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Design of a Website Information System Based on Microcontrollers at BMKG Class 1 Bandung

Yudhi Yanuar[1], Rika Wisnu Tiara[2], Lilis Emalia[3]

[1] Department of Informatics, Universitas Taruna Bakti, Indonesia, 40115
[2] Department of Computer Technology, Politeknik Pajajaran, Indonesia, 40123
[3] Department of Informatics Engineering, STMIK Mardira, Indonesia, 40233

yudhiyanuar2010@gmail.com

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Abstract

The purpose of this study is to design an information system for visits at BMKG Class 1 Bandung, the method used in this study is observation of objects and literature studies, in addition to using UML to describe the design and agile methods are used for designing information systems. In the development of a website-based information system using the PHP programming language and the Mysql system management database, in addition to using the esp32 microcontroller and RFID as a tool used for reading visit data, the test results of the visit information system at BMKG Class 1 Bandung resulted in the designed information system running well and effectively.

Keywords: Information System, Visits, Website, ESP32 Microcontroller

Abstrak

Tujuan dari penelitian ini adalah merancang sistem informasi untuk kunjungan di di BMKG Kelas 1 Bandung, metode yang digunakan dalam penelitian ini adalah observasi terhadap objek serta studi literatur, selain itu untuk melakukan digunakan UML untuk menggambarkan desain serta metode agile digunakan untuk perancangan sistem informasi. Dalam Pembangunan system informasi berbasis website dengan menggunakan bahasa pemrograman PHP serta database manajemen sistem Mysql, selain itu digunakan microcontroller esp32 dan rfid sebagai alat yang digunakan untuk media pembacaan data kunjungan. Hasil pengujian dari sistem informasi kunjungan pada BMKG Kelas 1 Bandung dihasilkan bahwa system informasi yang dirancang berjalan baik dan efektif.

***Kata-kata kunci**: Sistem Informasi, Kunjungan, Website, Microcontroller ESP32*

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1. Introduction

The Bandung Class 1 Meteorology, Climatology, and Geophysics Agency (BMKG) still manages visitor visits manually. Visitor registration [1] is conducted by filling out a form in person or via telephone, which is then recorded manually by the responsible staff member. This situation often leads to various challenges, such as difficulties in scheduling visits, the complexity of tracking visit history, and a lack of transparency and accuracy in managing visit data. In today's digital age, the need for an integrated and centralized information system has become increasingly critical.

The website-based visitor information system at BMKG [2] Class 1 Bandung aims to address these challenges. In the designed system, visitors can register for visits via the website [3] more easily and quickly. They can also view the availability of visit dates and times directly through the system [4]. Furthermore, the implementation of this information system is expected to optimize the visitor management process [5] at BMKG Class 1 Bandung. The development of a web-based visitor information system at BMKG Class 1 Bandung represents a strategic step in supporting digital transformation within the BMKG and enhancing services to the public and other stakeholders.

2. Method

Developing an information system requires a system development method, which serves as the initial step or phase in the design of the information system. Each system development method has its own strengths and weaknesses as well as distinct characteristics; the selection of a system development method is tailored to the requirements of the information system design. In the design of a website-based visitor management system using the ESP32 microcontroller [6] at the BMKG Class 1 office in Bandung, the Agile [7] method is used. This method was chosen because it adopts an approach that involves users in identifying solutions to address existing issues. Additionally, this method is highly suitable because the system is built iteratively[8] and incremental. The Agile method[9] aims to create innovative services that align with user needs and resolve existing issues. The stages of the method include Requirements, Design, Develop, Test, Deployment, Review, and Launch.

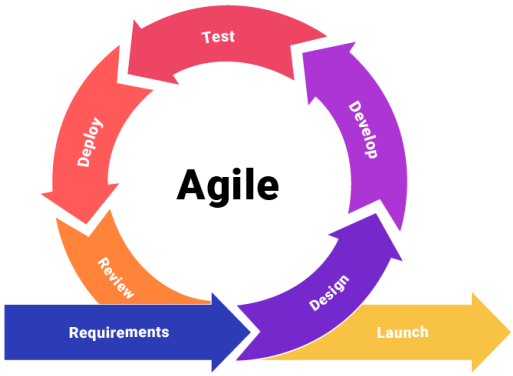

Figure 1. Stages of the Agile Method

From the stages of the Agile method, the author carries out system design activities according to each of its steps, where each activity can be seen in Table 1 below:

Table 1. Activity Steps

No	Stages	Activities
1	*Requirements*	In this stage, the author conducts observations regarding the needs for the information system to be developed, and also interviews the managing staff and visitors who have previously made visits. In this stage, the author obtains system requirements, including: a. The designed system can be used by visitors and administrators. Visitors can enter data related to their identity and the visit time, while staff can monitor and manage the system. b. The system must be able to connect to a database so that the data can be stored and management can be made easier. c. A system is needed that can automatically store visit data to avoid errors in the stored data. d. A system is needed that can display recap reports of visit data according to requirements.
2	*Design*	The design phase is carried out based on the requirements of the information system by using Unified Modeling Language (UML) diagrams to describe business processes and Entity Relationship Diagram (ERD) diagrams. The diagrams to be created include: a. A Use Case diagram illustrates the functional requirements of the information system from the perspective of actors using its features. b. An Activity diagram illustrates the flow of activities between actors and the system based on each feature. c. An ERD illustrates the relationships between entities as the basis for determining the database tables used in the visitor information system.

No	Stages	Activities
3	*Develop*	During the development phase, an information system was built. This phase was divided into two parts, namely: a. Software development for data management and visit processing, using HTML, CSS, and JavaScript for the frontend, while PHP was used for the backend. Additionally, MySQL was used for the system's database management to store data. b. To facilitate data collection and ease of data entry, a microcontroller-based device was created with the main components being an ESP32 and an RFID reader used to read visit data, and an RFID card as the medium for transmitting data. Additionally, supporting components such as a breadboard, buzzer, cables, and an LCD were also used.
4	*Test*	The testing phase is conducted to ensure that all system functions operate in accordance with the established requirements. The testing method used is Black Box Testing, which focuses on testing the functionality of each feature without considering the structure of the program code
5	*Deployment*	At this stage, the information system is being implemented in the operational environment, specifically at the Class 1 BMKG office in Bandung.
6	*Review*	The review phase is conducted to evaluate the results of the system's implementation by monitoring system usage and gathering feedback from users. The purpose of this phase is to identify challenges, shortcomings, and opportunities for further development.
7	*Launch*	The release phase is the final stage, involving the operational launch of the system once all functions are working as intended and evaluation results indicate that the system is ready for use

3. Results and Discussion

The research findings are presented in three sections: the system design, which describes the business processes of the designed information system, the system implementation which explains the results of the information system design, and finally the system testing, which details the results of the information system testing.

a. Design System

The system design section includes diagrams that illustrate the business processes of the information system designed using UML **[10]**. The diagrams used are the Use Case Diagram **[11]** and Activity Diagram **[12]**.

The use case diagram illustrates the business processes within the BMKG visit information system, as shown in **Figure 2.**

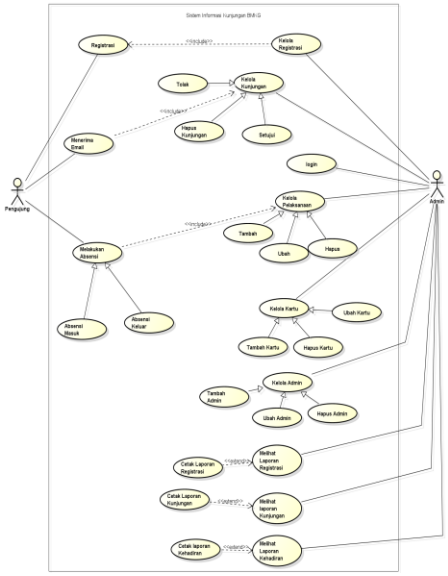

Figure 2. Use Case Diagram for the BMKG Visitor Information System

The activity diagram illustrates the sequenced activities between actors and the system within the BMKG visit information system, as shown in the following figure:

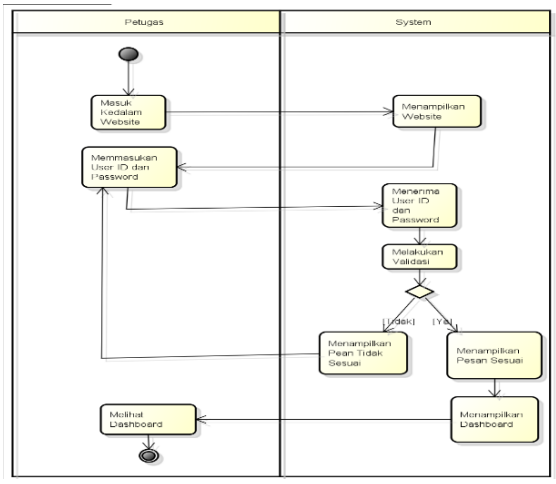

Figure 3. Login Activity Diagram

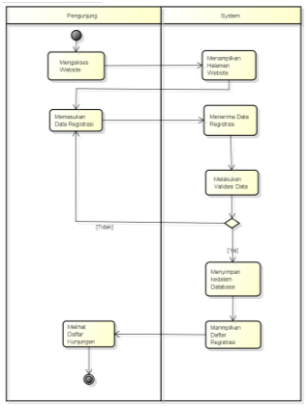

Figure 4. Registration Activity Diagram

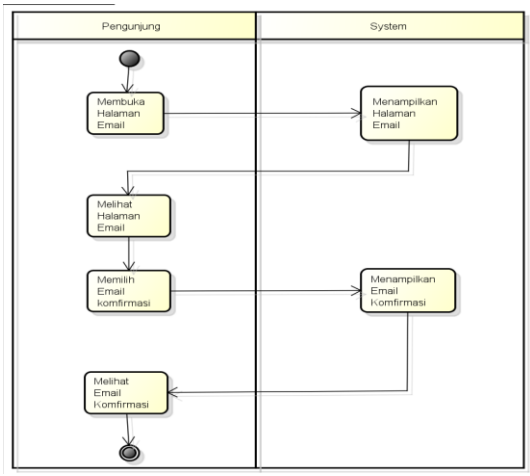

Figure 5. Activity Diagram Viewing the Confirmation Email

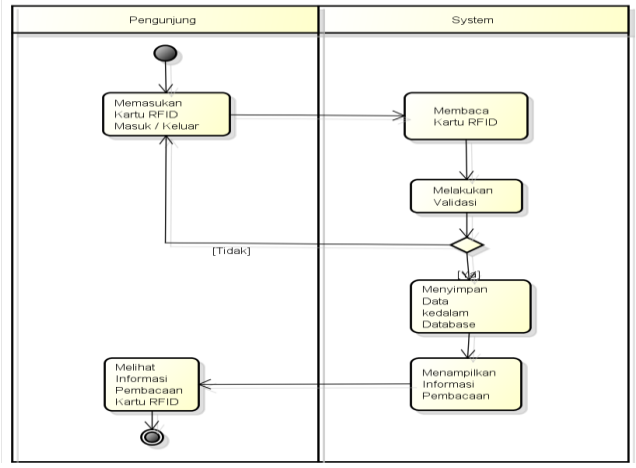

Figure 6. Activity Diagram Taking Attendance

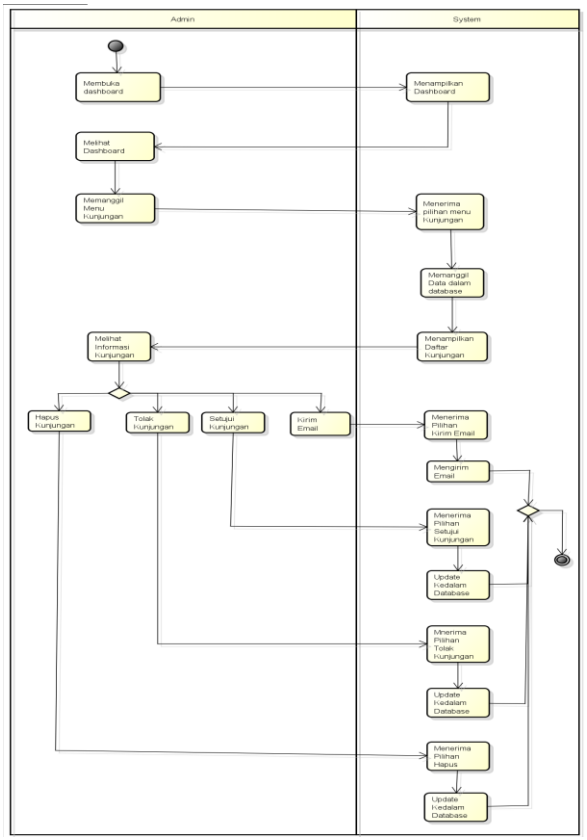

Figure 7. Activity Diagram Managing Visits

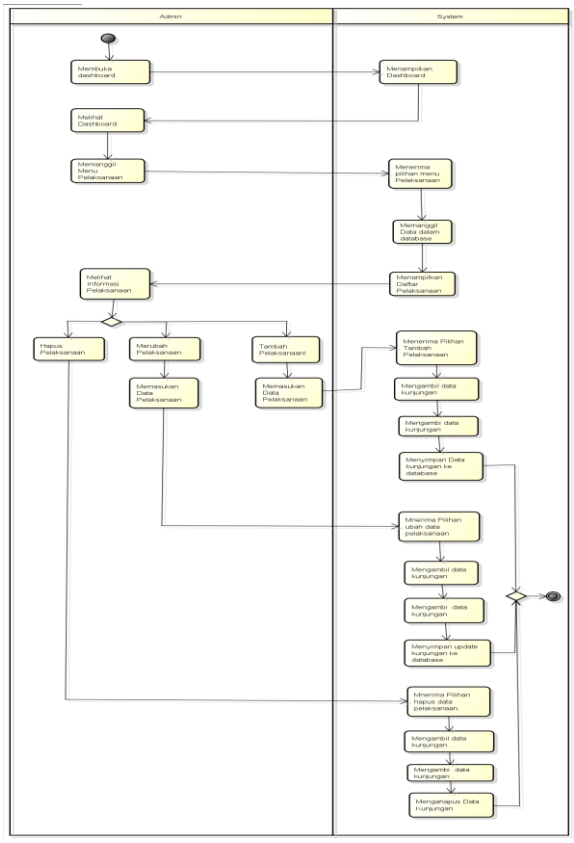

Figure 9. Activity Diagram Managing Attendance

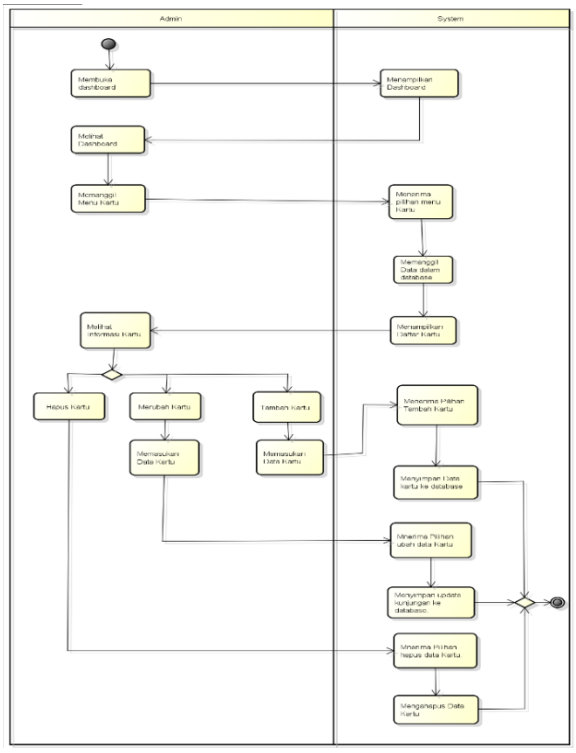

Figure 8. Activity Diagram: Managing Cards

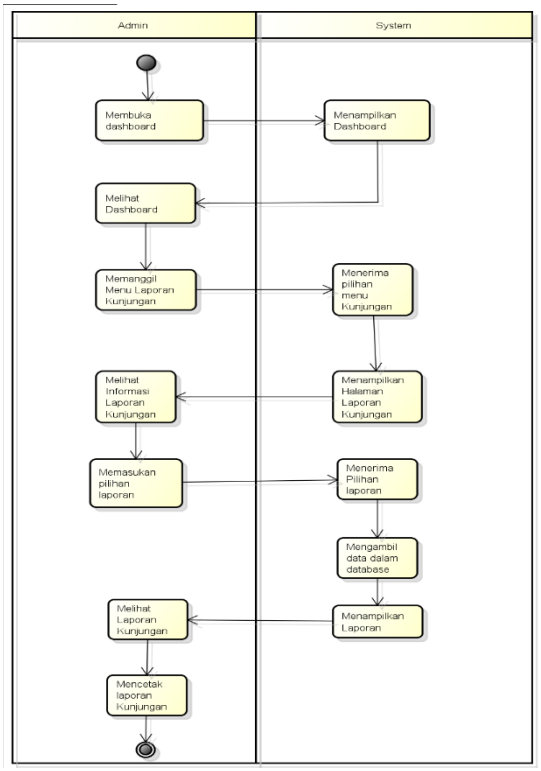

Figure 10. Activity Diagram Managing Registration Reports

b. Implementation System

The system implementation section presents the results of the implementation of a web-based visitor information system using an ESP32 microcontroller **[13]** at the BMKG Class 1 office in Bandung, including the design of the web-based software **[14]** and the ESP32 microcontroller, as shown in the following figure:

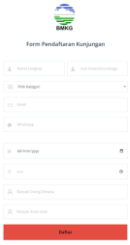

Figure 11. Registration Page

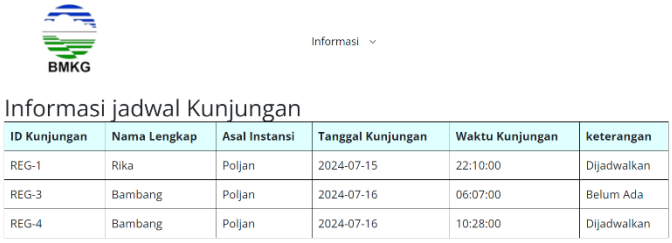

Figure 122. Visit Schedule Page

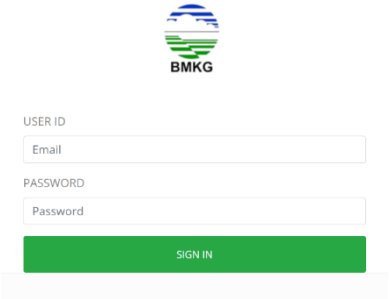

Figure 133. Admin Login Page

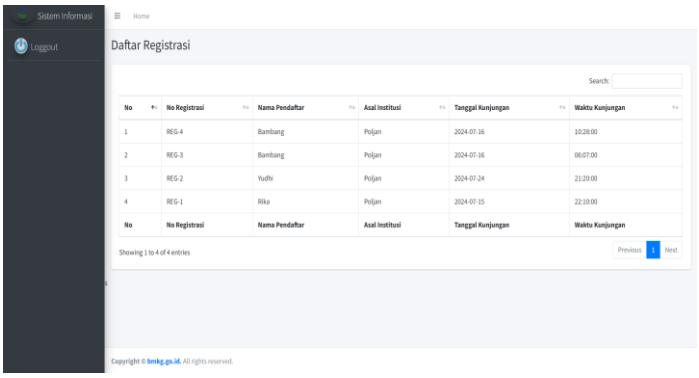

Figure 144. Registration Page

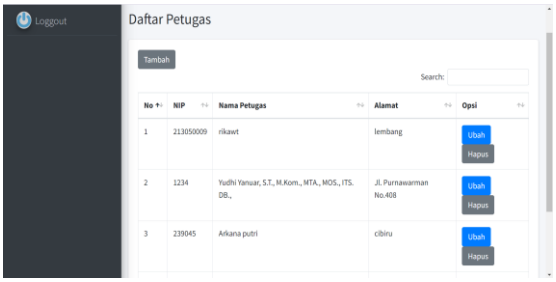

Figure 155. Admin List Page

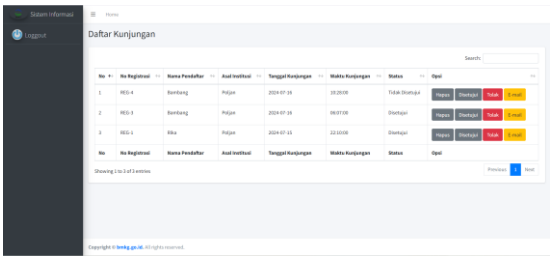

Figure 16. Visitor Log Page

Figure 167. Registration Report Page

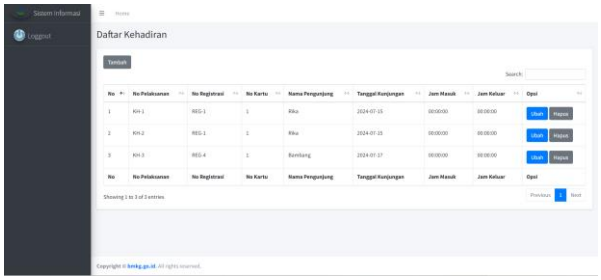

Figure 18. Attendance Sheet

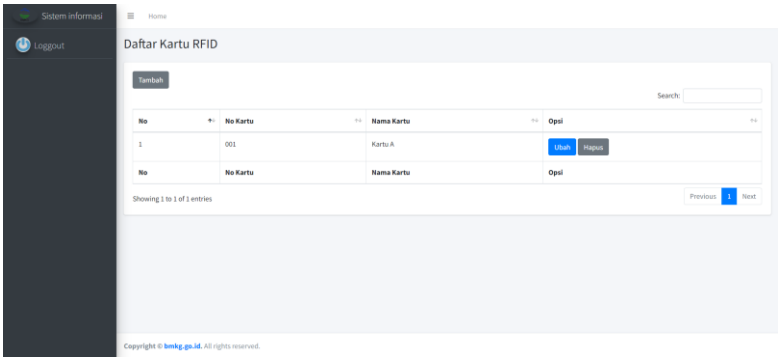

Figure 19. RFID Card List Page

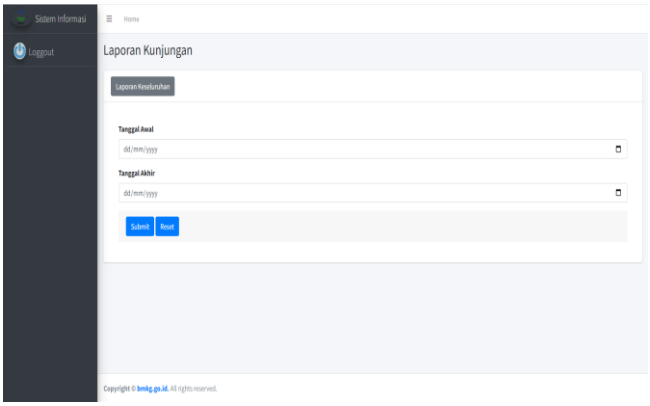

Figure 170. Visit Report Page

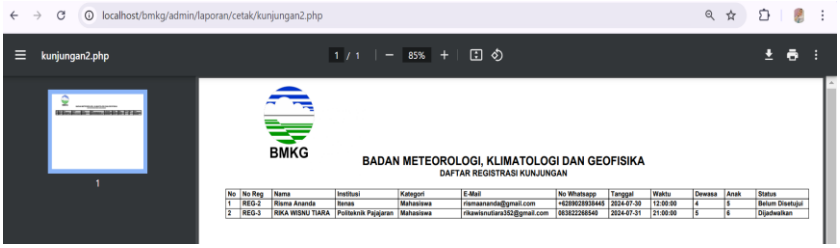

Figure 181. Visit Report Page

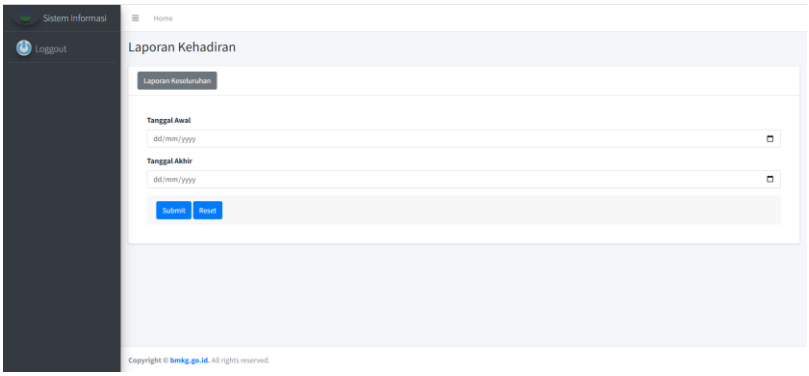

Figure 192. Attendance Report Page

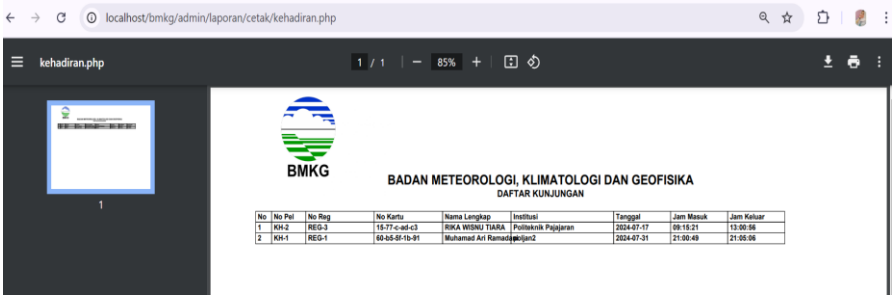

Figure 203. Visit Report Page

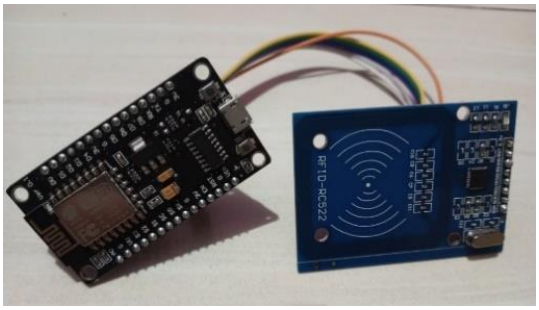

Figure 214. RFID Implementation

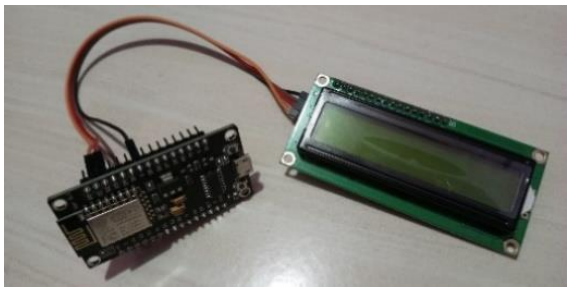

Figure 225. Implementation of LDC I2C

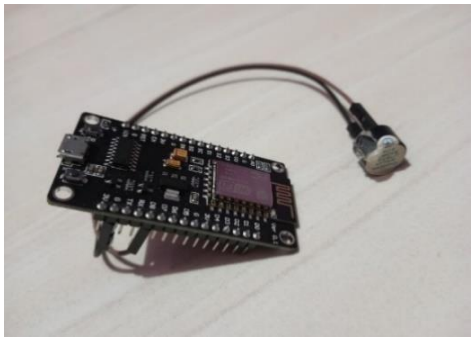

Figure 23. Implementation of the Buzzer

c. System testing

Black box testing **[15]** is a software testing method that focuses on testing the functionality of an application without considering its internal structure or source code. In black-box testing, the tester does not need to know how the software is implemented. The testing of the visit registration information system is **Table 2.**

Table 2. Information System Feature Testing

Test class	Test scenario	Expected results	Test results
Login admin	Fill in the username and password fields, then click the sign in button	The home menu is displayed, and the admin can choose which page to access.	Successful
Register	The registration form includes fields for visitors to fill in information such as their name, organization, number of people in their party, and other details. Once you have filled in all the fields, click the register button.	The data entered by registered visitors is stored in the BMKG database, then displayed on the registration data page and added to the registration table.	Successful
Visit schedule	A page displaying visitor registrations.	This page displays data from the registration table, which automatically adds a status column for visitors to view.	Successful
Agency Location	A page displaying links to agency maps that visitors can access.	When visitors click the Google Maps feature on this page, they will be automatically directed to the organization's location on Google Maps.	Successful
Registration List	Admins can access a page that displays data on registered visitors.	Admins can search for visitor data using the search feature on this page.	Successful
List of Visits	The admin can approve a visit by clicking the Approve, Reject, Delete, or Email button	When the Approve or Reject button is clicked, the visit status will be saved in the database, if the	Successful

Test class	Test scenario	Expected results	Test results
		Delete button is clicked, the data will be deleted, and if the Email button is clicked, you will be redirected to your email application with a message template automatically filled in by the system.	
Attendance list	Admins can view data on scheduled visits, including the time visitors check in and the time they check out.	The clock-in and clock-out times will be automatically filled in based on the time when the RFID card is scanned.	Successful
Admin Data List	The administrator can add, edit, or delete data for anyone who will manage the system.	The admin data will be stored in the BMKG database.	Successful
List of RFID cards	Administrators can add, edit, and delete RFID cards	The card data will be stored in the BMKG database.	Successful
Registration Report	The administrator enters the dates according to the required reports. These can be either comprehensive reports or reports for specific dates.	Administrators can view and print registration reports based on the selected time period.	Successful
Visit Report	The administrator enters the dates according to the required reports. These can be either comprehensive reports or reports for specific dates.	Administrators can view and print visit reports based on the selected time period.	Successful
Attendance Report	The administrator enters the dates according to the required reports. These can	Administrators can view and print attendance reports	Successful

Test class	Test scenario	Expected results	Test results
	be either comprehensive reports or reports for specific dates.	based on the selected time period.	
Save button	On the form that has a Save button, if you click it after entering data, the data will be saved to the database.	The data will be automatically saved in the BMKG database.	Successful
Delete button	On the form that contains a delete button, if you click it after selecting data, the data will be deleted from the database.	The data will be automatically deleted from the BMKG database.	Successful
Edit Button	On a form that has an Edit button, if you click it after entering data, the old data in the database will be replaced with the new, edited data.	The data will be automatically updated in the BMKG database.	Successful
Sign-up button	On the form, there is a Register button, when clicked, all the data that has been entered will be saved or registered in the database	The submitted data will be stored in the BMKG database and displayed on the website.	Successful
Email Button	Email button, When clicked, it will redirect the admin to the email app	In the email app, users are automatically directed to the intended recipient, and a template message is automatically generated that includes registration details such as the visit time, organization, visit date, etc., to be sent to the visitor.	Successful

Test class	Test scenario	Expected results	Test results
Submit Button	On the page containing the submit button, clicking it will display the data we selected and need.	The required data will appear and can be printed.	Successful
Reset Button	On the page containing the Reset button, clicking it will clear all forms that have been filled out but not yet submitted.	The form is now blank again, just like before.	Successful
Button Agrees	On the page containing the Agree button, clicking it will change the data status.	Approved data will change its status from not yet available to approved, and once approved, it will be scheduled.	Successful
Cancel button	On the page containing the Reject button, clicking it will change the data status.	Rejected data will change its status from not yet available to rejected and will not be scheduled.	Successful
Sign-in button	On the page where the sign-in button is located, clicking it will process the data so you can access the home page.	If the sign-in is successful, you will be taken to the page you are trying to access. If the sign-in fails, you will be prompted to fill out the form again.	Successful
Add button	On pages that have an Add button, clicking it will automatically take you to the form for adding data.	The data that has been successfully added will be stored in the BMKG database	Successful

4. Conclusion

Following the analysis and implementation of a web-based visitor information system at the BMKG Class 1 Office in Bandung, it can be concluded that the visitor information system has made the process of managing visitors more effective and efficient; furthermore, the generation of visitor reports has become easier and more accurate. These reports can be used for environmental management evaluations at the Class 1 BMKG in Bandung, as the system will provide detailed and structured visitor data.

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