

**EDUCATION SPACE OPTIMIZATION :RFID AND FINGERPRINT INTEGRATION WITH LoRa FOR**

**ADVANCED MONITORNG USING ESP8266**

A PROJECT REPORT

*Submitted by*

MANOHARAN JR - 513120106313

MAGESH K - 513120106311

MOULESHWARAN - 513120106503

***in partial fulfillment for the award of the degree***

**BACHELOR OF ENGINEERING**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

**THANTHAI PERIYAR GOVERNMENT INSTITUTE OF**

**TECHNOLOGY, VELLORE-632002**

**ANNA UNIVERSITY – 600025**

MAY 2024

**BONAFIDE CERTIFICATE**

Certified that this project report **“EDUCATION SPACE OPTIMIZATION : RFID AND FINGERPRINT INTEGRATION WITH LoRa FOR ADVANCED MONITORING USING ESP8266”** is the bonafide work of “**MANOHARAN JR (513120106313), MAGESH K (513120106311), MOULEESHWARAN H (513120106503)** who carried out the work under my supervision.

|  |  |
| --- | --- |
| **SIGNATURE**  **Dr. S. LETITIA, M.E.,Ph.D.,**  **PROFESSOR &**  **HEAD OF THE DEPARTMENT**  Department of Electronics and  Communication Engineering,  Thanthai Periyar Govt. Institute  of Technology, Vellore 632002 | **SIGNATURE**  **Dr. S.SATHISH BABU, M.E.,MBA.,Ph.D.**  **ASSOCIATE PROFESSOR**  **PROJECT SUPERVISOR**  Department of Electronics and  Communication Engineering,  Thanthai Periyar Govt. Institute  of Technology, Vellore 632002 |

Project Viva-Voce Examination held on…………………….

**Internal Examiner External Examiner**

**ACKNOWLEDGEMENT**

*The satisfaction that accompanies the successful completion of and task would be incomplete without the mention of the people who made it possible, here constant guidance and encouragement crowned our effects with success.*

*Our profound thanks goes to our Principal* ***Dr.P.K.PALANI., B.E., (HONS).,M.E.,Ph.D.*** *Thanthai Periyar Government Institute of Technology, Vellore, for scholarly guidance and valuable motivation throughout the curriculum.*

*We articulate our special honor to Professor* ***Dr.S. LETITIA , M.E., Ph.D.,*** *Head of The Department of Electronics And Communication Engineering, Thanthai Periyar Government Institute of Technology, Vellore, for her valuable suggestions and moral support.*

*We express our deep sense of gratitude to our guide* ***Mr.A.K.T. SATHISHKUMAAR ,M.E,*** *Associate Professor Department of Electronics and Communication Engineering, Thanthai Periyar Government Institute of Technology, Vellore, for his expert guidance and his encouragement throughout the project .*

*We would also like to thank our faculty advisors* ***Dr.M.MANIMEGALAI, M.E.,Ph.D.*** *and* ***Dr.R.DHANALAKSHMI, M.E.,Ph.D.,*** *and review committee members, Assistant Professors of Electronics and Communication Engineering Department for giving constant support and making our project successful.*

**ABSTRACT**

The project aims to revolutionize attendance tracking in educational institutions by introducing an automated Class Monitoring System leveraging RFID technology, ESP8266 WIFI module, and LoRa communication. Traditional manual attendance processes are not only time-consuming but also prone to errors, leading to inefficiencies in administrative tasks. To address these challenges, our system offers a robust solution that automates the attendance process, thereby reducing administrative workload and providing real-time attendance information. At its core, the system comprises two main components: the transmission side and the receiver side. The transmission side is equipped with an RFID reader and a fingerprint scanner for student identification, an ESP8266 WIFI module for internet connectivity, and a LoRa transmitter for seamless data transmission. Meanwhile, the receiver side consists of an ESP8266 module for WIFI connectivity, a LoRa receiver for data reception, and a buzzer for alerting administrators of attendance events. Additionally, an LCD screen on the transmission side provides visual feedback.

**TABLE OF CONTENTS**

|  |  |  |
| --- | --- | --- |
| **CHAPTER NO** | **TITLE** | **PAGE NO** |
| **1**  **2**  **3**  **4**  **5**  **6**  **7** | **ABSTRACT**  **List of Figure**  **List of Table**  **INTRODUCTION**  **OBJECTIVES**  1.1 Existing System  1.2 Proposed System  1.3 Problem Statement  **LITERATURE SURVEY**  **SOFTWARE TOOLS**  3.1 Arduino IDE Software  3.2 Embedded C  **HARDWARE TOOLS**  4.1 LCD DISPLAY  4.1.1 Introduction  4.1.2 Working  4.1.3 Pin Description For LCD  4.1.4 LCD Interfacing with Microcontroller  4.1.5 Advantages  4.1.6 Disadvantages  4.1.7 Applications  4.2 NODE MCU  4.2.1 Features  4.2.2 Arduino-like Hardware IO  4.2.3 Nodejs Style Network API  4.2.4 Lowest Cost WI-FI  4.2.5 Development Kit  4.3 FINGER PEINTER  4.3.1 Types of Fingerprint Scanners  4.3.2 Working principal  4.4 EM-18 RFID READER  4.4.1 Specifications  4.4.2 RS232 Interface Format  4.4.3 Working Principal  4.5 BUZZER  4.5.1 Buzzer Circuit  4.5.2 Types of Buzzer  4.5.3 Industries Served  4.5.4 Piezo Vs Magnetic Buzzers  4.5.5 Piezo Buzzer Characteristics  4.5.6 Magnetic Buzzer Characteristics  4.5.7 Benefits of Buzzer  4.5.8 Modern Application  **5.1 RESULT AND DISCUSSIONS**  5.1.1 Efficiency and Automation  5.1.2 Accuracy and Reliability  5.1.3 Real - Time Data Transfer  5.1.4 Cloud Integration  5.1.5 User Feedback and Acceptance  5.1.6 Further Improvements  **FUTURE SCOPE**  **CONCLUSION**  **REFERENCE** | 1  5  7 |

**LIST OF FIGURES**

|  |  |  |
| --- | --- | --- |
| **SI NO** | **FIG.NO** | **TITLE** |
| **1** | **3.1** | Arduino IDE Software |
| **2** | **3.2** | Embedded C |
| **3** | **4.1** | LCD DISPLAY |
| **4** | **4.1.1** | Introduction |
| **5** | **4.1.2** | Working |
| **6** | **4.1.3** | Pin Description For LCD |
| **7** | **4.1.4** | LCD Interfacing With Microcontroller |
| **8** | **4.1.5** | Advantages |
| **9** | **4.1.6** | Disadvantages |
| **10** | **4.17** | Applications |
| **11** | **4.2** | NODE MCU |
| **12** | **4.2.1** | Features |
| **13** | **4.2.2** | Arduino - like Hardware IO |
| **14** | **4.2.3** | Nodejs Style Network API |
| **15** | **4.2.4** | Lowest Cost WI - FI |
| **16** | **4.2.5** | Development Kit |
| **17** | **4.3** | FINGER PRINTER |
| **18** | **4.3.1** | Types of Fingerprint Scanners |
| **19** | **4.3.2** | Working Principal |
| **20** | **4.4** | EM - 18 RFID READER |
| **21** | **4.4.1** | Specifications |
| **22** | **4.4.2** | RS232 Inerfce Formant |
| **23** | **4.4.3** | Working Principal |
| **24** | **4.5** | BUZZER |
| **25** | **4.5.1** | Buzzer Circuit |
| **26** | **4.5.2** | Types of Buzzer |
| **27** | **4.5.3** | Industries Served |
| **29** | **4.5.5** | Piezo Buzzer Characteristics |
| **30** | **4.5.6** | Magnetic Buzzer Characteristics |
| **31** | **4.5.7** | Benefits of Buzzer |
| **32** | **4.5.8** | Modern Application |
| **33** | **5.1** | RESULT AND DISCUSSIONS |
| **34** | **5.1.1** | Efficiency and Automation |
| **35** | **5.1.2** | Accuracy and Reliability |
| **36** | **5.1.3** | Real - Time Data Transfer |
| **37** | **5.1.4** | Cloud Integration |
| **38** | **5.1.5** | User FeedbLISack and Acceptance |
| **39** | **5.1.6** | Further Improvements |

**LISTS OF TABLES**

|  |  |  |  |
| --- | --- | --- | --- |
| **SL.NO.** | **TABLE NO.** | **TITLE** | **PG.NO.** |
| **1** | **3.1** | Arduino |  |
| **2** | **4.1.3** | Pin Description For LCD |  |
| **3** | **4.4.3** | Basal Specification |  |

**CHAPTER I**

**INTRODUCTION**

In the contemporary educational landscape, the need for streamlined attendance tracking mechanisms within academic institutions is paramount. Manual attendance management systems are often fraught with inefficiencies, consuming valuable time and resources while also being susceptible to errors. To address these challenges, the proposed project endeavors to develop an innovative and automated Class Monitoring System harnessing the power of Radio-Frequency Identification (RFID) technology, alongside ESP8266 WIFI modules and LoRa communication protocols. This amalgamation of cutting-edge technologies aims to revolutionize attendance tracking processes, significantly mitigating administrative burdens and providing real-time attendance data accessible through cloud platforms.

The system's core components comprise an array of sophisticated hardware, including an RFID reader and fingerprint scanner for data transmission, supplemented by an ESP8266 module and LoRa transmitter for wireless communication. On the receiving end, an ESP8266 module coupled with a LoRa receiver facilitates seamless data reception, while a buzzer provides immediate feedback. Additionally, an LCD interface enhances user interaction and feedback. Cloud integration ensures that attendance data is not only securely stored but also readily accessible from anywhere, fostering enhanced administrative oversight and facilitating data-driven decision-making.

**1.1 Existing System**

The existing system of attendance tracking in educational institutions typically relies on manual methods, which are often laborious and error-prone. In these systems, instructors or administrative staff are tasked with taking attendance manually by calling out names or checking off student names on paper-based rosters. This process can be time-consuming, especially in larger classes, and is susceptible to inaccuracies due to human error. Moreover, the manual recording of attendance lacks real-time data updates, making it difficult for administrators to track attendance patterns and intervene promptly in case of any issues.

Additionally, traditional attendance systems do not provide a seamless way to monitor attendance remotely or integrate with other administrative processes. This lack of integration can result in inefficiencies and delays in updating attendance records, as well as difficulties in generating reports or analyzing attendance trends.

Furthermore, the reliance on manual attendance tracking methods can lead to accountability issues, as there is no foolproof way to ensure that students are accurately reporting their attendance or that instructors are taking attendance consistently.

Moreover, manual attendance tracking systems offer limited flexibility in terms of customization and scalability. As educational institutions grow or change their attendance policies, manual systems may struggle to adapt to new requirements or accommodate increased student populations.

Overall, the existing system of attendance tracking in educational institutions is characterized by its reliance on manual methods, which are time-consuming, error-prone, and lack real-time data updates. These limitations underscore the need for a more efficient and automated solution that leverages technology to streamline the attendance tracking process, reduce administrative workload, and provide real-time attendance information.

**1.2 Proposed System**

The proposed system aims to revolutionize the process of attendance tracking in educational institutions by introducing an efficient and automated Class Monitoring System using RFID technology, ESP8266 WIFI module, and LoRa communication for seamless data transfer. This innovative solution addresses the limitations of the existing manual attendance tracking system by leveraging advanced technologies to automate the process, reduce administrative workload, and provide real-time attendance information.

Central to the proposed system is the integration of RFID (Radio-Frequency Identification) technology, which allows for the automatic identification and tracking of students' attendance. RFID tags, embedded in student ID cards or wearable devices, emit radio signals that are detected by RFID readers positioned at strategic locations within the classroom. When students enter the classroom, their RFID tags are automatically scanned by the RFID reader, recording their attendance without the need for manual intervention.

The use of RFID technology offers several advantages over traditional manual attendance tracking methods. Firstly, it significantly reduces the time and effort required to take attendance, as the process is automated and does not rely on manual data entry. This not only frees up valuable instructional time but also eliminates the potential for human error associated with manual attendance taking.

Moreover, RFID-based attendance tracking provides real-time updates on student attendance, allowing instructors and administrators to monitor attendance patterns and identify potential issues promptly. By leveraging ESP8266 WIFI modules and LoRa communication, the system ensures seamless data transfer to a cloud platform, where attendance records are stored and accessible in real-time. This cloud-based approach enables administrators to access attendance information remotely, from any device with internet connectivity, facilitating efficient monitoring and management of attendance records.

Another key feature of the proposed system is its scalability and flexibility. The use of RFID technology allows for easy integration with existing student ID systems, making it suitable for educational institutions of all sizes. Additionally, the system can be customized to accommodate different attendance policies and requirements, such as late arrivals or early departures, ensuring adaptability to the specific needs of each institution.

Furthermore, the proposed system enhances accountability and transparency in attendance tracking. By automating the process and eliminating manual data entry, the system reduces the likelihood of errors or discrepancies in attendance records. This promotes greater accuracy and reliability in attendance tracking, enhancing trust and accountability among students, instructors, and administrators.

In addition to RFID technology, the proposed system may also incorporate biometric authentication, such as fingerprint recognition, for added security and accuracy. Biometric authentication can further streamline the attendance tracking process by providing a unique and irrefutable means of identifying students.

**1.3 Problem Statement**

Manual attendance tracking in educational institutions is cumbersome and error-prone. To address this, we propose developing an automated Class Monitoring System using RFID technology, ESP8266 WIFI module, and LoRa communication. This system aims to streamline attendance management, reducing administrative burden and providing real-time attendance data on a cloud platform. By leveraging RFID tags and fingerprint authentication, students' attendance can be accurately recorded without manual intervention. The system's hardware includes an RFID reader, ESP8266, LoRa transmitter, LCD display, and fingerprint scanner for the transmission side, while the receiving end comprises an ESP8266, LoRa receiver, buzzer, and cloud connectivity. This project aims to enhance efficiency, accuracy, and accessibility in attendance tracking within educational institutions.

**CHAPTER II**

**LITERATURE SURVEY**

**In 2023 A. -S. T. Hussain, T. A. Taha, S. R. Ahmed, S. A. Ahmed, O. K. Ahmed and H. Desa presented Automated RFID-Based Attendance and Access Control System for Efficient Workforce Management**

This paper focuses on designing an automated attendance and access control system using Radio Frequency Identification (RFID) technology. The current methods used by companies to track employee attendance are often inefficient and prone to errors. The proposed system aims to improve the process by automatically recording the working hours of employees using RFID tags in the form of ID cards. The RFID system consists of three components: an antenna, a transceiver, and transponders (tags). The antenna transmits a signal to activate the tag, which then transmits data back to the antenna. Unlike barcodes, RFID tags can be read from a distance and through various materials. The ID number on the RFID tag corresponds to the user’s information stored in a database. The work’s objective is to efficiently manage and analyze attendance data according to workplace regulations. The implementation includes designing the system using a PIC16F876A microcontroller, simulating the system with Proteus software, and analyzing the performance of the hardware and software components. The paper’s scope encompasses its applicability in both educational institutions and industries, ensuring effective modeling and evaluation of the RFID-based attendance system.

**In 2023 N. R et al. presented Biometric and RFID Passive Tag based Student Identification System for Secure Attendance Management**

This paper proposes a biometric and RFID passive tag-based student identification system for secure attendance management. The system utilizes the unique biometric features of each student, such as fingerprint, along with an RFID tag embedded in the student ID card to authenticate and track student attendance. The system is designed to overcome the limitations of traditional attendance management systems, such as manual entry errors, proxy attendance, and low accuracy. The proposed system provides an automated and secure attendance management solution that ensures accurate attendance recording and eliminates the possibility of fraudulent activities. A daily brief message service (SMS) delivered by a GSM (Global System for Mobile) module, notifying the guardian as to whether the individual has arrived at the institution. There will be a web application where students and instructors will view a student's current attendance and location on campus. The system has been implemented and tested in a real-world educational setting, and the results demonstrate its efficiency and reliability in managing student attendance.

**In 2023 P. Chavan et al. presented Smart Card Attendance Monitoring System Using RFID**

The Smart Card Attendance Monitoring System tracks attendance correctly and effectively in a variety of situations by utilizing RFID technology, smart motion sensors, and RFID-enabled smart cards. It prevents mistakes made by humans and provides accurate statistics by eliminating traditional attendance taking. The approach offers real-time tracking, allowing supervisors to address attendance developments quickly. It detects the presence and movement of people in the attendance regions using powerful motion detection technology. The technology may assess if an individual is actively present and engaged during the specified attendance period through looking at motion patterns.It enhances security through offering personalized smart cards that can be quickly disabled if lost or stolen, preventing unauthorized access, and supporting in avoiding acts of fraudulent attendance, such as card-sharing or leaving the smart card at the attendance area without the user's actual presence. The system is simple to use, with a web-based interface which enables admins to manage smart cards, produce reports, and analyze attendance data. Users may keep their smart cards in wallets for lanyards. Overall, the Smart Card Attendance Monitoring System offers improved accuracy, real-time tracking, enhanced security, convenience, streamlined processes, and data analysis capabilities compared to traditional attendance systems. It addresses the limitations of manual methods and provides a modern, reliable, and efficient solution for attendance tracking.

**In 2023 N. Ramakrishnan, A. A., A. Ali, M. S. A. and S. V. presented Wi-Fi Based Smart Attendance Monitoring System**

The attendance monitoring system provides a convenient way to track the presence of faculty members. In the past, faculty attendance was marked using traditional methods under the supervision of higher authorities such as the principal or department head. However, these methods were often outdated and prone to errors, leading to discrepancies in attendance records over the years. To address these issues, a new system was implemented using modern technology, specifically finger-punching and face recognition. This system replaced the old record books and other outdated methods, offering a more efficient and accurate way to manage faculty attendance. Additionally, a mobile application is developed for faculty or staff members to mark their attendance using their smartphones. This application utilizes Wi-Fi and location services to record attendance on campus. The recorded attendance data is securely stored in a database, allowing the administrator or main authority to access and modify the records as needed. This integrated system not only simplifies the attendance process but also ensures data integrity and provides real-time monitoring capabilities.

**In 2023 K. Sangeetha, M. Shobana, V. S. Nagul Pranav, S. Darunya, K. P. Madhumitha and M. Nidharshini presented IoT Based Identification And Attendance Monitoring System Using Design Thinking Framework**

The outdated study approach is inadequate at tracking employee and student movement, making it difficult for management to manually track attendance and uncover confusing and fraudulent activities. Design Thinking is a unique approach to solve problems that are ill-defined or unknown. CNN and RFID can track student and employee movements. CNN and RFID were suggested to improve management and track interest group activities. RFID and CNN Model were used to improve management and track interest groups. RFID and facial detection are used to verify student attendance. The RFID tags and facial detection technique allow management to track students and employees in and out of campus. An individual without an RFID card or with an unmatched face and ID card will trigger, alerting management and maintaining record of their attendance. This system used wireless networking, a webcam, a database management system, and passive RFID. When the RFID tag passed through the RFID reader in the read range zone, the database system recorded the data. Cameras and RFID readers read the face simultaneously. The software takes photos of all authorized users and stores them in a database. The system then saves the image in a face coordinate structure. This system sends staff and student data to management online for monitoring. Management may easily access student and employee personal records and track their availability. Hence using the five stages of Design Thinking this study impacts employee and student monitoring practices. The project cannot restrict punctuation, but it will assist management monitor attendance, detect fraud,and save time.

**CHAPTER III**

**SOFTWARE TOOLS**

**3.1 Arduino IDE:**

The Arduino Integrated Development Environment or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

**WRITING SKETCHES**

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension **.**ino. The editor has featsures for cutting/pasting and for searching/replacing text.

The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information.

The bottom right hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

NB: Versions of the Arduino Software (IDE) prior to 1.0 saved sketches with the extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

|  |  |
| --- | --- |
| https://www.arduino.cc/en/uploads/Guide/play.png | Verify [Checks your code for errors compiling it.] |
| https://www.arduino.cc/en/uploads/Guide/export.png | Upload [Compiles your code and uploads it to the configured board. See [uploading](https://www.arduino.cc/en/Guide/Environment#uploading) below for details].  Note: If you are using an external programmer with your board, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer" |
| https://www.arduino.cc/en/uploads/Guide/new.png | New [Creates a new sketch.] |
| https://www.arduino.cc/en/uploads/Guide/open.png | Open  [Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content.]  Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch late in the list, use the File | Sketchbookmenu instead. |
| https://www.arduino.cc/en/uploads/Guide/save.png | Save [Saves your sketch.] |
| https://www.arduino.cc/en/uploads/Guide/serial_monitor.png | Serial Monitor [Opens the [serial monitor](https://www.arduino.cc/en/Guide/Environment#serialmonitor).] |

Additional commands are found within the five menus: File, Edit, Sketch, Tools, Help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

**SKETCH**

* Verify/Compile [Text Wrapping Break]Checks your sketch for errors compiling it; it will report memory usage for code and variables in the console area.
* Upload [Text Wrapping Break]Compiles and loads the binary file onto the configured board through the configured Port.
* Upload Using Programmer [Text Wrapping Break]This will overwrite the boot loader on the board; you will need to use Tools > Burn Boot loader to restore it and be able to Upload to USB serial port again. However, it allows you to use the full capacity of the Flash memory for your sketch. Please note that this command will NOT burn the fuses. To do so Tools -> Burn Bootloader command must be executed.
* Export Compiled Binary [Text Wrapping Break]Saves a .hex file that may be kept as archive or sent to the board using other tools.
* Show Sketch Folder [Text Wrapping Break]Opens the current sketch folder.
* Include Library [Text Wrapping Break]Adds a library to your sketch by inserting #include statements at the start of your code. For more details, see[libraries](https://www.arduino.cc/en/Guide/Environment#libraries) below. Additionally, from this menu item you can access the Library Manager and import new libraries from .zip files.
* Add File... [Text Wrapping Break]Adds a source file to the sketch (it will be copied from its current location). The new file appears in a new tab in the sketch window. Files can be removed from the sketch using the tab menu accessible clicking on the small triangle icon below the serial monitor one on the right side o the toolbar.

**TOOLS**

* Auto Format: Formats code neatly by aligning opening and closing curly braces and indenting statements inside curly braces.
* Archive Sketch: Archives the current sketch in .zip format, placing it in the same directory as the sketch.
* Fix Encoding & Reload: Resolves discrepancies between editor char map encoding and other operating systems char maps.
* Serial Monitor: Opens the serial monitor window and initiates data exchange with any connected board on the selected Port. This typically resets the board if it supports Reset over serial port opening.
* Board: Selects the board being used. Descriptions of various boards are available below.
* Port: Lists all serial devices (real or virtual) on the machine, automatically refreshing every time the top-level tools menu is opened.
* Programmer: Selects a hardware programmer when programming a board or chip, not using the onboard USB-serial connection. Necessary for burning a bootloader onto a new microcontroller.
* Burn Bootloader: Burns a bootloader onto the microcontroller on an Arduino board, not required for normal use but useful when purchasing new ATmega microcontrollers. Ensure the correct board is selected before burning the bootloader, as this also sets the right fuses.

**SKETCHBOOK**

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar.

The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog.

**UPLOADING**

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The [boards](https://www.arduino.cc/en/Guide/Environment#boards) are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or/dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx, /dev/ttyUSBx or similar.

Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the File menu. Current Arduino boards will reset automatically and begin the upload.

**LIBRARIES**

Libraries offer additional functionality for sketches, enabling tasks such as hardware interfacing and data manipulation. To integrate a library into a sketch, navigate to Sketch > Import Library and select the desired library. This action automatically inserts necessary #include statements at the sketch's beginning and compiles the library along with your code. It's important to note that since libraries are uploaded alongside the sketch, they contribute to the overall space utilized by the board.

If a sketch no longer requires a library, remove its #include statements from the code. Libraries can be found in the reference, with some included in the Arduino software and others downloadable from various sources or via the Library Manager. From IDE version 1.0.5 onwards, you can import libraries from zip files directly into open sketches. Refer to instructions for installing third-party libraries.

**SERIAL MONITOR**

Displays serial data being sent from the Arduino or Genuino board (USB or serial board). To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux, the Arduino or Genuino board will reset (rerun your sketch execution to the beginning) when you connect with the serial monitor.

**REFERENCES**

Some preferences can be set in the preferences dialog (found under the Arduino menu on the Mac, or File on Windows and Linux). The rest can be found in the preferences file, whose location is shown in the preference dialog.

**BOARDS**

The board selection has two effects: it sets the parameters (e.g. CPU speed and baud rate) used when compiling and uploading sketches; and sets and the file and fuse settings used by the burn boot loader command. Some of the board definitions differ only in the latter, so even if you've been uploading successfully with a particular selection you'll want to check it before burning the boot loader. You can find a comparison table between the various boards [here](https://www.arduino.cc/en/Products/Compare).

Arduino Software (IDE) includes the built in support for the boards in the following list, all based on the AVR Core. The Boards included in the standard installation allows to add support for the growing number of new boards based on different cores like Arduino Due, Arduino Zero, Edison, Galileo and so on.

**3.2 EMBEDDED C**

Embedded C is the most popular embedded software language in the world. Most embedded software is written in Embedded C.It is a set of language extensions for the [C Programming language](https://en.wikipedia.org/wiki/C_Language) by the [C Standards committee](https://en.wikipedia.org/wiki/SC22) to address commonality issues that exist between C extensions for different [embedded systems](https://en.wikipedia.org/wiki/Embedded_systems).

Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as [fixed-point arithmetic](https://en.wikipedia.org/wiki/Fixed-point_arithmetic), multiple distinct [memory banks](https://en.wikipedia.org/wiki/Memory_bank), and basic [I/O](https://en.wikipedia.org/wiki/Input/output) operations. The C programming language is perhaps the most popular programming language for programming embedded systems.

Most C programmers are accustomed to environments offering standard library implementations and additional libraries for use. However, in embedded systems, such luxuries are rare. Embedded systems often lack the multitude of libraries typical in standard programming environments, and some may not even have a complete standard library.

In embedded systems, standard library functions must be directly linked due to the absence of dynamic linking capabilities. Space constraints often prevent inclusion of entire library files, leading programmers to develop custom standard C library implementations. Despite limitations, many development systems still provide commonly used standard libraries for C programmers.

Modern IDEs integrate compilers with advanced features like ICD support, breakpoints, and single-stepping, alongside assembly windows. C compilers have improved greatly, offering performance comparable to assembly. Tools now allow optimization customization, and using C enhances portability across different processor types

**BASIC CONCEPTS OF EMBEDDED C AND EMBEDDED PROGRAMING**

Embedded C, even if it’s similar to C, and embedded languages in general requires a different kind of thought process to use. Embedded systems, like cameras or TV boxes, are simple computers that are designed to perform a single specific task. They are also designed to be efficient and cheap when performing their task.

It can run on a wide variety of processors, regardless of their architecture. Unlike high level languages, Embedded C requires less resources to run and isn’t as complex. Some experts estimate that C is 20% more efficient than a modern language like C++. Another advantage of Embedded C is that it is comparatively easy to debug.

**EMBEDDED C COMPILERS**

There are a variety of different compilers on the market, manufactured by different companies that use Embedded C. One of the more popular ones is the Keil compiler. Because of this, Embedded C is also sometimes known as Keil C.

Embedded C has several keywords that are not present in C ([learn more about the concept of keywords in this course](https://www.udemy.com/learn-c-program/?tc=blog.embeddedctutorial&utm_source=blog&utm_medium=udemyads&utm_content=post135834&utm_campaign=content-marketing-blog&xref=blog)). These keywords are associated with operations needed by microprocessors. You will need to be familiar with all of them to be able to write Embedded C programs.

**EMBEDDED SYSTEMS PROGRAMMING**

Embedded systems programming is different from developing applications on a desktop computers. Key characteristics of an embedded system, when compared to PCs, are as follows:

* Embedded devices have resource constraints(limited ROM, limited RAM, limited stack space, less processing power)
* Components used in embedded system and PCs are different; embedded systems typically uses smaller, less power consuming components. Embedded systems are more tied to the hardware.

**EMBEDDED SYSTEMS USING DIFFERENT TYPE OF LANGUAGES:**

* Machine Code
* Low level language, i.e., assembly
* High level language like C, C++, Java, Ada, etc.
* Application level language like Visual Basic, scripts, Access, etc.

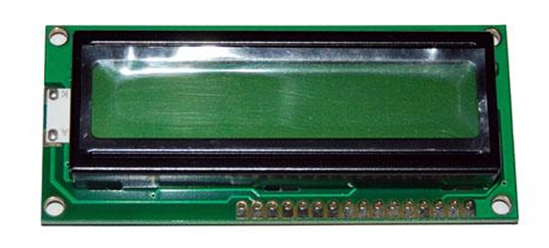
**CHAPTER IV**

**HARDWARE TOOLS**

**4.1 LCD DISPLAY**

**4.1.1 INTRODUCTION**

Liquid crystal cell displays (LCDs) used to display of display of numeric and alphanumeric characters in dot matrix and segmental displays.They are all around us in [laptop computers](http://computer.howstuffworks.com/laptop.htm), [digital clocks](http://electronics.howstuffworks.com/digital-clock.htm) and watches, microwave, [CD players](http://electronics.howstuffworks.com/cd.htm) and many other electronic devices. LCDs are common because they offer some real advantages over other display technologies. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.



An LCD is made with either a passive matrix or an active matrix display grid. An active matrix has a [transistor](http://searchcio-midmarket.techtarget.com/definition/transistor) located at each pixel intersection, requiring less current to control the luminance of a pixel. For this reason, the current in an active matrix display can be switched on and off more frequently, improving the screen refresh time.Passive matrix LCD's have dual scanning, meaning that they scan the grid twice with current in the same

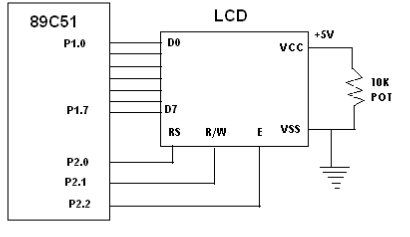
**4.1.2 WORKING**

The LCD technology described involves aligning liquid crystal molecules with a specific voltage to control light passage, requiring a +5V power supply with precise adjustments for contrast. Isolation of ground terminals and modules is crucial to prevent interference. LCDs are lightweight, thin, and energy-efficient but require external light sources for visibility. They undergo initialization before use and can be structured as passive or active matrix displays, with the latter offering better performance. The specific LCD in the project is a 16x2 character display with a 5x7 dot matrix, cursor, built-in controller, and operates with a 1/16 duty cycle on a +5V supply.

**4.1.3 PIN DESCRIPTION FOR LCD**

|  |  |  |
| --- | --- | --- |
| PIN NO | SYMBOL | FUNCTION |
| 1 | Vss | Ground terminal of Module |
| 2 | Vdd | Supply terminal of Module, +  5v |
| 3 | Vo | Power supply for liquid crystal drive |
| 4 | RS | Register select  RS=0…Instruction register  RS=1…Data register |
| 5 | R/W | Read/Write  R/W=1…Read  R/W=0…Write |
| 6 | EN | Enable |
| 7-14 | DB0-DB7 | Bi-directional Data Bus.  Data Transfer is performed once ,thru DB0-DB7,incase of interface data length is 8-bits;and twice, thru DB4-DB7 in the case of interface data length is 4-bits.Upper four bits first then lower four bits. |
| 15 | LAMP-(L-) | LED or EL lamp power supply terminals |
| 16 | LAMP+(L+)  (E2) | Enable |

**4.1.4 LCD INTERFACING WITH MICROCONTROLLER**



**4.1.5 ADVANTAGES**

* Consume much lesser energy when compared to LEDs.
* Utilizes the light available outside and no generation of light.
* Since very thin layer of liquid crystal is used, more suitable to act as display elements.
* Since reflectivity is highly sensitive to temperature, used as temperature measuring sensor.

# **4.1.6 DISADVANTAGES**

* Angle of viewing is very limited.
* External light is a must for display.
* Since not generating its own light and makes use of external light for display, contrast is poor.
* Cannot be used under wide range of temperature.

**4.1.7 APPLICATIONS**

* Watches
* Fax & Copy machines & Calculators.

**4.2 NodeMCU**

NodeMCU is an open source IoT platform.It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware, which is based on the ESP-12 module. The term “NodeMCU” by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language. It is based on the eLua project and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as Lua-cjson and spiffs. LUA based interactive firmware for Expressif ESP8622 Wi-Fi SoC, as well as an open source hardware board that contrary to the $3 ESP8266 Wi-Fi modules includes a CP2102 TTL to USB chip for programming and debugging, is breadboard-friendly, and can simply be powered via its micro USB port.

**4.2.1 FEATURES**

* Wi-Fi Module – ESP-12E module similar to ESP-12 module but with 6 extra GPIOs.
* USB – micro USB port for power, programming and debugging
* Headers – 2x 2.54mm 15-pin header with access to GPIOs, SPI, UART, ADC, and power pinsMisc – Reset and Flash buttons
* Power – 5V via micro USB port
* Dimensions – 49 x 24.5 x 13mm

**4.2.2 Arduino-like hardware IO**

Advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware. Code like Arduino, but interactively in Lua script.

**4.2.3 Nodejs style network API**

Event-driven API for network applications, which facilitates developers writing code running on a 5mm\*5mm sized MCU in Nodejs style. Greatly speed up your IOT application developing process.

**4.2.4 Lowest cost WI-FI**

Less than $2 WI-FI MCU ESP8266 integrated and easy to prototyping development kit. We provide the best platform for IOT application development at the lowest cost.

**4.2.5 Development Kit**

The Development Kit based on ESP8266, integrated GPIO, PWM, IIC, 1-Wire and ADC all in one board. Power your development in the fastest way combining with NodeMcu Firmware!

\* The ESP8266 chip requires 3.3V power supply voltage. It should not be powered with 5 volts like other arduino boards.

\* NodeMCU ESP-12E dev board can be connected to 5Vusing micro USB connector or Vin pin available on board.

\* The I/O pins of ESP8266 communicate or input/output max 3.3V only. i.e. the pins are NOT 5V tolerant inputs.

**4.3 FINGER PRINTER**

Finger print scanning technology uses a finger print scanner to identify people and provide a high level of security. It is most often used at access points of a building, to ensure that only appropriate people can enter a building or room. Finger scanning technology is now being used to provide security for a wide range of items, including computers.

In the case of a computer, finger scanner software is installed to allow the finger print scanner to identify people using the computer and deny access to anyone whose fingerprints do not match those of the people allowed to use the computer. Finger scanning technology provides a high level of security, as fingerprints cannot be stolen or given to someone else to use. Also, fingerprints are not lost or misplaced. For these reasons, finger scanning is now used for a variety of security purposes. Finger scanner development has lead to the improvement of fingerprint scanning for access reasons and the use of finger scanning for such things as computers, safety boxes, portable finger print scanners, and scanners that may be used by banks or the police.

**4.3.1 TYPES OF FINGERPRINT SCANNERS**

* Optic based sensors use light to read the image of the fingerprint.
* Capacitance-based sensors use electrical currents to read the image of the fingerprint.
* Radio frequency sensors use a radio frequency signal to read the image of the fingerprint.

**4.3.2 WORKING PRINCIPLE**

Different types of fingerprint scanners work in different ways. A capacitance-based finger print scanner generates an image of a fingerprint, using an electrical current. The sensor is connected to an integrator, which is connected to an inverting operational amplifier. When the finger is scanned, different ridges and valleys of the fingerprint result in different voltages. When a person is being granted access, the scanner will read the fingerprint and store it as a digital profile. When people are trying gain access by using the fingerprint scanner, the scanner processor reads the voltage output and determines whether it matches the fingerprints that are allowed access.For the other types of scanner, the process is very similar, except the image of the fingerprint is captured and read in different ways. An optic based sensor uses light to capture and read the fingerprint. A radio frequency sensor sends a radio frequency signal into the finger in order to capture and read the image of the fingerprint.



**4.4 EM-18 RFID READER**

This module directly connects to any microcontroller UART or through a RS232 converter to PC. It gives UART/Wiegand26 output. This RFID Reader Module works with any 125 KHz RFID tags

**4.4.1 SPECIFICATIONS**

* 5VDC through USB (External 5V supply will boost range of the module)
* Current: <50mA
* Operating Frequency: 125Khz
* Read Distance: 10cm
* Size of RFID reader module: 32mm(length) \* 32mm(width) \* 8mm(height)

**4.4.2 RS232 INTERFACE FORMAT**

10 ASCII DATA (card no.)+ 2 ASCII DATA (XOR result)

**E.g.** Card number is 4500C5D1E9B8 read from reader then the card number on card will be as below.

45 - Preamble

00C5D1E9 value in Hex = 12964329. / B8 is XOR value for (45 XOR 00 XOR C5 XOR D1 XOR E9)

Hence number on the card is 0012964329.

1. Data baud rate: 9600 bps

2. Data bit 8 bits

3. Parity check: None

4. Stop bit

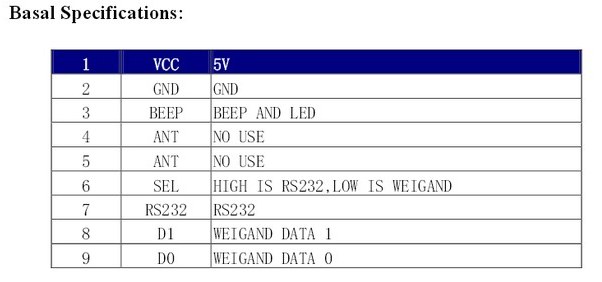
**4.4.3 WORKING PRINCIPLE**

**ACTIVE**

Active tags require a power source they’re either connected to a powered infrastructure or use energy stored in an integrated battery. In the latter case, a tag’s lifetime is limited by the stored energy, balanced against the number of read operations the device must undergo. One example of an active tag is the transponder attached to an aircraft that identifies its national origin.

**PASSIVE**

An RFID system typically consists of an antenna and semiconductor chip, enclosed within some form of encapsulation for protection. The tag reader powers and communicates with the tag, while the tag antenna captures energy and transmits the tag's ID. Encapsulation preserves the tag's integrity and shields the components from environmental factors. Designs for power transfer to the tag include magnetic induction and electromagnetic wave capture, utilizing the antenna's EM properties in both near and far fields to sustain tag operation.

.

**4.5 BUZZER**

A buzzer, a versatile audio signaling device, utilizes various mechanisms such as mechanical, electromechanical, magnetic, electromagnetic, electro-acoustic, or piezoelectric components. It can be activated by an oscillating electronic circuit or an audio signal source, serving to audibly indicate events or actions, such as button presses or system alerts. Buzzers generate distinct sounds, including clicks, beeps, or rings, which play a crucial role in providing feedback or signaling events in electronic devices and systems. Typically, they draw power directly from the device's power source but may also be battery-operated for uninterrupted functionality during mains outages. The term "buzzer" originates from the characteristic rasping noise produced by early electromechanical buzzers, which operated on stepped-down AC line voltage at 50 or 60 cycles per second. Other common signals for button presses include rings or beeps, contributing to the user experience and interaction with the device



**4.5.1 BUZZER CIRCUIT**

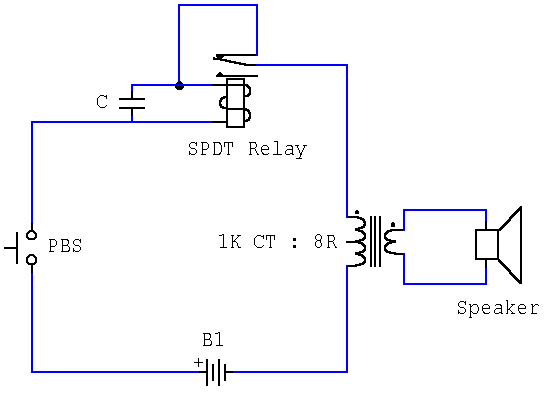


Fig Buzzer Circuit

This novel buzzer circuit uses a relay in series with a small audio transformer and speaker. When the switch is pressed, the relay will operate via the transformer primary and closed relay contact. As soon as the relay operates the normally closed contact will open, removing power from the relay, the contacts close and the sequence repeats, all very quickly so fast that the pulse of current causes fluctuations in the transformer primary, and hence secondary.

The speakers tone is thus proportional to relay operating frequency. The capacitor C can be used to "tune" the note. The nominal value is 0.001uF, increasing capacitance lowers the buzzers tone.

**4.5.2 TYPES OF BUZZER**

**ELECTROMECHANICAL**

Early devices were based on an electromechanical system identical to an [electric bell](https://en.wikipedia.org/wiki/Electric_bell) without the metal gong. Similarly, a [relay](https://en.wikipedia.org/wiki/Relay) may be connected to interrupt its own actuating [current](https://en.wikipedia.org/wiki/Electric_current), causing the [contacts](https://en.wikipedia.org/wiki/Switch) to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

**PIEZOELECTRIC**

A piezoelectric element may be driven by an [oscillating](https://en.wikipedia.org/wiki/Oscillation) electronic circuit or other [audio signal](https://en.wikipedia.org/wiki/Audio_signal) source, driven with a [piezoelectric audio amplifier](https://en.wikipedia.org/wiki/Piezoelectric_audio_amplifier). Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

Buzzers are typically used for identification and alarm purposes across many major industries.

### **4.5.5 PIEZO BUZZER CHARACTERISTICS**

Wide operating voltage: 3~250V

* Lower current consumption: less than 30mA
* Higher rated frequency
* Larger footprint
* Higher sound pressure level

**4.5.7 BENEFITS OF BUZZER**

* Warning systems like delta-larm or electric buzzers are crucial for alerting individuals during disasters or accidents, minimizing potential loss of life by facilitating timely evacuations.
* Electric alarm systems provide essential alerts about threatening liquid levels in areas such as lift pump chambers and sewage systems, enhancing safety in non-potable water applications
* In workplace settings, electric buzzers with timing software offer advanced features compared to traditional timers and bells, enabling synchronization with automatic software for efficient control over schedules.
* Electric buzzers find diverse applications in household appliances such as microwaves, washing machines, calculators, smoke detectors, and telephone ringers, enhancing their functionality

**4.5.8 MODERN APPLICATION**

* Novelty uses
* Judging Panels
* Educational purposes
* [Annunciator panels](https://en.wikipedia.org/wiki/Annunciator_panel)
* Electronic [metronomes](https://en.wikipedia.org/wiki/Metronome)
* [Game show](https://en.wikipedia.org/wiki/Game_show) [lock-out device](https://en.wikipedia.org/wiki/Lock-out_device)
* [Microwave ovens](https://en.wikipedia.org/wiki/Microwave_oven) and other [household appliances](https://en.wikipedia.org/wiki/Major_appliance)

**CHAPTER V**

**5.1 RESULT**

The development of an RFID-based attendance system using ESP8266 WiFi module and LoRa communication has shown promising results in automating the attendance tracking process within educational institutions. This section discusses the outcomes of the project along with the implications and potential improvements.

**5.1.1 Efficiency and Automation:**

The implemented system effectively automates the attendance process, eliminating the need for manual tracking. RFID technology enables quick and accurate identification of students as they enter the classroom, reducing the time required for attendance-taking compared to traditional manual methods. This increased efficiency allows teachers to focus more on teaching rather than administrative tasks, ultimately enhancing productivity within the educational environment.

**5.1.2 Accuracy and Reliability:**

The use of RFID technology ensures high accuracy and reliability in attendance tracking. Each student is assigned a unique RFID tag, which is read by the RFID reader upon entry. This eliminates the possibility of errors or fraudulent attendance reporting, enhancing the overall integrity of the attendance data. Furthermore, the integration of fingerprint authentication adds an additional layer of security, ensuring that attendance records are authentic and tamper-proof.

**5.1.3 Real-Time Data Transfer:**

The incorporation of ESP8266 WiFi module and LoRa communication enables seamless real-time data transfer between the transmitter and receiver sides of the system. Attendance data captured by the RFID reader and fingerprint sensor is transmitted wirelessly to the receiver side, where it is processed and stored in the cloud platform. This real-time data transfer ensures that attendance records are instantly updated and accessible to relevant stakeholders, including teachers, administrators, and parents.

**5.1.4 Cloud Integration:**

The integration of a cloud platform facilitates centralized storage and management of attendance data. Cloud-based storage ensures scalability and accessibility, allowing users to access attendance records from anywhere with an internet connection. Additionally, cloud integration enables advanced analytics and reporting capabilities, providing valuable insights into student attendance patterns and trends over time.

**5.1.5 User Feedback and Acceptance:**

Initial feedback from users, including teachers and administrative staff, has been largely positive. Users appreciate the convenience and reliability of the system, as well as its ability to streamline the attendance tracking process. However, there may be some resistance to adopting new technology initially, particularly among older faculty members who may be less familiar with RFID and IoT technologies. Effective training and support will be crucial in ensuring widespread acceptance and adoption of the system.

**5.1.6 Further Improvements:**

While the developed system has demonstrated effectiveness in automating attendance tracking, there are several areas for potential improvement.

1. Enhanced Security: Implementing additional security measures, such as encryption protocols for data transmission and multi-factor authentication, can further enhance the security of the system and protect against potential breaches.

2. Integration with Student Management Systems: Integrating the RFID-based attendance system with existing student management systems can streamline administrative processes and ensure seamless data synchronization across different platforms.

3. Mobile Application: Developing a mobile application for teachers and administrators to monitor attendance records, receive notifications, and generate reports on-the-go can further enhance the usability and accessibility of the system.

4. Scalability: Designing the system to be scalable to accommodate larger institutions with multiple classrooms and thousands of students will be important for widespread adoption.

An RFID-based attendance system using ESP8266 WiFi and LoRa communication can revolutionize education. It automates processes, improves accuracy, enables real-time data transfer, and integrates with cloud storage. Ongoing innovation is crucial for widespread adoption.

**CHAPTER VI**

**CONCLUSION**

In conclusion, the proposed RFID-based attendance system offers a robust and efficient solution to the challenges faced in manual attendance tracking within educational institutions. By integrating RFID technology with ESP8266 WIFI modules and LoRa communication, the system ensures seamless data transfer and real-time attendance monitoring. This automation not only reduces administrative workload but also minimizes errors associated with manual processes. Additionally, the system provides enhanced accuracy and reliability in attendance recording. With the ability to transmit data to a cloud platform, stakeholders can access attendance information conveniently and securely. Overall, the implementation of this system promises to streamline the attendance tracking process, optimize resource utilization, and enhance operational efficiency within educational settings.

**6.1 FUTURE SCOPE**

The proposed RFID-based attendance system offers various avenues for future enhancements. Integrating machine learning algorithms could optimize schedules and resource allocation by analyzing attendance patterns. Additionally, facial recognition alongside RFID and fingerprint authentication can enhance security and accuracy. Leveraging IoT principles, the system could monitor classroom environment factors. Mobile app integration offers flexibility, enabling real-time attendance tracking and notifications. Continuous innovation is key to further streamlining educational operations.

**REFERENCES**

Here are the paper citations with the keywords removed:

1. F. Ayodele, H. Singh and E. G. AbdAllah, "Securing RFID-Based Attendance Management Systems: An Implementation of the AES Block Cipher Algorithm," 2023 IEEE 13th International Conference on RFID Technology and Applications (RFID-TA), Aveiro, Portugal, 2023, pp. 99-102, doi: 10.1109/RFID-TA58140.2023.10290327.

2. A. -S. T. Hussain, T. A. Taha, S. R. Ahmed, S. A. Ahmed, O. K. Ahmed and H. Desa, "Automated RFID-Based Attendance and Access Control System for Efficient Workforce Management," 2023 7th International Symposium on Innovative Approaches in Smart Technologies (ISAS), Istanbul, Turkiye, 2023, pp. 1-6, doi: 10.1109/ISAS60782.2023.10391615.

3. S. Sharma, S. Monika, S. V. S. Prasad, K. Dasari and S. Kamaganikuntla, "RFID Based Low Cost Attendance Recording and Proxy Avoidance System," 2022 International Conference on Advancements in Smart, Secure and Intelligent Computing (ASSIC), Bhubaneswar, India, 2022, pp. 1-5, doi: 10.1109/ASSIC55218.2022.10088295.

4. M. I. M. Rozlan, S. B. Kutty, N. A. Sulaiman, N. S. M. Pakhrudin, S. Saaidin and M. Kassim, "RFID Based Attendance Monitoring System with LED Authentication," 2023 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS), Shah Alam, Malaysia, 2023, pp. 85-90, doi: 10.1109/I2CACIS57635.2023.10193394.

5. C. S. Kumar, S. Banka, J. Vaishnavi, S. Chandini, G. Himabindu and G. Meghana, "RFID Time and Attendance System based on IoT Technology," 2023 2nd International Conference on Automation, Computing and Renewable Systems (ICACRS), Pudukkottai, India, 2023, pp. 293-296, doi: 10.1109/ICACRS58579.2023.10404328.

6. N. R et al., "Biometric and RFID Passive Tag based Student Identification System for Secure Attendance Management," 2023 4th International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2023, pp. 1-6, doi: 10.1109/ICIEM59379.2023.10166924.

7. H. Jun Jie, H. Aysa Abdul Halim Sithiq and N. Azlina Abd Rahman, "Convergence of APCARD and RFID for Attendance System," 2022 IEEE International Conference on Distributed Computing and Electrical Circuits and Electronics (ICDCECE), Ballari, India, 2022, pp. 1-5, doi: 10.1109/ICDCECE53908.2022.9792991.

8. P. Chavan et al., "Smart Card Attendance Monitoring System Using RFID," 2023 International Conference on Computer Science and Emerging Technologies (CSET), Bangalore, India, 2023, pp. 1-6, doi: 10.1109/CSET58993.2023.10346694.

9. N. Ramakrishnan, A. A., A. Ali, M. S. A. and S. V., "Wi-Fi Based Smart Attendance Monitoring System," 2023 7th International Conference on Computation System and Information Technology for Sustainable Solutions (CSITSS), Bangalore, India, 2023, pp. 1-6, doi: 10.1109/CSITSS60515.2023.10334163.

10. K. Sangeetha, M. Shobana, V. S. Nagul Pranav, S. Darunya, K. P. Madhumitha and M. Nidharshini, "IoT Based Identification And Attendance Monitoring System Using Design Thinking Framework," 2023 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, 2023, pp. 1-6, doi: 10.1109/ICCCI56745.2023.10128367.

11. P. Zlatarov and G. Ivanova, "Design and Development of a Smartphone-Enabled Smart Card-Based Attendance Tracking Module for Personalized Education," 2023 7th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT), Ankara, Turkiye, 2023, pp. 1-6, doi: 10.1109/ISMSIT58785.2023.10304892.

12. V. K. PM, N. A N and S. Sudarshan, "RFID-Attendance System with Notification Using IFTTT Platform," 2024 International Conference on Intelligent and Innovative Technologies in Computing, Electrical and Electronics (IITCEE), Bangalore, India, 2024, pp. 1-4, doi: 10.1109/IITCEE59897.2024.10467546.

13. R. A, S. Brindha, S. S. B and G. A, "Smart Attendance System Using RFID and Face ID," 2022 International Conference on Communication, Computing and Internet of Things (IC3IoT), Chennai, India, 2022, pp. 1-5, doi: 10.1109/IC3IOT53935.2022.9768003.

14. D. Hanggoro, J. H. Windiatmaja and R. F. Sari, "Blockchain-based Attendance Management and Payroll System using Hyperledger Composer Framework," 2022 IEEE Region 10 Symposium (TENSYMP), Mumbai, India, 2022, pp. 1-6, doi: 10.1109/TENSYMP54529.2022.9864383.

15. S. R, S. Kavitha, N. Darwin, A. Titus, V. V. Kishore and D. B. S, "Smart RFID: Experimental Evaluation of Secured Students Attendance Handling System Using RFID," 2023 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI), Chennai, India, 2023, pp. 1-7, doi: 10.1109/ACCAI58221.2023.10200716.

16. S. K. Mekni, "Design and Implementation of a an IoT-based Kids Tracking System," 2022 2nd International Conference of Smart Systems and Emerging Technologies (SMARTTECH), Riyadh, Saudi Arabia, 2022, pp. 112-117, doi: 10.1109/SMARTTECH 54121.2022.00036.

17. N. Nizam et al., "Automated Attendance Management System: Leveraging Computer Vision for Efficient Tracking and Monitoring," 2023 IEEE 9th International Conference on Smart Instrumentation, Measurement and Applications (ICSIMA), Kuala Lumpur, Malaysia, 2023, pp. 111-115, doi: 10.1109/ICSIMA59853.2023.10373460.

18. S. Meivel, C. Praghadeesh, A. Ravinder and D. Sibisaran, "Hybrid Student Authentication System Using RFID Reader and Face Biometrics Using Deep Learning Techniques," 2022 International Conference on Applied Artificial Intelligence and Computing (ICAAIC), Salem, India, 2022, pp. 550-556, doi: 10.1109/ICAAIC53929.2022.9792810.

19. R. G, P. G, P. P N, A. P. S, V. Sekhar and N. S. Kumar, "Smart Attendance Monitoring System Using IoT," 2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2023, pp. 1099-1104, doi: 10.1109/ICACCS57279.2023.10112850.

20. V. Bittal, V. Jagdale, A. Brahme, D. Deore and B. Shinde, "Multifarious Face Attendance System using Machine Learning and Deep Learning," 2023 7th International Conference on Intelligent Computing and Control Systems (ICICCS), Madurai, India, 2023, pp. 387-392, doi: 10.1109/ICICCS56967.2023.10142759.