APPLIED INFORMATION TECHNOLOGY AND COMPUTER SCIENCE
e-ISSN: 2773-5141

AITCS

Vol. 5 No. 2 (2024) 692-711
https://publisher.uthm.edu.my/periodicals/index.php/aitcs

Development of a Web-Based IoT Class Attendance Monitoring System for a Primary School

Siti Sazleena Kamaruddin[1], Nayef Abdulwahab Mohammed Alduais[2]*

[1,2] *Fakulti Sains Komputer dan Teknologi Maklumat,*
Universiti Tun Hussein Onn Malaysia, Parit Raja, Batu Pahat, 86400, MALAYSIA

*Corresponding Author: nayef@uthm.edu.my
DOI: https://doi.org/10.30880/aitcs.2024.05.02.037

Article Info

Received: 13 June 2024
Accepted: 28 September 2024
Available online: 15 December 2024

Keywords

RFID, IoT, school, attendance

Abstract

The Web-Based Attendance Monitoring System is designed to efficiently track attendance for students, teachers, and staff at Sekolah Kebangsaan Abdullah. Currently, the school relies on manual methods, using paper for student attendance and punch cards for teachers and staff. This outdated process leads to inaccuracies in attendance records. The project was developed a Web-Based IoT Class Attendance Monitoring System for Primary Schools, employing the Waterfall Model for effective project management. The system, developed on a web-based platform, integrates RFID components with IoT, utilizing Arduino IDE and Visual Studio Code for testing. The integration of RFID with IoT provides real-time attendance data. With a functionality testing and User Acceptance Test (UAT), it focuses on ensuring that all features work correctly and that the software behaves as intended. The absence of user validation after registration that can be resolved by incorporating extra security measures and linking the system with a front-end website.

1. Introduction

In today's rapid education industry, efficient and accurate attendance tracking systems are becoming more needed. The attendance monitoring system is crucial to track all students, teachers, and staff attendance and record their data safely. It also can avoid any errors and data leaking. Using a manual procedure with paper will cause too many problems. It is inefficient to rely on manual procedures and paper-based systems to record attendance [1]. These systems are prone to inaccuracies and do not provide real-time attendance data. In this globalization era, the Internet of Things (IoT) is important to solve this problem. By using embedded IoT devices and sensors throughout the school infrastructure, these sensors may monitor and gather data on attendance.

The main purpose of this project is to simplify the process of recording student attendance data before they enter the class [2]. The system utilizes IoT technology with Radio-Frequency Identification (RFID) technology to create a smart school. Students, teachers, and staff need to scan their RFID cards to the scanner, and the data will be automatically recorded in the system [3]. By using IoT and RFID, all attendance data can be collected accurately, eliminating human error. Additionally, the proposed system can reduce the time they take to record their attendance.

1.1 Problem Statement

Attendance monitoring systems, though prevalent in many educational institutions, are still in their early stages at schools, relying on manual methods using paper sheets for student attendance. This approach poses challenges, including the potential for inaccuracies, identity verification issues, and the risk of data loss or

breaches due to exposure to sensitive information. Teachers and staff also face challenges with manual attendance recording, often remaining unaware of their attendance reports. The proposed solution involves implementing a smart school RFID system, alleviating these issues. Students scan their cards for attendance, promoting accountability and preventing manipulation. This eliminates the need for paper records, reducing the risk of data loss and privacy breaches. The RFID system facilitates accurate and efficient attendance tracking, allowing parents to monitor their child's performance and attendance statistics, fostering a more streamlined and secure attendance management process.

1.2 Objective

This project aims to develop a web-based attendance monitoring system that simplifies the process of recording student attendance data before they enter the class. The system also provides useful information to improve attendance management. Three main objectives for this project are:

- To analyze and design an online platform for an attendance monitoring system based on an Internet of Things (IoT) concept with Radio Frequency Identification (RFID).
- To develop a web-based monitoring system for schools by using IoT and RFID technologies
- To evaluate and test the developed web-based system by target users.

1.3 Scope

The project outlines three key scopes: first, implementing a versatile smart school attendance tracking system applicable beyond educational settings, extending to workplaces and businesses. Second, providing the system administrator with the capability to manage attendance records by updating, adding, and deleting entries in the database. Lastly, the attendance system is designed using PHP, SQL, HTML, and CSS. The IoT Class Attendance Monitoring System for Primary Schools consists of various modules, including registration for students, staff, and teachers, log-in with approval mechanisms, RFID card scanning for attendance, display of attendance data, profile editing, teacher and parent notifications, automatic warning letter generation for excessive absences, leave application functionality, attendance statistics, and graph generation, and a logout feature for users. This comprehensive system aims to streamline attendance management, enhance communication, and offer statistical insights into attendance patterns.

2. Related Work

This section will explain the development of the proposed system and compare between three existing systems.

2.1 Study of Development Web-Based IoT Attendance Monitoring System for School

This section discusses the existing IoT Attendance Monitoring System in Sekolah Kebangsaan Abdullah, employing RFID technology. The system, designed for students, teachers, staff, and parents, utilizes RC522 RFID as the hardware. Operating as a web-based solution, users can access the attendance data through a web-based GUI. The RFID cards store user attendance tracking data, requiring registration of student, teacher, and staff information in the RFID card reader database. Users simply scan their RFID cards upon arrival and departure to automatically record attendance details. Verification is indicated by scanner noises. Parents can register, log in, and monitor their child's reports, adding absentee letters if needed. Teachers and staff access the system to request leave and track attendance. Teachers also have the authority to receive parental absentee letters, and the give notice for students with over five days of absence.

2.2 Comparison with the Existing Systems

Section 2.2 explains the three existing systems that have been studied and compared with the developed system. These systems are compared based on several features, such as their accuracy, ease of use, and cost-effectiveness.

Table 1: Comparison of the existing system and proposed system

Features/System	IoT-Based Smart Attendance	The MEDAC Attendance System	Aplikasi Pangkalan Data Murid	IoT Attendance Monitoring

	System (SAS) using RFID	(iHadir System)	(APDM)	System for The Primary School
Registration	√	√	√	√
Login	√	√	√	√
Password protection	√	√	√	√
RFID	√	X	X	√
Display attendance	√	√	√	√
Edit profile	X	X	√	√
Notification	X	X	X	√
Report data	X	√	X	√
Attendance justification	X	√	√	√
Database	√	√	√	√

Table 1 provides a comparison of the features of existing systems and the proposed IoT attendance monitoring system in a primary school. The developed system is expected to have all the essential features, including RFID, report data, and database. One of the significant features of the proposed system is password protection, which will ensure security through password hashing. The existing systems also have features such as registration, login, and database, which are crucial for storing all the data and differentiating the roles of users such as teachers, parents, staff, and students. RFID hardware will be used by the students, staff, and teachers to record their attendance. The report data feature will allow parents, teachers, and staff to view their students' performance statistics and data. Finally, the attendance justification feature will enable parents to justify and insert an absent letter explaining why their children did not attend school.

3. Methodology/Framework

This section will explain the project methodology which is the Software Development Life Cycle (SDLC) Waterfall and all the phases in this methodology. The system development will be explained in this chapter.

3.1 Software Development Life Cycle (SDLC) Waterfall

The design process utilized in this work is known as the Linear Sequential Life Cycle or SDLC technique. This technique is applied in constructing, creating, and maintaining data on computer software and industrial systems. It's prevalent and most traditional software development building designs. This method is quite simple to understand and is mostly used for small-scale operations where the requirements are understood. It entails several stages where the result of a single phase gives the input for the following stage. The system is created to fulfill the needs of the end user during the second phase (design phase). This includes the data flow diagram, context diagram, and use case diagrams. During the implementation phase, the graphical user interface of the system was created using Hypertext Markup Language, Bootstrap Cascading Style Sheet, and JavaScript as front-end tools, and Hypertext Pre-processor and My Structure Query Language as back-end tools. The system communicates with the database on a distant server. It is to ensure that the software is mobile-responsive, making it easier for both professors and students to utilize the program. During the testing phase, the work of each component of the intended application was tested and integrated [4]. The Waterfall Model is a software development process that helps in completing project phases more efficiently. It is chosen because early requirements completion enables developers to fully define the project scope, document a detailed schedule, and design the overall application.

Breaking down the project stages into smaller phases helps to ensure the accuracy of the contents of the developed system. Using the Waterfall Model makes it easy to ensure that the progress of the project sticks to the schedule. Waterfall Model, there are six phases: planning, requirements analysis, design, implementation, testing, and deployment. Each phase concludes with an intermediate result or milestone.

3.2 Planning Phase

This phase is also used to identify the types of risks involved throughout the project. A well-planned project ensures that the project stays on schedule, and the progress is monitored effectively [5]. Developers need to plan all major activities, such as the development framework, project plan design, and project schedule. The Planning

Phase in the Waterfall Model encompasses activities like scheduling, process tracking, and project estimation. It identifies project risks and employs Gantt charts for planning and scheduling, ensuring a visual representation of the project timeline. During this phase, a meeting with Dr. Nayef Abdulwahab Mohammed Alduais, the project supervisor, occurred via Google Meet and face-to-face. Hazard identification is crucial in software development planning, ensuring technical activities and resource needs are outlined. Research studies during this phase gather data from journals, digital libraries, the internet, and books, focusing on attendance monitoring systems with RFID in schools. Overall, the planning phase is vital, ensuring efficient and accurate project completion by addressing hazards and collecting necessary data.

3.3 Analysis Phase

During the analysis phase of the Final Year Project, various methodologies were used to gather and analyze all requirements related to the project's development. One of the methodologies used was interviews, which are versatile and allow for in-depth analysis from a small sample size. Interviews also provide an opportunity to focus research on participants' perspectives [6]. The interviewee, Puan Habibah binti Abd Halam, oversees student attendance at Sekolah Kebangsaan Abdullah. In the analysis phase, software and hardware requirements were determined to guide the system development effectively. Early identification of these requirements ensures efficient resource allocation. This phase also addresses risk identification for project planning, facilitating the development of a contingency plan to mitigate potential challenges.

3.4 Design Phase

The design phase encompassed five key design aspects: general system architecture, user interface design, wiring diagram, Data Flow Diagram (DFD), Context Diagram (CD), and Entity Relationship Diagram (ERD). The general system architecture outlined the proposed system's overall structure and operation. User interface design depicted the monitoring website's layout for users and administrators. The wiring diagram illustrated physical connections among IoT components. These designs aimed to model and analyze system requirements. ERD showcased database entity relationships. Following the Waterfall Model in software development, wireframes were created during the design phase to guide UI development. Using Draw IO, a free online tool, wireframes were structured in black-and-white before adding visual elements, ensuring a well-structured and comprehensive design. Comparable examples were reviewed for inspiration in wireframing the developed system.

3.5 Implementation Phase

The implementation phase begins once the developed system has gained user acceptance. This is where all the source code is written as per requirements [7]. The primary school's IoT-based attendance monitoring system comprises RFID scanners for students, teachers, and staff, a database, and a monitoring website. An Arduino sensor, programmed through Arduino IDE, functions as the RFID scanner, detecting user cards and sending data to the phpMyAdmin-based database, managed using SQL. XAMPP facilitates client testing before deploying to a remote web server. Each component undergoes unit testing for accuracy before integration. The monitoring website, developed in Visual Studio code with PHP, HTML, CSS, JavaScript, and AJAX, enables administrators to access attendance and personal details from the database, ensuring a comprehensive and efficient system.

3.6 Testing Phase

Testing is a vital phase in the SDLC, occurring after the building phase in the Waterfall Model. During testing, all implemented code undergoes evaluation to ensure it meets functional and non-functional requirements. In this project, the final product is evaluated, emphasizing compliance with earlier phases' requirements. System tests, user acceptance tests, and accuracy tests are conducted before deployment. System testing identifies errors, crucial for system functionality. User acceptance testing ensures real-world applicability, recording system success and failure. This phase is integral for rectifying errors and ensuring the system operates as intended in diverse scenarios.

3.7 System Development Workflow

There is a total of five phases from the prototype model. As shown in Table 2, each phase has its assignment and output that need to be produced during the entire project development. Besides that, the output had been completed within the specific days that have been given.

Table 2: Software development activities and their task

Phase	Task	Output
Planning	☐ Proposed the project ☐ Determine the project schedule, activities, and output ☐ Identify the problem statement ☐ Determine objectives and project scope ☐ Study the features of the existing system	☐ Project proposal ☐ Develop a Gantt chart ☐ Literature review
Analysis	☐ Interview session with the staff of the school ☐ Identify the hardware and software requirements ☐ Determine functional and non-functional requirements	☐ Collect data from the interview ☐ Hardware and software specifications ☐ Functional and non-functional requirements
Design	☐ Design illustrated wireframe ☐ Design the user interface of the system ☐ Design the database	☐ DFD diagram ☐ ERD ☐ Interface of the system ☐ Database specification
Implementation	☐ Develop RFID scanner ☐ Develop a monitoring website system ☐ Develop database ☐ Integrate and develop system module	☐ RFID ☐ Monitoring website ☐ Developed system
Testing	☐ Conduct system testing ☐ Identify the bugs and fix it	☐ Fix and improve bugs ☐ User acceptance test

3.8 Analysis and Design

This section will explain functional and non-functional requirements, a detailed overview of DFD and ERD diagrams, wiring diagrams, and wireframe design.

Applied Information Technology and Computer Science Vol. 5 No. 2 (2024) p. 692-711

3.9 Functional Requirements

Functional requirements define what the system must do when it receives different inputs and what outputs it should produce as shown in Table 3.

Table 3: Functional requirements analysis

Module	User	Functionalities
Register	Administrator	This function allows admin to register the user account
Login	Administrator Teacher Staff Parent	This function allows users to insert their email and password when to log in to the system. Only the users who are already registered are allowed to enter the system.
Forgot password	Teacher Staff Parent	This function allows utilize the "Forgot password" function to update or change their current password by sending the recovery link through email.
Profile update and edit	Administrator Teacher Staff Parent	This function allows users to make changes to their personal information, such as their name, contact information, and address, as well as their account details, such as their email address and password. By utilizing this function, users can ensure that their information is up-to-date and accurate in the system.
Apply for leave	Teacher Staff	This function allows users to apply for leave and provide their leave information.
Approval leave	Administrator	This function allow administrator to view, edit and approve the leave that requested by the staff and teacher.
Notification	Teacher Parent Administrator	Parent will send the absent letter of their children to inform the reason of absent.
Report data	Administrator Teacher Staff Parent	This function allows users to view the report data and statistics of student, teacher and staff attendance. By accessing this feature, users can gain insights into the attendance patterns of student and identify any areas that may require additional attention or support.

Table 3: Functional requirements analysis (cont)

Identity card scanner	Student Teacher Staff	Every student, teacher, and staff will have their own RFID card with a

		unique ID.
Radio Frequency Identification (RFID)	☐ Student ☐ Teacher ☐ Staff	This function allows the user to record personal details instantly by scanning the RFID card on the reader.
Logout	☐ Administrator ☐ Teacher ☐ Staff ☐ Parent	This function allows users to log out of the system after utilizing an application.

3.10 Non-Functional Requirements

Non-functional requirements are an essential aspect of any system, as they define the properties that should be included in the system as stated in Table 4.

Table 4: Non-functional requirements

Requirement	Functionality
Performance	The system should not detect RFID cards of the students, staff, and teachers as fast as possible.
Security	The data of the students, staff, and teachers can only be accessed by the registered user and will not be from third-party people who don't have any access to it.
Availability and maintenance	Users and admin can check access to the monitoring website at any time, except for regular maintenance.
Usability	The user interface must be user-friendly and simple to use.
Integrity	The recorded data should be kept backups to the database.
Operational	The system should be accessible whenever there is an Internet connection.

3.11 DFD Context Diagram (DFD CD)

A context diagram highlights the exchange of data between the system and external entities. The diagram in Figure 1 illustrates the functional requirements or modules that can be performed by specific users in the developed system. For example, administrators can manage or register users, request user information, and more. Staff and teachers can view attendance reports, obtain IoT with RFID details, and perform other functions, while parents can receive notifications from teachers and more.

Applied Information Technology and Computer Science Vol. 5 No. 2 (2024) p. 692-711

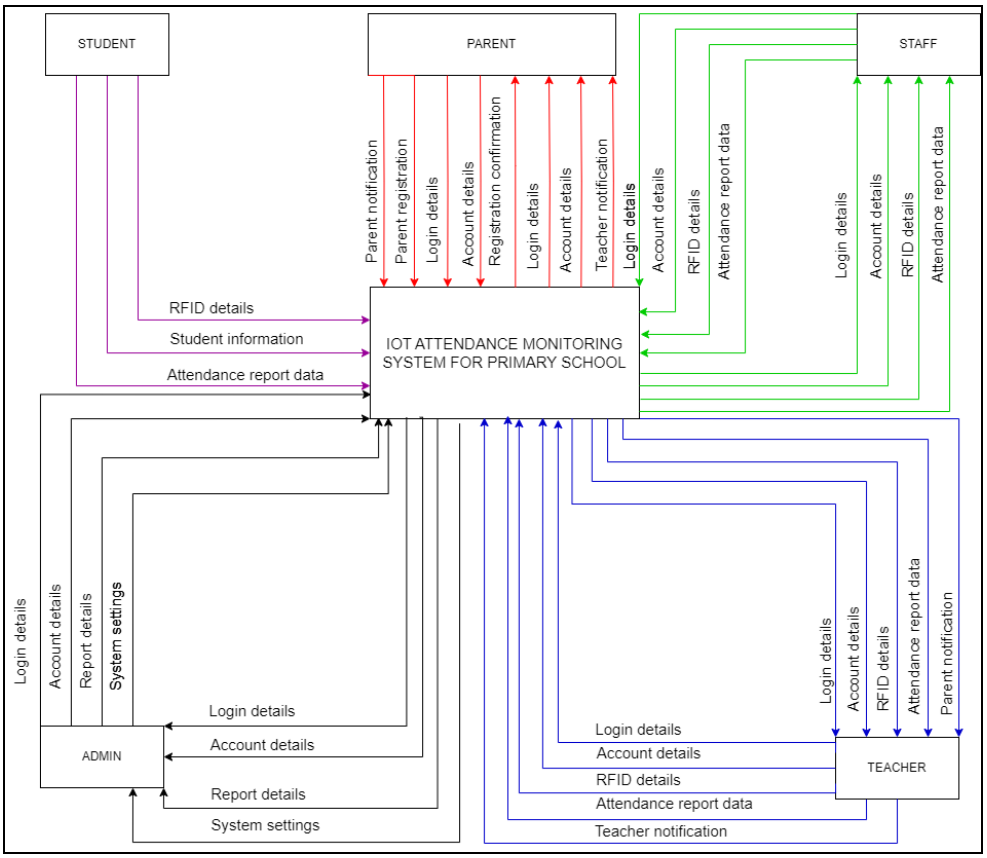

Figure 1: Context Diagram

3.12 DFD Level 0

The highest-level DFD provides an overview of the entire system, including the major processes, data flows, and data stores. However, it does not provide any details about the internal workings of these processes. In Figure 2, there is a data flow diagram for the proposed system. The diagram includes five entities, namely administrator, student, teacher, staff, and parent. The proposed system has several processes such as registering, logging in, managing notifications, school arrival, generating warning letters, generating report data, and managing leave. The data flow diagram illustrates the relationship between data, entity, process, and data store.

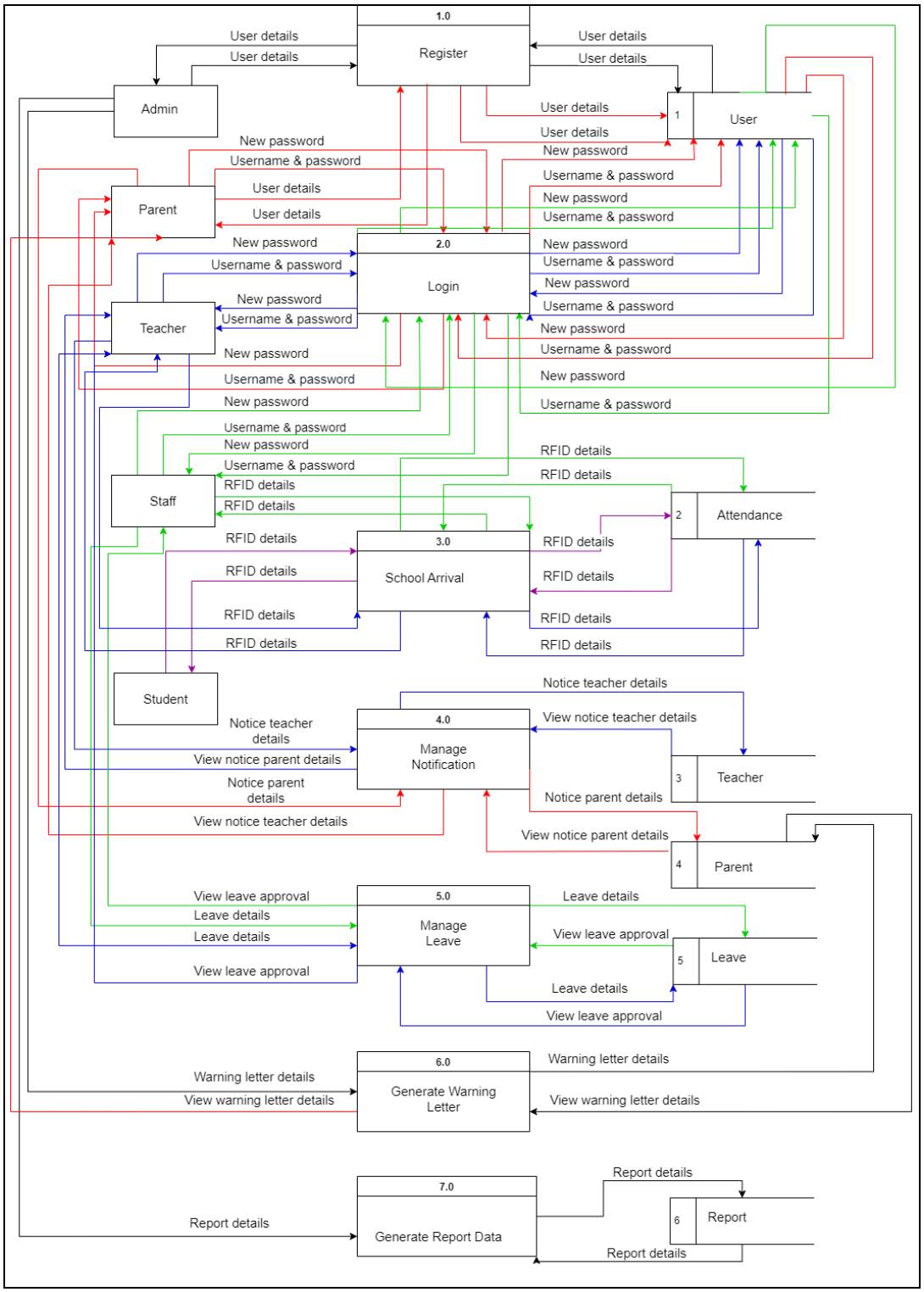

Figure 2: Data Flow Diagram Level 0

3.13 Entity Relationship Diagram

An Entity Relationship Diagram (ERD) is a graphical depiction of a database architecture that demonstrates the relationships between various elements in a database. Typically, an ERD has entities that represent data and relationships that represent the connection between data. Appendix E shows the Entity Relationship Diagram (ERD). There are six tables created in the database, For the user table, it is a table for user login credentials. The report table is for generating all the attendance reports. The attendance table is to store the data of the clock in and clock out of the user. The leave table is for the teacher and staff to apply for leave. For teachers and parents is for the notifications of warning letters and absent letters.

Applied Information Technology and Computer Science Vol. 5 No. 2 (2024) p. 692-711

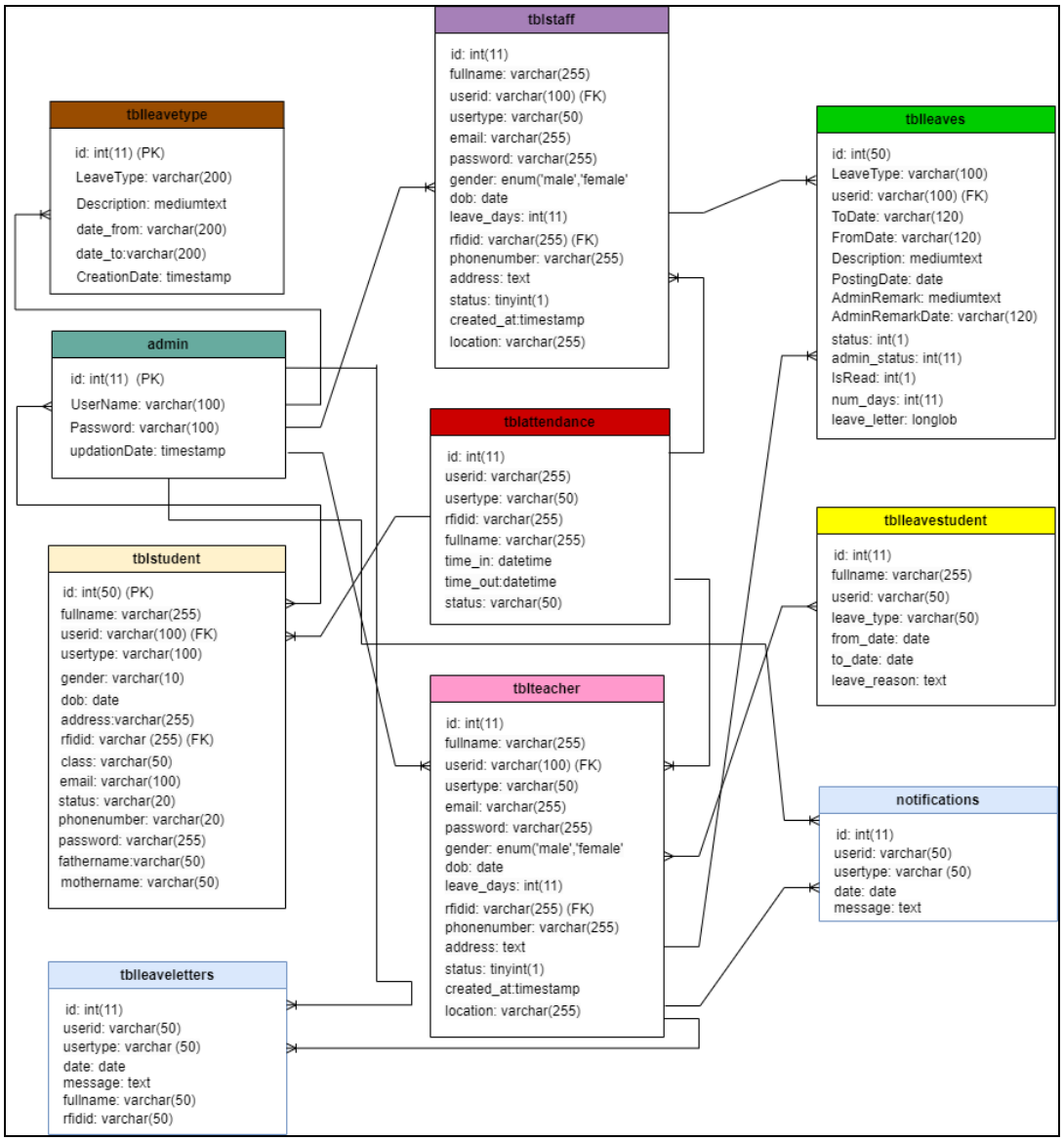

Figure 3: Entity Diagram Relationship

3.14 Interface Design

The process of designing the visual look and interaction features of a created system is known as interface design, often known as user interface (UI) design. The goal of UI design is to generate an efficient, effective, and engaging user experience for the system. shows the interface design for registering, login, homepage, profile, attendance, leave, and report.

4. Result and Discussion

Attendance Monitoring System for Primary School was implemented using Hypertext Preprocessor (PHP), Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), and Javascript. For the Internet of Things version, the C programming language was utilized and Arduino software is used to configure the hardware part which is RFID. MySQL served as the database management system, widely used for data management and storage across various applications.

4.1 System Implementation

Figure 4 illustrates the database connection code that links the system to the database. Establishing this connection enables the system to input data into the database and retrieve stored data from it.

```php
// Database connection
$servername = "localhost";
$username = "root";
$password = "";
$dbname = "attendance";

// Create connection
$conn = new mysqli($servername, $username, $password, $dbname);

// Check connection
if ($conn->connect_error) {
    error_log("Connection failed: " . $conn->connect_error);
    die("Connection failed: " . $conn->connect_error);
}
```

Figure 4: Database configuration and connection

The Arduino IDE was employed to write the program for the attendance using the C programming language. Figure 5 depicts the hardware setup for the attendance monitoring using RFID. The hardware used in this project are RFID tags that embedded with the user ID, RFID readers that can be used to scan RFID tags. In addition, in this project used connectivity modules which is ESP8266 to allow the system to connect to the Internet for data to be read and sent to a cloud service which is ThingSpeak.

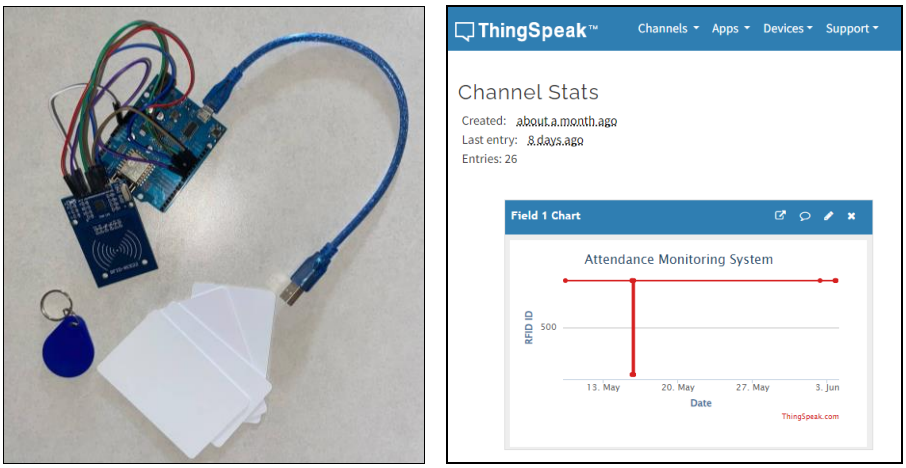

Figure 5: Hardware setup and IoT cloud database

A registration function is available for admin only in this developed system as in Figure 6. Admin can register all the information for student, teacher, staff and parent. The system verifies the provided details, such as name, user identification number, contact information, email, and other relevant information. It also cross-checks this data with existing records in the MySQL database. If the information is unique and hasn't been previously registered, the registration process initiates.

Applied Information Technology and Computer Science Vol. 5 No. 2 (2024) p. 692-711

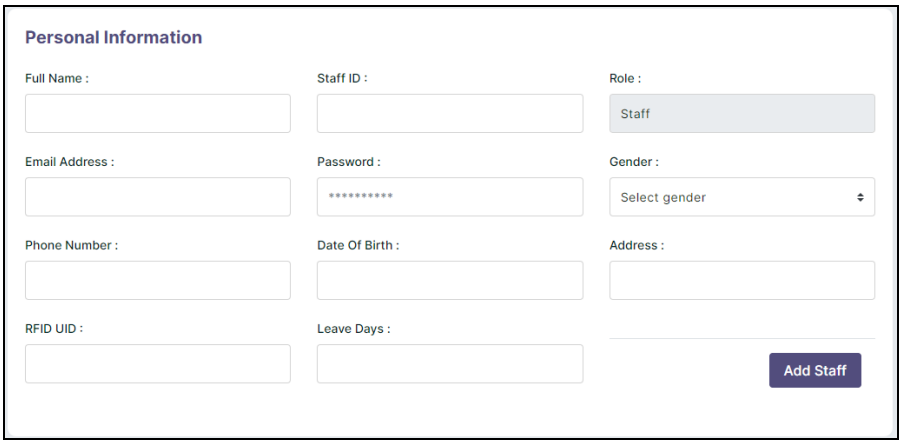

Figure 6: Registration form

A login function available for admin, teacher, staff and parent as shown in Figure 7. All these users can enter to the website by providing the email and their password. If the email or the password is not correct according to the data that had been saved during the registration process, it will show an error message. When a user forgets their password while attempting to log into their account, they can click the "Forgot Password" link on the login page, which redirects them to the Forgot Password page shown in figure below.

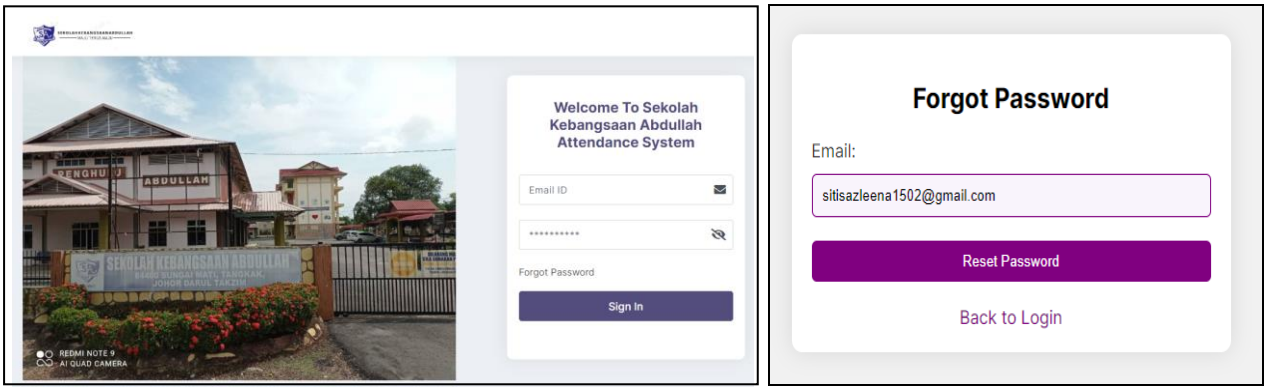

Figure 7: Login and forgot password function

For Figure 8 explain the function that admin can add leave type and the description. All the leave type will be list. Admin can delete or edit the leave type based on their preferences.

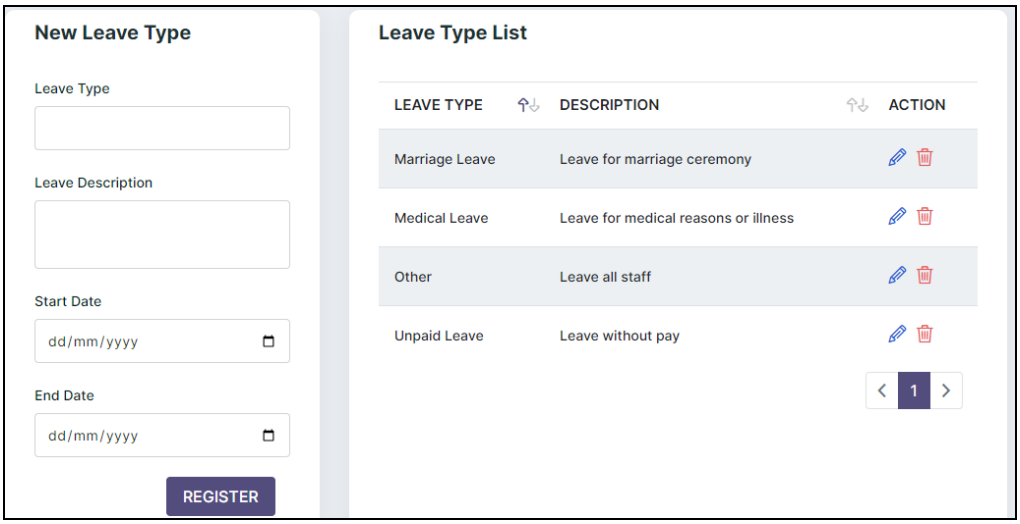

Figure 8: Leave type function

On the Figure 9, administrators can view detailed information about each leave request, such as the requester's details, type of leave, leave of days, and reason.

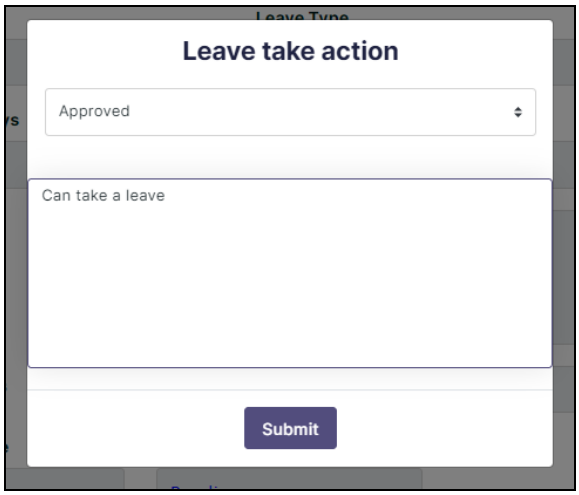

Figure 9: Leave approval

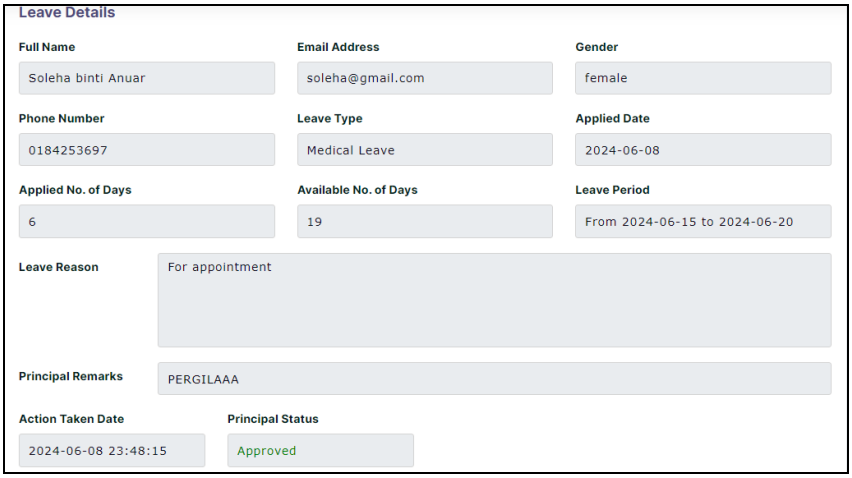

Figure 10: Leave information function

In the Figure 11 of apply leave function accessible to staff and teachers, they can easily request leave by providing all necessary details. Once submitted, their leave requests are automatically forwarded to the admin for approval. Additionally, staff and teachers can review their past leave records and take appropriate actions, such as modifying or canceling existing leave requests.

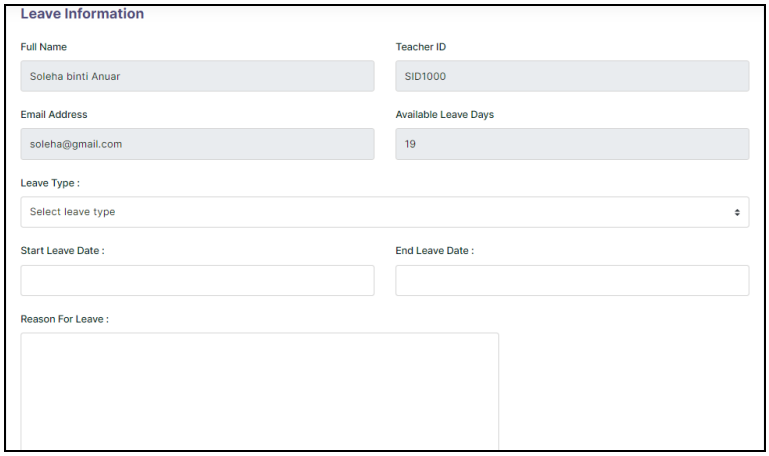

Figure 11: Apply leave page

Parents have the option to send an absence letter when their children are unable to attend school as in Figure 12, allowing them to explain the reasons for their child's absence.

Applied Information Technology and Computer Science Vol. 5 No. 2 (2024) p. 692-711

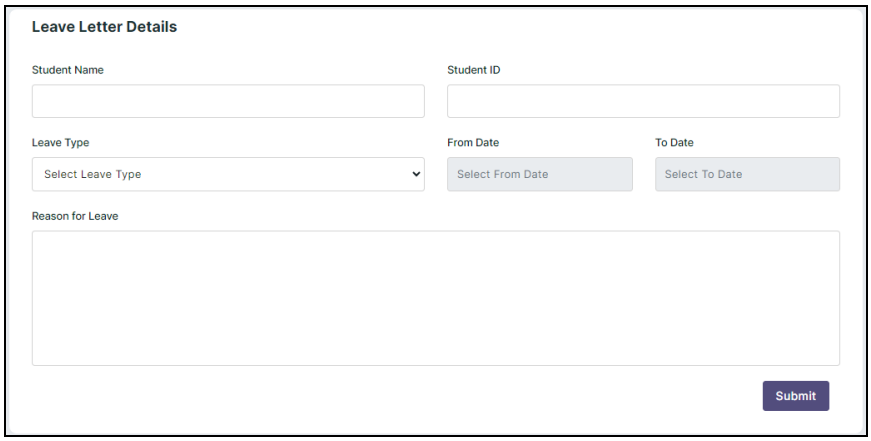

Figure 12: Student absent letter page

When users scan their RFID cards, the system immediately updates their attendance information on ThingSpeak and stores it in the database. This process captures details such as the user's name, RFID UID (Unique Identifier), user ID, timestamp (time of scan), and their attendance status as in Figure 13.

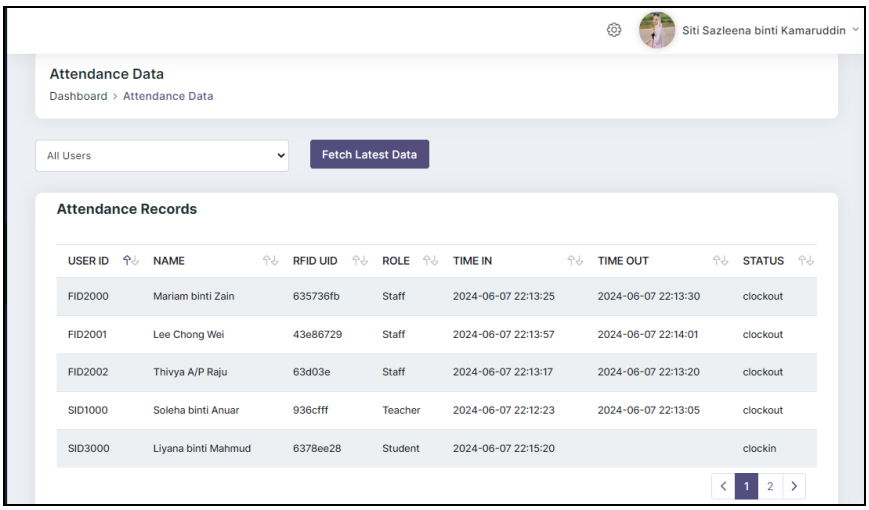

Figure 13: Attendance report

Figure 14 depicts the process of tallying the number of users after they have successfully registered. This successful registration means that a user has gone through all the necessary steps to create an account on the platform.

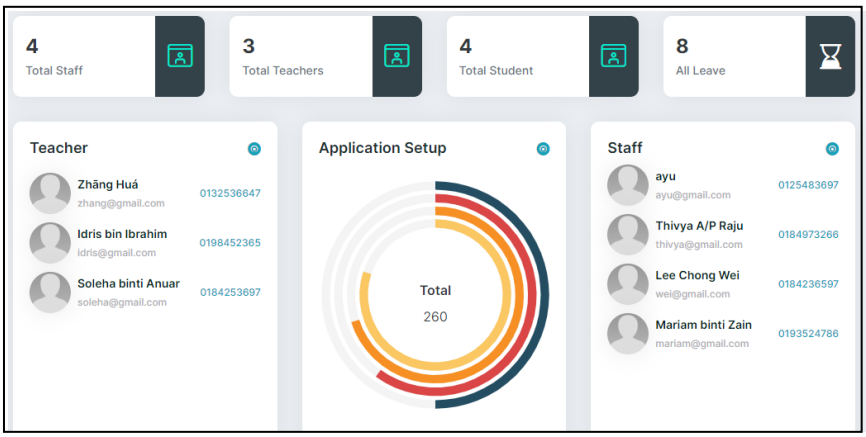

Figure 14: Report of number users and leave page.

4.2 System Testing

Two main type of testing were performed: system testing and user acceptance testing.

4.2.1 Functional Testing

Functional testing is to make sure that the workflow of the system function very well as shown in Table 5.

Table 5: Functional Testing

Test	Expected Result	Actual Result
	Identity Card Scanner Module	
User scan the RFID card to the reader	The setup between hardware and software successfully connected.	Pass
	System manages to detect the personal details of the user	Pass
	The data of the RFID card will be updated to ThingSpeak.	Pass
	Attendance Monitoring System using RFID Module	
User scan their RFID card to record the attendance	System manages to detect the RFID UID of the user.	Pass
	System display the RFID UID of the user successfully.	Pass
	The data in the ThingSpeak successfully stored in database	Pass
	System displayed the RFID UID in the system.	Pass
	User Management Module	
Register	The incomplete data input displayed an alert message indicates that the field is empty	Pass
	An alert message displayed to show the field should be unique for user ID and RFID ID.	Pass
	An alert message displayed that user need to enter valid email and phone number.	Pass
	Account successfully registered and the information stored to database.	Pass
Login	An alert message displayed indicates that the field is empty because incomplete data input.	Pass
	An alert message displayed indicates that the email and password should be match with the database.	Pass
	Login successfully and redirected to the dashboard.	Pass
Forgot password	An alert message displayed indicates that the field is empty because incomplete data input.	Pass
	An alert message displayed indicates that the email should be matched with database.	Pass
	Successfully sent email to reset the password.	Pass
Account management	User can successfully edit account information.	Pass
	Account information successfully updated.	Pass

Table 5: Functional Testing (cont.)

Test	Expected Result	Actual Result
	Leave Module	
Leave type	The system successfully adds the leave type into the system.	Pass
	The leave type successfully edited by admin for any changes.	Pass
	The leave type successfully updated into the system.	Pass
Apply leave	The staff and teacher successfully apply the leave.	Pass
	The system successfully sent the information of apply leave to admin site.	Pass
	Staff and teacher successfully edited and viewed the information of apply leave.	Pass
Approval leave	The admin successfully viewed the apply leave requested by the staff and teacher.	Pass
	The admin successfully can act to the requested leave whether want approve or reject.	Pass
	The admin successfully deleted the leave requested by the staff and student.	Pass
	The staff and teacher can successfully view the approval leave.	Pass
Absent letter	The parent successfully sent the absent letter into the system	Pass
	Report Module	
Attendance	The attendance report successfully can be viewed by the user.	Pass
Number of users	Successfully display the number and statistics of the user registered to the system.	Pass

4.2.2 User Acceptance Testing (UAT)

The User Acceptance Test (UAT) occurs at the end of the system development cycle to ascertain whether the system functions as intended and meets user expectations in real-world scenarios as shown in Table 6. It focuses on user interface and system function.

Table 6: Result of user acceptance testing

No	Acceptance Requirement	Ranking				
		1	2	3	4	5
User Interface						
I	Easy to use and understand	-	-	-	2	14
II	Navigation	-	-	-	2	14
III	Interface design (e.g: color, background, font).	-	-	-	-	16

Table 6: Result of user acceptance testing (cont.)

No	Acceptance Requirement	Ranking				
		1	2	3	4	5
System Function						
IV	Register function	-	-	-	3	13
V	Login function	-	-	-	-	16
VI	Account management function	-	-	-	4	12
VII	Leave function	-	-	-	7	9
VIII	Integration IoT with RFID function	-	-	4	5	7
IX	Attendance function	-	-	5	6	5
X	Report function	-	-	6	5	5

Figure 15 shows the result of user acceptance testing in bar char that explain involved only 16 users. Evaluation findings are presented graphically after collecting user data. These graphs depict user satisfaction levels, ranging from unsatisfied (Ranking 1) to highly satisfied (Ranking 5).

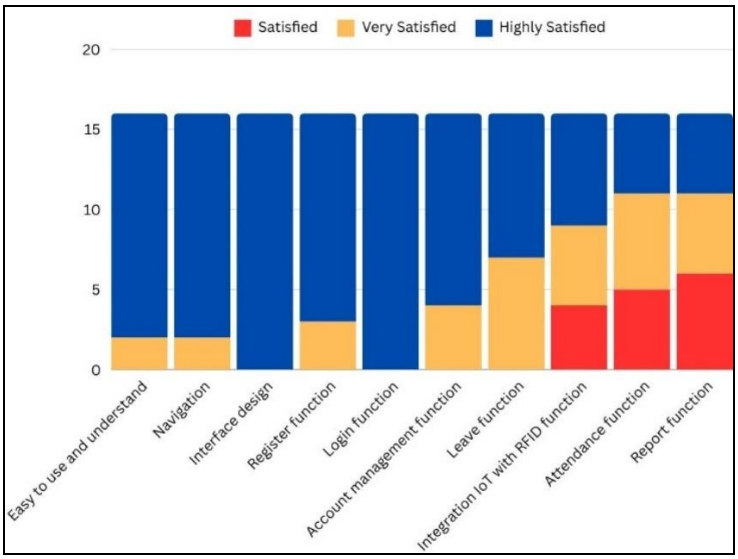

Figure 15: Result of user acceptance testing in bar chart

5. Conclusion

In conclusion, the development of a web-based IoT class attendance monitoring system using RFID successfully met all objectives. This system should allow institutions to streamline their attendance management processes and reduce the need for human intervention. However, the system has some limitations, such as the absence of user validation after registration. This issue can be resolved by incorporating extra security measures and linking the system with a front-end website.

Acknowledgment

The authors would like to thank the Faculty of Computer Science and Information Technology, Universiti Tun Hussein Onn Malaysia for its support.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

This journal requires that all authors take public responsibility for the content of the work submitted for review. The contributions of all authors must be described in the following manner:

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Siti Sazleena binti Kamaruddin, Nayef Abdulwahab Mohammed Alduais;* ***data collection:*** *Siti Sazleena binti Kamaruddin, Nayef Abdulwahab Mohammed Alduais;* ***analysis and interpretation of results*** *Siti Sazleena binti Kamaruddin, Nayef Abdulwahab Mohammed Alduais;* ***draft manuscript preparation:*** *Siti Sazleena binti Kamaruddin, Nayef Abdulwahab Mohammed Alduais. All authors reviewed the results and approved the final version of the manuscript.*

An author name can appear multiple times, and each author name must appear at least once. For single authors, use the following wording:

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

References

[1] Bharathy, G. T., Bhavanisankari, M. S., & Tamilselvi, T. (2021). Smart attendance Engineering and Management (IJAEM), 3(6), 1307. https://ijaem.net/issue_dcp/Smart%20Attendance%20Monitoring%20System%20using%20IoT%20and%20%20RFID.pdf

[2] Hasman, M. I., & Ahmad, I. (2022). RFID Attendance System. Journal of Engineering Technology, 10, 17-25. https://bmi.unikl.edu.my/wp-content/uploads/2022/11/17_25_RFID-Attendance-System.pdf

[3] Choe, W., Teh, Y., Low, Y., Eltaif, T., Minhad, K., Tan, J., & Bhuiyan, M. (2023). Design Of Attendance Information System Using RFID. Journal of Engineering Science and Technology, 18(1), 257-275. https://jestec.taylors.edu.my/Vol%2018%20Issue%201%20February%20%202023/18_1_18.pdf

[4] Oluwaseun, B. R., Muyiwa, O. L. U. G. B. E. B. I., Olanrewaju, B. A., Omolaran, B. B., & Iyabo, B. S. (2017). E-attendance system using waterfall software development life cycle simulation. Journal of Computer Science and Control Systems, 10(2), 10-15. https://www.researchgate.net/profile/Bashir-Bello-3/publication/321497189_E-Attendance_System_using_Waterfall_Software_Development_Life_Cycle_Simulation/links/5a25dfa9a6fdcc8e866ba0d2/E-Attendance-System-using-Waterfall-Software-Development-Life-Cycle-Simulation.pdf

[5] Albelbisi, Nour & Yusop, Farrah. (2019). Factors Influencing Learners' Self –Regulated Learning Skills in a Massive Open Online Course (MOOC) Environment. Turkish Online Journal of Distance Education. 20. 1-16. 10.17718/tojde.598191. https://www.researchgate.net/publication/334756512_Factors_Influencing_Learners'Self-Regulated_Learning_Skills_in_a_Massive_Open_Online_Course_MOOC_Environment/citation/download

[6] 1 recent trends in deep learning based natural language processing. (n.d.). https://arxiv.org/pdf/1708.02709.pdf

[7] Maguire, M., & Bevan, N. (1970, January 1). User Requirements Analysis. SpringerLink. https://link.springer.com/chapter/10.1007/978-0-387-35610-5_9

Applied Information Technology and Computer Science Vol. 5 No. 2 (2024) p. 692-711

Appendix A: Gantt Chart