faces in this module. Webcams can record faces, and still images can be uploaded. The user is shown in this shot with a straight posture, regular lighting, and no occlusion.

E. Features Extraction

In addition to being recorded in real time for registration purposes, student faces also allow the camera to remove background pixels from the face. Use pre-processing techniques in this module to determine which pixels are in the foreground. Take the foreground pixels out of the entire picture. An algorithm for extracting facial features, including skin tone and eye characteristics, has been presented.

Feature vectors are used to build these features. Feature vectors are made for each student in this module. A vector that includes several details about an object is called a feature vector. Feature spaces can be created by combining object feature vectors. The characteristics could collectively represent a full image or just one single pixel. The level of detail relies on what is being sought after or understood on the subject matter of the student. Next, categorise the features and locate the face of a person that matches the database. The person, known or unknown, is provided by the outcome. Provide pupils with their attendance based on a recognised person. Additionally find the unidentified faces and provide the attendance details.

III. METHODOLOGY

While many institutions and organisations consider attendance tracking to be essential, the conventional approaches are frequently unwieldy and ineffective. A unique way to simplify this procedure is to use hardware capabilities like the ESP32 camera module in conjunction with advances in artificial intelligence (AI) and neural networks. This paper describes the process of creating an intelligent attendance tracker with the ESP32 camera and artificial intelligence (AI), more especially convolutional neural networks (CNNs). This system's primary function is its ability to use image analysis to automatically detect and record attendance. The hardware interface is the ESP32 camera module, which takes pictures of people who enter a predetermined region. After that, these photos are loaded into a CNN model that is built with Python. The CNN model has been taught to recognise faces and compare them to a database of people who have registered. Preprocessing and data collecting are the first steps in the methodology. A set of face photos is assembled, guaranteeing variations in angles and lighting to increase the model's resilience. Preprocessing methods like augmentation and normalisation are used to improve the model's capacity for generalisation. Using the gathered facial sample data, CNN architecture is created and trained. Convolutional layers are usually used in the architecture for feature extraction, and fully linked layers are used for classification. The CNN model is installed on the ESP32 microcontroller after it has been trained and verified. Real-time inference may be done directly on the device by integration with the ESP32 camera module, removing the need for constant connections to remote servers and guaranteeing data security and privacy.

IV. DETAILED DESIGN

The suggested method creates a smooth and precise attendance tracking system by integrating ESP32 cameras, Convolutional Neural Networks (CNN), and the Python programming language. CNN is the perfect deep neural network for our objectives because it is well-suited for image recognition tasks. The network can reliably recognize people and log their attendance by learning from face picture data. The hardware element is the ESP32 camera module, which takes pictures of people entering the building. The CNN model that is implemented in Python is then used to process these images. After analysing the facial features, the model compares them to a database of well-known people. The attendance is recorded and an administrator report is created upon successful identification. There are various benefits of combining ESP32 camera technology with AI. First of all, it does away with the necessity for manual attendance keeping, saving on administrative work and possible mistakes. Second, even with different lighting or facial expressions, the application of CNN guarantees strong and trustworthy identification. Furthermore, the system is easily scalable to handle big groups of people, which makes it appropriate for use in both business and educational environments. The system's comprehensive reporting and real-time attendance tracking are advantageous to administrators. They are able to easily keep an eye on attendance patterns, spot trends, and quickly resolve any inconsistencies. The system can also be configured to deliver alerts or notifications in the event of unauthorised access or the absence of important users.

V. CONCLUSION

The Smart Attendance Tracker, which integrates an ESP32 camera and uses AI via a neural network model, provides an advanced solution for managing attendance. The system effectively detects and logs attendance by utilising Convolutional Neural Networks (CNN) and Python, obviating the necessity for human tracking. The ESP32 camera facilitates easy deployment in a range of contexts by improving portability and accessibility. The neural network's robust performance is ensured by its ability to adapt to a variety of facial traits and environmental variables through continual learning. This creative method improves accuracy, lowers mistake rates, and streamlines attendance tracking procedures. The Smart Attendance Tracker, which promises efficiency, dependability, and scalability for enterprises, organisations, and educational institutions alike, is a revolutionary leap in attendance management systems thanks to its mix of hardware integration and artificial intelligence capabilities.

REFERENCES

[1] Sri Krishna swetha, Kone, Kumar, Sandeep, Mahmood, Md: A study on smart electronics voting machine using face recognition and Aadhar verification with IO. Innov. Electr. Commun. Eng. 2019, 87–95 (2019)

[2] Deepika, J., Kalaiselvi, S., Mahalakshmi, S., Agnes Shifani, S.: Smart electronic voting system

[3] Devgirikar, S., Deshmukh, S., Paithankar, V.,Bhawarkar, N.: Advanced electronic voting

[4] Deepika, J., Kalaiselvi, S., Mahalakshmi, S., Agnes Shifani, S.: Smart electronic voting system based on biometrie identification-survey. ICONSTEM- 2017

[5] Devgirikar, S., Deshmukh, S., Paithankar, V.,Bhawarkar, N.: Advanced electronic voting machine using Internet of Things (IOT). NC-RISE 17 5(9), 83–85

[6] Rezwan, R., Ahmed, H., Biplop, M.:Biometrically secured electronic voting machine. R10- HTC (2017)

[7] Lavanya, S.: Trusted secure electronic voting machine. ICONSET 2011 (2011)

[8] Bohil, J., Henrich, C., Kempka, C.: Enhancing electronic voting machines on the example of bingo voting. IEEE Trans. Inf. Forensics Secur 4(4), 745–750 (2009)

[9] Bhuvanapriya, R., Rozil Banu, S., Sivapriya, P.: Smart voting. ICCCT 2017 (2017)

[10] Homepage on Arduino UNO: Available https://datasheet.octopart.com/A00006/Arduino- datasheet38879526.pdf

[11] Homepage on Finger Print Sensor: Available https://www.sunrom.com/p/finger-print-sensor-r305

[12] ESP32Datasheet. Available https://cdn.sparkfun.com/datasheets/IoT/esp32_dat asheet_en.pdf

[13] Homepage on LCD. Available https://www.engineersgarage.com/electronic- components/16x2-lcd-module-datasheet

[14] Homepage on HTTP. Available. https://www.tutorialspoint.com/http/http_parameter

[15] Homepage on LCD. Available https://www.engineersgarage.com/electronic-components/16x2-lcd-module-datasheet

[16] Homepage on HTTP. Available. https://www.tutorialspoint.com/http/http_parameters.html

[17] C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of ELECTRICAL ENGINEERING, Vol.63 (6), pp.365-372, Dec.2012.

[18] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011.

[19] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011.

[20] C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.

[21] Nagarajan C., Neelakrishnan G., Akila P., Fathima U., Sneha S. "Performance Analysis and Implementation of 89C51 Controller Based Solar Tracking System with Boost Converter" Journal of VLSI Design Tools & Technology. 2022; 12(2): 34–41p.

[22] C. Nagarajan, G.Neelakrishnan, R. Janani, S.Maithili, G. Ramya "Investigation on Fault Analysis for Power Transformers Using Adaptive Differential Relay" Asian Journal of Electrical Science, Vol.11 No.1, pp: 1-8, 2022.

[23] G.Neelakrishnan, K.Anandhakumar, A.Prathap, S.Prakash "Performance Estimation of cascaded h-bridge MLI for HEV using SVPWM" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:750-756

[24] G.Neelakrishnan, S.N.Pruthika, P.T.Shalini, S.Soniya, "Perfromance Investigation of T-Source Inverter fed with Solar Cell" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:744-749

[25] C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007

[26] M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022

[27] M Suganthi, N Ramesh, CT Sivakumar, K Vidhya, "Physiochemical Analysis of Ground Water used for Domestic needs in the Area of Perundurai in Erode District", International Research Journal of Multidisciplinary Technovation, pp: 630-635, 2019