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Development of RFID-Based Attendance Solution for Kuali Agrobox Cafe

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Abstract

This project introduces an innovative solution for managing employee attendance system at Kuali Agrobox Cafe, a renowned eatery in Mersing. By implementing RFID technology, the system significantly simplifies the process of recording employee attendance. The core of this system relies on the utilization of RFID cards and scanners. The hardware components include the ESP32 as the controller board and the RC522 RFID Module as the card reader. To facilitate efficient data management, a MySQL database is designed using phpMyAdmin. This database stores essential information, including employee details, RFID tag data, and attendance records. Each employee is provided with an individual RFID tag, typically in card form. To record their attendance, employees scan their RFID tags near the RFID reader, strategically placed at entry and exit points. The RFID reader captures the specific ID tag, which is then transmitted to the system for processing. The collected attendance information is processed within the system, associating it with the respective employees. Managers have access to this data through a user-friendly interface, enabling real-time monitoring, report generation, and effective attendance management tasks. This RFID-based solution revolutionizes attendance tracking at Kuali Agrobox Cafe, offering efficiency and convenience to both employers and employees. It simplifies the recording process and provides real-time access to attendance data for enhanced management capabilities.

Keywords: - RFID attendance, RC522, real-time monitoring

1. Introduction

Manual employee attendance tracking presents various challenges that impede the effectiveness and precision of workforce management. The process demands consistent efforts from administrative personnel to collect, organize, and oversee attendance data, which becomes increasingly arduous over time. Manual systems are vulnerable to employee exploitation, enabling time theft through the manipulation of attendance records (Ula et al., 2021 and Mankilik, Kama & Isitua, 2022). The absence of authentication measures in manual procedures heightens the risk of fraudulent activities. Without the assistance of automated tools, the analysis of attendance trends or patterns becomes intricate (Mankilik, Kama & Isitua, 2022 and Suale et al., 2023).

Considering these challenges, the project's focus is on enhancing employee attendance management through the integration of Radio Frequency Identification (RFID) technology. Renowned for its global acceptance, RFID utilizes low-power radio waves for automated object identification (Joshi et al., 2020 and Suale et al., 2023). The system comprises RFID tags, antennas, readers, and transceivers to facilitate seamless data exchange (Hasman & Ahmad, 2022 and Joshi et al., 2020).

The implementation of an RFID-based system aims to optimize the process of recording attendance, reduce reliance on manual data entry, and reduce physical workload. In addition, it addresses environmental concerns by minimizing the use of paper, specifically adapted for

Kuali Agrobox Cafe's employee attendance system. Kuali Agrobox is one of the popular eateries in Mersing town. On a daily working day, the employer at Kuali Agrobox Cafe manually records employee attendance through an online system utilizing the WhatsApp application. Data accessibility may be restricted as manual records are typically stored in physical or local digital formats. Managers may not have real-time access to attendance data, making it difficult to effectively monitor attendance. The use of this method presents a challenge to administrators due to unsystematic and potentially overlapping attendance data and the risk of data loss (Choe et al., 2023 and Hatta et al., 2021). This difficulty has a great impact in various other aspects such as the management of the employee salary system.

This developed system relies on RFID cards for proof of attendance, storing electronic information that is accessible to RFID readers. Employees simply scan their card to the RFID reader. The system incorporates the RC522 RFID Module to read employee cards, transmitting ID information to ESP32 before recording it in the database. This user-friendly approach empowers administrators to efficiently access and manage employee attendance records. RFID-based attendance systems automate the attendance recording process, eliminating the need for manual sign-ins or paper attendance sheets. Both administrative staff and employees benefit from this automation as attendance data is rapidly and accurately gathered without the necessity for manual data entry. Overall, the purpose of this research is to:

1. Design employee attendance system by using RFID technology.
2. Develop employee attendance database using phpMyAdmin.
3. Provide a user-friendly interface that allows administrators to manage, view, and modify attendance data as needed.

2. Literature Review

The author conducts a comparative analysis with existing RFID-based attendance systems. Qureshi (2020) proposed attendance tracking challenges in educational institutions at King Abdul-Aziz University (KAU), Saudi Arabia. It aims to implement a Radio RFID-based attendance system to overcome existing issues like time consumption, errors, truancy, and lack of parental contact. The proposed system offers robust, secure, and automatic attendance, leveraging modern technology to provide web-based and mobile interfaces, daily absent reports, and automatic SMS alerts to parents/guardians. Using a case study approach, the system is developed and tested at KAU, featuring both web and mobile interfaces. Users can access customized reports to monitor students' status, anticipating significant improvements in monitoring mechanisms for informed decision-making by parents and teachers.

Hatta et al. (2021) introduced Web-Based Student Attendance System utilizing RFID technology records student attendance through RFID equipment, including transponder radios, receivers, and transmitters. When triggered, RFID tags transmit digital data to the reader, facilitating identification and record-keeping. Integrated with web-based principles, RFID cards and readers capture attendance, aiding teachers in reviewing and storing data in a dedicated database. This system enhances class progression by addressing frequent absences and enables easy student tracking within school premises. Data integrity is maintained within the school database, allowing teachers to access student information even after leaving school.

Research conducted by Choe et al. (2023) emphasizes the potential of RFID technology in establishing a sustainable student attendance system. This system, leveraging RFID technology, validates students' identity, venue, time, and date by accessing data from RFID tags integrated into student cards. Essential components comprise the Arduino Mega 2560 board, MFRC522 RFID reader, DS3231 Real-Time Clock (RTC) module, LCD display, Arduino Ethernet Shield R3, and power adapter. The system prioritizes three key elements: the web server, network connectivity, and interfacing device. The web server manages data storage, handles HTTP requests, and hosts a website for database interaction. Network connectivity facilitates user and device connection to the web server. Meanwhile, the interfacing device acquires student ID data, forwards it to the web server, maintains local real-time data, and showcases information on an LCD screen (Choe et al., 2023).

In this research, the author chooses ESP32 as board controller due to board GPIO's capabilities, ease of programming, community support and cost-effectiveness. These attributes collectively make the ESP32 a highly suitable choice for managing RFID-based attendance systems (Oner, 2021). RFID system consists of various components that are connected to one another by a dedicated communication path. As shown in Fig. 1 the components of the RFID technology. Each component is integrated into the system to implement the benefit of RFID solution. The list of components is tag, reader, and database. RFID tags are classified as either passive or active.

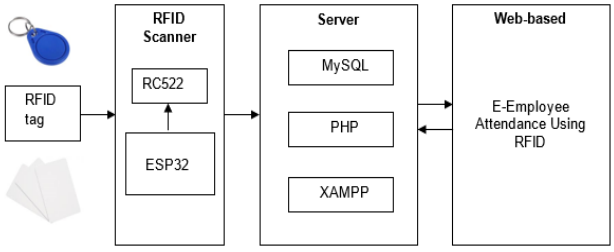


Fig. 1. Project block diagram

a) Tag

A passive RFID tag is one that does not have its own power supply. Thus, passive RFID tags must be in extreme proximity to an RFID reader and require the radio waves radiated by the reader to power the response, but active

RFID tags can complete entire functions if the device has its own battery power (Joshi et al., 2021).

b) Reader

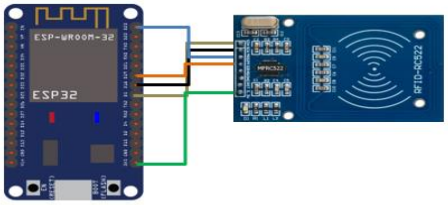
The RFID reader consists of an antenna and a radio frequency module, generating a high-frequency electromagnetic field (Hatta et al., 2021). Within the RFID reader, a microchip stores and processes data, accompanied by an antenna for signal reception and transmission. Reading information from the RFID tag requires proximity to the reader. Essentially, the RFID reader establishes an electromagnetic field, prompting electrons to pass through the tag's antenna, thereby energizing the chip (Oner, 2021 and Harum et al., 2023). In the context of this project, an ESP32 serves as the board controller for the RFID reader.

c) Database

A database is an organized collection of information, designed for easy access, management, and updates (Hatta et al., 2021 and Choe et al., 2023). In the proposed system, the author employs phpMyAdmin within the XAMPP environment to streamline database management and administration.

3. Methodology

This section provides a comprehensive overview and description of the system. Additionally, the electronic circuit's development and design, encompassing both software and hardware requirements, are illustrated in Fig. 2. To bring the presented system, a careful selection of hardware and software components is crucial. This selection is guided by three key criteria: cost-effectiveness, availability, and ease of programming. The RFID reader is seamlessly integrated into the ESP32 microcontroller device, forming an open circuit system through pins.



ESP32	RFID MFRC522
D5	SDA
D18	SCK
D23	MOSI
D19	MISO
D4	GND
3.3V	3.3V

Fig. 2. ESP32 connection to RFID module

The Arduino circuit facilitates signal transmission to a server powered by XAMPP, PHP, and MySQL, and serves as the repository for employee attendance records. At the front end of the developed system, a user-friendly web-based application, akin to a computer interface, interacts with the server. This integration is depicted in the block diagram of the proposed system as shown in Fig. 1.

3.1 Hardware Development

Correct wiring is essential for the integration of the ESP32 board and RFID MFRC522 module in the depicted project. Referring Fig. 2, the ESP32 requires six connections, namely D5, D18, D23, D19, D4, and 3.3V, to establish communication with the RFID module. Each of these connections serves a specific purpose in facilitating data transfer and control between the two components. Any deviation or error in the wiring arrangement can lead to communication failures and impact the overall functionality of the Arduino code.

3.2 Arduino Integrated Development Environment (IDE)

The Arduino Integrated Development Environment (IDE) serves as the primary platform for developing this system. The implemented code aligns with the desired output, displaying information such as the user's name, login time, and logout time as planned. Key parameters crucial for system operation include the hotspot name, password, device token, and URL. These details are essential prerequisites when executing the RFID functionality, ensuring the proper functioning of the system.

3.3 System and Database Design

The flowchart, illustrated in Fig.3, provides a comprehensive visual representation of the sequential steps involved in processing information within the developed project. Starting with raw data input, the flowchart systematically guides through diverse processing stages, logical decision points, and concludes by defining the program's outcome. This graphical representation serves as an effective tool to understand the software's information processing journey, elucidating the step-by-step flow from data initiation to program finalization.

The flowchart outlines a process where users employ an RFID Card, designated as an employee card by the company, to initiate scanning on the RFID module for detection. The RFID chip embedded in the employee card transmits data to the RFID Module. Subsequently, the ESP32 receives this transmitted data and undergoes processing through the database, facilitating the display of comprehensive records. These records provide detailed information about the employees who actively worked on the specific day as refer in Fig. 8. Referring Fig. 4, the author establishes four tables in the database. Among these, the user logs table takes precedence, serving as a pivotal repository where all database information is meticulously saved. This table functions as a comprehensive log, capturing and timestamping details about employee interactions with the RFID system. This

integrated system provides a robust solution for employee attendance tracking, ensuring accurate and organized records.

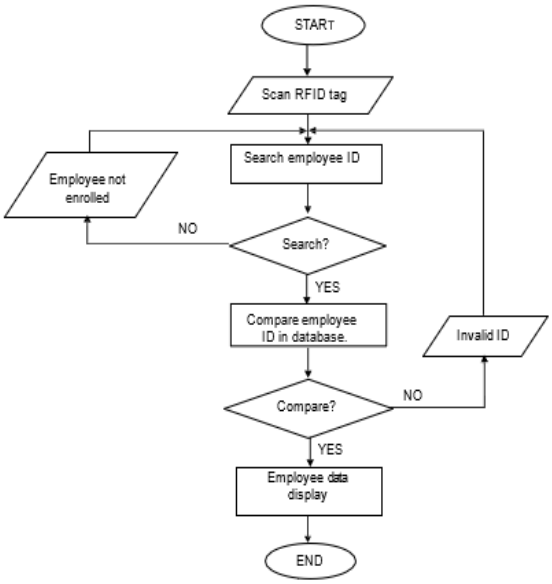


Fig. 3. Visual representation of of RFID card scanning process

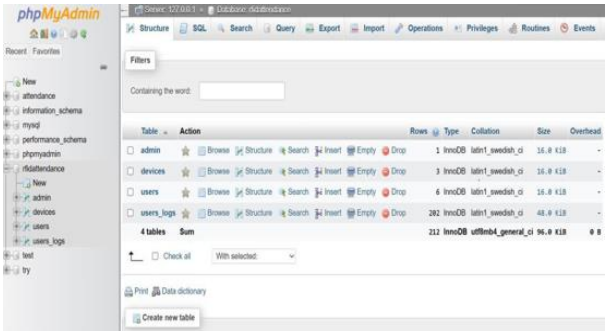


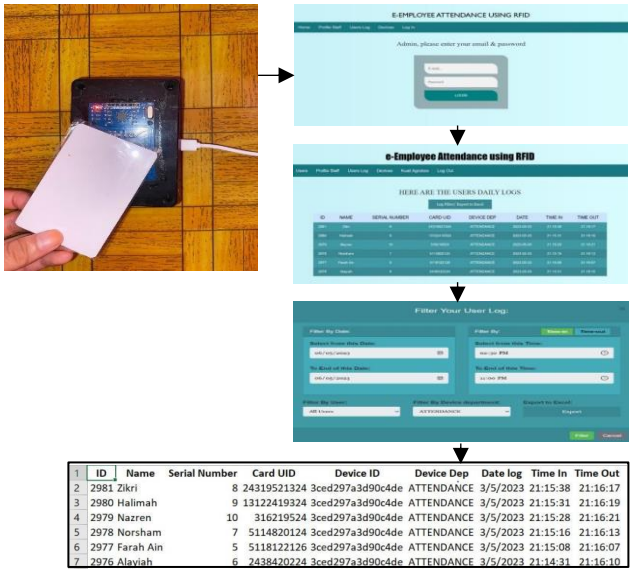
Fig. 4. Database design tables

4. Result and Discussion

This section described the successful conclusion of the project and presented a fully realized system. Key features include a polished website interface, a robust database ensuring secure data storage, and a detailed workflow prototype providing insights into the systematic development process. The discussion of project findings serves as a valuable resource for stakeholders, offering visibility into the project's evolution, understanding of the system's functionality, and the means to evaluate the final output. This comprehensive overview facilitates thorough understanding of proposed project successful.

4.1 Project Output

The system illustrated in Fig. 5 revolves around an RFID-based attendance management system. Staff members use RFID cards to scan, and the information is promptly displayed on a dedicated website accessible only to administrators. The user log page on the website provides key details crucial for attendance management such as Name, Card ID, Date, Time, Time In and Time Out.



	ID	Name	Serial Number	Card UID	Device ID	Device Dep	Date log	Time In	Time Out
2	2981	Zikri	8	24319521324	3ced297a3d90c4de	ATTENDANCE	3/5/2023	21:15:38	21:16:17
3	2980	Halimah	9	13122419324	3ced297a3d90c4de	ATTENDANCE	3/5/2023	21:15:31	21:16:19
4	2979	Nazren	10	316219524	3ced297a3d90c4de	ATTENDANCE	3/5/2023	21:15:28	21:16:21
5	2978	Norsham	7	5114820124	3ced297a3d90c4de	ATTENDANCE	3/5/2023	21:15:16	21:16:13
6	2977	Farah Ain	5	5118122126	3ced297a3d90c4de	ATTENDANCE	3/5/2023	21:15:08	21:16:07
7	2976	Alaviah	6	2438420224	3ced297a3d90c4de	ATTENDANCE	3/5/2023	21:14:31	21:16:10

Fig. 5. Data recording process after scanning an RFID card to the reader

4.2 System Design

The user log page becomes accessible post-admin login on the login page. It showcases staff data captured by scanning cards at the RFID reader. The displayed information includes the staff's name, ID, serial number, card UID, device department, as well as the date, time in, and time out. Refer Fig. 6, this user log page provides a comprehensive overview of the attendance records. Additionally, the system offers functionality to filter attendance records based on either the date or the employee's name, as illustrated in Fig. 7.

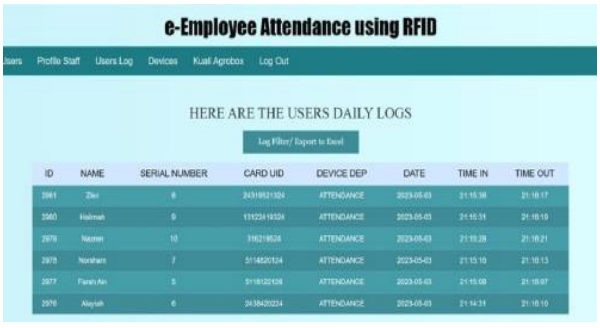


Fig. 6. Kuali Agrobox Staff Attendance Records

Fig. 7. The system capability to filter attendance record by date or employee name

Referring Fig. 8, the device manager features two essential buttons which are enrollment and attendance. Enrollment button is utilized for registering new cards within the RFID-based attendance system. It facilitates the process of adding new staff members or users to the system, associating their RFID cards for identification purposes. While attendance button is designed for staff members to scan their RFID cards, signifying their presence in the system. When pressed, it activates the RFID scanner, allowing staff members to record their attendance quickly and efficiently by scanning their ID cards.

Fig. 8. Device manager features

4.3 Database Recording System

The user logs table, illustrated in Fig. 9, plays a crucial role as a comprehensive log for user data, specifically catering to staff members. When staff members engage the RFID scanner to scan their ID cards, the system captures and meticulously stores relevant data. This recorded information includes intricate details about the staff member and is precisely timestamped with the current date and time. This systematic approach facilitating efficient tracking of attendance and user-related activities.

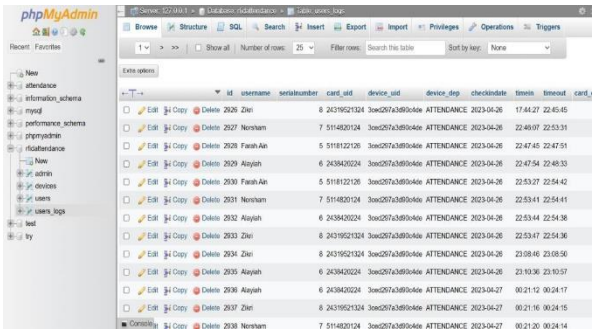


Fig. 9. A comprehensive record of staff attendance data

4.4 Client Feedback

This questionnaire as shown in Fig. 10 has been thoughtfully designed to gather essential feedback from respondents concerning the developed attendance system. The respondent pool, comprising clients from Kuali Agrobox and participants including lecturers and students engaged in the project's pilot phase (N=20), adds diverse perspectives to the evaluation process. Before answering the questionnaire, the researcher performed a direct demonstration to the respondents by showing the use of the attendance system directly or through a comprehensive step-by-step video display. This approach likely contributed to more informed and accurate feedback in the subsequent questionnaire.

According to Table 1, respondents generally express an affirmative sentiment, "Agree," with an overall mean score of 4.17 regarding their perception of the developed project. The highest mean is item 1 "I find difficulty when manually recording employee attendance" with mean score 4.45 and followed by Item 2 "The interface of the system is very attractive and uses appropriate colors". These high mean scores indicate a positive perception, highlighting the system's user-friendly interface and addressing challenges associated with manual attendance recording. Although items 6 and 7 have lower mean scores, but still maintain a high level of agreement among respondents.

Table 1. Finding of respondent feedback

	Item	Mean, $\bar{x}$
1.	I found difficulty when manually recording employee attendance	4.45
2.	The interface of this system is very attractive and uses appropriate colors.	4.40
3.	This system able to help companies record employee attendance well.	4.15
4.	This system has good security features.	4.15
5.	Adding new employee data is easy to implement using this system.	4.15
6.	Employee attendance data is easily checked using this system.	3.95
7.	The developed RFID reader can integrate well with the developed system.	3.95

The information collected serves as an important data source for researchers involved in system analysis studies. Respondents are encouraged to provide honest answers to assist the research group in improving the quality of the system for the benefit of all stakeholders.

5. Conclusion

The project has successfully accomplished its goal of constructing an RFID-based presence system seamlessly integrated with the ESP32 controller board. This endeavor yielded a straightforward attendance marking approach, surpassing the complexities of traditional methods. Notably, the system integrates a database utilizing the XAMPP server platform and PHPMyAdmin, ensuring real-time maintenance of records for every RFID card scan.

Based on feedback finding, responses revealed a positive reception from participants, affirming the effectiveness of the developed system. To further enhance project functionality in the future, the author recommends refining the attendance recording method by incorporating a feature to display total working hours. This enhancement aims to streamline salary payment processes.

Acknowledgement

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References

Harum, N., Mahin, N. A. A., Hamid, E., Emran, N. A., Anawar, S., & Asnawi, A. L. (2023). RFID Attendance System with Contagious Disease Prevention Module using Internet-of-Things Technology. *International Journal of Interactive Mobile Technologies*, *17*(18).

Hasman, M. I., & Ahmad, I. (2022). RFID Attendance System. *Journal of Engineering Technology*, *10*, 17–25.

Hatta, M., Ali, M., Hani, M., Hussin, M. H., Kamisan, A. S., Hafez, M., Shabudin, N., & Halim Omar, A. (2021). iHadir: Web-Based Student Attendance System Using RFID Technology. Multidisciplinary Applied Research and Innovation, 2(2), 385–392. https://doi.org/10.30880/mari.2021.02.02.047.

Joshi, A., Ahmad, A., Saxena, A., & Juneja, P. (2021). RFID based attendance system. *Int. J. Modern Trends Sci. Tech*, *7*, 40-43. https://doi.org/10.46501/ijmtst0701009.

Joshi, A., Juneja, P., & Saxena, A. (2020). RFID based attendance system. RFID Based Attendance System, 7(01),40–43. https://doi.org/10.46501/ijmtst0701009

Mankilik, I. M., Kama, H. N., & Isitua, C. C. (2022) Analysis of queueing theory: Biometric and manual attendance performance measures.

Oner, V. O. (2021). *Developing IoT Projects with ESP32: Automate your home or business with inexpensive Wi-Fi devices*. Packt Publishing Ltd.

Qureshi, M. (2020). The proposed implementation of RFID based attendance system. *International Journal of Software Engineering & Applications (IJSEA)*, *11*(3).

Sharma, A., & Kumar, S. (2020). *IOT Based Attendance System With COVID-19 Protection*. *X*(1), 1893–1896.

Suale, Y., Kamil, N. M., Musah, M. B., Zakari, M., & Farah, A. M. (2023). The Impact of Biometric Time and Attendance System on Workforce Management Outcomes: The Moderating Role of Managerial Commitment in the Service Sector in Northern Ghana. *International Journal of Business and Technology Management*, *5*(3), 442-455.

Ula, M., Pratama, A., Asbar, Y., Fuadi, W., Fajri, R., & Hardi, R. (2021, April). A new model of the student attendance monitoring system using rfid technology. In *Journal of Physics: Conference Series* (Vol. 1807, No. 1, p. 012026). IOP Publishing. https://doi.org/10.1088/1742-6596/1807/1/012026.