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IoT-Based Smart Attendance System Using RFID, NodeMCU, AWS And C#

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Abstract

Purpose: This paper introduces an IoT-based brilliant attendance system leveraging RFID technology, NodeMCU, AWS (Amazon Web Services), and C# programming language. The system's primary objective is to automate attendance monitoring efficiently. The system utilizes Radio Frequency Identification (RFID) technology for seamless identification and tracking of individuals, enabling quick and accurate attendance records. Employing NodeMCU and C# programming, the system establishes communication between RFID readers and the cloud platform. This integration allows for real-time data transmission and processing. Leveraging AWS services, the system securely stores and manages attendance data. Utilizing AWS offers the attendance management system scalability, reliability, and security. By amalgamating these technologies, the system ensures efficient and reliable attendance tracking while addressing security concerns associated with RFID technology.

Design/Methodology/Approach: The system incorporates RFID technology to uniquely identify individuals, using RFID tags/cards to streamline attendance capture. Utilizing IoT devices like NodeMCU, the system connects RFID readers to the internet, enabling data transmission to servers or cloud platforms. Upon scanning RFID tags, the system captures attendance data, processes it in real-time, and stores it securely in databases or spreadsheets.

Findings/Result: The paper highlights integrating IoT technology with RFID for creating an attendance system. The research emphasizes the utilization of Amazon Web Services (AWS) for cloud integration, enabling efficient data storage, processing, and retrieval for attendance management. The paper details application development using C# programming language to monitor the attendance system.

Originality/Value: The value and originality of the research and findings related to IoT-based brilliant attendance systems using RFID technology. Integration of IoT and RFID, Originality stems from the fusion of IoT and RFID for creating efficient attendance monitoring systems.

Paper Type: Experimental-based Research.

Keywords: IoT, RFID, attendance system, NodeMCU, smart attendance system.

1. Introduction

IoT (Internet of Things) has revolutionized various sectors, including attendance monitoring systems. Integrating IoT with RFID (Radio-Frequency Identification) technology has paved the way for sophisticated and efficient attendance management solutions. These systems leverage innovative hardware components like NodeMCU to create smart attendance systems capable of real-time tracking, data storage, and remote accessibility. Organizations, educational institutions, and businesses can streamline attendance management processes with IoT-based RFID attendance systems. These systems offer the advantage of automating attendance records, providing accuracy, reducing manual efforts, and enabling remote monitoring. They utilize cloud platforms like Adafruit.io, Firebase, and Google Sheets for data storage and accessibility, ensuring secure and convenient record-keeping. Research papers and projects in this domain highlight the significant benefits of implementing these technologies, emphasizing improved efficiency, accuracy, and accessibility in attendance monitoring. The fusion of IoT and RFID presents a promising avenue for creating advanced,

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reliable, and scalable attendance systems adaptable to diverse organizational needs.

2. Related Works

The series of publications authored by Chakraborty and Aithal explore diverse facets of IoT development using Sinric Pro and C#. These papers delve into innovative approaches to IoT application development and implementation strategies. Chakraborty et al. illustrate methodologies to construct IoT systems in C# using Sinric Pro, focusing on software-based creation [1]. Their work introduces IoT devices utilizing C# WPF through Sinric Pro, aiding in practical IoT device simulation [2]. They discuss the integration of AWS, ESP8266, and C# for industrial debug message display, enhancing industrial IoT applications [3]. The authors showcase an IoT-based switchboard for kids, leveraging ESP modules and AWS, emphasizing child-friendly IoT implementations [4]. Their work demonstrates the development of Alexa-enabled IoT devices employing C#, AWS Lambda, and ESP modules, enhancing voice-enabled IoT systems [5]. This paper simulates Alexa-enabled IoT devices using C# and AWS Lambda, providing insights into device functionality [6]. These papers contribute significantly to the expanding IoT-based C# development domain, presenting versatile applications and innovative IoT system design and implementation approaches[7-12]. Koppikar U et al. demonstrate in their paper on IoT-based smart attendance monitoring systems using RFID[13]. Shah et. Al., in their report, describes an IoT-based innovative attendance system (SAS) using RFID[14].

3. Objectives

❖ IoT-based RFID intelligent door lock systems aim to create advanced, secure, and remotely accessible door-locking mechanisms by integrating IoT technology with RFID components and microcontrollers like NodeMCU.

❖ Implementing RFID technology allows for fast access control, enabling authorized individuals to unlock doors using RFID cards, key rings, or smartphone applications.

❖ NodeMCU facilitates Wi-Fi connectivity, allowing the users to monitor and control door lock systems remotely.

❖ IoT technology enables these systems to provide real-time monitoring, data analytics, and personalized access control solutions, enhancing overall security protocols.

❖ Develop an efficient and automated attendance system leveraging IoT and RFID technologies for accurate and timely attendance tracking.

❖ IoT Based RFID Attendance System ensures timely attendance management and successful supervision of attendance records.

❖ Implement RFID technology to improve attendance monitoring systems, aiming to address issues such as timeliness and accuracy in record-keeping.

❖ Focus on resolving security concerns associated with RFID technology for attendance systems to prevent potentially fraudulent activities

❖ Implement RFID-based solutions for attendance systems, ensuring user-friendly and efficient mechanisms for recording and managing attendance data.
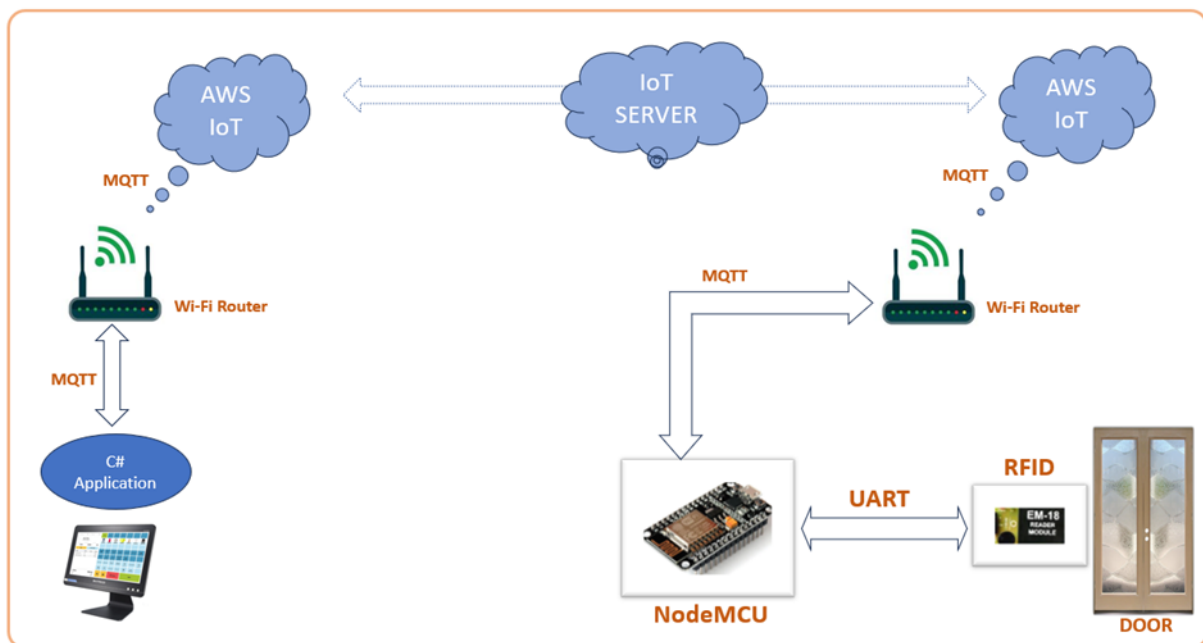
4. Approach and Methodology

Fig. 4.1: Block diagram of the project's architecture

Figure 4.1 depicts a block diagram of the project. We describe the blocks as below.

1) **AWS Cloud IoT**: The project's backbone is AWS IoT cloud infrastructure. It is a route where the data transaction happens. Initially, we need to create a setup to create a shadow register, which updates and fetches the data from the MQTT client, which is running inside the C# application. For example, the paper[7] demonstrates how to create an AWS account inside the AWS cloud.

2) **IoT Device(NodeMCU):** We need a physical device to send the data to the AWS IoT. The paper[8] demonstrates how to create an IoT device that is able to send and receive from the AWS IoT cloud. We need to provide Wifi router ID and Password for communication over Wifi. Then, NodeMMCU can connect with the cloud. Here, NodeMCU plays two roles. One is to read the data from the RFID devices, and the second one is to send the received card ID to the IoT cloud. And once our C# authenticates the card, it triggers the Door magnet to open the door.

3) **RFID Devices:** The several Radio frequency identification devices available in the market. The easiest and most available module is EM-18. It has a UART interface, which is easy to integrate with the NodeMCU module. It should be as powerful so that employees' cards inside the pocket can read the card without needing to open and touch the RFID reader. We can use EM-18 to test the experiment for our experiment, but in real scenarios, the more enormous antennae are suitable for smart operation. The Read or write protocol depends on the model of the reader. We need to follow the datasheet to integrate with NodeMCU.

4) **The server Application:** The Card database is installed inside the PC application, which is written using C#. Once it reads the card and updates the shadow register, on the other side of the architecture, it updates the data and keeps the attendance of the employee.

5. Experiment

Now, we can do experiments for our better understanding. We need to follow the following steps:

1) First, we must arrange the hardware NodeMCU, door magnetic lock, etc., in an online store.
2) Once the hardware is ready, create an AWS cloud account if not available. Create an IoT profile. The referenced paper[7] can guide us.
3) Create a C# application using Visual Studio. The community edition is free and for individual use. We can download and install it.
4) Now run the system. Once any card is placed in front of the reader, it should reach the C# application and be saved to the database as attendance record.

6. Recommendations

❖ Conduct thorough testing to ensure the reliability and robustness of the IoT-based intelligent door lock system. Evaluate its functionality in various scenarios.

❖ Prioritize system security by implementing robust encryption protocols for data transmission between the IoT devices, enhancing protection against unauthorized access.

❖ Optimize the user interface through smartphone apps or web interfaces, ensuring simplicity and ease of use for managing access permissions.

❖ Consider implementing alternative access methods or backup power sources to ensure uninterrupted functionality during network outages or power failures.

❖ Establish a routine maintenance schedule for the system components and keep the software/firmware up to date to address potential vulnerabilities and enhance system performance.

7. Conclusion

The development of IoT-based smart attendance systems using RFID technology has demonstrated significant advantages in attendance management. Implementing IoT with RFID offers innovative solutions for attendance monitoring in various domains. it illustrates practical implementations utilizing NodeMCU and enhancing accessibility and efficiency in attendance recording. Studies like Smart Attendance Monitoring Systems using IoT and RFID and IoT-based automatic Attendance Management Systems identify challenges related to security in RFID technology, emphasizing the need for improved security measures to prevent fraud. Internet of Things-Based Intelligent Attendance System discusses various smart attendance management systems, highlighting RFID alongside other technologies like fingerprint sensors and facial recognition for attendance monitoring.

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