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IOT – Enabled Staff Presence Monitoring System in Classroom

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***Abstract*—** In modern educational institutions, the ability to swift and efficiently manage staff availability is essential for maintaining seamless operations. This model presents a Staff presence monitoring System designed to automate and streamline the process of finding and assigning substitute staff members when regular staff are unavailable. By utilizing advanced communication technologies, the proposed system enables staff to quickly report their unavailability and facilitates the immediate search for qualified replacements. When a staff member enters the classroom on time, they use a barcode scanner attached to their ID card to register their presence. If delayed by more than 3 minutes, the Arduino Uno-controlled system promptly signals their absence in the staffroom via a speaker, ensuring quick awareness. Additionally, the system automatically identifies and assigns a replacement staff member based on real-time availability, minimizing classroom disruption. The staff presence monitoring system also offers features that provide insights into staff availability patterns, enabling institutions to make informed decisions about staffing and scheduling. By improving communication, reducing response times, and enhancing overall staff management, the system contributes to a more organized and efficient educational environment. Overall, the proposed staff presence monitoring system represents a significant improvement in human resource management within educational settings, facilitating smoother operations and minimizing disruptions to educational activities.

Keywords: component; Bar code scanner, Arduino, Speaker, USB host module, RTC module

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I. INTRODUCTION

In earlier days, managing staff availability was a manual process that relied heavily on paperwork and verbal communication. This approach often led to inefficiencies and delays in handling staff absences and scheduling replacements. As educational institutions expanded and operations became more complex, the demand for a faster and more organized method of tracking staff attendance and managing absences became apparent. Traditional methods were no longer adequate in modern educational environments, where timely responses to staff shortages are critical to maintaining smooth operations. To address these challenges, institutions have started leveraging technological advancements by implementing automated systems that streamline staff availability management, thereby improving response times and minimizing disruptions.

II.RELATED WORK

[1] Wi-Fi Based Staff Attendance Monitoring System is aims to replace traditional manual attendance methods, which are time-consuming and prone to errors, with an automated solution that enhances efficiency and accuracy. The authors propose utilizing Wi-Fi-enabled devices, such as smartphones or laptops, to track staff presence within an institution. By leveraging the existing Wi-Fi infrastructure, the system automatically logs the presence of staff members when their devices connect to the institution's Wi-Fi network. The system then updates the attendance records in real time, which can be accessed by the administration to monitor attendance patterns.

This system significantly reduces the manual workload associated with attendance management, ensures better accuracy in attendance records, and provides a non-intrusive and convenient way to track staff presence without additional hardware investments. The Key findings are,

- The use of Wi-Fi infrastructure for attendance monitoring eliminates the need for additional hardware, reducing implementation costs.
- The system increases accuracy by automating attendance tracking and minimizing manual errors.
- Real-time updates provide institutions with timely and reliable data for monitoring staff attendance patterns.

[2]. RFID Based Attendance Monitoring System with LED Authentication is to improve the accuracy, efficiency, and security of attendance monitoring in institutional settings like schools and workplaces. The authors propose a solution to the traditional manual attendance systems that are prone to human error, manipulation, and inefficiency. By leveraging RFID (Radio Frequency Identification) technology, the system allows automated data collection when an RFID-enabled ID card is scanned, which then records the user's presence. To enhance security, the authors incorporate an LED-based authentication mechanism, which works in conjunction with the RFID tags. This added layer of verification ensures that only authorized personnel can mark their attendance, thereby preventing fraudulent behavior like proxy attendance.

The system's architecture includes an RFID reader, an LED for authentication, and a server where attendance data is stored. It also features a user-friendly interface that enables staff and administrators to view real-time attendance records. This setup not only speeds up the process of recording attendance but also ensures higher accuracy and security compared to traditional or standalone RFID systems. The key finds are,

- The RFID-based system significantly reduced the time required for attendance recording by automating the process and minimizing human intervention.
- The LED authentication feature provided an extra layer of security, reducing incidents of proxy attendance and ensuring only legitimate users could mark their presence.
- The system allowed real-time monitoring of attendance data, making it easier for administrators to track and manage attendance effectively.

[3]. Design and Implementation of an Automatic Staff Availability Tracking System is focus on automating the process of tracking staff presence and absence, offering a practical solution that leverages modern technologies for institutions such as schools, universities, or corporate settings.

The system described in the model utilizes a combination of wireless networking, database management, and mobile applications to track staff movements and attendance. The proposed system aims to increase efficiency by replacing traditional manual methods, which are often time-consuming and prone to human error. The automated system can notify relevant departments when a staff member is unavailable and suggest replacements, streamlining the process of finding substitutes.

The architecture of the system relies on RFID (Radio Frequency Identification) technology, which is implemented through staff identification cards or tags. These cards interact with RFID readers placed in key locations, such as entryways or workstations, providing real-time data on staff movements. The system is also integrated with a central database that stores all relevant data, allowing for easy access, monitoring, and retrieval of staff attendance records.

Additionally, the system is designed to be scalable and adaptable to different institutional needs, with features that allow customization for different organizational structures. The authors highlight the importance of the system's flexibility in enhancing overall staff management processes, reducing administrative overhead, and improving operational efficiency. The key findings are,

- The system effectively monitors and tracks staff availability in real time using RFID technology, ensuring timely data updates.
- By automating the attendance tracking process, the system significantly reduces the chances of human error associated with manual tracking methods.
- The system can be scaled to suit various institutional needs and is adaptable for customization based on the organizational structure.

III.PROPOSED SYSTEM

The proposed staff presence monitoring system automates the process of finding and assigning substitute staff members when regular staff are unavailable within a time. By utilizing advanced communication technologies like Barcode scanner through Arduino, the system enables staff to quickly report their unavailability and facilitates immediate searches for qualified replacements. It is designed to provide real-time alerts for staff delays through an Arduino Uno-controlled mechanism, which signals absences in the staffroom via a speaker. Additionally, the system offers insights into staff availability patterns, allowing institutions to make more informed staffing and scheduling decisions. This contributes to creating a more organized and efficient educational environment, ensuring minimal disruptions to classroom activities.

Hardware Needed:

1. Barcode Scanner:

A barcode scanner is a device that reads and interprets the information encoded in barcodes, which are machine-readable representations of data. Barcodes are typically printed in the form of parallel lines and spaces that vary in width, representing numbers or characters. These codes can be found on products, packaging, tickets, and identification cards, among other items.

Barcode scanners come in various types, including handheld, stationary, and mobile devices. Handheld scanners are commonly used in retail environments, allowing cashiers to quickly scan items at checkout. Stationary scanners are often installed at points of sale or in warehouses for inventory management Mobile scanners, which can be integrated into smartphones or tablets, offer flexibility and portability for tasks such as stocktaking and shipment tracking.

The primary function of a barcode scanner is to capture the data encoded in a barcode and convert it into a readable format

for computers or software applications. This capability streamlines processes such as inventory control, sales transactions, and data entry, significantly improving efficiency and accuracy in various industries. Overall, barcode scanners play a crucial role in modern logistics, retail, and supply chain management by facilitating quick and reliable data capture.

Figure 3.1 Barcode Scanner

3.Arduino:

Arduino is an open-source electronics platform that simplifies the process of creating interactive electronic projects. It consists of both hardware and software components, making it accessible to hobbyists, educators, and professionals alike. The hardware component includes a range of microcontroller boards, such as the Arduino Uno, Mega, and Nano, which can read inputs from sensors and control outputs like motors, lights, and displays.

The accompanying software, the Arduino Integrated Development Environment (IDE), allows users to write, compile, and upload code to the microcontroller. The programming language used is a simplified version of C/C++, making it user-friendly for beginners while still powerful enough for advanced projects.

Arduino's versatility and ease of use have made it popular in various applications, including robotics, home automation, art installations, and educational projects. With a large community of users and extensive online resources, including tutorials and libraries, Arduino encourages collaboration and innovation. This platform has significantly contributed to the growth of the maker movement, empowering individuals to experiment and create their own electronic devices, prototypes, and applications, thus bridging the gap between technology and creativity.

Figure 3.2 Arduino

3. Speaker:

A speaker is a device that converts electrical energy into sound, allowing users to experience audio from various sources such as music, movies, and voice. Speakers work on the principle of converting electrical signals into mechanical movement, which creates sound waves. They typically consist of several components, including a diaphragm (or cone), voice coil, magnet, and enclosure. When an audio signal is fed into the speaker, it passes through the voice coil, generating a magnetic field that causes the diaphragm to vibrate. These vibrations produce sound waves that we perceive as audio.

Speakers come in various types and sizes, including portable Bluetooth speakers, bookshelf speakers, and large floor-standing models. They can be used in different applications, from personal listening to professional audio systems in concert venues and theaters. Many modern speakers also incorporate advanced technologies such as Bluetooth connectivity, allowing for wireless streaming from smartphones and other devices. Additionally, some speakers are designed for specific purposes, such as subwoofers for deep bass or satellite speakers for surround sound systems. Overall, speakers play a crucial role in delivering quality audio experiences in both personal and professional settings.

Figure 3.3 Speaker

Integrated System Needed:

1. Arduino IDE

The proposed Staff Presence Monitoring System is a cutting-edge solution aimed at enhancing staff management in modern educational institutions. By automating and streamlining the process of finding and assigning substitute staff members when regular staff are unavailable, the system helps ensure seamless classroom operations. Leveraging advanced communication technologies, staff can easily report their unavailability, triggering an immediate search for qualified replacements. The system integrates an Arduino Uno-controlled mechanism, where staff members use a barcode scanner attached to their ID card to register their presence upon timely classroom entry. In cases of delays exceeding three minutes, the system alerts the staffroom through a speaker and LED, enabling quick awareness of the absence. Furthermore, the system automatically assigns a replacement staff member based on real-time availability, minimizing classroom disruptions. The data gathered also provides insights into staff availability patterns, supporting informed decisions regarding staffing and scheduling. Through improved communication, reduced response times, and optimized staff management, this system contributes to a more organized and efficient educational environment, ensuring smoother operations and uninterrupted learning activities.

2. Embedded C:

Embedded C is a high-level language derived from C, designed for programming embedded systems—specialized devices with dedicated functions. It provides efficiency, hardware-level control, and features like fixed-point arithmetic and register manipulation. Embedded C's portability allows code reuse across platforms, making it ideal for resource-constrained devices like microcontrollers. It supports real-time hardware interfacing and is used in applications from home

appliances to industrial machinery. Tools like real-time operating systems (RTOS) help manage tasks in complex embedded applications.

IV. SYSTEM DESIGN

1. System Architecture:

Software architecture diagram is a graphical representation of the high-level structure and interactions within a software system. It provides a visual overview of the system's components, their relationships, and how they collaborate to achieve the system's functionality. These diagrams help illustrate how various software components interact and are interconnected. These diagrams typically include:

- **Components:** These represent the major parts of the system, such as modules, layers, or services.
- **Interfaces:** They define how components interact with each other, including the methods, protocols, or APIs they use.
- **Dependencies:** These show the relationships between components, indicating which ones rely on others for functionality.
- **Data Flows:** They illustrate the movement of data between components and subsystems, showing how information is processed and transformed.
- **Deployment:** In some cases, the diagram may also depict the physical or logical deployment of components across hardware or software environments.

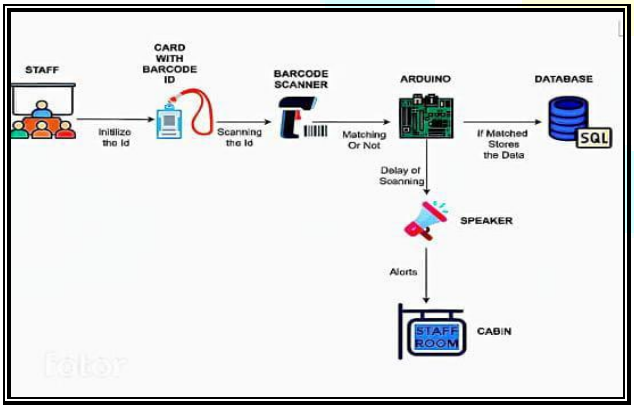

Figure 4.1 Architecture Diagram

2. Data Flow Diagram:

A Data Flow Diagram (DFD) is a visual representation used in software engineering and systems analysis to illustrate the flow of data within a system or process. It provides a structured way to depict how data moves from input sources through processes to output destinations. The Data flow diagram of the system is shown in figure 5.2, DFDs employ standardized symbols to represent different components:

- Terminal (START/STOP): This is used to represent the start and end of the flowchart
- Processes (Square): These represent functions or transformations applied to input data to produce output data.
- Data Flows (arrows): These depict the movement of data between processes, data stores, and external entities.
- Data Stores (rectangles): These represent where data is stored within the system.
- External Entities (rectangles): These denote sources or destinations of data outside the system boundary.
- Decision (Diamond): This symbol is used to check any condition or take decision for which there are two answers. Yes (True) or No (False)

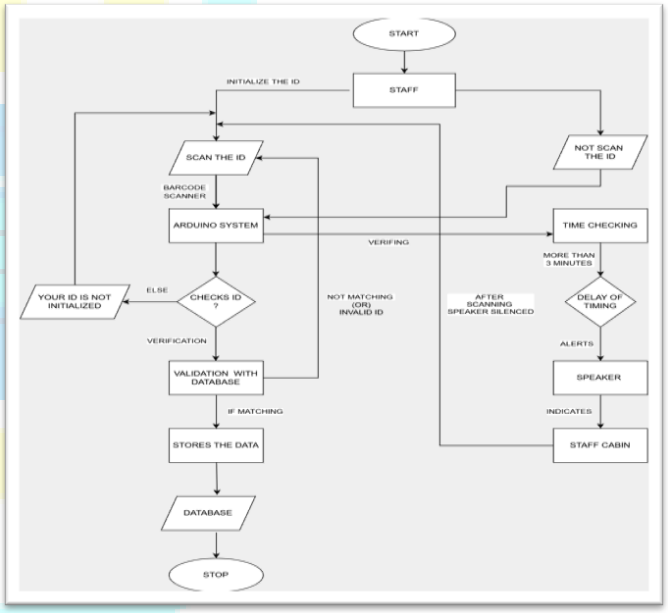

Figure 4.2 Data Flow Diagram

3. Circuit Diagram:

The provided flowchart outlines the operation of an staff presence monitoring system designed to monitor staff access to a cabin. The system begins by initializing the ID card. When a staff member scans their ID using a barcode scanner, the Arduino system processes the data. If the ID is not initialized or invalid, the system alerts the user. Otherwise, it verifies the ID against the database. If there's a match, the system validates the entry and stores the data. If the ID doesn't match or is invalid, the system silences the speaker and delays further attempts. Additionally, a time check is implemented to prevent unauthorized access after prolonged inactivity. If the scanning time exceeds three minutes, the system also raises an alert. Once the verification process is complete, the system grants access to the staff cabin, indicated by the speaker. The flowchart concludes with the system stopping its operation.

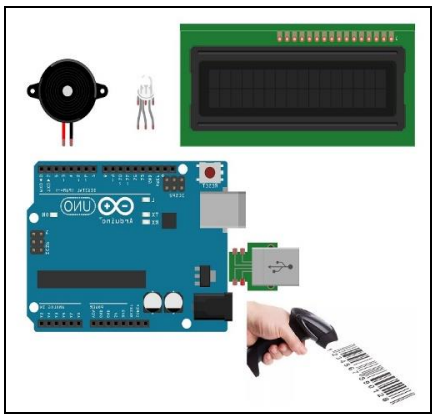

Figure 4.3 Circuit Diagram

V. RESULT

The IoT-enabled staff presence monitoring system is designed to track staff access to a cabin. The process begins with the initialization of the ID card. When a staff member scans their ID using a barcode scanner, the Arduino system processes the data. If the ID is either uninitialized or invalid, the system alerts the user. If the ID is valid, the system verifies it against the database. Upon finding a match, the system validates the entry and logs the data. If the ID does not match or is invalid, the system silences the speaker and delays further attempts. Additionally, the system implements a time check to prevent unauthorized access after prolonged inactivity. If the scanning time exceeds three minutes, the system raises an alert. Once the verification process is complete, access to the staff cabin is granted, indicated by the speaker.

Figure 5.1 Proposed Result

VI. CONCLUSION

The staff presence monitoring system effectively automates the process of finding and assigning substitute staff members when regular staff are unavailable. By leveraging advanced communication technologies, the system enables quick reporting of unavailability and facilitates immediate replacement searches. Additionally, the Arduino Uno-controlled system provides real-time alerts for staff delays, signaling absences through a speaker in the staff room. Furthermore, the system offers valuable insights into staff availability patterns, empowering institutions to make informed staffing and scheduling decisions, leading to a more organized educational environment.

VII. REFERENCE

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