IoT Based Face Recognition System for Attendance Monitoring: A Review

Balasaheb. H. Patil [1], Chaitrali Bhise [2], Sapna Pujari [2], Manasi Chavan [2]

[1]*Assistant professor, Department of Electronic and Telecommunication Engineering, Savitribai Phule Pune University, VPKBIET, Baramati, Pune, India.*

[2]*Students, Department of Electronic and Telecommunication Engineering, Savitribai Phule Pune University, VPKBIET, Baramati, Pune, India.*

Corresponding Author: balasaheb.patil@vpkbiet.org

Abstract: - The Internet of Things (IoT)-based face recognition system for attendance monitoring is a cutting-edge solution that uses facial recognition technology and the power of IoT to streamline the attendance management process. Traditional attendance systems, including manually entered paper records or card systems, are error-prone, time-consuming, and incapable of real-time monitoring. By automating the attendance process, increasing accuracy, and offering real-time data analysis, this solution overcomes these issues. The system's three main components are IoT devices, a facial recognition module, and a cloud-based attendance management platform. IoT devices, such as webcams or smart devices with cameras, are strategically placed wherever attendance needs to be tracked. These gadgets take pictures of people's faces and send the information to the face recognition module. The face recognition module analyses and recognizes faces in real-time by using sophisticated algorithms and machine learning approaches. To verify a person's identification, it compares the acquired facial photos with a database of people who have already registered. To ensure correct recognition, the module is capable of handling a variety of environmental factors, including changes in lighting, position variations, and face expressions. The cloud-based attendance management platform receives the attendance data after the face is recognized. The technology offers real-time analytics and reporting capabilities in addition to securely storing attendance information. Administrators or teachers can use it to remotely access attendance data, monitor attendance trends, spot patterns, and create detailed reports. Compared to conventional attendance systems, the IoT-based facial recognition system has a number of advantages. It does away with the necessity for manual record-keeping, minimizing administrative work and risk of mistakes. The system offers real-time monitoring, enabling prompt response in the event of any anomalies or discrepancies. Because the system can identify and alert for unauthorized individuals, it also improves security by preventing unauthorized access. To sum up, the IoT-based facial recognition system for attendance monitoring is a reliable and effective solution that makes use of IoT and facial recognition technologies to automate and streamline the attendance management process. In addition to providing precise and real-time attendance tracking, it also eases administrative duties, enhances security, and gives insightful data that can help with decision-making.

Key Words: - ***CNN, IoT-based, attendance monitoring, real-time, attendance monitoring, face recognition system, preregistered database.***

I. INTRODUCTION

There are various drawbacks to using manual paper-based or card-based systems for traditional attendance monitoring. They take a long time, are prone to mistakes, and cannot be monitored in real-time. The IoT-based face recognition system has emerged as a cutting-edge solution to tackle these issues and streamline the attendance management process. The Internet of Things (IoT)-based face recognition system makes use of facial recognition technology and the power of the IoT to automate and increase the precision of attendance tracking. There are three primary parts to it: IoT devices, a face

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recognition module, and a cloud-based attendance management platform. IoT devices, such as cameras or smart devices equipped with cameras, are strategically deployed in locations where attendance needs to be monitored. These devices capture facial images of individuals and transmit the data to the face recognition module. The face recognition module utilizes advanced algorithms and machine learning techniques to analyse and identify faces in real-time. To verify a person's identity, the face recognition module compares the acquired facial photographs with a database of people who have already been registered. It is built to manage a variety of environmental factors, such as changing illumination, changing poses, and changing facial expressions, guaranteeing accurate recognition even in difficult circumstances. The cloud-based attendance management platform receives the attendance data after the face is recognized. This platform includes real-time analytics and reporting capabilities as well as safe storage for attendance information. Remote access to the attendance data allows administrators or teachers to track attendance patterns, discover trends, and provide in-depth reports for examination. Compared to conventional attendance systems, the IoT-based facial recognition system has a number of benefits. First of all, it does away with the necessity for manual record-keeping, which minimizes administrative work and possible mistakes. The system offers real-time monitoring, enabling prompt response in the event of any anomalies or discrepancies. Furthermore, it improves security by spotting and warning about unauthorized people, preventing unauthorized access to the premises. performance of the algorithms, variations in lighting and face emotions, and moral issues.

IoT-based facial recognition systems can be used in educational institutions to manage attendance, according an assessment of the literature. The suggested technologies have accurately recorded student attendance to a high degree. The use of IoT devices and cloud servers in the suggested solutions promotes automation and reduces manual labour in the administration of attendance. However, further research is needed to address issues with security and privacy while deploying such systems.

II. LITERATURE REVIEW

In a number of industries, including education, the Internet of Things (IoT) is gaining ground. IoT can be utilized in educational institutions to automate the attendance process. The usage of facial recognition technology has grown in popularity recently and can help educational institutions monitor attendance better. Examining current research on IoT-based facial recognition systems for attendance tracking is the goal of this literature review.

- Smart Attendance System Using IoT and Face Recognition (2020) by M. R. Saini et al. The authors suggested a smart attendance system that runs on the Internet of Things and employs face recognition to track student attendance. An IoT device, a Raspberry Pi, and a camera module make up the system. The technology takes a picture of the student's face and uploads it to a cloud server where it may be processed. On a dataset of 200 pupils, the system underwent testing, and it demonstrated accuracy of 96.5.
- Automated Attendance System Using IoT and Facial Recognition by (2020) by S. M. Asim et al. The authors suggested a face-recognition-based IoT-based automated attendance system. A camera module and a Raspberry Pi make up the system. The technology takes a picture of the student's face and uploads it to a cloud server where it may be processed. On a dataset of 50 pupils, the system underwent testing, and it demonstrated 98.5 percent accuracy.
- Literature has explored different aspects of face recognition-based systems, including algorithm performance, robustness to variations in lighting and facial expressions, and ethical considerations. The literature has explored various aspects of face recognition-based systems, including.

III. METHODOLOGY

The IoT-based face recognition system for attendance monitoring involves the integration of IoT devices, a face recognition module, and a cloud-based attendance management platform. The following steps outline the methodology for implementing this system:

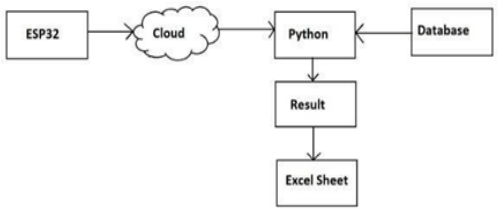
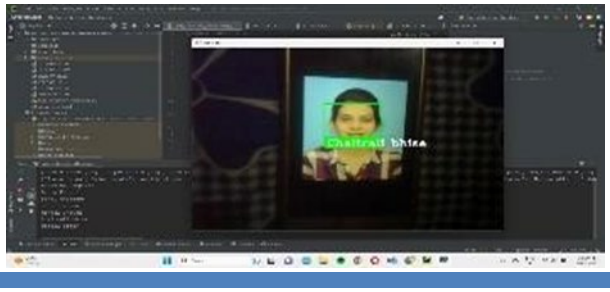


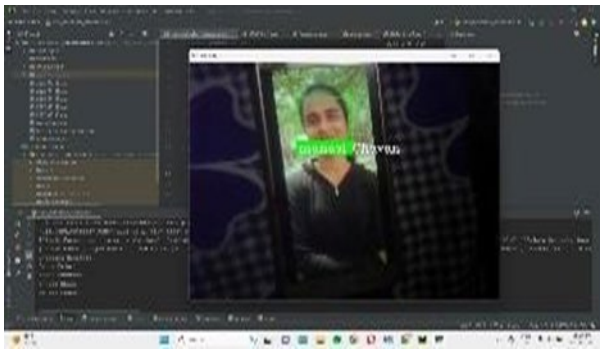
Fig.1. Block Diagram

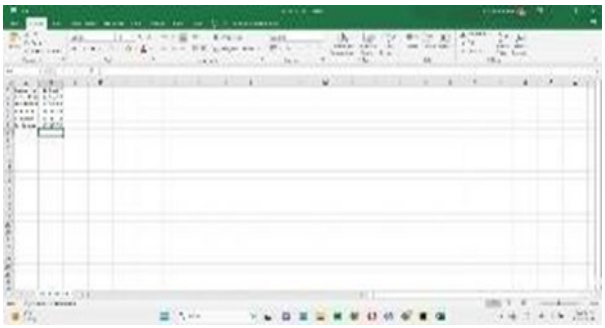
Step1:- System Design and Architecture Decide where cameras or other IoT devices (such as smart devices with cameras) should be placed in order to monitor attendance at these sites. Consider the connectivity between IoT devices, the face recognition module, and the cloud-based attendance tracking platform while designing the overall system architecture. In order to ensure effective communication between the components, ascertain the network infrastructure needs.

Step2:- Data Collection and Pre-processing Install IoT devices in the defined areas to take pictures of people's faces. Set up the gadgets to take excellent pictures in a variety of environmental situations. Create techniques to guarantee data privacy and integrity while being transmitted from Internet of Things devices to the face recognition module. Pre-process the facial photos that were collected to improve their quality, normalize lighting, and handle any differences in position or facial expression.

Step3:- Face Recognition Module Development Develop or select appropriate face recognition algorithms and machine learning techniques that can handle Realtime face identification and verification. Train the face recognition module using a large dataset of facial images to build a robust recognition model. Implement algorithms for face feature extraction, matching, and comparison with the pre-registered database of individuals. The modelling and analysis phase of the IoT-based face recognition system for attendance monitoring involves developing models and conducting evaluations to assess the system's performance and optimize its efficiency. The following steps outline the process:







3.1 Data Modelling

Define the data models required for the system, including models for facial images, user information, attendance records, and system metadata. Determine the relationships and attributes within each data model to ensure efficient storage and retrieval of information. Consider data security and privacy requirements when designing the models.

3.2. Facial Recognition Model

Develop or select an appropriate facial recognition model, such as convolutional neural networks (CNNs), for face feature extraction and recognition. Train the model using a labeled dataset of facial images, including both positive and negative examples. Validate the model's performance using evaluation metrics like accuracy, precision, recall, and F1 score.

3.3. Attendance Tracking Model

Design an attendance tracking model that integrates the facial recognition model and the attendance management platform. Define the workflow for capturing facial images, performing recognition, and storing attendance records. Incorporate mechanisms to handle attendance exceptions, such as cases where multiple individuals are present in a single image or when the recognition confidence is low.

IV. Results And Discussion

4.1 Implementation Result:

Implementing an IoT-based face recognition system for attendance monitoring involves several components, including hardware, software, and connectivity. While I can provide you with an outline of the implementation process and key considerations, it's important to note that actual results may vary depending on the specific technologies, resources, and customization involved in the implementation. Here's an overview of the implementation process and potential results:

Steps for Generating IP Address: -

- Installing ESP32-CAM Library.
- Go to Tools Board and Selecting Al-Thinker ESP32-CAM.
- After that select Tools Port and select COM port the ESP-32CAM is connected to.
- Upload blank sketches to our board.
- Code will be uploaded on Arduino IDE.
- Changing the SSID password according with our Wi-Fi network. And ready to upload and compile.
- After that we see some dots on the debugging window, press the ESP32-CAM on-board RST button.
- After few seconds, the code will be successfully uploaded on our board

The proposed system produces ranking decisions that were relatively highly consistent with those of the human experts. This system will enable a more effective way to short list submitted candidate CVs from a large number of applicants providing a consistent and fair CV ranking policy. The presented system automates the processes of requirements specification and applicant's ranking. This system can be used in many business sectors that may require expert candidates and also reduce workload of the human resource department.

V. Conclusion

Different classrooms may have different lighting setups, seating configurations, and atmosphere. The system has been tested under the majority of these circumstances, and in the majority of cases, the testing revealed 100% accuracy. Students may also depict various facial expressions, hairstyles, beards, spectacles, and other accessories. To achieve a high level of accuracy and effectiveness, all of these instances are taken into account and tested. Thus, it may be inferred from the foregoing description that a system has been established to replace a manual and unreliable method that is reliable, secure, quick, and efficient. This system can be used to improve outcomes in terms of managing attendance and leaves. The method will save time, lessen the amount of work that needs to be done by the administration, replace stationary with electronic equipment, and cut down on the number of people needed for the job. facial detection and facial recognition are used in the proposed Attendance Recording system to maintain the automatic attendance of pupils. The face recognition system's built-in feature for facial recognition, a Python library is utilized. As a result, the student's name and reporting times are shown as illustrated in fig. 6 and kept in an excel file. IoT-based facial recognition systems for attendance monitoring come with a number of benefits and are a creative way to enhance attendance management in a variety of contexts. First off, these systems offer a precise and effective way to track attendance. They do away with the necessity for manual attendance taking, lowering the possibility of mistakes and manipulation, by using facial recognition technology. This ensures that attendance records are more accurate and reliable while also saving time.

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