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Implementation of NodeMCU ESP8266 Microcontroller for Teacher Attendance System at SMK Swasta Pemda Rantauprapat

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Abstract

NodeMCU is an open source IoT platform, NodeMCU ESP8266 can be used for Internet of Things (IOT) because the facilities are equipped with Wi-Fi, RFID is a process of identifying objects or objects using radio frequency, this device is widely sold in stores online at a very low price. The type of research used in this research is qualitative research, while the data collection method used is observation andto study, the design method uses the method postage type. This system tests every piece of hardware used and tests the software from a specific functional perspective. The result of this study is the teacher attendance system using Microcontroller NodeMCU ESP8266 replace the manual attendance recording model in the attendance book by writing the entry and rturn hours and filling in the teacher's signature with id card attached to the device RFID connected to microcontroller NodeMCU ESP8266. Thus, reducing the occurrence human error when recap attendance, and reduce paper use.

1. INTRODUCTION

RFID (Radio Frequency Identification) was developed as a new technology that makes it easier for people to identify various things, one of which is to use it as a teacher attendance system. The reason for choosing the RFID sensor as an identification tool is because it has several advantages, namely the data reading speed of 0.5 seconds and human error rarely occurs. The data read by the RFID sensor will be sent to the website via the NodeMCU ESP8266 microcontroller.

NodeMCU is a microcontroller that has a versatile wifi module because it is equipped with GPIO, ADC, UART and PWM, and this device also has an affordable price that is cheaper so it is suitable for users who have a small budget but still want to give good results. for data display can also be seen on a website specifically designed for the attendance system that was built.

NodeMCU ESP8266 functions as a client and also as a controller for presence data that is processed by the RFID-RC522 sensor. NodeMCU ESP8266 will receive input from the sensor to control the attendance data input and send presence condition data to the server and receive data from the server to determine whether the input attendance results are successful or fail to be input into the presence application, the website will include recording and reporting of attendance Teacher. Attendance systems that utilize technology have been widely used in SMK schools in Labuhanbatu because technology can facilitate work and increase more accurate data compared to manual.

However, regarding the issue of teacher absenteeism at Vocational High Schools (SMK), especially at the Rantauprapat Regional Government Private Vocational School which is located on Jl. K.H Dewantara No. 104 Rantauprapat, taking teacher attendance is currently felt to be ineffective and often makes it difficult for teachers to take attendance every day. Taking attendance is still done in a manual way, without utilizing information and communication technology, the manual attendance process is still used for all teachers & employees who work at the Rantauprapat Regional Government Private Vocational School.

The manual attendance process is carried out by the teacher filling out and signing on the attendance paper sheet given by the picket officer, then returning it to the picket officer. Manual attendance has various drawbacks such as requiring a lot of paper and ink, requiring a lot of space for storage and frequent human errors when recapping attendance data, frequent manipulation of attendance data by the teacher such as accelerated entry times, so the report that will be received by the principal is very messy and does not match the facts that occur in the field. Based on the above problems, the authors want to develop an existing attendance system at Rantauprapat Regional Government Private Vocational Schools with the title "Implementation of the NodeMcu ESP8266 Microcontroller for the Teacher Attendance System at Rantauprapat Regional Government Private Vocational Schools" in order to improve the teacher attendance system for the better and make it easier for teachers to take attendance by how to scan a teacher's tag card that will be distributed to each teacher and school employee, so that data will be saved automatically to the server according to the time when the card was scanned, and using this device can save costs because the price is very cheap and can increase order in attendance teacher and school facilities to make attendance reports.

2.1. Supporting Theory

a. Microcontroller

Mirocontroller is a microprocessor system in which there is a CPU (Central Processing Unit), RAM (Random Access Memory), ROM (Read Only Memory), input-output ports (I/O interface), timer, which are interconnected so that the microprocessor is able to work various applications, where the contents of this microprocessor are packaged properly in one ready-to-use chip. The microcontroller can be directly programmed with the contents of the ROM according to the rules for use by the manufacturer [1]. Other studies have concluded that a microcontroller is a digital electronic device that has controls where there are inputs and outputs that are controlled by a program that can be written and deleted in a special way [2]. The NodeMcu ESP8266 microcontroller has been integrated with various features, this board is equipped with WiFi features and opensource firmware, as well as a communication chip in the form of USB to serial. So that in programming only requires a USB data cable.

b. Understanding System

The system is a number of parts and elements that are collected and combined with each other, the combined components work to produce a certain goal [3]. The purpose of system design is to provide an overview of the system to be created and to design a complete structure for the programmers and other supporters involved, forming a system so that it can be accepted by both users and system operators. to satisfy a need for system users.

c. Understanding System

Absence is a document that records the attendance time of each teacher at school, this teacher attendance record can be in the form of an ordinary attendance list, it can also be in the form of an attendance card filled in with a time recording machine. Time keeping can be divided into two parts, namely attendance time keeping and shop time keeping. Absence is a process of recording attendance when visiting a company, school, and other offices. The presence of the teacher in teaching and learning activities at school is a component that needs to be considered in every school, because a teacher will be the main benchmark for the teaching and learning process to run every day.

Private Vocational High Schools (SMK) Pemda Rantauprapat have a teacher attendance system, this system records teacher attendance by filling in names and hours of entry using a manual method with paper media as a place for attendance data, using this manual system is considered inaccurate because many teachers those who fill in the attendance list do not match the hours when they are present at school, the attendance data also looks very untidy and is sure to make it difficult to make attendance reports for the school principal.

2.2. Company Overview

2.2.1. History of Private Vocational Schools of the Regional Government of Rantauprapat

Rantauprapat Regional Government Private Vocational School was founded in 1971 located on Jl. K.H Dewantara No. 104 Rantauprapat and inaugurated by Mr. Iwan Maksum. At that time, Mr. Ir. Iwan Rifai Alam. At that time the department at the school was only Mechanical and Building Engineering, with only 6 rooms for study, 1 teacher's room, 1 Administration/Principal room and 2 rooms for practice consisting of Mechanical and Building Engineering. Ended the position of Mr. Ir. Iwan Rifai in 1985 was replaced by Mr. Maksum, BSc. Mr. Maksum added another department. His major was Electrical Power Installation Engineering after Mr. Maksum, BSc finished his position in 1998 then was replaced by Mr. Raja Alam, B.A, from 1998 to 2000 and after leaving office was replaced by Mr. Drs. Amrah Uther. However Mr. Drs. Amrah Uther did not take office for long and was replaced by Drs. Syahban Parinduri from 2002 to 2006, not long after the principal's seat was replaced by Mr. Waluyo S.Pd. Added 2 majors, namely Light Vehicle Engineering and Computer and Network Engineering during the tenure of Mr. Waluyo S.Pd. only until 2010. After that he was replaced by Mr. Edi Tua, S.Pd, here Mr. Edi Tua, S.Pd created a new department, namely Motorcycle Engineering. Then in 2016, Mr. Aprianto, S.Pd., M.M. until 2019. In 2020, Drs. Khairul Akbar and in 2021 who will become the Principal of the School, Mr. Drs. Bahder Johan Lumban Gaol to date. Currently there are 24 rooms for study, 6 workshop rooms consisting of Machining Engineering (TP), Computer and Network Engineering (TKJ), Simulation and Digital Communication Laboratory (SIMDIG), Motorcycle Engineering and Business (T&BSM), Engineering Electric Power Installation (TITL) and Automotive Light Vehicle Engineering (TKRO), 1 library, 1 teacher's room, 1 administration/principal and 1 Hall room and 1 Mushollah. At this time the area of the school is 6449 M2.

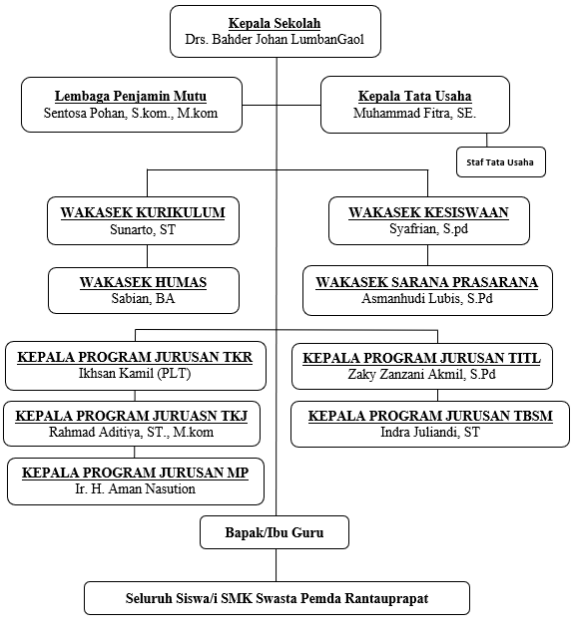


Figure 2.1 Organizational structure of SMK Swasta Pemda Rantauprapat

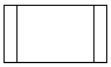
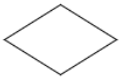
2.3. System Planning

a. System Flowcharts

A flowchart is a graphic sketch showing the sequence and procedure steps of a program graphically. Flowcharts usually make it easier to solve a problem such as a problem that needs to be evaluated and studied further, flowcharts help analysis to solve problems into smaller segments. Examples such as existing processes in an organization that has a series of repetitive activities. each change of activity will be broken down into a number of small steps, from these steps, we can look for which steps can be improved (improved). The steps mentioned above will be easier to understand if we describe them in a section which we usually call a flowchart [4]. The program flowchart describes a sequence of instructions with certain

symbols to help programmers solve problems in a program. The following is a flowchart symbol that can be seen in table 2.1.

Table 2.1 Flowchart symbols

SIMBOL	NAMA	FUNGSI
	TERMINATOR	Permulaan/akhir program
	GARIS ALIR (FLOW LINE)	Arah aliran program
	PREPARATION	Proses inisialisasi/pemberian harga awal
	PROCESS	Proses perhitungan/proses pengolahan data
	INPUT/OUTPUT DATA	Proses input/output data parameter, informasi
	PREDEFINED PROCESS (SUB PROGRAM	Permulaan sub program/proses menjalankan sub program
	DECISION	Perbandingan pernyataan, penyeleksian data yang memberikan pilihan untuk langkah selanjutnya

2.4. Programming Used

a. Programming PHP (PHP Hypertext Preprocessor)

PHP programming is a scripting language that integrates with HTML (HyperText Markup Language) which will run on the server side. This means that all the syntax that we will provide will be fully executed on the server, and only the results will be sent to the browser [5]. To use this program, you must understand that this program is not an independent program because you have to activate the program that created it when you want to run the program that was created, examples of programs namely, PHP, java, these programs run under the browser page. There are also examples of opening and closing PHP programming programs, which can be seen in table 2.2.

Table 2.2Opening and closing of PHP programs

Awal	Akhir
<?	?>
<?php	?>
<script language="php">	</script>
<%	%>

b. Arduino programming

Arduino is an open source aimed at anyone who wants to make prototypes of interactive electronic equipment based on flexible and easy-to-use hardware and software. The microcontroller is programmed using the Arduino programming language which has syntax similarities to the C++ programming language [6]. The Arduino programming language is slightly different and also has its own characteristics. There are three main parts that make up the Arduino programming language, namely function, value, and structure.

1. Function

Functions are used to control the Arduino board, with functions we can analyze characters, perform mathematical operations, and other things.

2. Values

Values will represent constants and variables, data types that can be used such as Boolean, char, array, float, and others similar to C++ programming.

3. Structure

Structure is part of the Arduino language that contains code elements, such as operators.

2. RESEARCH METHOD

a. NodeMCU ESP8266

NodeMCU is an open source IoT platform. It is a hardware device in the form of a System On Chip ESP8266 made by Espressif System NodeMCU8266 which can be seen as shown in Figure 2.1.

Figure 2.5 NodeMCU ESP8266

NodeMCU ESP8266 is a chip that features Wifi 2.4GHz and bluetooth which has a design size of 40mm which has been designed for the best power performance radio power that has robustness and reliability and can be versatile for various applications and power scenarios.

This microcontroller supports creating Internet Of Things application systems, because this microcontroller has provided a wifi module in the microcontroller chip. Seen in the picture above there are various kinds of pins from the ESP8266. These pins can be used as input or output to turn on lights, LCD, and even to drive DC motors. It can be concluded that this microcontroller is a component that provides several functions that most microcontrollers have, the advantage is that you can already have wifi and Bluetooth modules on this device, so you don't need to add external components anymore to carry out the development of Internet of Things projects [7].

b. RFID RC522 + TAG (ID CARD)

The rapid development of technology today provides many enormous benefits. This built system introduces wireless technology which is very well known as RFID, where the meaning of RFID itself is the process of identifying a person or object using radio transmission frequencies. To read information from a small device called a tag or transponder (Transmitter + Responder) RFID uses radio frequency, where later the RFID tag will recognize itself when it detects a signal from a compatible device, namely an RFID reader or RFID Reader [8].

RFID is a sensing system device that uses sensors to detect radio frequency identification is a technology based on wireless and Non-Line of Sight (NLOS) to retrieve information, the concept of how radio waves work on RFID is able to collect information from transponders (tags) to RFID readers, The advantages of this technology can make it easier for the teacher attendance system to be implemented in this system. RFID + Tag technology can be seen in Figure 2.5.

Figure 2.7 RFID RC522 + ID Tag

c. Jumper Cables Female to female

Jumper cables are cables that are used to connect between components used in making prototype devices, according to needs jumper cables can be used in various versions, jumper cables can be connected to microcontrollers such as NodeMCU. The characteristics of this jumper cable have a length of 10 to 20 cm. In designing an electronic circuit design, a cable is needed to connect it, this jumper cable is really needed in this research. The following is the shape of the jumper cables in Figure 2.6.

Figure 2.8 Jumper cable

d. Software Arduino IDE

Arduino IDE (Integrated Development Environment) is software used to create, edit program code, and upload program code to Arduino. Arduino has its own programming language, the program code used in the Arduino programming process can be referred to as the Arduino sketch or commonly referred to as the Arduino source code. The extension used as the Arduino source code file is "ino" [9]. Arduino itself is the easiest embedded system development tool in the world, for example various program code examples have been provided for use by users to learn advanced programming [10].

e. Sublime Text 3

Sublime Text 3 is a text editor based on Python, a text editor that has many features that make it easier for programmers to type every line of program code, has an elegant appearance, and is quite popular among developers [11]. According to Supono and Putratama (2016:14) "Sublime Text is a text editor software used to create or edit applications". So sublime text is a text editor application for writing program code and text that can run on various operating system platforms that use Python API technology which has been updated to python 3.8 [12].

f. Database MySQL

XAMPP is an Apache web server software that has been integrated with PHPMyAdmin and MySQL, XAMPP acts as a web server on a local computer, and can also be called a Cpanel virtual server that can help modify websites without having internet access, XAMPP can be installed on various types of OS (Operating System), Apache Server, PhpMyAdmin, MySQL, and Python [13].

When XAMPP is run there are several programs running for data storage needs including the following.

1. PhpMyAdmin

   PhpMyAdmin is a PHP programming language web application through an interface that makes it easy to do database processing and has a more attractive appearance. This application supports HTML, CSS, and JavaScript programming languages. PhpMyAdmin is also used to handle administration in MySQL or to create a database, it can also be called MySQL with an interface [14].

2. MySQL

MySQL has an abbreviation of My Structured Query Language which has the intention of being a program that runs as a server and provides access to a number of databases that are multithreaded, or multiuser [15].

3. RESULT AND DISCUSSION

1. Input Planning

In designing the input for this system, a series of devices is needed to build an attendance system using the NodeMcu ESP8266. The following is a series of attendance systems using the NodeMcu ESP8266 which can be seen in Figure 3.3.

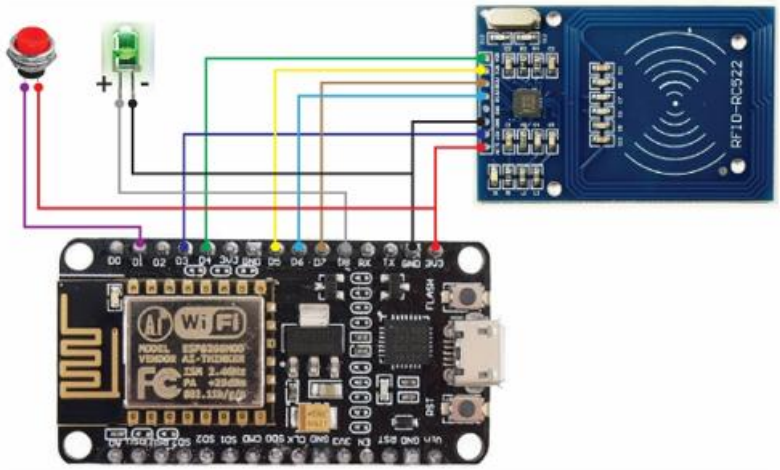


Figure 2.8 Jumper cable

Table 3.6 Connection of RFID pins to NodeMCU ESP8266

RFID-RC522	*NodeMCU ESP8266*
3.3 V	3.3 V
RST	D3
GND	GND
MI	D6
MOSI	D7
SCK	D5
SDA	D4
IRQ	Not in use

Table 3.7 push button connection to NodeMCU ESP8266

Push Button	*NodeMCU ESP8266*
Pin 1	3.3 V
Pin2	D1

Table 3.8 Connection of LEDs to NodeMCU ESP8266

LED	*NodeMCU ESP8266*
Positive pins (+)	D8
Negative pins (-)	GND

2. Display Program

This research will discuss the implementation of the teacher attendance system using the NodeMcuESP8266 microcontroller at Rantauprapat Regional Government Private Vocational Schools. The following is a series of teacher attendance system tools using the NodeMcu ESP8266 and RFID RC522 which can be seen in Figure 4.9.

Figure 3.3 Series of teacher attendance system

a. Input display for adding teacher data

The "Teacher Data" menu has a button to input teacher data into the database so you can record attendance with an ID card tag. The following is the input display for adding teacher data, which can be seen in Figure 4.10.

Figure 4.10 Display of added teacher data

b. Display the data input form that will be stored in the database

The teacher data input form for filling in the card number will be scanned on the card on the attendance device, the name and position will be filled in manually according to the existing teacher data, then stored in the teacher attendance database. The following displays the teacher data input form which can be seen in Figure 4.11.

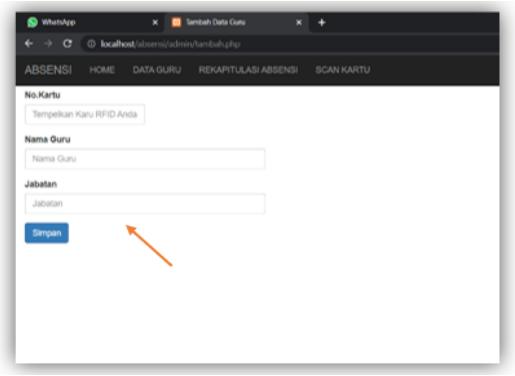


Figure 4.11 Display of input form for adding teacher data

c. Card number input display by scanning the card on the device

Scan the card to get the card number which will be stored in the database by pasting the card on the teacher attendance device and the card number will appear on the website form for inputting teacher data. The following is a scanned display of the ID card tag, which can be seen in Figure 4.12.

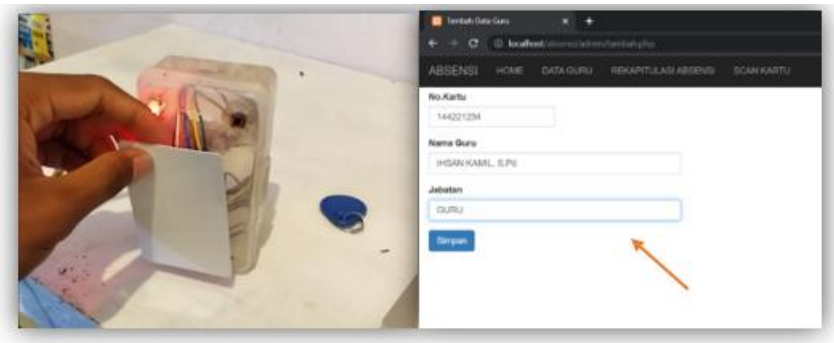


Figure 4.12 Input display with card scan on device

d. Display of techer data that has been registered

Registered data will appear in the attendance system. The following shows the teacher data that has been registered into the system can be seen in Figure 4.14.

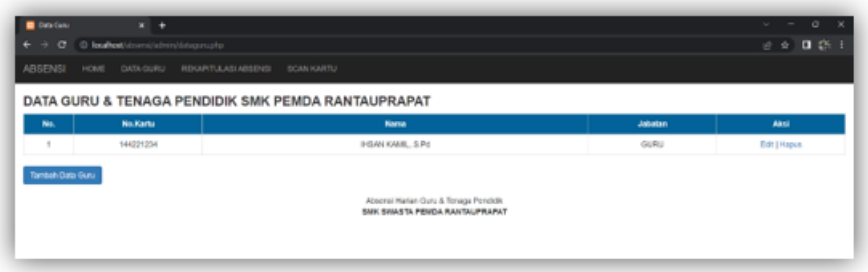


Figure 4.14 Display of registered teacher data

e. Attendance taking display

Taking attendance using a card that has been registered into the system. The following is a scanned display of the attendance card for the teacher absentee system for private vocational schools in the regional government of Rantauprapat, which can be seen in Figure 4.15.

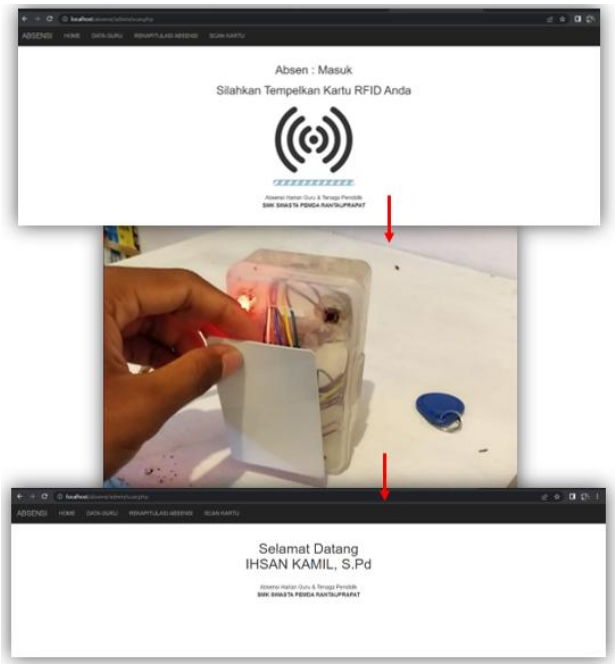


Figure 4.15 View of taking attendance

Display of taking attendance home with the same card. The following display for taking home attendance can be seen in Figure 4.16.

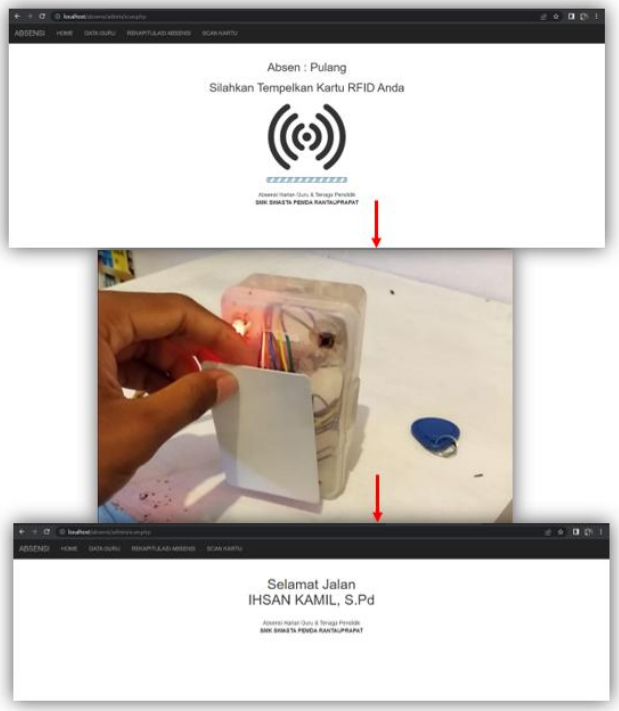


Figure 4.16 View of taking attendance home

f. Absence recapitulation display

The results of the attendance record through scanning the card when entering and returning the data will be entered into the "absence summary" menu which displays data and the time when attendance was taken by the regional government vocational school teacher rantauprapat. The following display of attendance recapitulation can be seen in Figure 4.17.

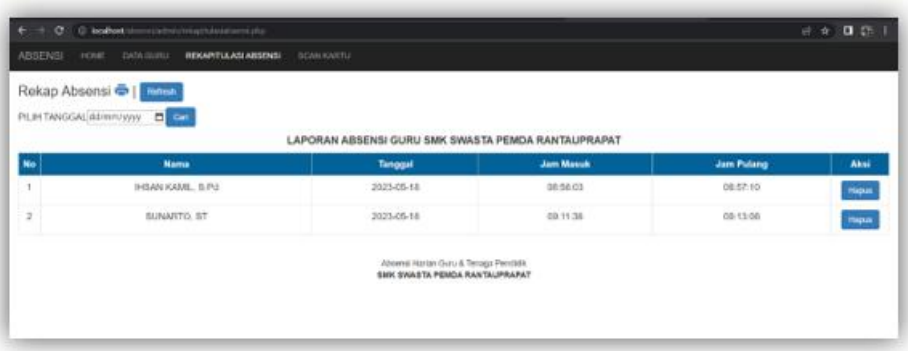


Figure 4.17 Display of attendance recapitulation

4.3. Program Testing Results

a. Absence Device Test Results

Testing this device functions to find out the response of the id card used which will be read by the system on the website and stored in the database, this attendance device also provides a button to change the mode of attendance with two attendance options entered with the absent attendance option, the teacher will press the attendance mode button , because the teacher on duty at the rantauprapat regional government private vocational school has different entry and return times, according to the teaching lesson schedule that has been determined by the vice principal of the curriculum field, after the mode is in accordance with the choice desired by the teacher concerned, the teacher will stick the card on attendance device, if the device is working properly it will give a notification with the red LED light on for a few seconds and will display on the monitor screen according to the attendance mode used, if the device is not working it will have a red LED light notification which has a longer life duration old and do not have notifications on the monitor screen. The results of testing the attendance device can be seen in table 4.1.

Table 4.1 Conclusion of testing the teacher attendance system device

Components tested	Test scenario	Expected results	Results
Kartu id, RFID Reader, NodeMCU8266, Monitor	Paste the id Card on the Reader	Reader receives and sends the code obtained from the id card to NodeMCU8266 and NodeMCU8266 will send messages to be read on the website which can be seen on the monitor screen	[√] As expected [ ] Inappropriate

b. Web Application Testing Results Teacher attendance

On the attendance website it is used to control and view attendance activities that are carried out when entering and returning home. There are also 3 menus, namely card scanning, teacher data, attendance

recapitulation. The card scan menu will display the results of the scanned card, if the scanned card has not been registered in the Rantauprapat government private vocational school teacher attendance system, the website will display the message “Sorry! Unrecognized Card”. If the card has been registered, the website will display "Welcome (Name of card owner)" displaying a message for entry attendance mode and for return attendance mode "Goodbye (Name of card owner)". The results of testing the card scan menu can be seen in table 4.2.

Tabel 4.2 Kesimpulan hasil pengujian tampilan scan kartu

No	Components tested	Test scenario	Expected results	Results
1	RFID tag/teacher id card and system	unregistered card scan	the system refuses and displays the message “Sorry! Unrecognized Card”	[√] As expected [ ] Inappropriate
2	RFID tag/teacher id card and system	Scan the card that has been registered with the attendance mode	the system receives and displays the message "Welcome (name of cardholder)"	[√] As expected [ ] Inappropriate
3	RFID tag/teacher id card and system	scan the card that has been registered with the return attendance mode	the system receives and displays the message "Goodbye (name of card owner)"	[√] As expected [ ] Inappropriate

On the "Teacher Data" menu there is a button to add teacher data, if the form is filled in correctly the website will display a pop up "Saved" the data will be automatically saved into the database if the form is not filled in when the save button is clicked the website will display a "No Card" pop up Must be Filled” and this message will appear according to the form that is still empty. The results of testing the teacher data menu to add teacher data from the scan results of the teacher's ID card can be seen in table 4.3.

Table 4.3 Conclusion of the test results of the added teacher data menu

No	Components tested	Test scenario	Expected results	Results
1	RFID tag/teacher id card and system	Adding teacher data with*scan* together	*form* the card number is filled in automatically, the teacher name and position form can be filled in manually, if the save button is executed it will display the message "Saved"	[√] As expected [ ] Inappropriate
2	RFID tag/teacher id card and system	Adding teacher data with*scan* together	*form* no card does not display the number code from the id card / all blank forms have not been filled in, if the save button is executed it will display the message "Card No must be filled in"	[√] As expected [ ] Inappropriate

The "Absence Recapitulation" menu will display attendance data, on this menu the admin can view and make weekly or monthly attendance reports as needed, the menu is equipped with the search for the desired date and reports can be printed immediately, the admin can also delete data if the data want to be removed.

4. CONCLUSION

From the research conducted and after analyzing and overcoming the problems, it can be concluded as follows:

1. The Rantauprapat Regional Government Private Vocational School teacher attendance system using the NodeMCU ESP8266 microcontroller was successfully built. This teacher attendance system consists of a dashboard page (teacher attendance at private vocational schools in Rantauprapat local government), teacher data pages consisting of "add data" and "delete data", then scan card pages, display messages for taking attendance and attendance recapitulation pages to view attendance data. which is successfully inputted and prints the attendance report results.
2. This private Vocational High School teacher attendance system for Rantauprapat Local Government can display information that is easily understood by the user. This application also has a good influence on the effectiveness and efficiency of the teacher attendance process at the Private Vocational School of the Regional Government of Rantauprapat. In terms of implementation, the teacher at the Rantauprapat Regional Government Private Vocational School attaches the ID tag card to the reader to take attendance at the Rantauprapat Regional Government Private Vocational School and attaches the ID card back when returning from the Rantauprapat Regional Government Private Vocational School.

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