Attendance System using RFID Tag

1.Ramanathan M, UG Student,Panimalar Engineering College, India
2.SaranKumar K, UG Student,Panimalar Engineering College, India
3.Rishi J, UG Student,Panimalar Engineering College,India
4.Stephan.J, Assistant Professor,Panimalar Engineering College, India

Abstract
This article discusses the creation of a student attendance system based on radio frequency identification (RFID). Every time a pupil enters the classroom in accordance with the established customary attendance method, they must physically stamp the attendance form. Even though it might seem typical, such a system lacks mechanisation, which can lead to a variety of issues. This includes the time wasted by the students searching for and signing their name on the attendance sheet, the possibility that some students might purposely or accidentally sign the name of another student, and the possibility that the attendance sheet might get misplaced. Additionally, in some circumstances, the instructor must call out the students' names to determine whether they are present or not.All the above- mentioned issues can be avoided by having a system that can instantly record students'attendance when they flash their student identification at the RFID scanner.Our system's main objective is to track students' attendance, and having a system online that is accessible at all times from anywhere can be very helpful for teachers in this regard.When considering the larger picture, implementing the system across the academic staff will be advantageous to academic administration because student attendance is one of the most important factors in enhancing the effectiveness of instruction and keeping track of their students' success. Additionally, this system offers useful web tools for simple record-keeping that are accessible to both lecturers and other academic administration staff members, specifically with a focus on tracking students' Progress.

Keywords:-RFID,students attendance, online system, web, sensor, Arduino, Attendance system,

Introduction:

An attendance system using RFID tags typically involves tagging students with RFID tags and then using RFID readers to capture the tag ID as students enter or leave a designated area, such as a classroom or school campus. The captured data can be used to automatically track attendance records and generate report

To implement such a system, you will need the following components:

1. RFID tags: These are small devices that can be attached to student IDs, keychains, or wristbands. Each tag has a unique ID that can be read by an RFID reader.
2. RFID readers: These are devices that can read RFID tags within a certain range. You will need to install readers at the entrance and exit points of the designated area.
3. Database: The captured data needs to be stored in a database for tracking and reporting purposes. You can use a database management system like MySQL or PostgreSQL to store the data.
4. Software application: You will need to develop a software application that can read the data from the RFID readers and store it in the database. You can use a programming language like Python, Java, or C# to develop the application.
5. User interface: You will also need to develop a user interface for administrators and teachers to view attendance records and generate reports. You can use web development frameworks like Django or Ruby on Rails to develop the user interface.

When a student enters or leaves the designated area, the RFID reader captures the tag ID and sends it to the software application. The application then stores the data in the database. The user interface allows administrators and teachers to view attendance records and generate reports based on the captured data.

RFID Tag and RFID Reader

RFID readers are gadgets that can read or extract data from RFID tags.Both active and passive RFID readers are available. a lively An RFID reader can detect an active RFID tag at a distance of a few metres in line of sight, as opposed to a passive RFID reader, which can only detect passive RFID tags when they are within a few centimetres of the reader.An affordable RFID reader that can scan passive RFID tags is used by the system. It requires 12V from a power source and operates at 125 kHz. Between reader and antenna, the effective detection distance is approximately 5 cm. The RFID reader's core component is the EM4095 RFID transponder IC.. [2]

Each RFID tag is unique and has a specific identification number or serial number, allowing it to differentiate between various products. Additionally, some RFID tags contain data that can only be read by an RFID reader. The three types of RFID tags are passive, semi-passive, and active, with the primary difference being that active and semi-passive RFID tags contain an internal battery, unlike passive RFID tags[2].

figure 1:RFID Reader Gate

figure 2: RFID Tag

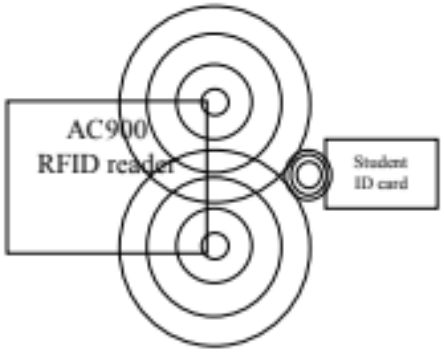

figure 3: RFID reader and student RFID tag communication

Frequency	Mode	Range	Transfer rate
125–135 kHz	Passive	Short range (up to 0.5 m)	Low
13.56 MHz	Passive	Medium range (up to 1.5 m)	Moderate
860–930 MHz	Passive	Medium range (up to 5 m)	Moderate to high
433 MHz	Active	Ultra long (up to 100 m)	High
2.45 GHz	Active	Long range (up to 10 m)	Very high

Frequency and range of RFID tags

Data Reporter:

Every 30 minutes, the Data Reporter must repeat the process of collecting logging data from the RFID reader, including the student ID, date, and time. The data is delivered to the web server for database storage after it has been gathered by the Data Reporter. This component must be able to resume automatically every time the operating system is rebooted and run uninterrupted continually. In other words, the Data Reporter must acquire and transmit data uninterruptedly while operating in the background.

Web Server:

The term "web server" is used to describe any piece of software or hardware (such as a computer) that facilitates the online delivery of material to users. By responding to requests from a user's browser with HTML documents (web pages) and files, it serves as the fundamental component of a website's functioning. A data collector, a database, and graphical user interface (GUI) pages that enable online interaction with system users are some of the components included in the web server to support the system's dynamic characteristics..[5]

Data Collector:

The online data collector plays a critical role in the functioning of the system by constantly monitoring the data received from the Data Reporter component. It is responsible for ensuring that the data is accurate, complete, and free of errors before forwarding it to the database for storage. This process of data collection and analysis is essential for various purposes, such as generating reports, identifying patterns, and monitoring the performance of the system.

Arduino:

There are multiple ways in which Arduino can be used in a web-based attendance system. One of the ways is the RFID attendance system, where the RFID reader is connected to an Arduino board to scan the unique ID of RFID tags allocated to each user. After scanning, the Arduino sends the tag ID to a web server over an Ethernet or Wi-Fi connection, which stores the attendance data in a database and generates reports. Another way is the Biometric attendance system, where an Arduino board can be connected to a biometric sensor like a fingerprint or facial recognition scanner. When a user scans their biometric information, the Arduino sends the data to a web server to mark attendance. Lastly, the QR code attendance system uses a QR code scanner connected to an Arduino board, where users scan their QR code from their mobile devices. The Arduino sends the attendance data to the web server.

In all these scenarios, Arduino functions as a mediator between the hardware and web server. The Arduino code can be programmed to handle the input data types and send them to the server in the right format. The web-based attendance system can be created using different web development frameworks and databases according to the specific application requirements.

Database:

Our database is used to primarily store the data gathered by the RFID reader and is an organised collection of data that is tailored for our system. Additionally, the database also contains data obtained through the online web interface, such as student personal information and class schedules.Our online system can manipulate the recorded student attendance record by querying the database for complex data retrieval in order to provide users with more features [3]. This covers automated tasks like adding up a student's attendance by figuring out the attendance rate for a particular course.

Graphical User Interface (GUI):

The graphical user interface (GUI) of the system was created with the aim of providing a pleasant and user-friendly experience to its users. Depending on the user's category, either students or academic staff, they are granted access to exclusive member areas where they can view their personal information or monitor their students' data. The GUI is constructed using dynamic web pages that are powered by a database, meaning that the data extracted from the database is used to populate the information presented on the web pages. The GUI is segmented into four main modules, namely the user list, log, timetable, and attendance.[4]

SYSTEM IMPLEMENTATION:

The system implementation was conducted based on the previously presented system design. The implementation process followed a process flow consisting of five main steps, as depicted in Figure 4. Additionally, the deployment of networked RFID readers is displayed in Figure 5.

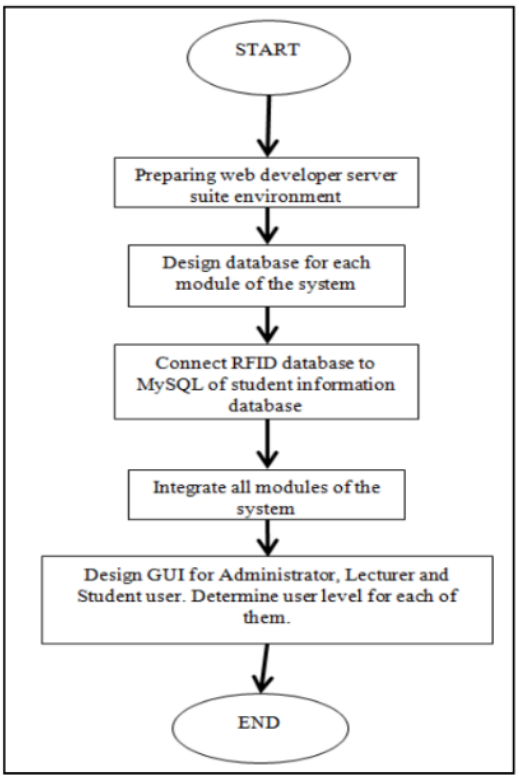

figure 4:Overall process flow in developing the Web Based Student's Attendance System

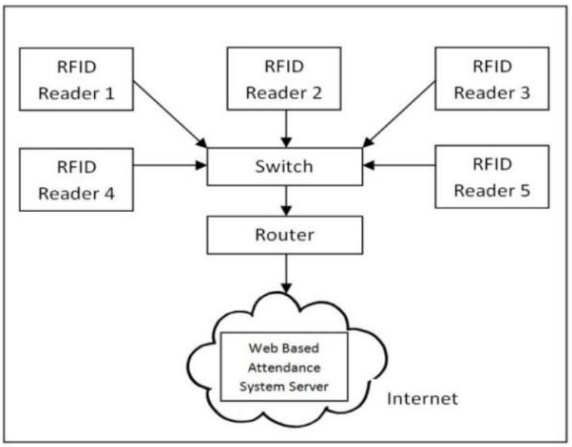

figure 5: Data exchange between a student card and an RFID reader

RFID (Radio Frequency Identification) tags are small devices that can be attached to or embedded in objects and are used for automatic identification and tracking. RFID systems consist of three components: the RFID tag, the RFID reader, and the backend system. Implementing a system in an RFID tag involves designing and programming the tag to perform specific functions. Here are some steps that may be involved in implementing a system in an RFID tag: Determine the requirements of the system: Before implementing a system in an RFID tag, it is important to determine the requirements of the system. This includes understanding the type of data that needs to be stored on the tag, the frequency of data updates, the range of the tag, and the required read and write speeds. [5]

1 .Choose the right RFID tag: There are different types of RFID tags available, each with their own capabilities and limitations. Choose a tag that meets the requirements of the system, including the type of data that needs to be stored and the environmental conditions where the tag will be used.

2 .Design the tag antenna: The antenna is an important part of the RFID tag, as it is used to communicate with the RFID reader. Design the antenna based on the frequency of the RFID system and the size of the tag.

3 . Program the tag: Program the tag with the required data and functionality. This may include storing data on the tag, configuring the tag to respond to specific commands from the reader, and implementing security features to protect the data on the tag.

4. Test the tag: Test the tag to make sure it complies with the system's criteria. This may entail evaluating the tag's read and write speeds, read and write range, and the accuracy of the data contained on the tag.

5.Deploy the tag: Deploy the tag in the desired environment and integrate it with the backend system. This may involve configuring the RFID reader to communicate with the tag and setting up the backend system to process the data from the tag.

Overall, implementing a system in an RFID tag requires a thorough understanding of the requirements of the system, as well as the capabilities and limitations of the RFID technology. It also requires careful design, programming, and testing to ensure that the tag performs as expected.

System Device for RFID:

The system's readers use RFID-Mifare terminals that may be installed in separate classrooms or laboratories to denote distinct locations. In this arrangement, a router is linked to the hub or switch to create internet access, which is required to connect the RFID readers to the Data Reporter via the TCP/IP protocol. Through an RJ45 connector, also known as a LAN port, the readers are linked to a hub or switch. Due to this configuration, each RFID-Mifare terminal utilised by the system's readers may be placed in a different lab or classroom to represent a different location.[5]

Web Development:

In the early stages of developing a web application, the developers typically work on a local host to create and test the software before deploying it to a live server. During this phase, a web server is needed to run the application on the local host, and the XAMPP server is one such web server that can be used for this purpose. The XAMPP server is installed on the local computer and provides an environment for generating, experimenting with, and debugging PHP scripts.[1]

To manage and store the data used by the programme, in addition to the web server, a database server is also required.In the event that the web application is being developed on the local host, a database server is installed on the same machine as the XAMPP server. This configuration enables the scripts to interact with the database and exchange information between them.[5]

The structure of the database is critical for the successful development of the web application, as it dictates how the data will be organised and accessed by the scripts. Thus, it is imperative to have a meticulously planned and executed database design to ensure the efficient operation of the application. In the forthcoming discussion, we will provide a brief explanation of the database design used in the locally hosted web application.[5]

My SQL Database:

The student attendance monitoring web-based system is connected directly to a MySQL database, which consists of four main tables used to store the collected data. The Log table comprises all user logging data, including student ID and check-in time. This data is collected by the RFID reader and forwarded to the Data Collector component, which stores it in the database. The User table stores personal information, such as names, addresses, phone numbers, and other profile data, of the students. The Timetable table contains information related to scheduled classes, such as the time, location, and course code.[1]

Subsequently, the Attendance database is responsible for tracking the analysis of the students' attendance data. A set of predefined SQL queries are written into common functions to simplify data insertions, updates, and retrievals. These functions are used to display web pages, providing a user-friendly interface to the users of the system. With the help of these SQL queries, the attendance data can be analysed and presented in a meaningful way, making it easier for academic staff to monitor and evaluate student attendance patterns. This system is designed to enhance the efficiency of the academic process and promote transparency in student attendance tracking.

GUI Design:

Access to the member area is restricted only to users who have successfully completed the login process, which serves as a form of authentication. This is done to prevent unauthorised users from accessing the system. The system is designed to accommodate three distinct user categories, namely administrators, lecturers, and students, and the level of access granted to each user is dependent on their category. While users in the Administrator category have full access to the system's data and can moderate and modify it as necessary, other user categories are granted limited system access.

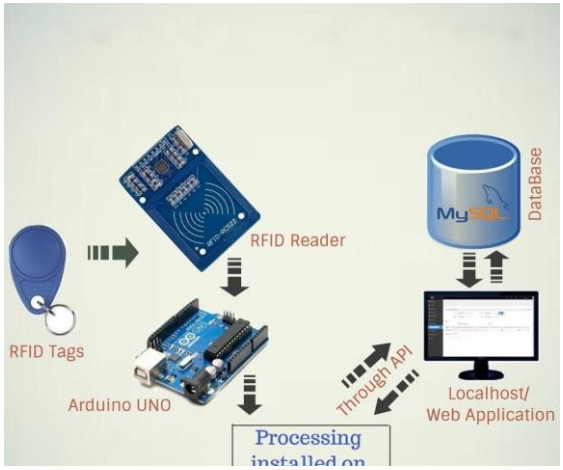

Figure 6

System Testing and Result

To assure the accuracy and completeness of the system, system testing has been done on the entire system environment, including the hardware, client-side application, and server-side application.To assure the accuracy and completeness of the system, system testing has been done across the system environment, including the client-side application, server-side application, and hardware.[1]

Hardware and Application integration testing:

In order to make sure the RFID Reader is working properly and capturing the ID and current timestamp from a variety of RFID student cards, it was put to the test.

The RFID Reader is initially flashed with a brand-new student card to capture and identify the card's unique ID. The recorded ID is then used to register the mapped student ID in the system.

Once registered, the student card may be flashed in front of an RFID scanner to track attendance. For this, the log data—which contains the current timestamp—is used.

It was necessary to configure the Data Reporter component in order for it to be able to obtain log data from the RFID Reader and transmit it to the Data Collector. The Data Reporter component and the log table (in the database) are then both kept watch for fresh log data to verify whether Data Reporter has properly retrieved and transmitted the log data to Data Collector, who will deposit the data into the log table. If no fresh log data was captured, the components of the Data Reporter and Data Collector were troubleshooted and adjusted until they successfully performed the required function. Figure 7 depicts the process flow for testing hardware and applications.

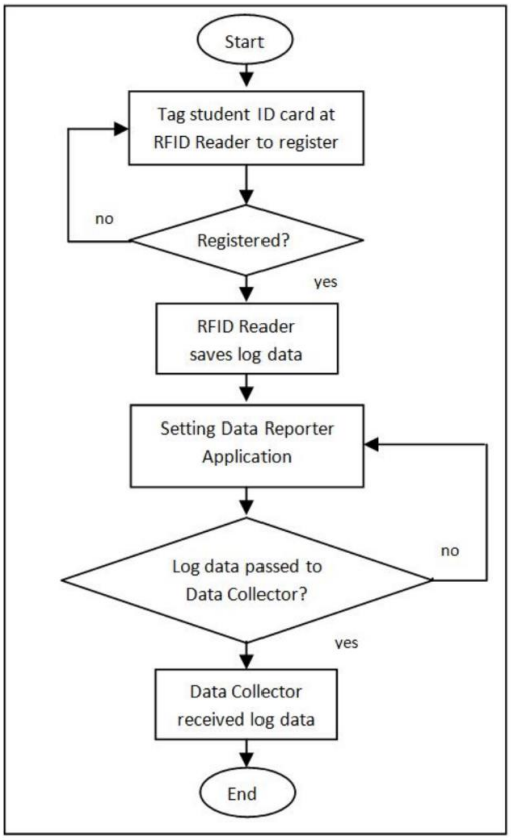

Figure 7:The hardware and application testing process flow

Online System:

In order to unit test the online components, a web browser was used to view their results. Each defined component underwent this testing throughout the coding stage. The output was specifically checked using a web browser after a certain function of an online component was coded in PHP. The function would be examined in a PHP editor for any display problems or errors. A procedure of testing similar to this was also applied to the SQL queries that were run on the database. It was debugged until the desired results were obtained if any query gave inaccurate results.

The overall system testing would be finished once all online pages were properly displayed by performing an integrated system test between the RFID reader and the online system. The process flow of the online system testing is shown below.

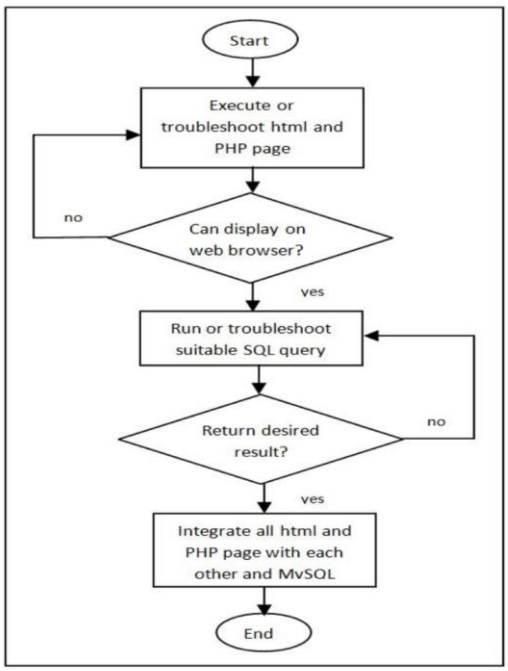

Figure 8:The online system testing flow

System Testing and Result:

Overall, we succeeded in constructing the prototype for a web-based student attendance system that we set out to do. The user-login authentication process was successfully tested to prevent unauthorised access to the system. A user is given access to the main page, which displays a menu detailing the options available to them, after successfully signing in. Figure 9 displays the login page for the web-based student attendance system. [1]

Only the system administrator has access to the Web Based Student Attendance System's Users List page, as shown in Figure 10. The administrator may filter the list of users on this page based on their role, such as administrator, lecturer, or student, and it provides information about every user in the system. The administrator can also click the equivalent option to remove or add new users The Student Attendance System User details page, which presents comprehensive data about a particular student, is seen in Figure 11. The administrator has access to all users' information, whereas a professor can only see those of users who have been designated as students.Information on one student's account may only be viewed by that student. An administrator can modify any user's details on such a website, and a lecturer can update a student's details, but students are not allowed to change any of their data..[1]

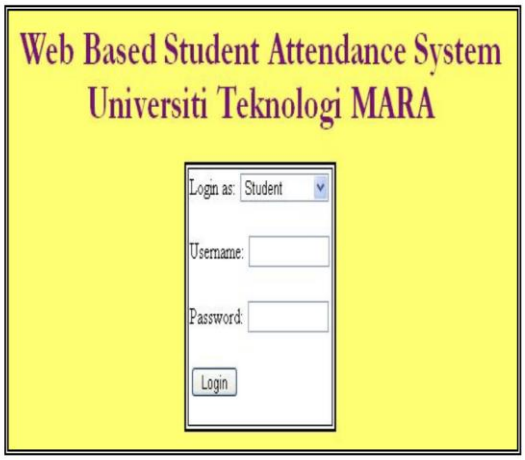

Figure 9: Web-Based Student Attendance System login menu

Figure 10: Attendance List menu

Performance Measurement:

Performance measurement in an RFID system is important to ensure that the system is functioning properly and meeting its intended goals. Here are some key performance metrics that can be measured in an RFID system:

1.Read range: This is the maximum distance at which an RFID reader can detect and communicate with an RFID tag. It is important to measure the read range to ensure that the system is capable of detecting tags at the desired distance.

2 Read rate: This is the number of tags that can be read per second by an RFID reader. Measuring the read rate is important to ensure that the system is capable of processing tags at the desired rate.

3.Data integrity: This is the accuracy and reliability of the data stored on the RFID tag. Measuring data integrity is important to ensure that the data can be read and processed correctly by the system.

4.Tag memory: This is the amount of data that can be stored on an RFID tag. Measuring tag memory is important to ensure that the system can store the necessary amount of data.

5.Tag lifespan: This is the expected lifespan of an RFID tag. Measuring tag lifespan is important to ensure that the system can operate for the desired length of time without requiring tag replacement.

6.Interference and reliability: This refers to the potential for interference from other sources of radio frequency signals, which can impact the reliability of the RFID system. Measuring interference and reliability is important to ensure that the system can operate in the desired environment without being affected by other signals.

By measuring these performance metrics, it is possible to identify any issues or limitations in the RFID system and make improvements to optimise its performance.

Conclusion:

The Web-Based Student Attendance System, utilising Radio Frequency Identification technology, is a highly beneficial tool for academic institutions. It is a more efficient and accurate alternative to the conventional manual method of monitoring and recording student attendance. The system's semi-automated process involves students swiping their ID cards in front of an RFID reader to register their attendance. The system provides several advantages, such as being an online web-based central database for student attendance records. This allows administrators and lecturers to access and edit attendance data from any computer with an internet connection and web browser, without requiring special software installation. This online approach also reduces the risk of data loss that is associated with manual filing methods. Moreover, it saves time for lecturers and teachers while taking attendance online, which can lead to improved quality of instruction. The developed system has the potential to be enhanced by adding new modules and features or improving the web-interface design. Additionally, the system's capabilities can be extended to track staff attendance records, providing an invaluable improvement.

Acknowledgement

Abbreviations:

1)RFID :Radio-Frequency Identification
2)SQL :Structured Query Language
3)HTML :HyperText Markup Language
4)TCP :Transmission Control Protocol
5)IP :Internet Protocol
6)LAN :Local Area Network
7)XAMPP :X stands for cross platform ,A-Apache, M-MYSQL, P-PHP,P-Perl .
8)PHP :Hypertext Preprocessor

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