

RFID & Face Recognition Based Smart Attendance System Using Raspberry Pi

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Abstract- Smart attendance systems that use radio frequency identification (RFID) and facial recognition technology are cutting edge solutions for automating and securing the recording of attendance. Proxy attendance is common and conventional attendance techniques are tedious. For reliable identification, this system combines RFID with Raspberry Pi-based real-time facial recognition. The device takes a picture of the user and checks it using a facial recognition algorithm whenever they scan their RFID card. In order to indicate attendance, both credentials must be same. Educational institutions and companies benefit from the system's increased dependability, less manual labor, and enhanced security. A secure, automated, and time-saving approach to controlling attendance is the smart attendance system that uses radio frequency identification and facial recognition technology. A combination of hardware components such as a Raspberry Pi, USB camera, RFID reader, LEDs, buzzer, and LCD and software technologies such as face recognition and cloud-based messaging allows the system to reduce human contact and eradicate fraudulent attendance. This innovative method of reliable and accurate attendance monitoring might be useful for any kind of institution, including but not limited to schools, colleges, workplaces, and organizations.

Keywords: RFID, Face Recognition, Raspberry Pi, Smart Attendance System, Biometric Authentication, OpenCV, LBPH Algorithm, Computer Vision

I. INTRODUCTION

To keep track of who is present and engaged, institutions like schools, universities, and organizations rely heavily on attendance management systems. Despite their widespread usage, traditional attendance systems have a number of drawbacks, such as relying on paper records or human registers. Time, physical labor, and the possibility of human mistake characterize these approaches. Furthermore, the accuracy and reliability of the data might be

compromised in manual attendance systems due to proxy attendance, which occurs when one individual marks attendance in place of another. Consequently, these issues need a safe and automated attendance system.

The proliferation of smart attendance systems is directly attributable to the meteoric rise of AI and embedded system technology. Automated data capture and identity verification are made easier by technologies like face recognition and radio frequency identification (RFID). Face recognition technology uses a person's facial traits to confirm their identity, whereas radio frequency identification (RFID) technology enables users to scan a unique RFID card to identify themselves. Incorporating both of these technologies into the attendance system strengthens its defenses against intrusion.

With the help of Raspberry Pi and RFID and face recognition technology, we can automate and enhance the accuracy of the attendance process. An RFID reader, USB camera, LCD screen, LEDs, and a buzzer are all part of this system's hardware, which is mostly controlled by a Raspberry Pi. The system reads the card ID and takes a picture of the user's face using the USB camera at the same time as they scan their RFID card. To ensure that the user is who they say they are, the facial recognition system checks the picture against a database.

After the user's identification has been properly validated, the system will indicate their presence and show the result on the LCD panel. Upon successful authentication, a green LED indicator will turn on and the buzzer will make one beep sound. To notify the user of an incorrect entry, the system lights a red LED and makes numerous beep noises if the user is not

registered or if the facial recognition fails. Whether or whether their attendance has been logged successfully may be understood by users with this rapid response.

The system's automated data management is another important aspect. An Excel file is immediately created to record the attendance data, which includes the user's name, date, and time, for future reference. There will be less administrative labor and no need for human data input thanks to this digital record keeping. Teachers and administrators may also keep tabs on student attendance from afar in real time thanks to the system's ability to send alerts to a Telegram account. In sum, by integrating RFID, facial recognition, and Raspberry Pi, the suggested system offers a clever, dependable, and effective method for tracking attendance. Not only do these technologies work together to make attendance records more accurate, but they also make things more secure and transparent. When precise attendance monitoring is crucial, this technique works well in classrooms, offices, and other similar settings.

II. LITERATURE SURVEY

The limitations of human attendance monitoring have prompted some researchers to propose automatic solutions. In the beginning, most systems relied on manual registers, which were labor-intensive, prone to human error, and mostly utilized as stand-ins for actual attendance. As a result of these issues, several research have investigated the possibility of using automated technologies such as radio frequency identification (RFID), biometrics, and face recognition to improve attendance monitoring systems. Several studies have looked at attendance systems that use radio frequency identification. Everyone who works for or attends these institutions receives an RFID card that has a unique identification number. When an RFID scanner reads the card, the system instantly logs the information into a database, keeping track of attendance. Radio frequency identification technology enables less human interaction and faster attendance tracking than traditional methods. Researchers have shown that RFID devices are insufficient to prevent proxy attendance as users may always give over their RFID cards to another individual. To top it all off, scientists have developed attendance

systems that use face recognition software to beef up safety. Devices equipped with image processing algorithms may recognize faces when the user directs the camera's beam toward a person. It is common practice to use algorithms such as Haar Cascade, PCA, and LBPH for face recognition and identification. Scientists have shown that face recognition algorithms can reliably identify individuals and automatically record attendance data, all without any human intervention.

More and more research is focusing on multimodal attendance systems that include several technologies such communication modules, face recognition, fingerprint biometrics, and radio frequency identification. The use of several authentication mechanisms allows these systems to surpass single-mode systems in terms of security and dependability. An RFID-facial recognition hybrid is one multimodal system that verifies the user's identity and the card's legitimacy before recording attendance in an effort to significantly reduce fraud and impersonation. In addition, researchers have been working on attendance systems that use cloud connectivity and IoT technology in the last several years. Digital databases, spreadsheets, or cloud services automatically save the data, and administrators may remotely monitor attendance using these technologies. Faster access to attendance figures, better transparency, and less administrative work are all results of the automated data storage and real-time communication capacity.

The study's authors concluded that an RFID/facial recognition software hybrid was the most effective method of attendance tracking. Based on these findings, the proposed project would include implementing a Raspberry Pi-based smart attendance system with RFID and facial recognition capabilities. Users would be notified using messaging platforms, and the technology would digitally retain attendance records automatically.

In 2011, K. Susheel Kumar, Vijay Bhaskar Semwal, and R. C. Tripathi developed an automated system that uses the AdaBoost and PCA algorithms to recognize and label the presence of individuals in laboratories.

Using face recognition technology, Djoanna Marie V. Salac (2020) proposed an Android-based attendance monitoring app to improve the efficiency and reliability of class attendance management. A deep learning-based face recognition attendance system was developed by Raj Mhatre, Shashank Angane, and Pallavi Vartak (2020) with the aim of automatically identifying students and recording their attendance at educational institutions. Using Raspberry Pi and OpenCV, Vignesh Kanna P, Anusuya K.V, and Vaishnavi P (2021) created a smart attendance system that incorporates RFID and face recognition. The system automates the recording of attendance and saves the data in a cloud database. Authors Shrey Bhagat, Vithal Kashkari, Shubhangi Srivastava, and Ashutosh Sharma (2022) proposed a face recognition-based method to automate school attendance tracking and minimize human error.

III. METHODOLOGY

Integrating hardware components and software algorithms, the Smart Attendance System utilizing Raspberry Pi automates the attendance process using RFID and face recognition. To authenticate users and keep track of attendance, the system makes use of a Raspberry Pi, a USB camera, an RFID reader, an LCD screen, a buzzer, green and red LEDs, and an LED driver. Multiple steps comprise the technique, which includes RFID identification, facial recognition, attendance tracking, and alerting.

Block diagram

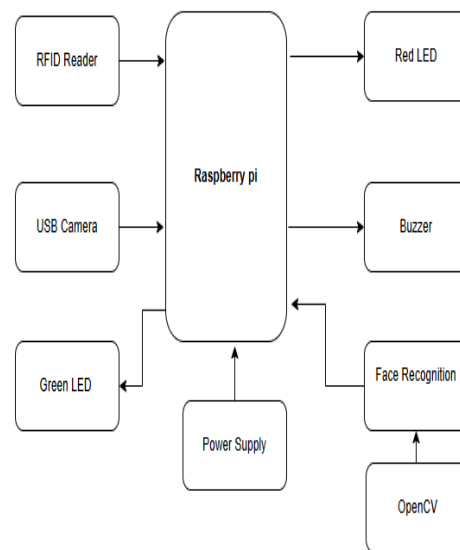


Figure 1: block diagram

The suggested system is a Raspberry Pi-based smart attendance system that uses radio frequency identification (RFID) and facial recognition technology to securely and automatically record attendance. To make sure that only approved users may check in and out, this system uses a combination of radio frequency identification and facial recognition. The use of two-factor authentication greatly enhances the system's dependability and drastically decreases the likelihood of proxy attendance.

The Raspberry Pi is the brains of the operation, linking and controlling the many hardware parts such the USB camera, RFID reader, LCD screen, buzzer, green and red LEDs. A user's face data and a special RFID card are both saved in the system's database. The system activates the USB camera to record the user's face when they scan their RFID card with the RFID reader, reading the card ID. After the picture of the face is taken, it is compared to a database of previously photographed faces using a face recognition algorithm. By comparing the user's recorded data with the RFID card ID and face picture, the system verifies the user's identification and accurately stamps their attendance. The attendance has been recorded when

the green LED goes ON and the buzzer makes a single beep sound, after successful verification. Unauthorized users are detected when the RFID card is not registered or when the facial recognition does not match the recorded data. The individual is not registered in the system, as shown by the red LED turning ON and the buzzer producing five beep noises. Users may see their name and the status of their attendance, such as "Attendance Marked" or "User Not Registered," on the LCD display, which delivers unambiguous feedback.

Following successful verification of attendance, the system will immediately save the information of the attendance, including the user's name, date, and time of entry, to an Excel sheet. The digital record streamlines and simplifies the process of managing attendance. You may utilize the data that is saved for things like future reference, making reports, and analyzing attendance. The system also has a notification system that works with Telegram. When a user checks in, the system notifies a pre-set Telegram account of their attendance. Administrators or instructors may keep tabs on attendance from a distance and get information in real-time. In sum, by integrating Raspberry Pi with radio frequency identification and facial recognition technology, the suggested system offers a safe, automated, and intelligent method for managing attendance. It is well-suited for use in educational institutions, workplaces, and other organizations since it streamlines processes, eliminates opportunities for fake attendance, and guarantees precise record keeping.

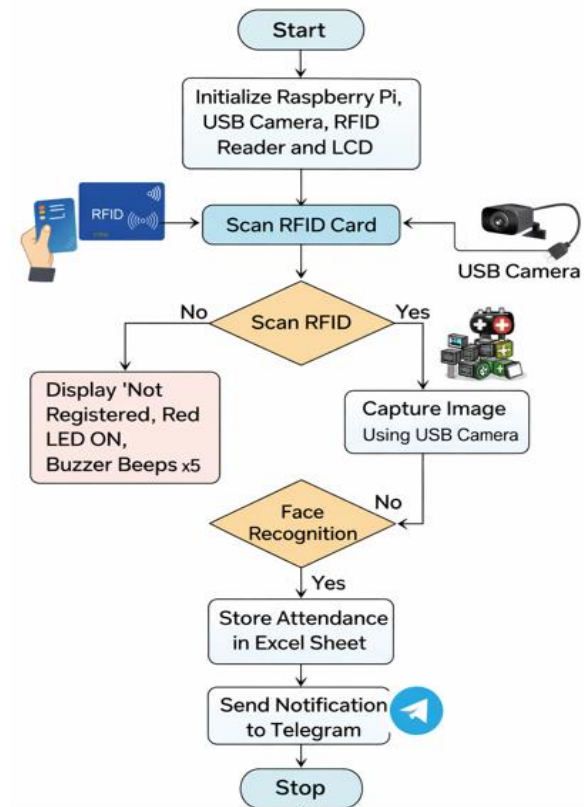


Figure 2: Flowchart of the system

Combining RFID identification with facial recognition technology, the Raspberry Pi-based smart attendance system automatically records users' attendance after verifying their identity. Identification, verification, and data storage are all handled by the system via a combination of software and hardware components. When turned on, the system's Raspberry Pi automatically sets up the RFID reader, USB camera, LCD screen, LEDs, and buzzer, among other connected devices. The user is prompted to scan their RFID card by means of an LCD display. The RFID reader is the source of constant input to the Raspberry Pi.

Users only need to bring their RFID cards within range of the reader for it to pick them up and transmit the cards' unique identifier (UID) to the Raspberry Pi. When an RFID card is scanned, the system verifies its record in the database. The system will activate the red LED and buzzer, and a message will be shown on the LCD to indicate that the user is not permitted, if the card is not registered.

The system will activate the USB camera to record the user's picture if the RFID card is registered. Computer vision libraries are used to apply face recognition algorithms to the acquired picture. After identifying the face, the algorithm checks it against a database of previously saved facial photos. The system verifies the user's identification and records their attendance if the facial recognition result is a match to their registered user record. When the attendance registration is successful, the buzzer will make one beep sound and the green LED will switch on. The time, date, and name of each attendee are also automatically recorded in an Excel spreadsheet. The technology notifies a user via their internet-connected Telegram account once the attendance has been recorded. Teachers and administrators may keep tabs on student attendance from anywhere at any time with this feature.

In this way, the system eliminates the need for human intervention and prevents the use of proxy attendance by integrating RFID identification with facial recognition verification for precise and safe automated attendance monitoring.

IV. RESULTS



Figure3: Hardware setup

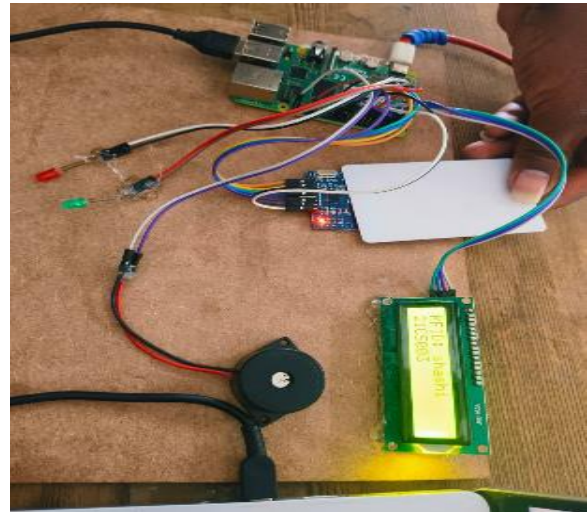


figure4:output display on lcd

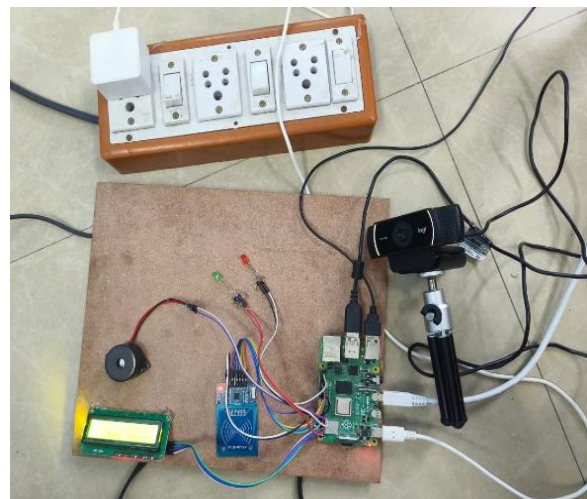


Figure5: final output

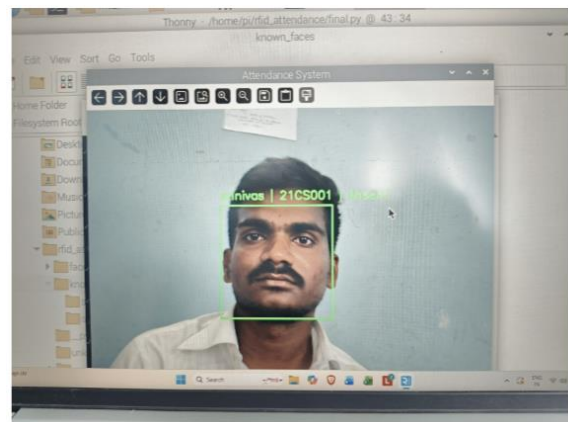


figure:6 Face recognition

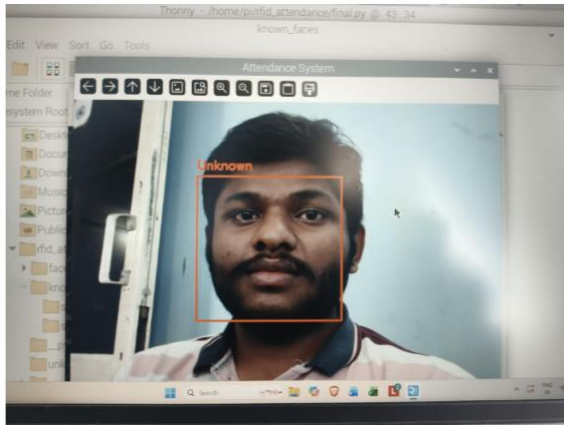


figure7:Unknown face

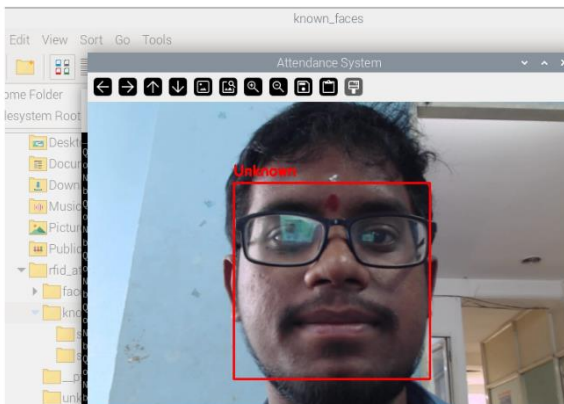


figure8;Output unknown face prediction

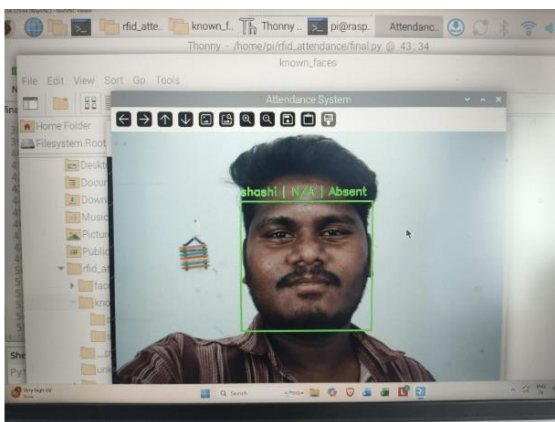


Figure9:Prediction attendance

V. CONCLUSION

An automated, safe, and effective method for controlling attendance is the Smart Attendance System based on RFID and face recognition utilizing Raspberry Pi. Manual attendance registers and other

outdated techniques invite human mistake and proxy attendance. The suggested method enhances the accuracy and reliability of attendance tracking by incorporating current technologies like RFID and facial recognition. The Raspberry Pi serves as the hub that links all the hardware parts of this project, such as the USB camera, RFID reader, LCD screen, LEDs, and buzzer. The user's face is captured by the USB camera and their identification is verified using face recognition algorithms when they scan their RFID card. To make sure that only authorized users may indicate their attendance, we've implemented a dual authentication technique. When the attendance is correctly recorded, the system not only notifies the user verbally but also visually via an LCD display, buzzer, and LEDs. An Excel page is instantly updated with the user's name, date, and time of attendance after their identification has been validated. Moreover, administrators may remotely and in real-time monitor attendance thanks to the system's attendance alerts sent to a Telegram account. The suggested solution keeps digital data correct, decreases manual labor, and eliminates proxy attendance. By combining RFID with face recognition, it further strengthens security by confirming the identity of the user. All sorts of places that need precise attendance monitoring may benefit from the system's features, including classrooms, universities, workplaces, and factories. Finally, the RFID and Face Recognition Based Smart Attendance System showcases the integration of embedded systems, computer vision, and IoT technologies to provide an intelligent and dependable solution for managing attendance. Data storage in the cloud, attendance tracking apps for mobile devices, and cutting-edge AI methods to fortify system defenses and performance are all potential developments in the near future.

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