

SYSTEM FOR ATTENDANCE TRACKING BASED ON THE INTERNET OF THINGS THAT MAKES USE OF A FINGERPRINT SENSOR ACCESS BY STAFF AND PARENT

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Abstract:

A trendy method for tracking attendance records in schools, colleges, and companies is an IoT-based attendance monitoring system that uses a fingerprint sensor. The solution links a fingerprint sensor to a cloud-based database using Internet of Things (IoT) technology, providing real-time tracking of attendance records. To verify users' identities and keep track of their attendance, the system employs a fingerprint sensor. The collected data is subsequently sent to a cloud-based database, where it is safely kept and accessible to authorized individuals whenever and wherever needed. The method reduces the possibility of fraud or mistakes and does away with the necessity for human attendance records. This paper discusses the design, implementation, and evaluation of an IoT-based attendance monitoring system using a fingerprint sensor and a cloud-based database for both teachers and parents.

Keywords: Arduino, LCD16x2, Fingerprint Sensor, RTC Module, cloud, IoT

1. Introduction

The term Internet of Things or IoT refers to a network of gadgets that are connected to the internet and are capable of exchanging data. IoT may be utilized to build an attendance tracking system that employs a fingerprint sensor to track attendance and stores the information in the cloud. The technology functions by capturing each person's specific biometric information using a fingerprint sensor. To confirm the person's identification, the sensor next compares the data it has collected with a database of fingerprints that have already been saved. Once the person's identification has been verified, the system logs their attendance and uploads the information to the cloud. A network of distant servers utilized for data processing,

management, and storage makes up the cloud. The cloud may be used to store all of the user's attendance data in a single location for an attendance tracking system. As long as there is an internet connection, this enables access to the data from anywhere in the globe. The benefits of utilizing an IoT attendance tracking system. For acquiring student attendance, the suggested system employs a fingerprint recognition approach. Because of the simplicity and precision of fingerprints, humans have been utilizing them for recognition reasons for a very long time.

The identification of fingerprints is dependent on two factors;1.Persistence: the core qualities and attributes do not change over time.2.Individuality: every person in the world has a unique fingerprint. Current fingerprint-matching techniques were developed in the late 16th century and advanced significantly in the twentieth century. Fingerprints are commonly employed in forensic laboratories and identification units and are regarded as one of the most mature biometric technologies.1. Accuracy: Fingerprint sensors offer great accuracy in confirming a person's identification, lowering the possibility of mistakes in attendance records.2. Convenience: The system saves time and reduces paperwork by doing away with the need for manual attendance records, making it easy for both employers and employees.3. Security: Because fingerprint information is personal to each person, nobody can fabricate attendance records.4. Accessibility: Since data on the cloud is accessible from anywhere in the globe, it is simpler for employers to track attendance from a distance. Overall, an IoT-based attendance monitoring system equipped with a fingerprint sensor provides a dependable, accurate, and secure method of tracking attendance data.

1.1 Contribution of the Work

Attendance monitoring is accurate because of the use of fingerprint technology, which eliminates the chance of mistakes or false entries. Saving time: The technology removes the need for manual attendance monitoring, saving both instructors and students time. Improved security: The system guarantees that only authorized users have access to attendance records, eliminating the chance of tampering or illegal access. Tracking real-time attendance data: The system may give real-time attendance data, which can be valuable for following attendance trends and spotting possible problems. Cost-effective: When compared to traditional attendance tracking systems, the usage of IoT technology with fingerprint technology can be cost-effective. Simple integration: The system can simply link with other school administration systems, such as student information systems, making attendance records and student data management easier.

1.2 Related works

There are several existing methods of IoT-based attendance monitoring systems using Arduino.

(i) RFID-based Attendance System Using Arduino: RFID tags are affixed to individual ID cards in this manner. RFID scanners attached to an Arduino board positioned at entry points scan RFID tags in real-time to collect attendance statistics. With IoT technology, the acquired data is subsequently transferred to a cloud-based database for additional processing and analysis.[2]

(ii) Bluetooth Beacon-based Attendance System Using Arduino: Bluetooth beacons are put at entrance points in this manner. When the beacons come within range, they send a signal to the individual's mobile device. The mobile device delivers a signal to an Arduino board, which collects and transmits attendance data to a cloud-based database utilizing IoT technology[8]

(iii) Smart Camera-Based Attendance System Using Arduino: Smart cameras with face recognition technology are deployed at access points in this manner. The camera takes a picture of the person's face, which is then evaluated by an AI system to identify the person and track attendance statistics. With IoT technology, the gathered data is subsequently transferred to a cloud-based database[1]

2. Proposed Model

The proposed system will have client-server architecture, with the Arduino board acting as the client, sending data to the server via the Wi-Fi module. This data will be stored in a database, and a web interface will be provided for teachers to view and manage attendance records. The client-server architecture will ensure that the data is securely stored and that the system is easy to use and manage. The Arduino board will be used to store the reading of the Fingerprint sensor as well as to control the Wi-Fi module and send the data to the server. The server will store the data in a database, which will be accessible via a web interface.

The web interface will allow teachers to view and manage attendance records. They will be able to view attendance for a particular day or a range of days. They will also be able to add new students to the system, edit existing student records, and delete students from the system. The interface will also allow teachers to generate reports and graphs based on attendance data. The system will be secured using encryption, ensuring that the data is kept safe and secure.

The system will also be designed to be user-friendly, enabling teachers to easily manage attendance records. Overall, the proposed system will provide an efficient, secure, and user-friendly way for teachers to manage student attendance records. It will allow them quickly and easily view, edit, and delete attendance records, as well as generate reports and graphs based on the data. The system will also include advanced security features such as encryption and authentication to guarantee the privacy and integrity of attendance records. Encryption will ensure that the data is protected and cannot be accessed by anyone who does not have the right key to decode the data. Authentication will ensure that only authenticated users can access the system and its data. Furthermore, the system will also include additional authentication measures such as multi-factor authentication and biometrics to ensure that only authorized users can access the system.

The system will also have various levels of access control so that users can only access certain parts of the system and its data. Furthermore, the system will also have detailed audit logs, so that any changes made to the system and its data can be tracked and monitored.

Finally, the system will also have an automated backup feature, so that the data is always up to date and can be

quickly restored in case of any disruptions to the system. Overall, the system will include robust security measures to guarantee the privacy and integrity of attendance records.

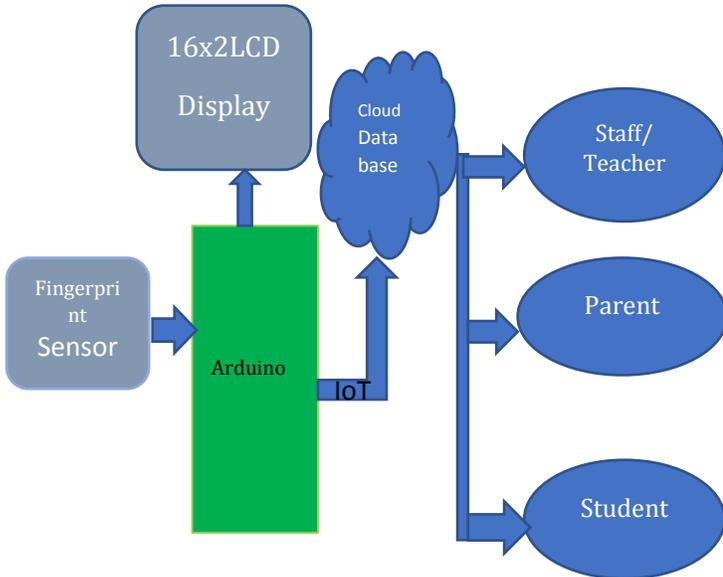


Figure 1.1 Overall Flow of the Proposed Model

- **Biometric Sensor:** This component is responsible for capturing attendance data. The biometric sensor detects fingerprints.
- **Arduino Board:** This component acts as the main controller for the system. It receives data from the biometric sensor and sends it to the IoT module for further processing.
- **IoT Module:** This component is responsible for connecting the Arduino board to the internet. It can be a Bluetooth module that sends attendance data to a central server.
- **Central Server:** This component receives attendance data from the IoT module and processes it. It stores the attendance data in a database and generates reports based on it.
- **User Interface:** This component is responsible for displaying attendance data to the user. It can be a web-based dashboard or a mobile application that shows real-time attendance data to teachers or administrators.

Overall, the system captures attendance data through the biometric sensor, processes it using the Arduino board and IoT module, and sends it to the central server for storage and reporting. The user interface allows teachers or administrators to view attendance data in real-time, making it easier to manage attendance records.

2.1 Arduino UNO

To automate the process of taking attendance and lessen the effort of teachers or administrators, attendance tracking systems can employ Arduino.

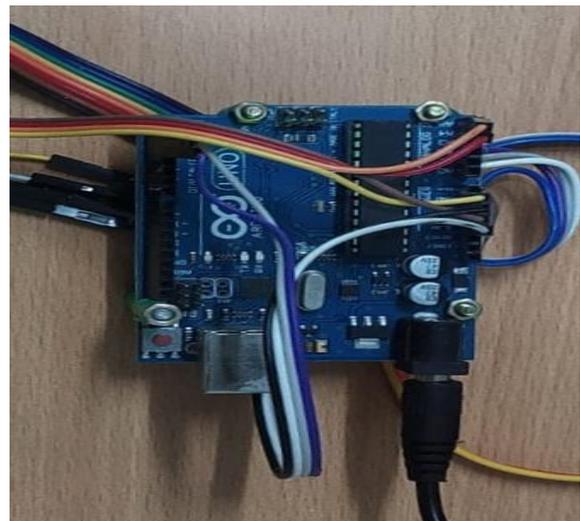


Figure 2.1 Arduino UNO

The following are some of the capabilities of Arduino in systems for tracking attendance:

- **Data collection:** To gather attendance information, Arduino can be connected to a variety of sensors, barcode scanners, and biometric sensors. The Arduino board is then used to process and store the obtained data.
- **Processing:** Arduino can process sensor-based attendance data and carry out several tasks such as student identification, attendance percentage calculation, and report generation.
- **Display:** Arduino can show real-time attendance data on an LCD panel or transfer the data to a computer or mobile device for display.
- **Communication:** Arduino may exchange data with other devices using Bluetooth to send

attendance information to a central database for additional processing and analysis.

Ultimately, the role of Arduino in an attendance monitoring system is to deliver a cost-effective and efficient solution for gathering and processing attendance data, lessen the administrative or instructor workload and enhance the accuracy of attendance records.

2.2 Fingerprint Sensor:

An attendance monitoring system can make use of a fingerprint sensor to precisely track each person's attendance using their particular fingerprint pattern.



Figure2.2 Biometric Sensor

A fingerprint sensor in an attendance monitoring system can do the following tasks, for example:

- **Identification:** Based on each person's distinctive fingerprint pattern, a fingerprint sensor may successfully identify them. When a person places their fingertip on the sensor, the sensor records an image of their fingerprint and compares it to the templates that have been recorded to identify the person.
- **Data collection:** At the start and end of a class or work session, a fingerprint sensor can take a person's fingerprint to record their attendance. The gathered information is subsequently put into a database for processing and analysis.
- **Accuracy:** As each person's fingerprints are distinctive and difficult to replicate or fake, fingerprint sensors offer a high level of accuracy for tracking attendance.

- **Integration:** To automate the attendance tracking process and produce real-time attendance reports, fingerprint sensors can be readily combined with other devices like microcontrollers or PCs.

2.3 RTC(Real Time Clock)

A real-time clock (RTC) is an important component in an IoT-based attendance tracking system that employs fingerprint identification. The RTC provides accurate and dependable timekeeping, which is necessary for keeping track of attendance records.

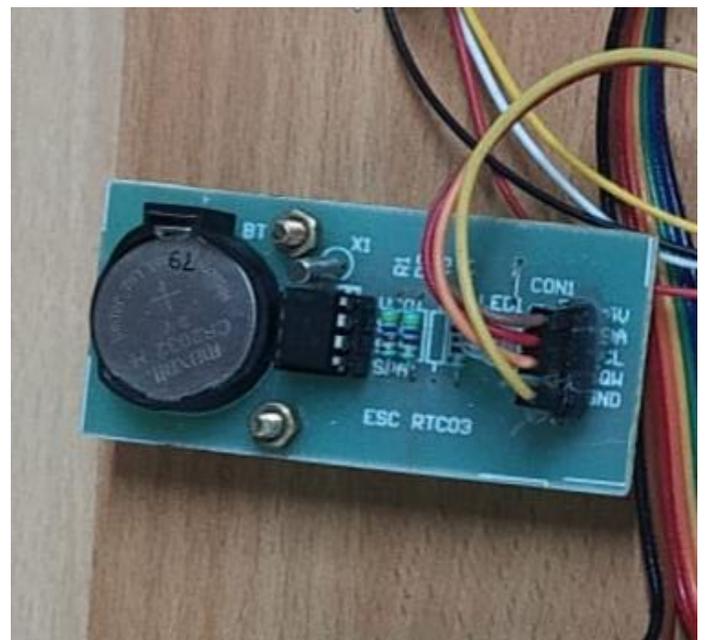


Figure2.3 Real Time Clock

Here's how an RTC can be integrated into an IoT-based attendance monitoring system using fingerprint recognition:

- When an employee scans their fingerprint, the system records the scan's timestamp.
- The timestamp is subsequently sent to the RTC module, which synchronizes it with the current time.
- The timestamp is subsequently saved in a database alongside the employee's identity information.

- The system may then create reports that reflect each employee's attendance data.

By including an RTC in the attendance tracking system, the system can ensure that attendance data are accurate and trustworthy even when there is no internet connection accessible. The RTC guarantees that the system's time is always correct, independent of external variables.

2.4 Display

A 16*2 LCD screen The following methods can be used to construct an IoT-based attendance tracking system with a fingerprint sensor:



Figure2.4 Biometric Attendance

- Hardware setup includes attaching the 16*2 LCD panel and fingerprint sensors to a microcontroller board such as Arduino or Raspberry Pi. The proper cables and jumper wires can be used to make the connections.
- Setup of the fingerprint sensor: The fingerprint sensor must be programmed to detect the fingerprints of the users whose attendance must be recorded. The fingerprint data can be saved in the memory of the sensor.

- LCD configuration: The LCD must be programmed to display pertinent information such as the date, time, and attendance data.
- IoT setup: To enable remote access and control of the attendance monitoring system, the IoT module must be coupled with the microcontroller board. This can be accomplished through the use of Wi-Fi or other wireless communication protocols.
- Attendance tracking: By putting the user's finger on the fingerprint sensor, the attendance monitoring system is triggered. The fingerprint will be recognized by the system, and the user's attendance will be recorded. The attendance records may be viewed on the LCD and accessed remotely via the IoT module.
- Data analysis: To provide insights and reports, attendance records may be evaluated using data analytics technologies. This can be beneficial in recognizing patterns and trends in attendance behavior and, if appropriate, implementing remedial steps.

2.5 Cloud database

A cloud database can be used in an attendance monitoring system to store and manage attendance data. Here are some of the functions of a cloud database in an attendance monitoring system:

- Storage: A cloud database can store attendance data in a centralized location, making it easily accessible and secure. The attendance data can be stored in various formats such as text files, spreadsheets, or databases.
- Access: A cloud database allows authorized users to access the attendance data from anywhere, anytime. This makes it easier for teachers, administrators, and students to access and review attendance records.
- Security: A cloud database provides a high level of security by encrypting attendance data and providing access only to authorized users. This helps to prevent unauthorized access, data theft, or data loss.

- **Real-time Updates:** A cloud database allows attendance data to be updated in real-time as individuals scan their fingerprints. This provides immediate feedback and ensures accurate attendance records.
- **Reporting:** A cloud database can generate teacher, student, and administrator attendance reports. This helps to track overall attendance rates, identify attendance patterns, and take appropriate action when necessary.

Overall, the function of a cloud database in an attendance monitoring system is to provide a secure and efficient way to store, manage, and access attendance data from anywhere, anytime.

2.5 IMPLEMENTATION

The sensor module records the fingerprint image when a person presses their finger against the fingerprint sensor. To confirm a person's identification, the fingerprint recognition algorithm analyses the fingerprint picture. If the identification is confirmed, the microcontroller uses the Ethernet or Wi-Fi module to send the attendance record to the cloud. The software application stores the attendance record in the cloud. Using the IoT platform account, the attendance record is available for access and analysis from any location. For optional real-time monitoring, the attendance record can be shown on the display module.

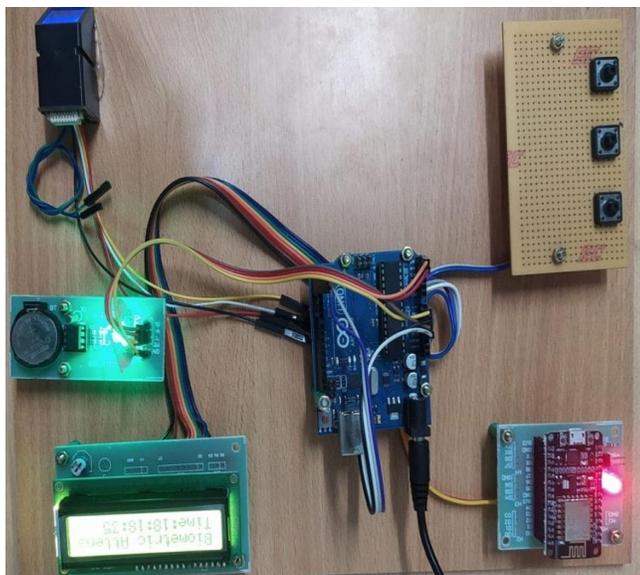


Figure 2.5 Hardware of system

3.5 Experimental Results and Discussion

The results of an attendance monitoring system using IoT and Arduino would include:

- **Accurate Attendance Records:** The use of IoT and Arduino in attendance monitoring systems ensures accurate attendance records. The attendance data is captured in real-time, and there is no need for manual recording, reducing the chances of errors.
- **Real-Time Feedback:** The attendance monitoring system using IoT and Arduino provides real-time feedback to users on their attendance status. This provides a sense of ownership and encourages users to be punctual.
- **Improved Security:** The use of biometric authentication in the attendance monitoring system ensures that only authorized users can register their attendance. This improves security and reduces the chances of attendance fraud.
- **Remote Access:** The attendance data captured by the IoT-based attendance monitoring system is stored in a cloud-based database, which can be accessed remotely by authorized users. This allows for easy monitoring of attendance data from anywhere, anytime.
- **Cost-Effective:** The use of Arduino and IoT in attendance monitoring systems is cost-effective compared to traditional attendance monitoring systems. It eliminates the need for manual recording, reduces the chances of errors, and requires minimal maintenance.

Overall, the implementation of an attendance monitoring system using IoT and Arduino provides accurate, real-time attendance data, improves security, and reduces costs, making it a valuable tool for organizations and institutions.

3. Conclusion

The IoT-based attendance tracking system using Arduino and a fingerprint sensor is an effective and efficient way to manage attendance in various settings, such as schools, universities, and businesses. The system provides accurate and real-time attendance data, reduces the time and effort

required for manual attendance management, and eliminates the possibility of attendance fraud. With the integration of IoT technology, the system allows for remote access to attendance data, making it easier for administrators and educators to monitor attendance trends and identify areas for improvement. Additionally, the use of Arduino and a fingerprint sensor ensures the security and privacy of the attendance data. Overall, the IoT-based attendance tracking system using Arduino and a fingerprint sensor is a cost-effective and reliable solution that can significantly improve attendance management processes in various settings.

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