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Case Study of Attendance System Design Based on Web and Mobile

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Abstract

The current problem is that the attendance process at SMA Negeri 1 Rantau Pulung is still done manually. This becomes a problem when the attendance book is lost or exposed to water, which causes the writing on the attendance book to become blurry. The impact that could occur if the attendance application is not made is that SMA Negeri 1 Rantau Pulung will continue to carry out the attendance process manually and could be affected by the problems mentioned previously. Another impact is being left behind in the field of technology in the current era of digitalization. The step in solving the problem was that the researcher contacted the principal of SMA Negeri 1 Rantau Pulung to offer a presence application, then the researcher asked for the data needed to build the presence application. The temporary results currently obtained are that the presence application has been successfully developed and can now carry out the attendance qrcode scanning process. The conclusion from the interim results of this research is that web and mobile based attendance applications have been successfully developed. The presence application can generate QR codes on the web and can scan the generated QR codes via a mobile application.

Introduction

The school digitalization program is a new breakthrough in education that utilizes the latest technological developments in various learning processes in schools (Ridwan et al., 2023). Therefore, digitalization in schools is one of the ways to improve the quality of education in the country according to Ekarina in her research (Ridwan et al., 2023). According to Ridwan et al. (Fitriati et al., 2023), presence is one of the main supports that can support and motivate every activity carried out in an agency or school.

Attendance activities in public high school 1 Rantau Pulung still use a manual method, namely the teacher calls the names of students and students in the class then checks the attendance book containing the names of students and students in the class. Therefore, teachers at State Senior High School 1 Rantau Pulung will be inconvenienced at the end of the semester when recapitulating the attendance of students and students, sometimes the teacher will ask the secretary of each class for help in recapitulating the attendance. Sometimes there are also problems that arise due to the loss of the attendance book or the attendance book is damaged (Allison et al., 2019; Reyes, 2020; Jabbari & Johnson, 2023). So, that the attendance recapitulation process is hampered because it has to find a book and correct the student attendance data in the book (Indra et al., 2020; Naz, 2023; Holth, 2021; Förster et al., 2022). Therefore, the researcher designed an attendance system that can store attendance data from students and female students at public high school 1 Rantau Pulung.

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The method that will be used to design a presence system at the high school of negeri 1 Rantau Pulung is research and development supported using the waterfall model. The attendance system is expected to help the attendance process for students and help teachers to store attendance data (Sawhney et al., 2019; Munthe et al., 2021; Elaskari et al., 2021).

The purpose of this research is to develop a web based attendance system and mobile application that can store student and student attendance data. Increase digitalization in the school environment through a presence system at the senior high school of negeri 1 Rantau Pulung, align with research from Sukowati et al. (2019). With this attendance system, it is expected to be useful to support academic quality, such as: helping teachers in storing student attendance data at SMA Negeri 1 Rantau Pulung. Replacing manual attendance with a web based attendance system and mobile applications in order to reduce the risk of loss and damage to attendance due to using books (Tamilkodi, 2021; Pei et al., 2019; Taylor et al., 2023).

Methods

Data Source

The data used in this study were obtained from the principal of SMA Negeri 1 Rantau Pulung. The following table is attached to the data obtained.

Table 1. Research Data Table

Class	Grade Level	Number of Students			Total Class	Total Students
		L	P	Total		
X-I	10	10	21	31	12	330
X-II	10	12	18	30		
X-III	10	11	20	31		
X-IV	10	13	18	31		
XI-I	11	11	17	28		
XI-II	11	14	16	30		
XI-III	11	12	16	28		
XI-IV	11	13	16	29		
XII IPS 1	12	15	13	28		
XII IPS 2	12	15	9	24		
XII MIPA 1	12	8	12	20		
XII MIPA 2	12	6	14	20		

The data in the table above is the latest data taken in 2024. Researchers collected data on March 21, 2024 which was then immediately processed to help complete the research.

Analysis and Design

Functional Requirements

This research explains the functional requirements in 3 parts which are described as follows.

Input Requirement

The system can input login data

System can scan student attendance qrcode

The system can input class data

Process Requirements

The system can save the login data

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The system can save student attendance data

The system can save class data

Output Requirements

The system can provide student data

The system can provide student attendance data

The system can provide stored class data

Non-Functional Needs

Non-functional requirements are hardware and software requirements used to process data. The following are the non-functional requirements used in this research.

Software Requirements

In this research there are software needs that are needed to complete this research. Here are some of the software used. Operating System (OS), Windows 11 which is used as the operating system in the process of completing the research. Visual Studio Code, is the code editor platform chosen to build the attendance system. Programing Language, the programming language that will be used to build the attendance system is PHP. Laravel, is the framework used to complete the attendance system in this research. Draw.io is the software used to create the diagrams used in this research.

Hardware Requirements

The following are the hardware specifications used to create the attendance system as well as the system used to complete the research. 1.19 GHz Dual-Core intel core i5 processor, 8 GB Ram, 256 GB SSD storage.

System Design

System design is part of a structured system planning and development process to achieve the desired end result. The process that occurs in system design consists of several stages that are needed to ensure that the designed system can function according to the desired results.

Physical Design

Physical design is a design that contains the database table structure and user interface design of the attendance system created. The following is the physical design made in this study.

Table Design

The following is the design of the database table structure used to store data in this study.

Users Table

Table 2. Table Structure Users

Users		
Attributes	**Data Type**	**Description**
id	bigint	Primary key, auto generate from system
name	varchar	Entered by students when creating an account
email	varchar	Is a foreign key, inputted by students when they want to create an account and when doing the login process.
roles	varchar	Is a role that is owned by the user, be it a teacher or student admin.
phone	varchar	This is the user's cellphone number that can be inputted on the teacher admin page.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

address	varchar	This is the residential address owned by each user.
password	varchar	This is the account code used to verify the account in the login process.
remember_token	varchar	This is a field that will store a unique token when the user logs in.
created_at	timestamp	Represents the time when data is created, system generated
updated_at	timestamp	Represents the time when data is deleted, the system generates

Table 2 is a table that contains user data that will be stored, there are only two data inputted by users when logging in, namely email and password owned by students.

Subjects Table

Table 3. Table Structure Subjects

Subjects		
Attributes	**Data Type**	**Description**
id	bigint	Primary key, auto generate from system
title	varchar	This is the name of the lesson that will be saved to the system
teacher_id	bigint	Is an id that comes from the users table with the role of teacher
semester	varchar	Is a field that contains data on the semester that is currently taking place at the school
academic_year	varchar	Represents the current school year
mapel_code	varchar	This is the mapel code that each subject has
description	text	A brief description of the subject
created_at	timestamp	Represents the time when data is created, system generated
updated_at	timestamp	Represents the time when data is deleted, the system generates

Table 3 is a table containing subjects data that will be stored in the database.

Schedules Table

Table 4. Table Structure Schedules

Schedules		
Attributes	**Data Type**	**Description**
id	bigint	Primary key, auto generated by the system.
subject_id	bigint	Foreign key, derived from the subject id in the subjects table
day	varchar	This is a field that stores the day the subject takes place
start_time	varchar	This is a field that stores data in the form of when the subject starts
hour_finished	varchar	Is a field that stores data in the form of when the subject is completed
room	varchar	Is a field that stores data in the form of classrooms at the school
attendance_code	varchar	This is the code used to generate the qrcode.
year_academic	varchar	Represents the current academic year
semester	varchar	Represents the current semester.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

created_by	varchar	This is a description of who created the data
updated_by	varchar	Information on who changed the data
deleted_by	varchar	This is a description of who deleted the data
created_at	timestamp	Represents the time when data is created, system generated
updated_at	timestamp	Represents the time when data is deleted, the system generates

Table 4 is a table that contains data on all lesson schedules registered in the system.

Student Schedules Table

Table 5. Table Structure Student Schedules

Student Schedules		
Attributes	**Data Type**	**Description**
id	bigint	Primary key, auto generated by the system.
schedule_id	bigint	This is a field that stores the student's lesson schedule. Schedule id comes from the id in the schedules table.
student_id	bigint	This is a field that stores student IDs that come from the users table with student roles.
created_at	timestamp	Represents the time when data is created, system generated
update_at	timestamp	Represents the time when data is deleted, the system generates

Table 5 is a table that will store student lesson schedule data in SMA Negeri 1 Rantau Pulung.

Mapels Attendance Table

Table 6. Structure Table Absence Mapels

Mapels attendance		
Attributes	**Data Type**	**Description**
id	integer	Primary key, auto generated by the system.
schedule_id	bigint	This is a field that stores the lesson schedule. Schedule id comes from the id in the schedules table.
student_id	bigint	This is a field that stores student IDs that come from the users table with student roles.
year_academic	varchar	Represents the current academic year
semester	varchar	Represents the current semester.
meeting	varchar	This is a field that stores data in the form of which meeting the attendance is used for.
status	varchar	This is a field that stores information on whether or not students are present
Description	varchar	This is a field that stores information on whether the student is present or absent but there is an explanation why the student is absent.
latitude	varchar	field that stores Location data of students who take attendance
longitude	varchar	field that stores Location data of students who take attendance
created_by	varchar	This is a description of who created the data
update_by	varchar	Information on who changed the data
deleted_by	varchar	This is a description of who deleted the data

ISSN: 2716-3865 (Print), 2721-1290 (Online)

created_at	timestamp	Represents the time when data is created, system generated
updated_at	timestamp	Represents the time when the data is deleted, the system generates

Table 6 is a table structure that contains attendance data for SMA Negeri 1 Rantau Pulung.

Web User Interface Design

The following is the web user interface design applied in this research. The web user interface is the part that is seen by users of the attendance system when they access the system via a web browser (Nadhan et al., 2022; Chen et al., 2020; Yayla et al., 2021). Users who access the attendance system via the web are teacher admins who are tasked with managing attendance system data.

Teacher Admin Login User Interface

The design of the admin login user interface is the design of the login page made for the admin so that he can enter the next page. Here is a view of the design of the admin login page.

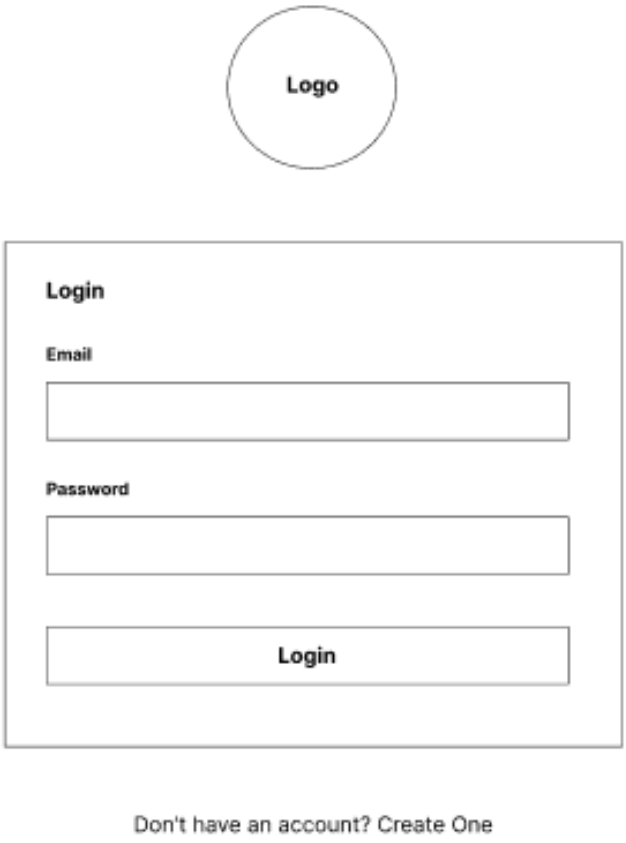

Figure 1. Admin Login User Interface

User Interface Dashboard Admin User List

The design of the admin user interface user list is the first page seen by the teacher admin when he has successfully logged in. This page is the page used by the teacher admin to see all users of the attendance system. Teacher admins can change, delete, and add user data on this page. The following is a view of the user list admin dashboard design.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

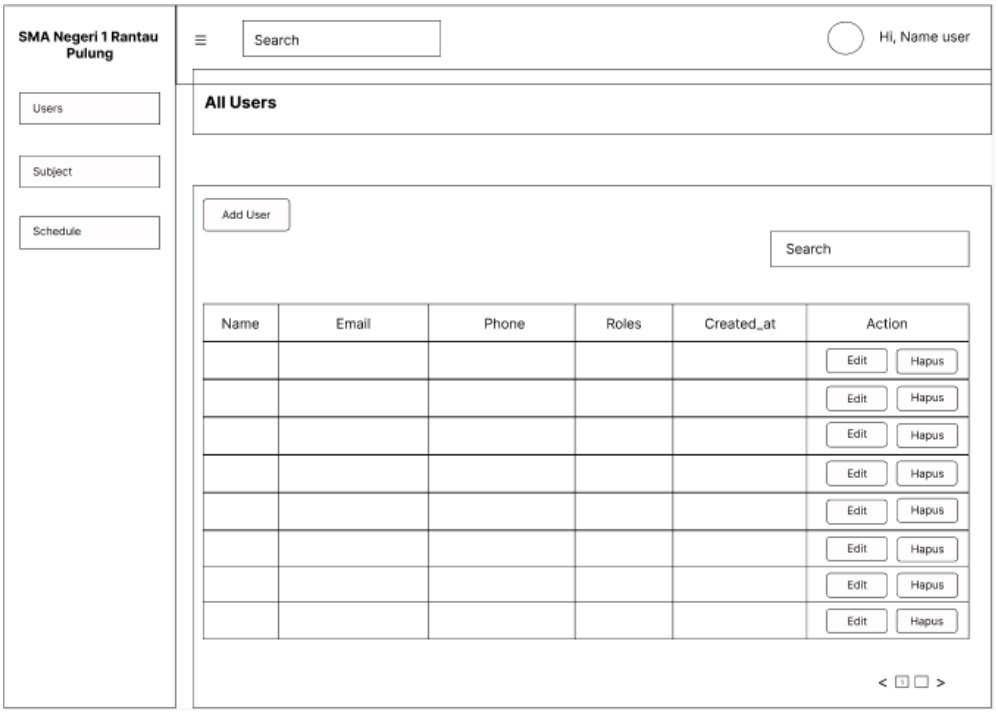

Figure 2. Admin Dashboard User List

User Interface Edit Users

The design of the edit users page is a page used by the admin to change the user data of the attendance system. Some data that can be changed by the admin on this page are user name, user email, user cellphone number, and user address. The following is a view of the design of the edit user's page.

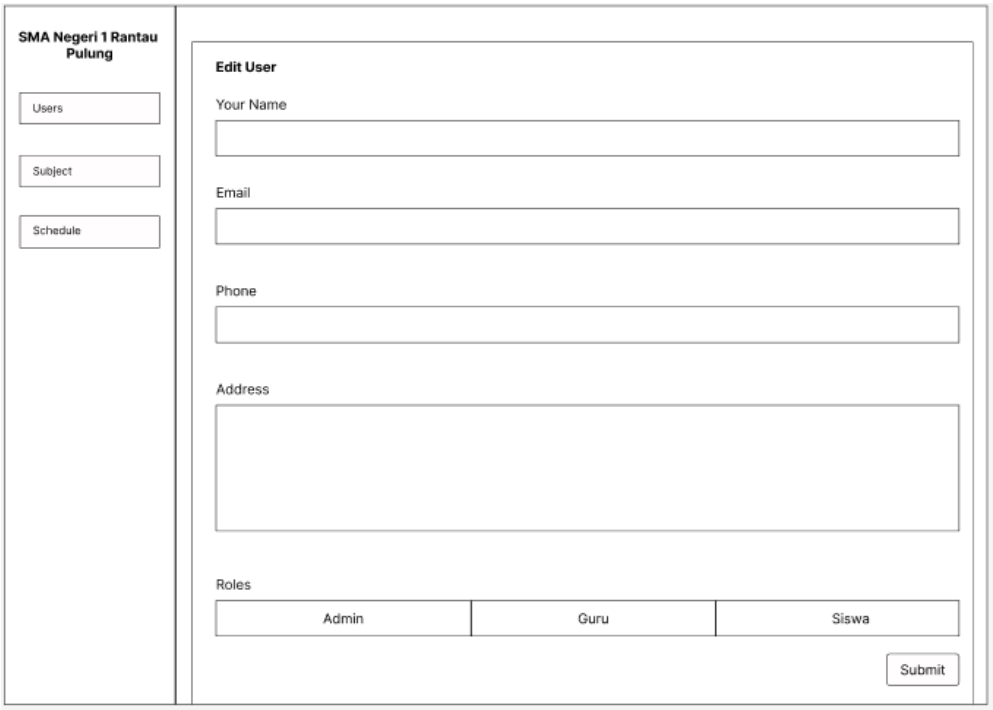

Figure 3. Edit Users Page

Subject List page

The design of the subject list page is a page design that will be used by the admin to view data related to the subjects registered in this attendance system. The data that can be seen by the

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admin on this page are the teacher's name, subject, semester, school year, and subject code. Admins can add, change, and delete data related to subjects on this page. The following is a view of the draft subject list page that will be used by the admin.

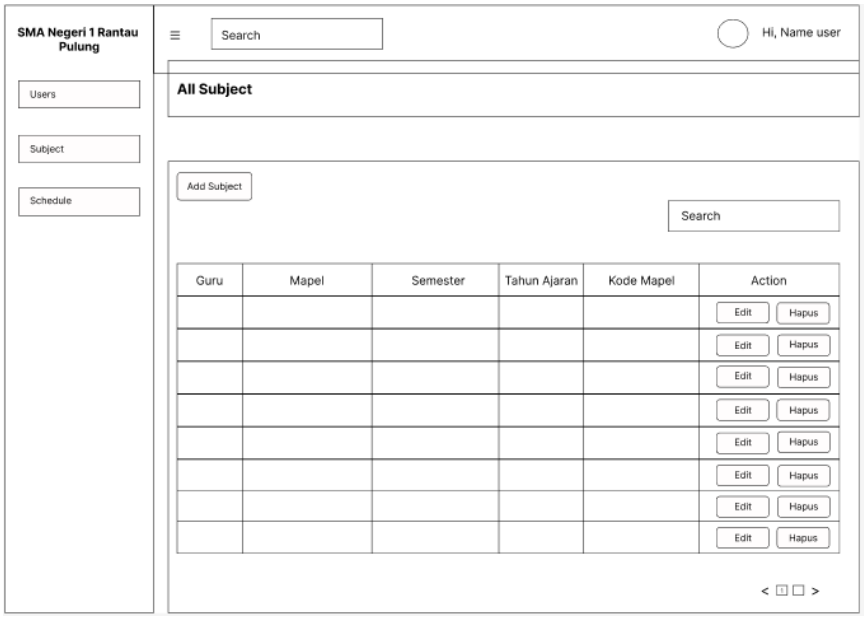

Figure 4. Subject List Page

Edit Subject List page

The design of the edit subject list page is a page used by the admin to change data related to subjects registered in the attendance system (Wenny et al., 2022; Ishaq & Bibi, 2023; Kinoshita et al., 2019). Some of the data that can be changed by the admin on this page are teacher name, subject, semester, school year and subject code. The following is a view of the design of the edit subject list page.

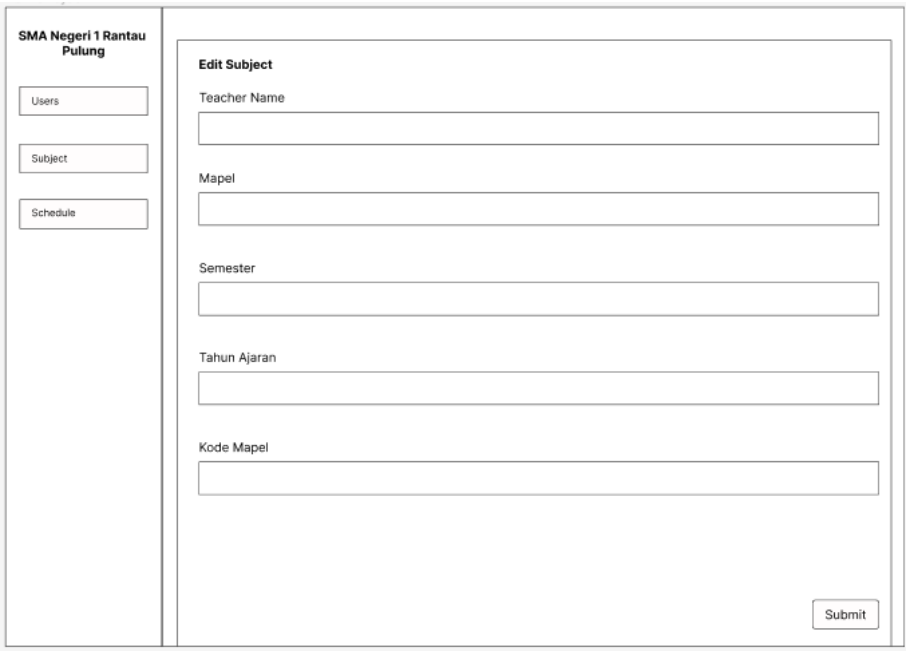

Figure 5. Edit Subject List Page

Schedule List page

The design of the schedule list page is a page design that will be used by the admin to view data related to the schedule of subjects registered in this attendance system. The data that can

ISSN: 2716-3865 (Print), 2721-1290 (Online)

be seen by the admin on this page is the name of the lesson, the day the lesson is held, the time the lesson starts, the time the lesson finishes, and the classroom. Admins can generate qrcodes, as well as change, and delete data related to the subject schedule on this page. The following is a view of the draft subject list page that will be used by the admin.

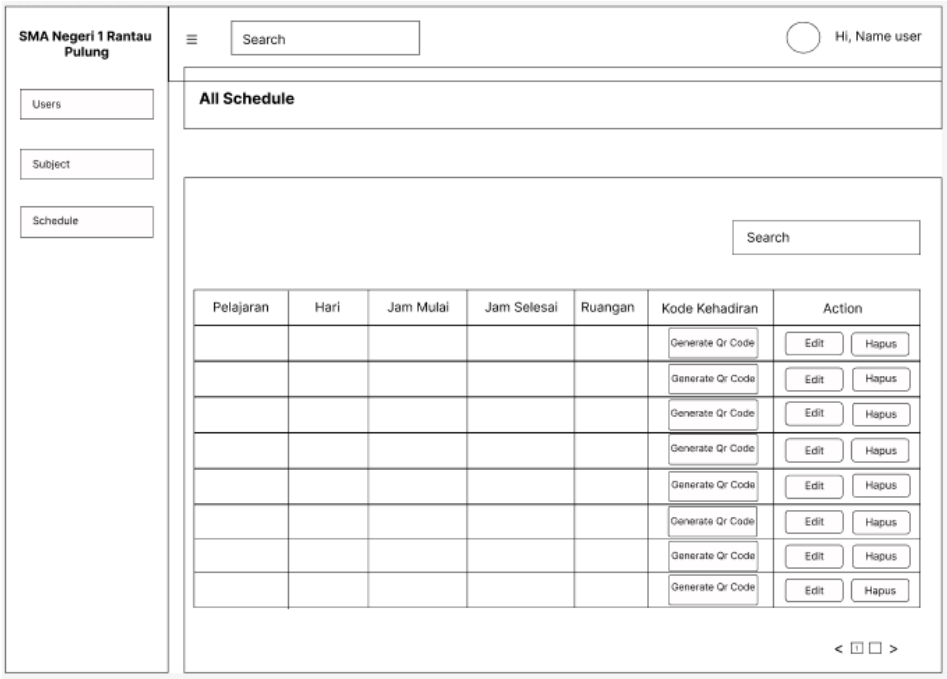

Figure 6. Schedule List Page

Edit Schedule List

The design of the edit schedule list page is a page used by the admin to change data related to the schedule of subjects registered in the attendance system (Najaf et al., 2023; Alpasan et al., 2021). Some of the data that can be changed by the admin on this page are the name of the lesson, lesson day, start time, finish time and room. The following is a view of the design of the edit schedule list page.

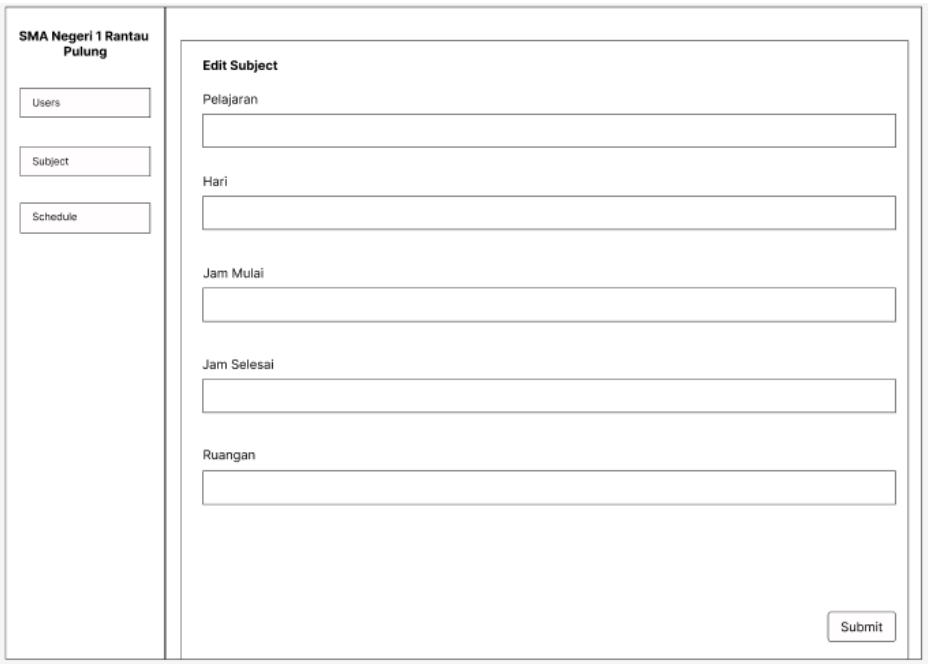

Figure 7. Edit Schedule List

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Generate QrCode

The design of the generate qrcode page is a page used by the admin to generate the attendance qrcode used in the attendance process. Admin generates qrcode by entering the subject code into the form. Here is a view of the design of the generate qrcode page.

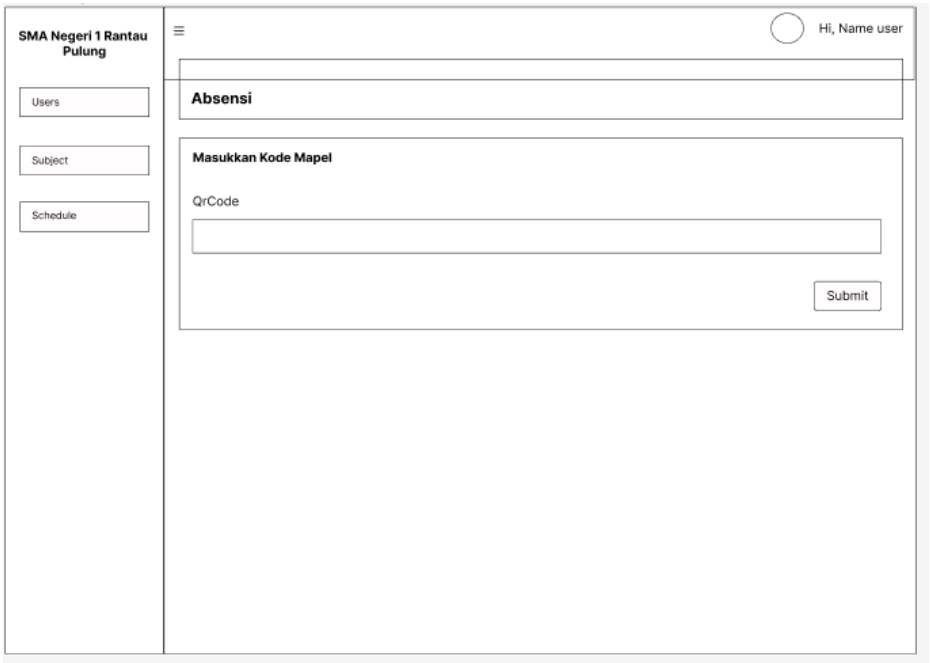

Figure 8. Generate QrCode page

Attendance QrCode Page

The design of the attendance qrcode page is a page that will display the qrcode which is the result of generating the subject code by the admin (Nasution & Hanum, 2022; Liew & Tan, 2021). The qrcode will be used by students to take attendance. The following is a display of the attendance qrcode page that displays a qrcode.

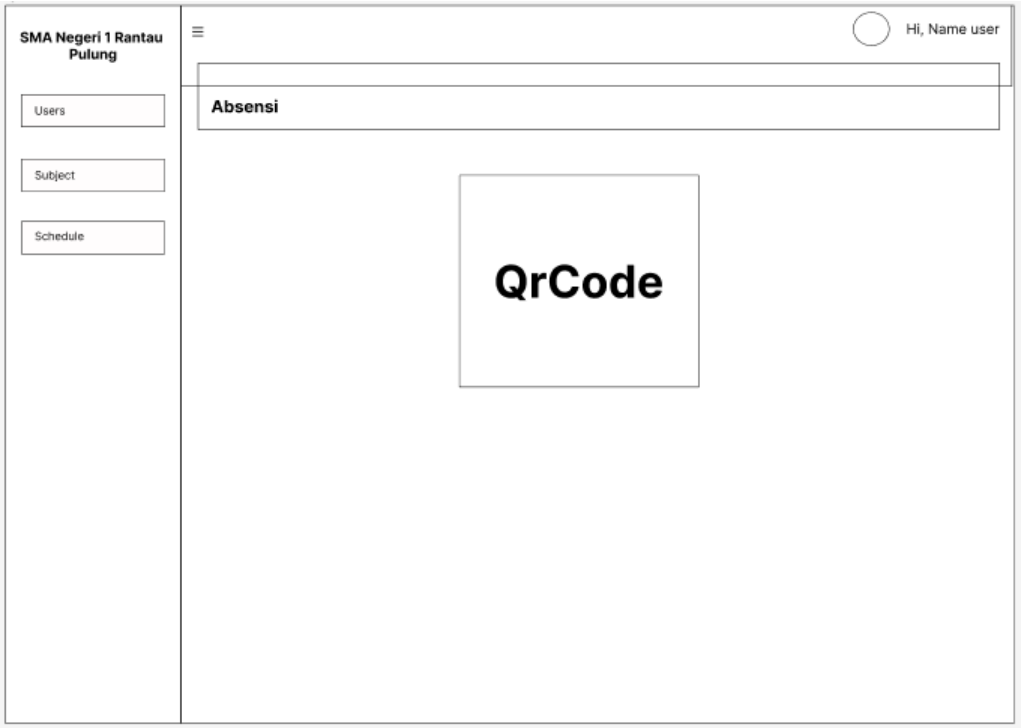

Figure 9. Presence QrCode Page

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Android Mobile User Interface

Android mobile user interface is an interface that is seen by users when accessing the attendance system through the smartphone that the user has.

Login Page Button

The login button page is the first page that will appear when opening the attendance application (Deviana et al., 2021; Noor et al., 2023). This page is used by students who already have an account to enter the next page by clicking login. The following is a view of the login page that has been designed by researchers.

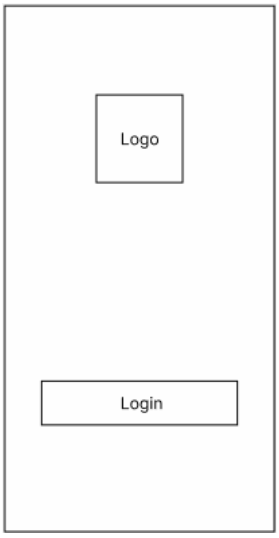

Figure 10. Login Button Page

Student Login Page

The student login page is the page that appears after the user clicks the login button. On this page the user, namely the student, will enter the email and password to be able to access the next page. The following is a view of the teacher and student login pages.

Figure 11. Student Login Page

Student Dashboard Page

The student dashboard page is a page that appears when students successfully login. The following is a design view of the student dashboard page that appears when the student is successfully logged in.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

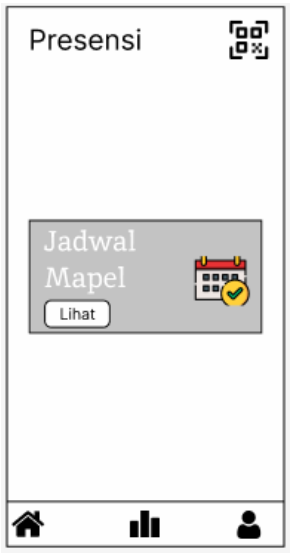

Figure 12. Student Dashboard Page

Student Course Schedule Page

The student mapel schedule page is a page that displays the schedule of subjects owned by the student (Sánchez-Carracedo & López, 2021; Marciniak, 2020). This page appears when the student clicks on the subject schedule on the student dashboard page. The following is a view of the mapel schedule page.

Figure 13. Student Subject Schedule Page

Attendance Scan Page

The attendance scan page is a camera page that will be used to scan the student attendance qrcode. This page appears when students click the icon at the top right. The following is the display of the student attendance scan.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Figure 14. Student Attendance Scan Page

Student Profile Page

The student profile page is a page that displays the profile of the student. This page appears when students click the icon on the bottom right. The following is a view of the design of the student profile page.

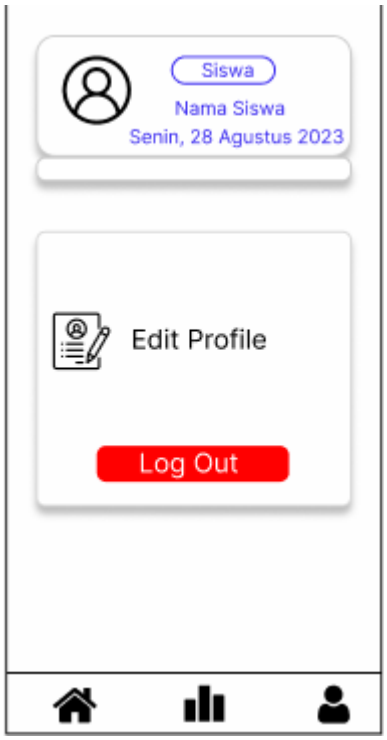

Figure 15. Student Profile Page

Log Out Button

The log out button is a button used by teachers to exit the attendance page and return to the login page. This button is used by teachers when they want to re-login with another account.

Results and Discussion

The prototype of the attendance system in this research was carried out using several tools, namely PHP, Laravel, Dart, and Flutter. The web-based backend and front end parts are made

ISSN: 2716-3865 (Print), 2721-1290 (Online)

using PHP as a programming language and Laravel as a framework that is used to facilitate building the backend and front end of the attendance system. The front end part on the smartphone mobile device is made using dart as a programming language and flutter as a framework that is used to facilitate building the front end of the attendance system. The following are the results of the prototype that has been made.

Web Prototype Results

The following is a prototype of the attendance system that runs on the web. The attendance system on the web is a system used by admins in managing attendance system user data.

Teacher Admin Login

The teacher admin login page on the web is used by the teacher admin to enter the attendance system. After entering the system will display the dashboard page to the admin who logs in.

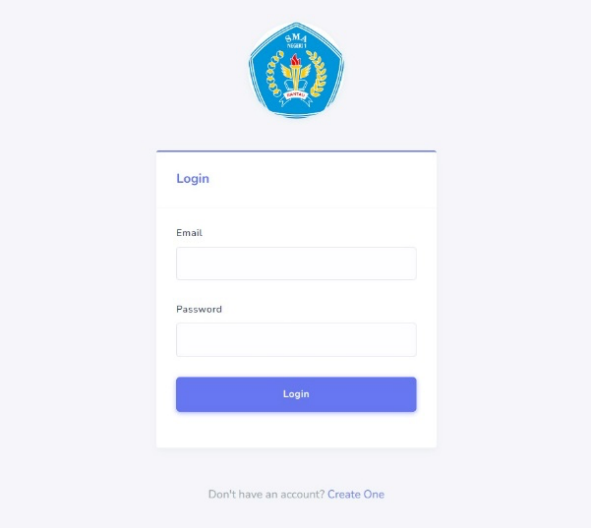

Figure 16. Admin Login Prototype

Teacher Admin Register

The register page is a page used by teacher admins to create an account that will be used to log in. The page is created for teacher admins who do not yet have an account. Teacher admins must have an account to enter the attendance system.

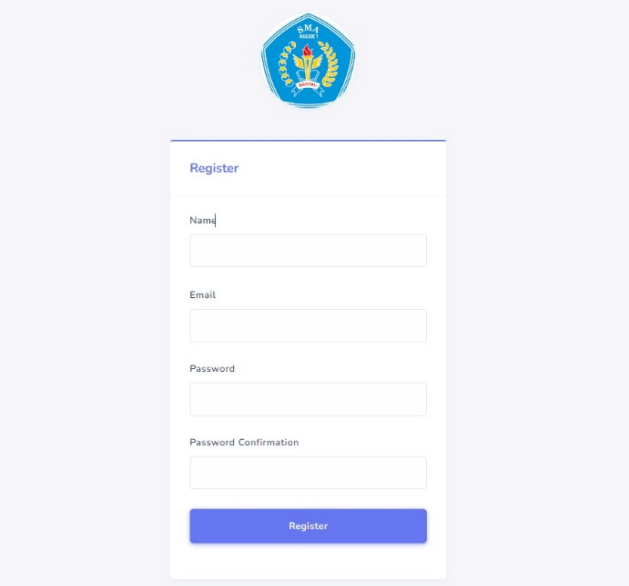

Figure 17. Admin Register Prototype

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Teacher Admin Dashboard

The dashboard page is a page that will appear when the admin successfully logs into the attendance system.

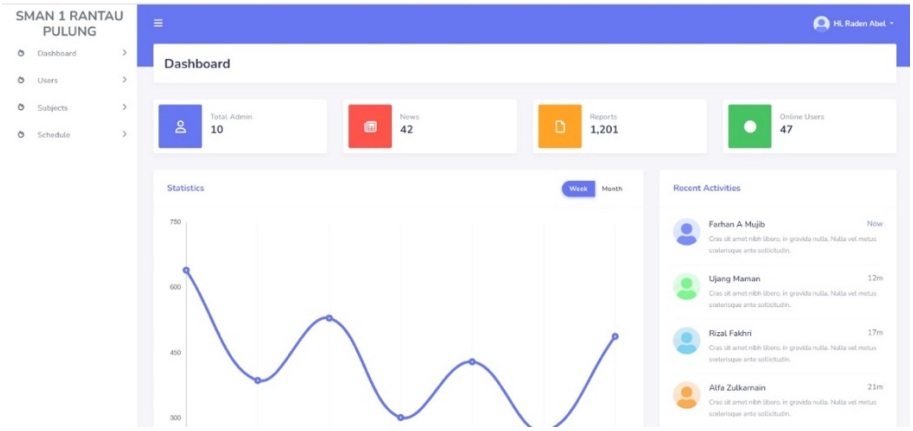

Figure 18. Admin Dashboard Prototype

User List

This is a page that displays all users who have access to the attendance system. Teacher admins can manage user data such as adding, changing, and deleting. The red delete button is an action used when the teacher admin deletes user data.

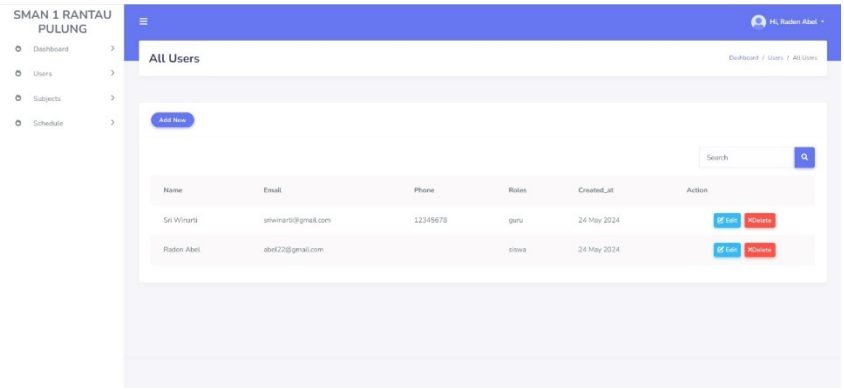

Figure 19. Prototype User List

Add User

The add user page is a page used by the teacher admin to add user data that can access the attendance system. Users access the attendance system through an application on a smartphone.

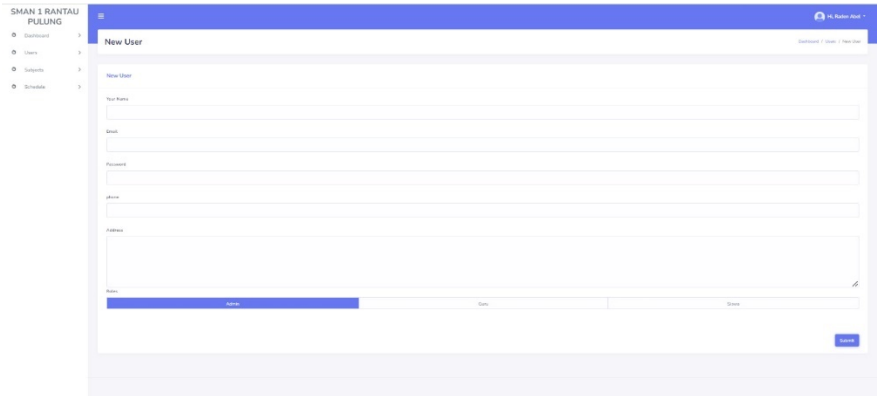

Figure 20. Prototype of Add User Page

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Edit User

The edit user page is a page used by the teacher admin to change user data that has been registered in the attendance system. Teacher admins can change user data for various reasons, one example is if there is a mismatch of user data registered in the attendance system.

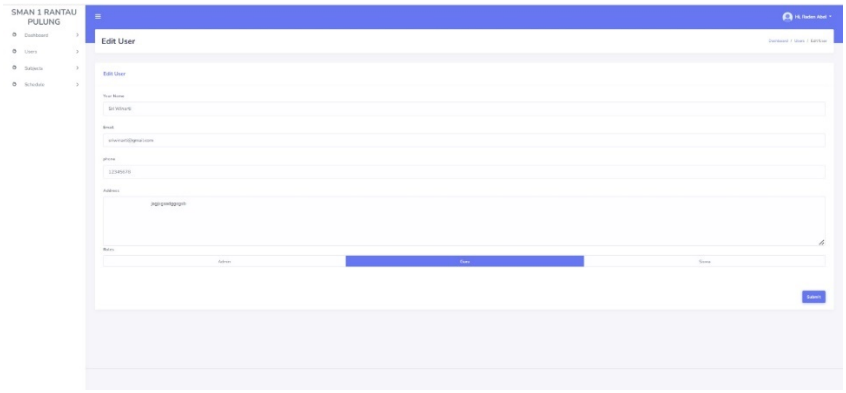

Figure 21. Prototype of User Edit Page

Subject List

The subject list page is a page used by teacher admins to manage subject data contained in the school. Teacher admins can add, delete, and change subject data on that page. just like the user list page, teacher admins can delete subject data using the red delete button.

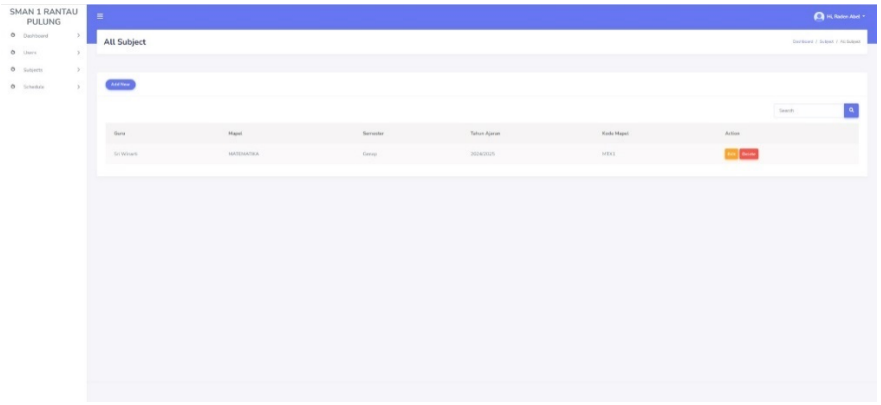

Figure 22. Prototype of Subject List Page

Add Subject List

The add subject list page is a page for adding subject data. The page will display a teacher form whose data comes from user data on the user list page that has a role as a teacher.

Figure 23. Prototype of Add Subject Page

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Edit Subject

The edit subject page is a page used by the admin teacher to change the subject data registered in the attendance system. admin teachers can change subjects using the blue edit button. The button will display the edit subject page to the admin. Inappropriate subject data can be changed on the page.

Figure 24. Prototype of Edit Subject Page

Schedule List

The schedule list page is a page used to manage subject schedule data. On this page the teacher admin can change, delete, and add data related to the subject schedule. Just like the previous two pages, the teacher admin can delete subject schedule data using the red delete button. This page is also used by the teacher admin to generate a presence qrcode that is used by students during class attendance.

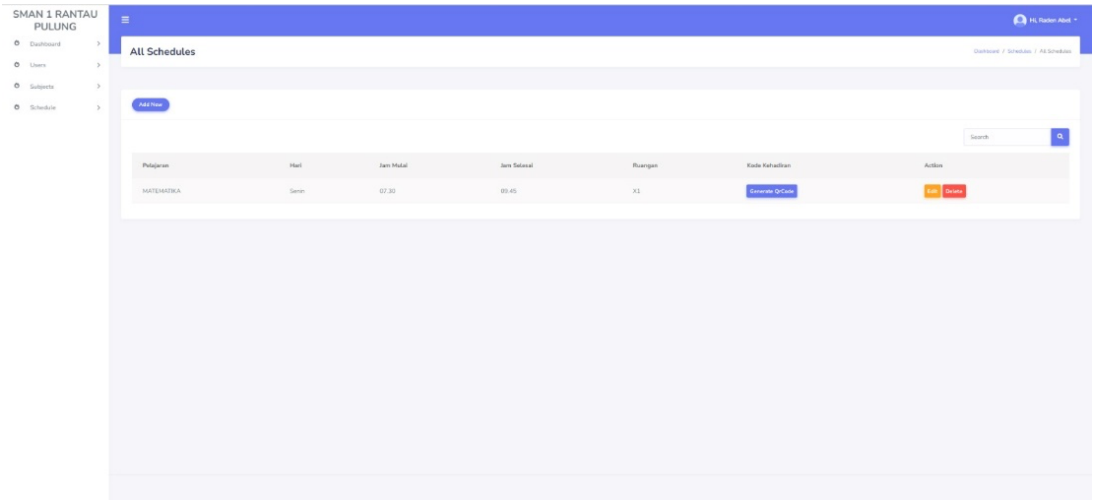

Figure 25. Schedule Page Prototype

Add Schedule

The add schedule page is a page used to add subject schedule data. The lesson data on this page is data that comes from the subject list page.

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Figure 26. Prototype of Add Schedule Page

Edit Schedule

The edit schedule page is a page used to change the subject schedule data that has been stored in the attendance system. The subject schedule data is data that comes from the add schedule page.

Figure 27. Prototype of Schedule Edit Page

Generate QrCode

The generate qrcode page is a page for creating qrcodes used by students during class attendance (Nuhi et al., 2020; Bakar et al., 2021; Wijaya et al., 2022). Teacher admins can create qrcodes by using the blue generate qrcode button. The page will display a page containing the attendance code form. Admin teachers must input the attendance code that has been registered.

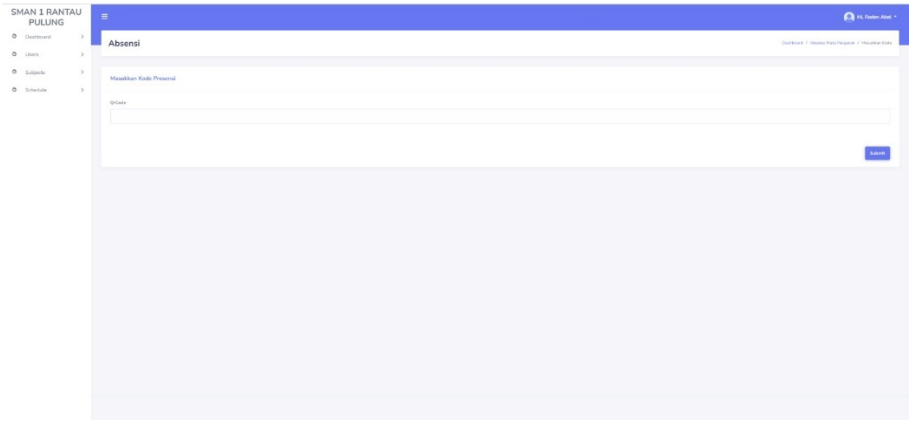

Figure 28. Prototype of Generate QrCode Page

ISSN: 2716-3865 (Print), 2721-1290 (Online)

QrCode page

The qrcode page is a page that displays the qrcode that has been created by the teacher admin on the previous page. The qrcode is used for the presence of students and students who attend SMA Negeri 1 Rantau Pulung.

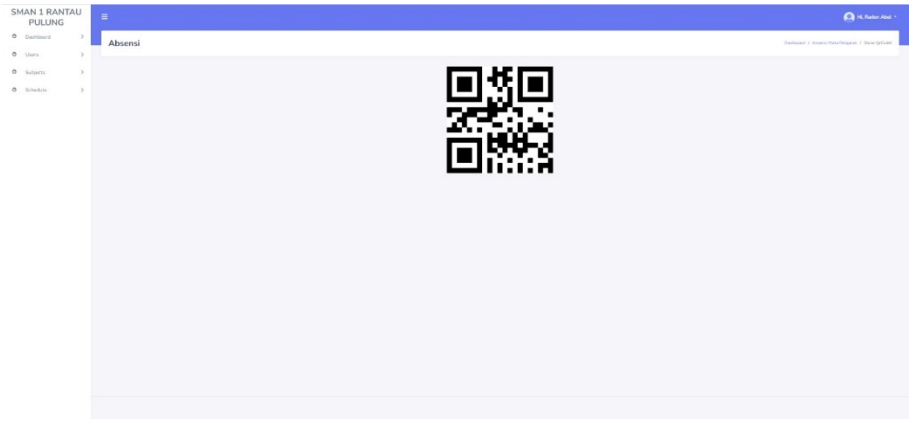

Figure 29. QrCode Page Prototype

Android Mobile Prototype Results

The following is a prototype of the attendance system that runs on the user's mobile android. The attendance system on mobile android is a system used by students to take attendance.

Student Start Screen

The start screen page is the page that first appears when students use this attendance application. This page displays the school logo and a login button that will display the login page when clicked.

Figure 30. Student Start Screen

Student Login

The student login page is a page used by students to enter the main page of this attendance application. Students are required to enter an email and password that has been registered with the system in order to access the main page of the application.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

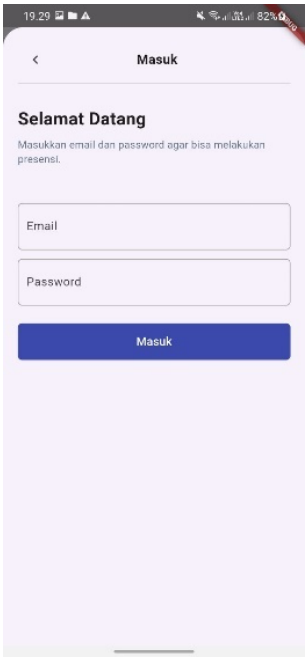

Figure 31. Student Login

App Home Page

The main page of the application is a page that appears when students successfully login and access the attendance application.

Figure 32. Main Page of Attendance Application

Subject Page

The subject page is a page that displays the subject schedule of students who access the attendance application (Nieuwoudt, 2020; Muthuprasad et al., 2021). students can access the page in two ways, namely by clicking see on the student mapel schedule card or by clicking the icon in the middle of the bottom.

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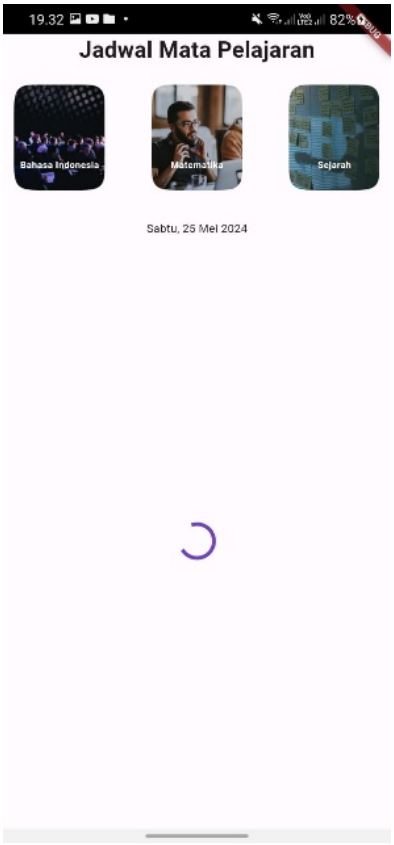

Figure 33. Subject Card

Figure 34. Subject Icon

Attendance Scan Page

The attendance scan page is a page that will display the scan button. This page also displays the name, role, and current time. The stored attendance history will appear on this page.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

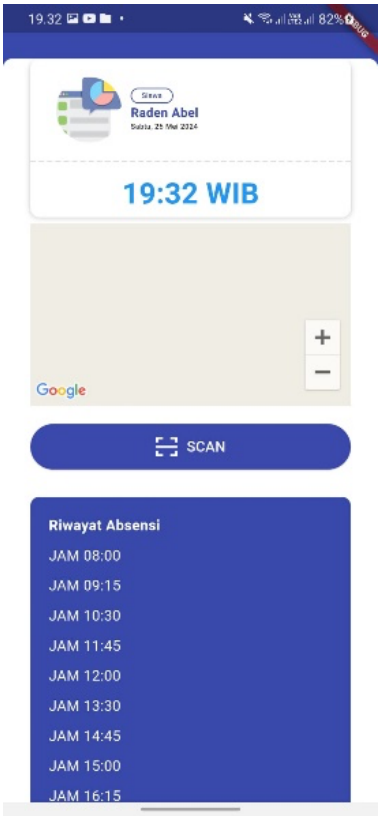

Figure 35. Attendance Scan

Scan QrCode

The qrcode scan page is a page used to scan the qrcode that has been generated by the admin. This page requires camera access permission to run.

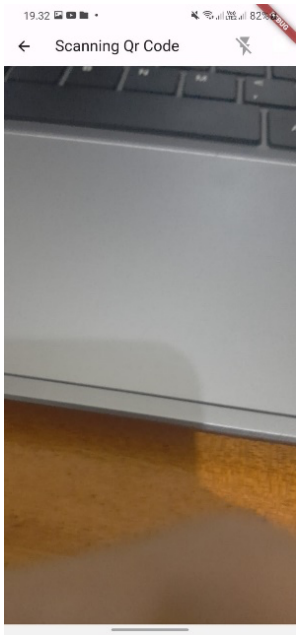

Figure 36. Scan QrCode

Student Profile

The student profile page is a page that displays the identity of the student who is logged in to the attendance application. This page also provides a logout button that is used to exit the application.

ISSN: 2716-3865 (Print), 2721-1290 (Online)

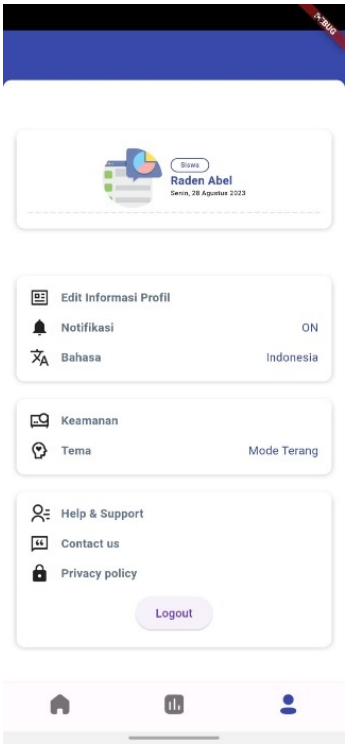

Figure 37. Student Profile

The results of making this attendance system application are in the form of a web based attendance system and an android mobile application. A web based attendance system is a presence system that is used by the admin to manage user data that uses the attendance system (Rahmatulloh et al., 2019; Naen et al., 2021). The web based attendance system can also be used to manage subject data and subject schedules. Admins can create qrcodes that students use for attendance through a system that runs on the web.

Presence application based on mobile android is a presence application that is used by users in the form of students to take attendance (Wiriasto et al., 2020; Andre & Suciadi, 2022). The current results, the attendance application can login using an account that has a student role. The application can also scan qrcodes that have been created by the admin on a web based attendance system. The current android mobile based attendance application can display the location of users who use the attendance system.

At the time of system testing there were still several obstacles that occurred, both on web based systems and android mobile based applications. The web based attendance system still has problems when it wants to display the number of admins registered on the attendance system (Yadav & Bhole, 2019; Nazara & Nasien, 2024). The number of registered admins will be displayed on the dashboard of the attendance system. The web based attendance system also still cannot display photos from the profile of users who access the system. Android mobile based applications in testing still cannot display student subject schedules and cannot display user profiles of students who are logged in to the attendance application.

Conclusion

The conclusion that researchers can draw from this research is that the attendance application that can store student and student attendance data can be built using several tools, namely php, laravel, xampp, mysql, flutter, and dart. The system or attendance application that has been built stores student and student attendance data into the mysql database used by researchers. The results of this study can help teachers and students because the attendance process does not need to use paper and pen anymore, students only need to scan the qrcode that the teacher has generated. The attendance process that was previously carried out manually was

ISSN: 2716-3865 (Print), 2721-1290 (Online)

successfully developed into an automatic attendance process using a web-based attendance system and mobile applications. This also increases digitalization in the school environment which previously still used manual methods to automatically use the attendance system that has been developed at SMA Negeri 1 Rantau Pulung.

References

Allison, M. A., Attisha, E., Lerner, M., De Pinto, C. D., Beers, N. S., Gibson, E. J., ... & Weiss-Harrison, A. (2019). The link between school attendance and good health. *Pediatrics*, *143*(2). https://doi.org/10.1542/peds.2018-3648

Alpasan, B. G. B., Maligang, A. K., & Esimos, M. J. V. (2021). Public High School Web-Based Attendance Monitoring System with SMS Notification. *International Journal of Social Science and Human Research*, *4*, 12. https://doi.org/10.47191/ijsshr/v4-i12-67

Andre, A., & Suciadi, M. F. (2022, April). The online attendance system models for educational institutions. In *AIP Conference Proceedings* (Vol. 2470, No. 1). AIP Publishing. https://doi.org/10.1063/5.0080180

Bakar, S. A., Salleh, S. N. M., Rasidi, A., Tasmin, R., Hamid, N. A. A., Nda, R. M., & Rusuli, M. S. C. (2021). Integrating QR code-based approach to University e-class system for managing student attendance. In *Advances in Computer, Communication and Computational Sciences: Proceedings of IC4S 2019* (pp. 379-387). Springer Singapore. https://doi.org/10.1007/978-981-15-4409-5_34

Chen, T., Peng, L., Jing, B., Wu, C., Yang, J., & Cong, G. (2020). The impact of the COVID-19 pandemic on user experience with online education platforms in China. *Sustainability*, *12*(18), 7329. https://doi.org/10.3390/su12187329

Deviana, H., Laila, E., Darlies, M., & Pratama, D. (2021, February). Designing Student and Lecturer Attendance System Application Using Progressive Web Apps (PWA). In *4th Forum in Research, Science, and Technology (FIRST-T1-T2-2020)* (pp. 563-567). Atlantis Press. https://doi.org/10.2991/ahe.k.210205.094

Elaskari, S., Imran, M., Elaskri, A., & Almasoudi, A. (2021). Using barcode to track student attendance and assets in higher education institutions. *Procedia Computer Science*, *184*, 226-233. https://doi.org/10.1016/j.procs.2021.04.005

Fitriati, F., Rosli, R., & Iksan, Z. H. (2023). Enhancing Prospective Mathematics Teachers' Lesson Planning Skills through Lesson Study within School University Partnership Program. *Journal on Mathematics Education*, *14*(1), 69-84.

Förster, M., Maur, A., Weiser, C., & Winkel, K. (2022). Pre-class video watching fosters achievement and knowledge retention in a flipped classroom. *Computers & Education*, *179*, 104399. https://doi.org/10.1016/j.compedu.2021.104399

Holth, P. (2021). A retrospective 60-year review of Murray Sidman's Tactics of Scientific Research and some of its influence on behavior analysis. *Journal of the Experimental Analysis of Behavior*, *115*(1), 86-101. https://doi.org/10.1002/jeab.645

Indra, E., Yasir, M., Andrian, A., Sitanggang, D., Sihombing, O., Tamba, S. P., & Sagala, E. (2020, June). Design and implementation of student attendance system based on face recognition by Haar-like features methods. In *2020 3rd international conference on mechanical, electronics, computer, and industrial technology (MECnIT)* (pp. 336-342). IEEE. https://doi.org/10.1109/MECnIT48290.2020.9166595

Ishaq, K., & Bibi, S. (2023). IoT based smart attendance system using RFID: A systematic literature review. *arXiv preprint arXiv:2308.02591*. https://doi.org/10.48550/arXiv.2308.02591

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Jabbari, J., & Johnson Jr, O. (2023). The collateral damage of in-school suspensions: A counterfactual analysis of high-suspension schools, math achievement and college attendance. *Urban Education*, *58*(5), 801-837. https://doi.org/10.1177/0042085920902256

Kinoshita, S., Niibori, M., & Kamada, M. (2019). An attendance management system capable of mapping participants onto the seat map. In *Advances in Network-Based Information Systems: The 21st International Conference on Network-Based Information Systems (NBiS-2018)* (pp. 897-902). Springer International Publishing. https://doi.org/10.1007/978-3-319-98530-5_80

Liew, K. J., & Tan, T. H. (2021, September). QR code-based student attendance system. In *2021 2nd Asia Conference on Computers and Communications (ACCC)* (pp. 10-14). IEEE. https://doi.org/10.1109/ACCC54619.2021.00009

Marciniak, M. A. (2020). Mentoring STEM undergraduate research projects in a large community college. *Primus*, *30*(7), 777-789. https://doi.org/10.1080/10511970.2019.1639227

Munthe, B., Arifin, A., Nugroho, B. S., & Fitriani, E. (2021, June). Online student attendance system using android. In *Journal of Physics: Conference Series* (Vol. 1933, No. 1, p. 012048). IOP Publishing. https://doi.org/10.1088/1742-6596/1933/1/012048

Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID-19 pandemic. *Social sciences & humanities open*, *3*(1), 100101. https://doi.org/10.1016/j.ssaho.2020.100101

Nadhan, A. S., Tukkoji, C., Shyamala, B., Dayanand Lal, N., Sanjeev Kumar, A. N., Mohan Gowda, V., ... & Endaweke, M. (2022). Smart attendance monitoring technology for industry 4.0. *Journal of Nanomaterials*, *2022*(1), 4899768. https://doi.org/10.1155/2022/4899768

Naen, M. F., Adnan, M. H. M., Yazi, N. A., & Nee, C. K. (2021). Development of attendance monitoring system with artificial intelligence optimization in cloud. *International Journal of Artificial Intelligence*, *8*(2), 88-98. https://doi.org/10.36079/lamintang.ijai-0802.315

Najaf, A. R. E., Alexander, J. D., Tarmidzi, K., & Kurnia, F. (2023). Designing a Web-Based Elementary School Attendance System Using the Laravel Framework. *RIGGS: Journal of Artificial Intelligence and Digital Business*, *1*(2), 64-68. https://doi.org/10.31004/riggs.v1i2.116

Nasution, M. F. A., & Hanum, L. (2022). Meeting Attendance Design Using Web-Based Qrcode On Diskominfo Kota Tebing Tinggi. *Journal of Information Systems and Technology Research*, *1*(2), 58-67. https://doi.org/10.55537/jistr.v1i2.122

Naz, Z. (2023). Recapitulation, Implications and Recommendations. In *Politics of Quality Improvement in English Further Education: Policies and Practices* (pp. 193-206). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-24008-9_10

Nazara, E. M., & Nasien, D. (2024). Employee Attendance System Using Rapid Application Development Method Based on Location Based Service. *Journal of Applied Business and Technology*, *5*(2), 96-104. https://doi.org/10.35145/jabt.v5i2.148

Nieuwoudt, J. E. (2020). Investigating synchronous and asynchronous class attendance as predictors of academic success in online education. *Australasian journal of educational technology*, *36*(3), 15-25. https://doi.org/10.14742/ajet.5137

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Noor, M. F. A. M., Ibrahim, A. F., & Jamaluddin, M. N. F. (2023). Development of Employee Attendance Management System using Flutter. *Journal of Computing Research and Innovation*, *8*(2), 178-188. https://doi.org/10.24191/jcrinn.v8i2.369

Nuhi, A., Memeti, A., Imeri, F., & Cico, B. (2020, June). Smart attendance system using qr code. In *2020 9th mediterranean conference on embedded computing (MECO)* (pp. 1-4). IEEE. https://doi.org/10.1109/MECO49872.2020.9134225

Pei, Z., Xu, H., Zhang, Y., Guo, M., & Yang, Y. H. (2019). Face recognition via deep learning using data augmentation based on orthogonal experiments. *Electronics*, *8*(10), 1088. https://doi.org/10.3390/electronics8101088

Rahmatulloh, A., Gunawan, R., & Darmawan, I. (2019, March). Web services to overcome interoperability in fingerprint-based attendance system. In *2018 International Conference on Industrial Enterprise and System Engineering (IcoIESE 2018)* (pp. 277-282). Atlantis Press. https://doi.org/10.2991/icoiese-18.2019.49

Reyes, A. (2020). Compulsory school attendance: The new American crime. *Education Sciences*, *10*(3), 75. https://doi.org/10.3390/educsci10030075

Ridwan, M., Setiawan, E., Putra, M. F. P., Gazali, N., Bjelica, B., Karami, A., ... & Kurtoğlu, A. (2023). Mapping Research on Learning Media in Physical Education: Bibliometric Analysis of Past Findings and Future Research Agenda. *Revista iberoamericana de psicología del ejercicio y el deporte*, *18*(5), 572-579.

Sánchez-Carracedo, F., & López, D. (2021). A service-learning based computers reuse program. *Sustainability*, *13*(14), 7785. https://doi.org/10.3390/su13147785

Sawhney, S., Kacker, K., Jain, S., Singh, S. N., & Garg, R. (2019, January). Real-time smart attendance system using face recognition techniques. In *2019 9th international conference on cloud computing, data science & engineering (Confluence)* (pp. 522-525). IEEE. https://doi.org/10.1109/CONFLUENCE.2019.8776934

Sukowati, P., Ngarawula, B., & Lung, F. S. (2019). Commitment to care CSR more than mining in the activities of mineral and coal mining industry in Indonesia. *International Journal of Recent Technology and Engineering (IJRTE)*, *8*(2).

Tamilkodi, R. (2021). Automation system software assisting educational institutes for attendance, fee dues, report generation through email and mobile phone using face recognition. *Wireless Personal Communications*, *119*(2), 1093-1110. https://doi.org/10.1007/s11277-021-08252-2

Taylor, H., Van Rooy, D., & Bartels, L. (2023). Digital justice: a rapid evidence assessment of the use of mobile technology for offender behavioural change. *Probation Journal*, *70*(1), 31-51. https://doi.org/10.1177/02645505211065694

Wenny, T. N., Suhartono, S., & Parenreng, J. M. (2022). Development of Lecture Attendance System Using QR Code in Information and Computer Engineering Education Study Program of Universitas Negeri Makassar. *Elinvo (Electronics, Informatics, and Vocational Education)*, *7*(1), 19-26. http://dx.doi.org/10.21831/elinvo.v7i1.47865

Wijaya, R., Kristianto, S., Hasibuan, Y. B., & Alexander, I. (2022, October). Contactless Student Attendance System Using BLE Technology, QR-Code, and Android. In *Conference on Innovative Technologies in Intelligent Systems and Industrial Applications* (pp. 527-537). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-29078-7_46

Wiriasto, G. W., Aji, R. W. S., & Budiman, D. F. (2020, October). Design and development of attendance system application using android-based flutter. In *2020 Third International*

ISSN: 2716-3865 (Print), 2721-1290 (Online)

Conference on Vocational Education and Electrical Engineering (ICVEE) (pp. 1-6). IEEE. https://doi.org/10.1109/ICVEE50212.2020.9243190

Yadav, V., & Bhole, G. P. (2019, February). Cloud based smart attendance system for educational institutions. In *2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon)* (pp. 97-102). IEEE. https://doi.org/10.1109/COMITCon.2019.8862182

Yayla, A., Korkmaz, H., Buldu, A., & Sarikas, A. (2021). Development of a remote laboratory for an electronic circuit design and analysis course with increased accessibility by using speech recognition technology. *Computer Applications in Engineering Education*, *29*(4), 897-910. https://doi.org/10.1002/cae.22340

ISSN: 2716-3865 (Print), 2721-1290 (Online)