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Smart Exam Hall Attendance System using Raspberry Pi

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Abstract

With increasing demand for a reliable and automated attendance system has increased the use of embedded systems, facial recognition software, and the Internet of Things (IoT) in schools. In this paper we propose an intelligent attendance management system that is built upon Raspberry Pi, camera modules and performs real-time face detection, alignment, extraction of features and recognition using optimized computer vision and deep learning techniques that can work on limited hardware. To adapt for the changes in light, device position and person expressions, it uses edge computing techniques and small models that enable fast computations (low latency). In educational setups, attendance records are maintained and accessed for real-time tracking, reporting, and analysis of data through web and desktop applications. Results from live trials are showing in class performance, high recognition and low false acceptance rates. The suggested framework enhanced efficiency, accuracy, and reliability with minimal human involvement by offering a scalable, affordable, and fully automated alternative to traditional attendance systems.

Keywords: IoT, Facial Recognition, Smart Attendance System, Computer Vision, Deep Learning, Embedded Systems, Real-Time Monitoring

Introduction

The monitoring of attendance is a basic requirement in any educational institution, as it is a vital parameter for assessing student engagement and discipline. The traditional method used for monitoring student attendance, such as manual roll calls, paper-based systems, RFID cards, and fingerprint scanning, have been commonly used for this purpose[8, 12]. However, there are number of disadvantages associated with the traditional systems, including their inefficiency, human error, proxy attendance, and lack of scalability[10]. With an increase in class size and the use of technology in educational institutions, there is a necessity for an intelligent system for student attendance management.

In recent years, the development of the Internet of Things (IoT), embedded systems, artificial intelligence, and computer vision have opened a new platform for the automation of attendance systems[3, 11]. For example, the IoT has the ability to interconnect smart devices, enabling the processing and transmission of data in real time[3]. In addition, the use of AI in the development of a facial recognition system offers a non-intrusive and reliable approach for the identification of individuals[6]. This provides a platform for the development of a smart attendance system for the identification of students.

Facial recognition is recognized as an effective biometric approach owing to its touchless feature, high degree of accuracy, and ease of implementation[13, 15]. Unlike fingerprint or RFID-based alternative, facial recognition does not require any physical touch or specific tokens, thus improving the level of convenience and hygiene[5]. By using computer vision-based method, facial recognition solutions are able to recognize faces, identify unique patterns, and match them against prerecorded patterns for identifying individuals[6].

With the advent of low-cost cameras and embedded computing solutions like Raspberry Pi, it becomes feasible to introduce facial recognition in educational environments[9, 13]. The application of facial recognition on embedded devices and edge computing devices has its own pros and cons[14]. The application of edge computing allows for the processing of data on devices, eliminating the need for cloud servers. This improves system responsiveness, reduces latency, enhances privacy, and reduces the need for bandwidth[7]. However, devices such as Raspberry Pi have limitations on processing power, memory, and power supply. This calls for an optimized algorithm, a lightweight deep learning model, and an optimized processing pipeline.

The development of a facial recognition system that is effective requires the proper selection of the model, detection methods, and performance optimization[6]. A regular IoT based smart attendance system includes several components. These components are usually interconnected and comprise image acquisition devices, facial detection and recognition components, data storage components, and user interface components[3, 15]. Cameras are used to capture live images or video streams of students attending classes. These images are then processed to detect faces. Face detection is usually carried out using various algorithms like Haar Cascade, Histogram of Oriented Gradients (HOG), Multi-Task Cascaded Convolutional Neural Networks (MTCNN), YOLO and MediaPipe based deep learning-based face detection[6, 15]. After detecting faces, facial alignment and processing are applied to improve accuracy.

Feature extraction algorithms like Local Binary Pattern Histogram (LBPH), Eigenface, FaceNet, ArcFace, and SFace are used to extract numerical values representing facial characteristics. These values are then compared with stored values in a database to recognize students and record their attendance[5, 6]. Apart from facial recognition, an efficient management system on attendance must also encompass the use of powerful data management solutions. This is whereby the cloud computing or hybrid solutions come in to aid the system to efficiently store, retrieve and analyze the data tied to attendance[1, 3]. Web or desktop applications will allow the users to visualize and analyze attendance and student management, and other operations with it in a proper way[4]. On other than this, strong security measures are also needed to establish a good attendance management system that would assist in the security of personal information and adherence to the laws that relate to privacy[10].

The other determinant that is of essence as far as the use of facial recognition systems in the real classroom setting is the aspect of environmental variability. Both detection and recognition accuracy varies with response to changes in lighting conditions, camera angles, facial expression, occlusions and student movement[15]. Thus, effective attendance algorithms should be developed to meet these challenges with the use of adaptive preprocessing mechanisms, image processing filters, image-matching algorithms, and robust recognition frameworks[6]. Optimization techniques, including model quantization, resolution reduction, multi-threading, and runtime acceleration systems (e.g., ONNX Runtime), are commonly used to make sure that the programs can run in real-time on embedded systems[14].

Recent studies proved that it is possible to introduce smart attendance systems based on a set of IoT, embedded computing, and AI-facial recognition systems[1, 3, 15]. Different literature has been conducted on architectures of Raspberry Pi, Bluetooth Low Energy (BLE), cloud-based IoT systems, face detection models based on deep learning, and intelligent analytics systems to improve the performance of systems [1, 7, 9]. Among the advantages of automation mentioned in these works, there are a lower administrative burden, increased precision of attendance, low proxy attendance, and better transparency of academic processes[4, 10]. Nevertheless, more detailed solutions that would be more accurate, computationally efficient, and scalable, as well as based on the real-life use, are still needed[14].

The creation of a smart attendance monitoring system also leads to the expensive smart campus programs. Smart campuses are meant to utilize digital technologies to enhance learning environments, manage the resources better, enhance security, and facilitate the use of data-driven decisions[10]. Attendance automation is part of this ecosystem and allows connecting smoothly to learning management system (LMS), academic analytics, and institutional databases. Such systems helps to provide early intervention policies, enhance student interaction, and aid teachers in tracking academic development, by producing quality attendance information[4].

This study aims at developing and testing an IoT-based attendance management system (facial recognition based) optimized with embedded hardware. The proposed framework would integrate real-time image capture, robust face detection and recognition pipelines, secure data storage systems as well as user-friendly web and desktop interfaces. Its emphasis is on efficient use of constrained resources, increased robustness to environmental variations and real world deployability in traditional classrooms. The system will provide a robust, low cost and privacy-preserving solution that increases attendance accuracy while reducing redundancy in manual tasks and operational complexity. Such functions follow closely to the embedded intelligence and edge computing up to the latest computer vision techniques, focusing on the contribution to development of automated attendance technologies. It is also more efficient and robust, and it lays the groundwork for further system evolution (e.g., behavioral analytics, emotion recognition, smart learning systems interconnectivity). As we continue to experience the digital revolution in learning institutions, smart attendance systems are a significant step towards the development of smarter, more efficient and data-driven academic environments.

Literature Review

Faster growth of digital technology has also introduced major changes in some of the old forms of education and administration, including school attendance management[10]. There are other traditional attendance systems also widely practised as utilizing paper roll call and manual registration, but they have collective drawbacks like being impractical, tenuous information availability, proxy and once for all big overhead operation[8, 12]. With the increasing class sizes and digitalization of universities, there is a need for secure and intelligent automatic attendance system in class[3]. Researchers have attempted variety of technologies such as biometric, RFID, IoT and computer vision based face recognition for improving accuracy of attendance and operational efficiency[1, 3, 15].

RFID and finger-print based biometric solutions were some of the early attempts at automating attendance[2]. The RFID based attendance systems use ID tags that must be carried on a person to be identified at entrance of the classroom/floor[2]. Although such systems help to ease the burden on teachers, they are not tamper-proof and if a student lends his/her RFID card to someone else it does not guarantee that person's proxy attendance[2]. Moreover, readers and card issuances are costly to operate and manage. Fingerprint based attendance systems allow for better identity authentication as they are made up of biometric features that differ from person to person[16]. But they involve direct contact with sensors, bringing hygiene risks and lagging attendance efficiency for big lectures. In addition, the correct rate of fingerprint recognition will be influenced by pollution and damp and damage degree of sensor's surface.

With the rise of computer vision and machine learning, facial recognition has become a viable option for automated attendance monitoring[13, 15]. Face recognition systems allow users to perform unconstrained, non-invasive and natural access control. In contrast to the fingerprint or radio-frequency identification (RFID) systems, facial recognition does not have physical contact or a dedicated access card that could be lost and is thus suitable for real-world classroom environments[5].

The recent rising popularity of embedded hardware platforms like the Raspberry Pi and inexpensive camera modules contributes to cost-effective deployment on a large scale [9, 13].

Some researchers have investigated the deployment of IoT enabled attendance system using embedded systems and network communications [3, 11]. IoT facilitates the connected smart devices to sense, analyze and send data content to centralized databases or cloud environments regarding attendance[3]. These tools often combine sensors, cameras, wireless communication modules and microcontrollers to realize automatic attendance system using IoT[7]. Cloud-based service in such systems makes it possible for the school administrators and teachers to view record attendance from remote places (locations), prepare reports/analyse pupil's participation behavior[1, 4]. Nevertheless, using cloud infrastructure could provoke latency, dependence on bandwidth, and privacy of data.

To overcome the above challenges, many researchers have studied the use of edge computing methods to enable face recognition and processing on embedded computers[14]. This eliminates the need for constant internet connectivity, cuts down the time taken for face-recognition, and improves privacy by storing sensitive data on the device itself. Owing to its small size, lower cost, and compatibility with different computer vision libraries, Raspberry Pi has been used as an edge device for attendance automation[9]. Due to the limited computational power and memory available for the system on a Raspberry Pi, model optimization and algorithm choices become critical for real-time attendance[14].

Face detection, which aims to locate human faces in an image or video frame, is a fundamental module in facial recognition attendance systems. Classical face detection approaches are edge-based (Haar Cascade and HOG)[6]. Haar Cascade is the cascade of weak classifiers trained on positive and negative face samples, providing fast detection but with a low stability when light and pose change[6]. HOG-based detection achieves better shape description and works well in complex situations; however, it still has higher computational complexity for embedded platforms. Although they are pioneering, these techniques are problematic with occlusions in the faces and low resolution images and operating environment.

The initial step of the computer vision in a computer vision face recognition attendance system is the face detection. It identifies the human faces on the pictures and color frames on the video. The Haar Cascade as well as the Histogram of Oriented Gradients are some of the common methods used to detect faces[6]. Haar Cascade classifier The Haar Cascade classifier is an ensemble of weak classifiers that have been trained on positive and negative face samples. It will not withstand changes in the lighting and pose, but it is good at detection speed. HOG-based detection is better at representing the shape and performance of certain complex cases but is too costly to run on embedded systems. There is some limitation with these classical methods when working with occlusions, low resolution images, variations in illumination and cluttered backgrounds which has stimulated the initiation of newer deep learning based methods which have since taken over as the leading tendency in face detection studies.

Convolutional neural networks have the ability to create the hierarchical representation of facial features using huge data collections. It is now easier to identify faces even in crowded photographs, in low-light or when individuals are turned on their side. Nevertheless, a vast majority of the current systems are heavy processing requirements - which are difficult to run with a barebone.

Once the face has been detected systems extract important visual information into few numbers that identify people. Eigenfaces, Fisherfaces, LBPH used to dominate this area[(6)]. A popular method involves the application of PCA so as to reduce the data size, but the outcome is not good when there is a change in lighting. Fisherfaces increase separation between classes by focusing on the differences between groups, but LBPH instead focuses on tiny scale texture changes. Due to its rapidity and good performance in different light conditions, LBPH continues to appear in small systems more than others[(6)].

In recent years, deep learning-based face recognition models have achieved remarkable improvements in accuracy and generalization. Models like FaceNet, ArcFace, VGG-Face, DeepFace and SFace make use of CNN design for discriminative facial embedding[(15)]. These embeddings contain faces in a high dimensional vector space and can be matched by distance function such as cosine similarity or Euclidean distance. ArcFace leverages an angular margin loss and FaceNet uses triplet loss to improve the distinguishability of feature. These deep learning models have surpassed near-human performance on standard benchmarks, but their computational cost is quite high and hence model quantization, pruning and runtime acceleration are required for deployment on embedded platforms[(14)].

Several researchers have explored performance optimization techniques to ensure real-time facial recognition on Raspberry Pi and similar devices[(14)]. Model quantization reduces numerical precision to lower memory usage and computation cost. The strategies of the resolution reduction and frame skipping are aimed to ensure that the processing speed is not reduced at the cost of recognition. Executions can be performed using multi-threading to perform video capturing and inference simultaneously in order to maximise throughput and reduce latency. Importantly, such frameworks as ONNX Runtime and TensorFlow Lite enable to execute deep learning model inference on resource-constrained hardware efficiently.

Besides recognition accuracy, there is also the problem of environmental robustness which is also a major concern when using classroom-based facial recognition devices[(15)]. Lighting, camera, movement of students, occlusions, and change in facial appearance can be very important in the performance of the system. The alignment and preprocessing methods have been suggested by the researchers to equalize the facial pictures before the recognition. Face alignment algorithms are algorithms that correct image orientation through the identification of facial features, enhancing recognition. Noise reduction filters, histogram equalization improve the quality of images in low-light settings. There has also been the use of object tracking algorithms to ensure continuity of the identity through video frames to minimize false positives and irrelevant recognition requests.

Another important feature of smart attendance solutions is attendance data management and integrating the system[(4)]. Most of the research has integrated web based platform or desktop applications to handle attendance records, produce reports, and offer easy to use administrator and faculty dashboards. The latest deployments, as a rule, are on backend systems like Node.js, Express.js, and database platforms like MySQL or MongoDB to store and retrieve attendance data safely.

The facial recognition-based attendance systems need more security and privacy measures[(10)]. Facial data is very sensitive and as such, researchers have insisted on encryption, secure authentication, and access control mechanisms to ensure that it is not used illegally. The edge computing strategies can be used to reduce the privacy jeopardy by storing biometric information on local devices instead of sending it to outer servers[(14)].

Comparative studies carried out on a series of studies revealed that the performance depends on various levels depending on the detection algorithms, recognition models, size of the data set, and the environmental factors[(15)]. Deep learning models have been experimentally demonstrated to be more accurate and strong in recognition than the classical models. However, it is not effective in severe lighting conditions or poor camera view or inadequate training information.

Scalability also comes as an aspect, which is highlighted in recent studies in as far as the attendance management systems are concerned[(3)]. Large learning institutions require those solutions that can assist hundreds and even thousands of students and not significantly deteriorate performance. Attendance record can be synchronized with academic performance data automatically by means of Learning Management Systems (LMS).

Nevertheless, even though there is a great improvement in smart attendance technologies, there are a number of drawbacks. The issue with embedded systems is still their computational capabilities; they are not able to implement the most complex deep learning models. The variability of the real world environment presents persistent issues of reliability of recognition. The moral issues of biometric surveillance and data privacy need stringent policy and technical protection.

All in all, existing sources prove the viability and benefits of facial recognition attendance system based on the use of IoT [1, 3, 15]. The systems highly reduce the burden of the administration, increase accuracy of the attendance, minimize proxy attendance as well as supporting good decisions in learning institutions.

This work is built on the prior research by proposing an optimized IoT-based attendance system to trade off recognition, computational performance, real-time, and privacy protection. The proposed system will overcome the limitations and provide edge computing, efficient face recognition pipeline, and convenient data management solutions to support the development of the smart attendance technologies.

Methodology

The suggested face recognition attendance system is built on the Internet of Things (IoT) employing a methodological and research-intensive approach that ensures a high level of accuracy, automation, scalability, and real-time functioning in a higher institution of learning. The general system architecture is based on the embedding hardware, computer vision, machine learning methods, and the IoT to provide the automated attendance monitoring with minimum human involvement. The system planning and requirement analysis, hardware selection, software development, image acquisition, face detection and recognition, data management, cloud integration, and experimental validation are some of the stages that exist in the development process. These tests assure the system of working well in the actual classroom settings.

The key processing unit integrated in this system is the Raspberry Pi 4 Model B since it has an acceptable balance of computing power, price, size, and power usage. The four core processor and adequate memory can allow real-time performance of image processing and face recognition operations. The Raspberry Pi is attached to a high-resolution USB camera which uses live video streams to display students in the classroom at any given time. The camera records image frames after specified time intervals to have a balance between processing speed and detection efficiency. The system is supported by the stable power supply, and the SD card is applied to store the operating system, trained face datasets, recognition models, and attendance records to provide chances to utilize the system in real-time and off-line modes.

The software structure is coded in Python because it supports multiple computer vision libraries, machine learning as well as embedded system libraries. The system is based on the Raspberry Pi OS that offers the best compatibility with the system hardware parts, camera functionalities, and management of system resources. OpenCV library is being used in real time image processing and face recognition, NumPy is being used in numerical computations and matrix operations that are needed in processes of feature extraction and recognition. Student information, facial templates, attendance, timestamps and authentication data are stored in a structured and safe way using a relational database system like SQLite or MySQL.

Facial recognition commences as the real time camera module captures an image frame. The video frames are handled in series and preprocessed to make them more recognized with high accuracy and with a strong capability to stand in diverse environmental conditions. Some of the preprocessing include conversion to grayscale to make the computation faster, equalization of histograms to ensure that contrast is enhanced in those situations where the lighting is not even, filter to remove noise and resizing of the image to uniform dimension of the input. The steps are used to enhance detection efficiency in a classroom setting where there can be a significant change in the intensity of light, camera angle, facial expression, and partial occlusions.

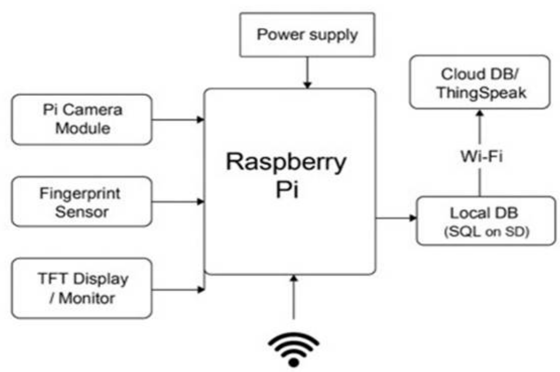

Fig. 1: Architecture Block Diagram of the Proposed System

Face detection is then carried out after preprocessing so as to recognize the facial areas of each image frame. The algorithm of the computer vision detection is adopted to identify and isolate the areas of the face and remove the background information that does not matter. It is an operation that enhances the efficiency of processing as it narrows down to areas that are relevant on the face. After detection of the faces, the areas are levelled and scaled to ensure a uniform orientation, size, and location. The detection algorithm is made to deal with real world issues like motion blur, more than one face on a single frame, distance change between the camera and the objects, as well as, head movement.

The extractions of features produce unique biometric descriptions of faces that are identified. At the enrollment phase several faces of the individual students are taken in various lighting conditions and angles so as to enhance reliability of recognition. The images are then manipulated to get the facial landmarks, structural features, and deep feature embeddings, which is specific to a person. The resultant features of faces are placed in the database as reference templates. At real-time recognition, the templates are compared to similarity-matching algorithms with features obtained in the live camera image. On the occurrence of a similarity score surpassing an assigned confidence value, the system will verify the identity of the student and automatically take note of the attendance. This will be useful in avoiding impersonation and proxy attendance which are the greatest constraints of the traditional attendance systems. The decision-making module will review the results of the recognition as well as decide whether attendance is favorable. After a student has been successfully identified, the system logs the presence of the student and the timestamp of the student as well in the database. The recognition confidence level should be sufficiently high or unambiguous, otherwise, the system can refuse the entry, or it can be signaled to be subjected to additional verification. This is a mechanism that handles data integrity, false acceptance rates and also enhances reliability of the system as a whole. Also, system logs are kept to identify attempts of recognition and system activities to enable auditing, debugging, and performance analysis.

Attendance data, face templates, and other information about the students is stored in a secure database that allows efficient retrieval of the data, reporting of the data and storing of the data in the long run. The schema of the database contains student identification information, attendance time stamps, evaluation confidence scores and system activity records. User authentication, controlling access, and data encryption are security mechanisms that prevent sensitive biometric information and adherence to privacy rules. The system also has the capability of offline storage where the system will still work even in the event where the network connectivity is not available. When reconnected, data stored can be synchronized with servers located remotely.

The system architecture has integrated IoT based cloud synchronization, which allows remote access and real-time tracking. Authenticated attendance records are sent safely to cloud servers through safe communication protocols. This enables the administrators, the faculty and the academic authorities to have access to attendance records, create reports, trends and classroom activities via web-based or desktop interfaces. Data synchronization solutions are created to work in a stable state even in the unstable network environment where data loss can be avoided and coherence between the local and cloud databases may be maintained.

An interactive system is created that includes a user-friendly graphical interface to help interact with the system, visualize and manage it. The interface shows real-time recognition output, attendance confirmation messages, system performance indicators and system logs. Administrative will encompass registration of students, database management, generating attendance reports, record editing and exporting data among various formats. The interface is user friendly and it assists the institutional decision making by offering automated analytics and attendance overview as well as real time monitoring.

There is a lot of testing and evaluation to determine the accuracy of the system, reliability, efficiency of the processing and robustness of the system during real classroom conditions. The experimental trials are carried out at different levels of light, sitting position, camera position and student movement conditions. Some of the performance metrics assessed include recognition accuracy, false acceptance rate, false rejection rate, response time and processing latency. The optimization strategies such as resolution optimization, load balancing of computations, and optimization of the models are applied to provide real time functionality on the resource-sensitive embedded systems. The continuous change of the system improves the accuracy of detection, stability of recognition, and stability.

As the analysis shows, the proposed system is able to achieve a high recognition rate, but with low computation overhead, which makes it applicable in resource-constrained embedded systems. The methodology is such that it makes the solution scalable, cost-effective, safe and practical to implement in learning institutions. The proposed system is a completely automated, contact-free, and efficient attendance management system that uses embedded intelligence, computer vision, and internet of things (IoT) to deliver a fully automated system. This system will cut down on administrative duties, eliminate fraudulent attendance, enhance transparency, and aid in making academic decisions based on data.

Result

The developed and designed IoT based facial recognition attendance system was implemented in real classroom-like environment to check the accuracy, efficiency and reliability during its operation. Natural academic environment performance under experimental test conditions measured through evaluating different lighting conditions, seating configuration and movement of students except natural condition. The system showed a high recognition accuracy, whereby it recognized registered students and registered the attendance at minimal delay. Face detection and recognition operating in real time on the embedded platform were efficient, which verified that it is possible to execute intelligent attendance monitoring over resource-constrained hardware.

The performance analysis established that the performance of the system had been at a high recognition rate with low false acceptance and false rejection rate. The automated attendance marking system also conserved a lot of manpower and eliminated proxies attendance therefore improved the integrity and transparency of the attendance records. The facial recognition module also worked even when the students exhibited natural variations in facial expressions, head-location and partial occlusions indicating that the module is not sensitive to the environmental pressures. The system could also stand in performance where one had more than one face in camera view at a given time which justifies the scalability to be applied in a medium sized classroom.

The results of the experiment prove that the suggested unit is scalable, cost-efficient, and completely automated to manage attendance in a learning institution. With IoT integration connectivity, embedded computing and a computer vision-based facial recognition, the system helps to increase the accuracy of attendance, decreases the workload of administrative staff, and increases the efficiency of institutions. The findings show that intelligent and contactless systems of tracking attendance are practically feasible in the real-life academic setting, a fact that provides a stable basis and future developments and implementation on a mass scale. Additionally, the suggested system is capable of keeping the performance stable even in cases of a long classroom session, the speed of frame processing and attendance logs being consistent and stable. The IoT-based system also enables the integration of the attendance information with the central servers, once the data is synchronized, the chances of data loss are minimized, and the data is kept securely. The embedded platform was also shown to be energy efficient in its operation and hence qualified to be deployed continuously in academics. The scalable nature of the design and its ability to be extended into a number of classrooms with minimal alterations to the infrastructure. On the whole, the system is a viable, automated, and smart solution, which helps to support the digital transformation projects in contemporary educational institutions and optimize the efficiency of operations and data accuracy.

Table 1: Examination Attendance Record

AISSMS IoT Examination Attendance	
Date	2026-01-07
Subject	Analog Electronics
Invigilator	M. P. Gajare
Name	Remark
Arvan	Present
Rohit	Present
Ruhi	Present
Shivam	Present
Sneha	Present
Mayur	Present

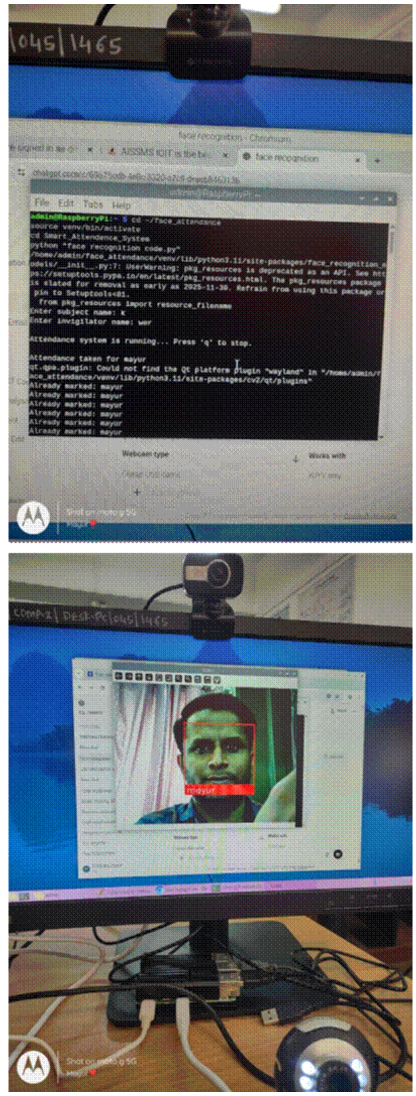

Fig. 2: (a) Terminal Output Showing Real-Time Attendance Marking (b) Real-Time Face Recognition Output on Embedded System

Findings

An experimental evaluation of the proposed IoT-based facial recognition attendance system is performed, which shows that the system can offer an accurate, efficient and automated attendance detection in real-time classroom environments. Deep learning-based facial recognition models significantly outperform traditional feature-based approaches in terms of accurate subject recognition, robustness against variations in light conditions and diversity if human expressions. Both optimized pipeline of detection and recognition, which ensures real-time performance on one side and acceptable computational load for resource-constrained devices on the other side are integrated. Additionally, the system can reduce human workload and swarfing also minimize the proxy attendance and increase the data consistency. Secure data must only be stored in the system with public access and can be assigned by role, thereby providing additional protection for user privacy and ease of administration.

Conclusion

The IoT enabled facial recognition attendance system is a way to manage attendance today. It is cost-effective, reliable and automatic. This system uses edge computing and smart computer vision to automate tasks that take a time to do by hand. By doing it reduces fake attendance and makes recordkeeping more accurate. The system is designed to keep privacy in mind and works in time. This allows it to support users making it suitable for large educational institutions. These institutions can use it for transformation and smart classroom management at a reasonable cost. The facial recognition attendance system helps with attendance management. It makes the process easier and more efficient. The system is helpful for schools and colleges looking for an affordable solution. It provides a level of accuracy and is easy to use. The IoT enabled facial recognition attendance system is a solution. It supports the needs of institutions. The system is a cost- way to manage attendance. It is an automatic approach. The facial recognition attendance system is useful for managing attendance. It helps institutions to keep accurate records.

References

1. Narayanan VA. Smart Attendance Marking System Using Bluetooth Low Energy and Facial Recognition Technology. *International Journal for Research in Applied Science and Engineering Technology*. 2022;10(2):493-500. Available from: 10.22214/ijraset.2022.40305
2. Samaddar R, Ghosh A, Sarkar SD, Das M, Chakrabarty A. IoT & Cloud-based Smart Attendance Management System using RFID. *International Research Journal on Advanced Science Hub*. 2023;5(03):111-118. Available from: 10.47392/irjash.2022.020
3. Akter F, Akhi AB, Farin NJ, Khondoker MM, Saklayen MG. IoTSAMS: A Novel Framework for Internet of Things (IoT) Based Smart Attendance Management System. *Intelligent Control and Automation*. 2018;09(03):74-84. Available from: 10.4236/ica.2018.93006
4. Pakhare N, Walhekar P, Kokate N, Nikule S, Patil S. Smart Attendance Analytics and Reporting. *International Journal For Multidisciplinary Research*. 2024;6(6). Available from: 10.36948/ijfmr.2024.v06i06.31766
5. Al-Mallah RH, Alhelal D, Abdulhammed R. ASSAS: An automatic smart students attendance system based on normalized cross-correlation. *Bulletin of Electrical Engineering and Informatics*. 2021;10(2):732-741. Available from: 10.11591/eei.v10i2.2746
6. Lin CL, Huang YH. The Application of Adaptive Tolerance and Serialized Facial Feature Extraction to Automatic Attendance Systems. *Electronics*. 2022;11(14):2278. Available from: 10.3390/electronics11142278
7. Perez-Siguas R, Matta-Solis EP, Matta-Solis H, MattaZamudio L. Raspberry Pi-based wireless automatic assistance control system used by health center staff. *International Journal of ADVANCED AND APPLIED SCIENCES*. 2023;10(6):1-7. Available from: 10.21833/ijaas.2023.06.001
8. Rohith R, Cherian KG, Nair AR, Athira SR, John R. Real Time Attendance Management. *International Journal of Engineering Research and Technology*. 2019;8(5). Available from: 10.17577/IJERTV8IS050515
9. Kazi S, Pasha F, Gorme F, Bata H. Raspberry Pi in Attendance Tracking System. *International Journal of Computer Applications*. 2017;162(7):15-19. Available from: 10.5120/ijca2017913382
10. Kumar VD, Alam M, Polat K. Interactive Attendance System for Modern Education Using Computational Intelligence. *Journal of the Institute of Electronics and Computer*. 2021;3(1):75-86. Available from: 10.33969/jiec.2021.31006
11. Pella SI, Likadja F, Odja M, Ina WT. Rancang bangun sistem presensi berbasis IoT. *Jurnal Media Elektro*. 2020;:60-67. Available from: 10.35508/jme.v0i0.2969
12. Priya GL, Pandimadevi M, Priya GR, Ramya P. Implementation of Attendance Management System using SMART-FR. *IJARCCE*. 2014;:8532-8536. Available from: 10.17148/ijarcce.2014.31140
13. Shekar SB. Smart Classroom Attendance System Using Face Recognition and Raspberry Pi. *International Journal for Research in Applied Science and Engineering Technology*. 2022;10(7):3175-3181. Available from: 10.22214/ijraset.2022.45718
14. Touzene A, Abed AW, Slimane L. An Embedded Intelligent System for Attendance Monitoring. 2024;. Available from: 10.48550/arXiv.2406.13694
15. Azmi F, Saleh AM, Ridwan A. Smart Management Attendance System with Facial Recognition Using Computer Vision Techniques on the Raspberry Pi. *International Journal of Innovative Research in Computer Science & Technology*. 2023;11(1):38-44. Available from: 10.55524/ijircst.2023.11.1.9
16. Wapanda IA, Dahiru AB. Evaluating the effectiveness and performance of an examination hall attendance system with high performance face recognition and fingerprint technology. *International Journal of Science Research and Technology*. 2025;7. Available from: 10.70382/tijsrat.v07i9.043