



Design and Development of Automatic Door Locking and Attendance System Using Vaccine Certificate Based on the Internet of Things

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Abstract. For offline study, State Polytechnic of Sriwijaya still uses a manual student attendance recording system. Nowadays, such a system is less effective because of there are significant increment of student both student's opportunities to manipulate attendance data and admin's working is not efficient as well. In addition, level of the security of the laboratory room at the Telecommunications Engineering Laboratory is still low because of using conventional locks, so that way we need an automatic door security system device that uses a magnetic door lock to maintain security at all times and uses a QR Code on the vaccine certificate to be detected. The needed is motivated by event at the end of 2019 at which whole of world has been shocked by the increasing outbreak of the Corona Virus-19 (Covid-19), including in Indonesia. Indonesia itself has taken anticipatory steps in efforts to prevent Covid-19 through a vaccination program. Vaccines to prevent exposure to the Covid-19 virus. The purpose of this report is to design and manufacture an automatic door lock and attendance system using a vaccine certificate, and to create a more effective automatic door lock and attendance system. Based on the tests that have been carried out and seeing the purpose of the manufacture, it can be concluded that the tool has been tested and can be used to assist the attendance system and automatic door locking by using an Internet of Things-based vaccine certificate and so that the spread of Covid-19 does not spread and the security system with automatic door lock for the better.

Keywords: Magnetic Door Lock · QR Code · Vaccine Certificate

1 Introduction

Since the end of 2019, the whole world has been shocked by the increasing outbreak of the Corona Virus -19 (Covid-19), including in Indonesia. Indonesia itself has taken anticipatory steps in efforts to prevent Covid-19 through a vaccination program. Everyone who has undergone a vaccination program will be given a Covid-19 vaccination certificate, as proof that the person concerned has undergone a Covid-19 vaccination. This is one of the steps to prevent the spread of Covid-19.

Currently, the Sriwijaya State Polytechnic is still using the system for recording student attendance manually. This system of recording student attendance is still not effective. As well as the security of the Telecommunications Engineering laboratory room still uses conventional keys. The use of conventional keys is currently considered less effective.

Therefore, the author tries to find a solution to this problem so that the spread of Covid-19 does not spread and the security system with automatic door locks becomes better, especially at the Telecommunications Engineering Laboratory of the Sriwijaya State Polytechnic by utilizing vaccine certificates as the main subject. The author has the idea to take the title “Design and Development of Automatic Door Locking and Attendance System Using Vaccine Certificate Based on the Internet of Things”.

2 Related Works

2.1 Node MCU ESP8266

ESP8266 is a Wi-Fi module that functions as an additional device for microcontrollers such as Arduino so that it can connect directly to Wi-Fi and make TCP/IP connections. This versatile Wi-Fi module is already a SoC (System on Chip), so we can do programming directly to the ESP8266 without the need for an additional microcontroller [1]. By adding the ESP8266 library to the board manager we can easily program with the Arduino program base. Therefore, many people use this module to create Internet of Things (IoT) projects [2] (Fig. 1).

2.2 QR Code

QR Code is a two-dimensional code as a development of a bar code or barcode. The initial purpose of making a QR Code is to accommodate kanji and kana characters, because QR Codes are only able to encode alphanumeric [3]. The QR Code contained in the Covid-19 vaccine certificate provides information about a person’s vaccination

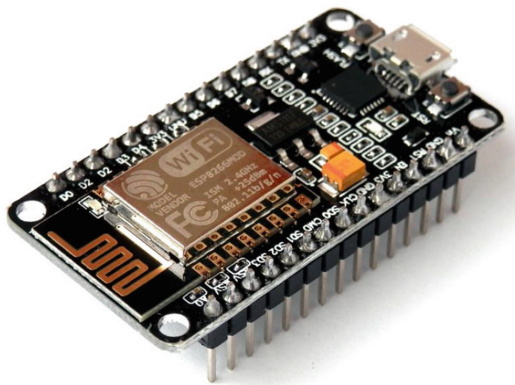


Fig. 1. Node MCU ESP8266.



Fig. 2. Vaccine certificate



Fig. 3. Magnetic Door Lock.

status, including the name of the card owner [4]. This information is valid and unique, which means that the name of the cardholder is really the name of the person concerned and not someone else's name [5] (Fig. 2).

2.3 Magnetic Door Lock

Magnetic Door Lock is a device with very strong magnetic properties which is generated electromagnetically and works as a door lock [6]. When the Magnetic Door Lock is given a voltage it will become a very strong magnet. Magnetic Door Lock uses electric current to produce a stronger magnetic force [7]. Magnetic Door Lock uses electromagnetic force to stop the door from opening, making it ideal for security [8] (Fig. 3).

2.4 Internet of Things

Internet of Things (IoT) is a term that emerged with the notion of accessing electronic devices through the internet [9]. Access to these devices occurs due to human relationships with devices or utilizing the internet network. Access to these devices occurs because of the desire to share data, share access, and also consider security in access [10].

3 Hardware and Software Design

This research uses quantitative and qualitative methods. Quantitative research is more focused on the numbers of test results or measurements, while qualitative research is more focused on the text displayed on the computer screen in real-time about the perpetrators who have taken the action of littering. This research method is divided into 2, namely the design of hardware and design of software.

3.1 Hardware Design

In hardware design which is the concept of tool making. The making of this final report is the design of an automatic door lock and attendance system using a vaccine certificate based on the Internet of Things. The electronic devices used in this tool are QR Code Scanner, Node MCU ESP8266, LCD, Relay, and Magnetic Door Lock (Figs. 4, 5 and 6).

3.2 Software Design

In the design of software or software consists of several programs that function to control the hardware. Program modules made for hardware are: a QR code data collection program module that uses a QR Code scanner and Vaccine Certificate as input and a database created with a website that is used to store registered data. Make a temporary

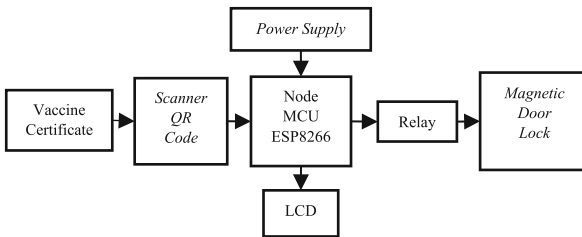


Fig. 4. Hardware Block Diagram.

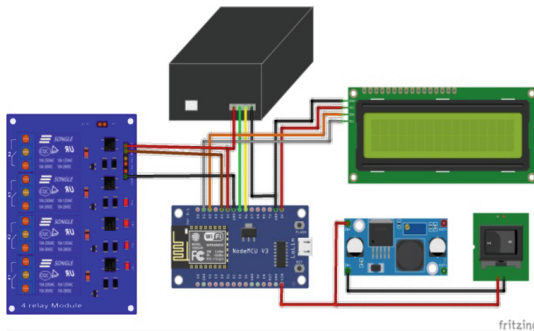


Fig. 5. Wiring Diagram.

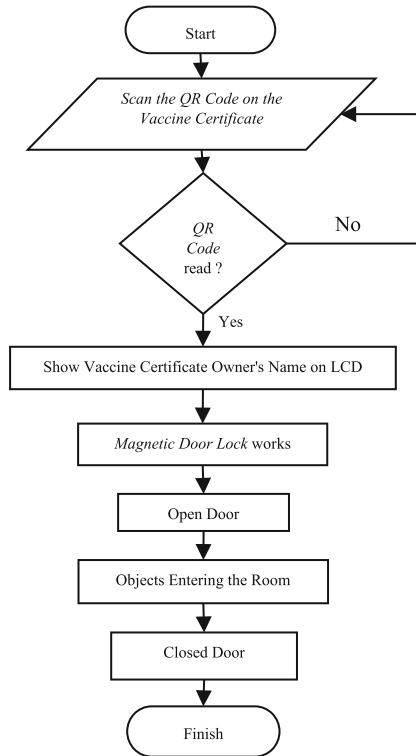


Fig. 6. Tool Operational Sequence Flowchart.

Absensi Sertifikat Vaksin



Fig. 7. Login Page.

design that focuses on presentation, namely making a database view. The following is an image of the attendance system software design (Figs. 7 and 8).

3.3 Work Principle

In this attendance system Node MCU is the main component that functions as a micro-controller. The Node MCU receives voltage from the adapter which can be set ON/OFF using the appropriate switch. The working principle of this access rights and attendance



Fig. 8. Dashboard View.

tool begins with the QR Code input. The QR Code will provide input when the QR Code on the vaccine certificate is brought closer to the QR Code Scanner, so people who want to be present at the same time to open the door must direct the vaccine certificate first to the QR Code Scanner. If the owner of the vaccine certificate is recognized, the Magnetic Door Lock will ON and the door opens and the user name will appear in the database as attendance, the LCD will display the words “Class-Name”, but if the QR Code on the vaccine certificate is not recognized, the LCD will display “Sorry, You Are Not Registered!”. The door will be locked again automatically after the magnetic door lock relay delay has reached the set time. The QR Code on the vaccine certificate must be registered first, to register the ID we must use a computer/laptop and enter the data needed for attendance in the database, with a method like this it allows access to enter the room will be safe because only registered people can access the room.

4 Results and Discussion

The results of the design that has been made are divided into 2 parts, namely hardware and software, the hardware is the result of a tool that has been designed while the software is the result of the design of making a website as a database implementation.

4.1 Hardware Design Results

The following is a display of the tool that has been made from various sides with a casing made of acrylic material and a pre-designed module layout (Figs. 9, 10, 11, and 12).

4.2 Software Design Results

The following is a display of the results of the implementation of the system that has been made according to the design.



Fig. 9. Overall Toolkit View.



Fig. 10. View of Toolkit from Front.



Fig. 11. View of Toolkit from Above.



Fig. 12. Side View of Toolkit.

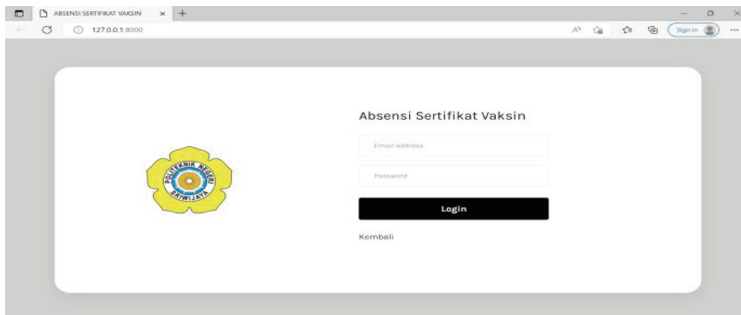


Fig. 13. Login Page View.

4.2.1 Login Page

On the login page, the admin enters student and lecturer data (Fig. 13).

For those who can login, only admins and lecturers are used to view graphs of absent students.

4.2.2 Dashboard Page

The following is a page to display the number of students, admins, lecturers, and rooms in the registered database (Fig. 14).

4.2.3 Attendance Page

On the previous dashboard page, on the sidebar there is an action column then select attendance, then the admin can confirm the students who entered today and can also edit the previous student attendance, by looking at the attendance menu, time and the name of the room used (Fig. 15).

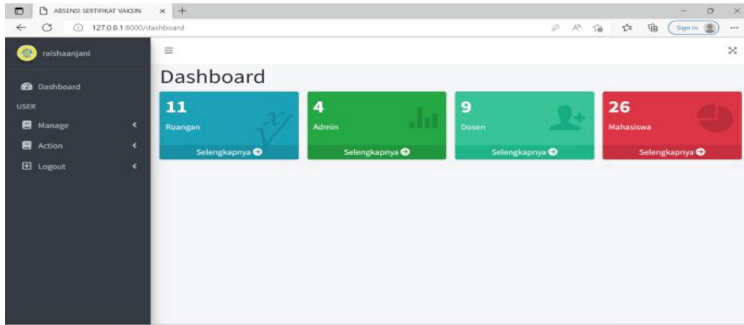


Fig. 14. Dashboard Page View.

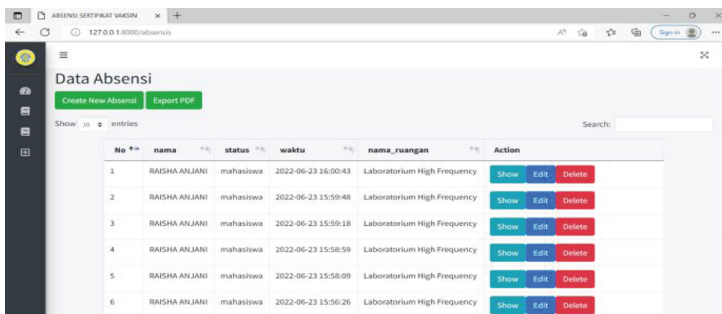


Fig. 15. Attendance Page View.



Fig. 16. Add Student Page View.

4.2.4 Add Student Page

On the Student page, only admins can add students by filling in their name, npm, class, nick, date of birth, vaccine code 1 and vaccine code 2. After filling out click the submit button at the bottom. Admin can select the student menu in the sidebar then select action then select student, then there is a “Create New Student” button (Fig. 16).

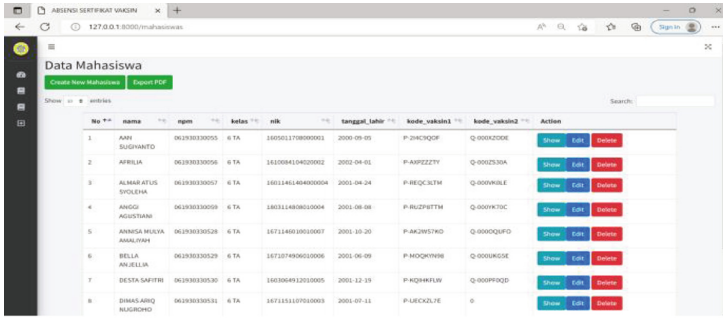


Fig. 17. Student List Page Display.

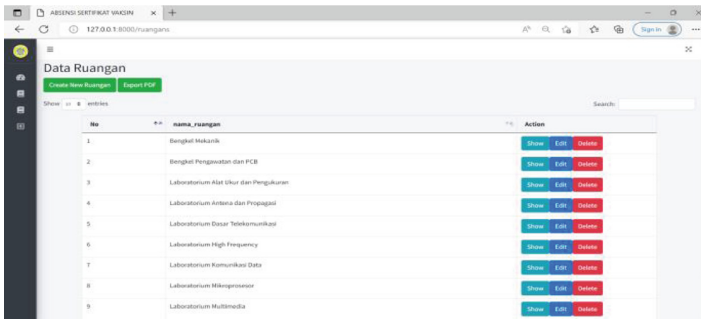


Fig. 18. Room List Page View.

4.2.5 Student List Page

This student list displays information about student personal data, deletes students and registers QR Code on vaccine certificates (Fig. 17).

4.2.6 Room List Page

This page admin can add and remove existing rooms (Fig. 18).

4.2.7 Lecturer Registration Page

This page admin can add or register lecturers so that lecturers can see the graph of absent students (Fig. 19).

4.2.8 Database Implementation

A web-based application to display attendance was developed using the MySQL database as a data storage medium. The name of the database created is db_absensi_sertifikat. This database has 15 tables, namely: attendance, admin, lecturer, failed_job, student, model_has_permission, model_has_role, password_resets, permissions, personal_access_token, role, role_has_permission, room, and user (Fig. 20).

Table 1. Test Results using QR Code Scanner


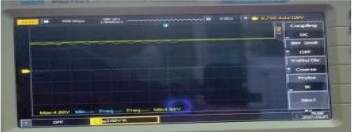
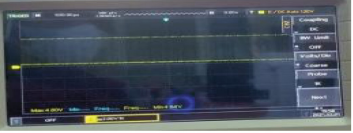
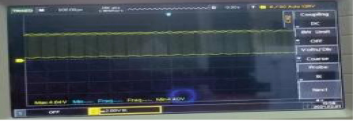

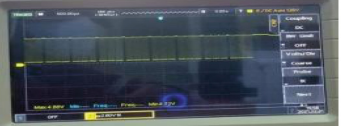
No	Name	Testing Distance	Status in Database	Response <i>Magnetic Door Lock</i>	Attendance success
1	Aan Sugiyanto	3 cm	registered	not open	not absent
		5 cm		open	Attendance
		7 cm		open	Attendance
		9 cm		open	Attendance
		11 cm		open	Attendance
		13 cm		open	Attendance
		15 cm		open	Attendance
		17 cm		open	Attendance
		19 cm		not open	not absent
		21 cm		not open	not absent
2	Raisha Anjani	2 cm	registered	not open	not absent
		4 cm		open	Attendance
		6 cm		open	Attendance
		8 cm		open	attendance
		10 cm		open	Attendance
		12 cm		open	Attendance
		14 cm		open	Attendance
		16 cm		open	Attendance
		18 cm		open	Attendance
		20 cm		not open	not absent
3	Baring Jumadi Asru	3 cm	registered	not open	not absent
		5 cm		open	Attendance
		7 cm		open	Attendance
		9 cm		open	Attendance
		11 cm		open	Attendance
		13 cm		open	Attendance
		15 cm		open	Attendance
		17 cm		open	Attendance
		19 cm		not open	not absent
		21 cm		not open	not absent
5	Salwa Kamila	3 cm	not listed	not open	not absent
		5 cm		not open	not absent
		7 cm		not open	not absent
		9 cm		not open	not absent

(continued)

Table 1. (continued)

No	Name	Testing Distance	Status in Database	Response Magnetic Door Lock	Attendance success
		11 cm		not open	not absent
		13 cm		not open	not absent
		15 cm		not open	not absent
		17 cm		not open	not absent
		19 cm		not open	not absent
		21 cm		not open	not absent

Table 2. Quantitative Test Results on LCD

Test Point	Tool	Waveform	Description
LCD (SDA)	When detecting Vaccine Certificate		Voltage : 4,88 V Frequency : 667,66 Hz
LCD (SDA)	When the Magnetic Door Lock is Open		Voltage : 4,88 V Frequency : 2 KHz
LCD (SDA)	When the Magnetic Door Lock is Closed		Voltage : 5,80 V Frequency : 10 KHz
LCD (SCL)	When detecting Vaccine Certificate		Voltage : 4,64 V Frequency : 2,5 KHz
LCD (SCL)	When the Magnetic Door Lock is Open		Voltage : 4,56 V Frequency : 4 KHz
LCD (SCL)	When the Magnetic Door Lock is Closed		Voltage : 4,88 V Frequency : 3,33 KHz

microcontroller. The tests carried out were reading the QR Code, reading distance, and data on attendance.

This test is carried out to see how far the measured QR Code is from the QR Code scanner to open the door. The QR Code scanner component is used as data input to detect the QR Code and is used as attendance and also as a door opener. In Table 1, from these settings I got an analysis that the relay contained in the QR Code scanner circuit is only a switch, while to adjust the delay it is in the Magnetic Door Lock circuit itself.

The working system is when the vaccine certificate on the QR Code Scanner is detected, the relay will work actively for Magnetic Door Lock, after Magnetic Door Lock is active, the door will open and the user can enter the room accompanied by the user being present when opening the door, and if the user does not close the door again, the Magnetic Door Lock will reactivate after the set delay time.

From the Table 1 I also analyze that what affects registered or unregistered people can enter or break through the door, namely the condition of the Magnetic Door Lock. So if registered and unregistered users want to enter the room logically, unregistered users will not be able to enter the room because the QR Code on the vaccine certificate is not registered but in fact the QR Code on the vaccine certificate that is not registered can still enter the room. The room even though it is not registered because when another registered user enters the room he does not close (lock) the door again or is in a continuous open condition then an unregistered person can enter without detecting the QR Code, but that person will not be considered present at the attendance.

4.4 Quantitative Testing

See Tables 2, 3, and 4.

Table 3. Quantitative Test Results on Relays for Magnetic Door Lock



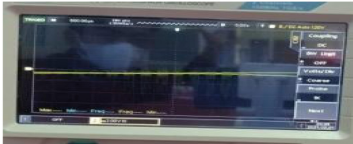


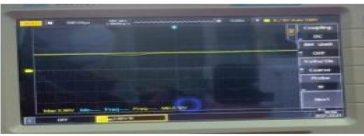

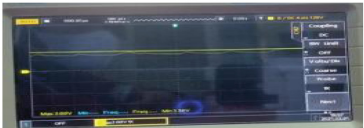
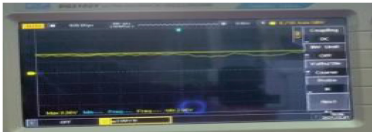
Test Point	Response	Waveform	Description
Relay	When detecting Vaccine Certificate		Voltage : 2,72 V Frequency : 2,5 KHz
Relay	When the Magnetic Door Lock is Open		Voltage : 2,16 V Frequency : 2,5 KHz
Relay	When the Magnetic Door Lock is Closed		Voltage : 2,72 V Frequency : 3,33 KHz

Table 4. Quantitative Test Results on QR Code Scanner

Test Point	Response	Waveform	Description
Scanner QR Code (Tx)	When detecting Vaccine Certificate		Voltage : 3,04 V Frequency : 2 KHz
Scanner QR Code (Tx)	When the Magnetic Door Lock is Open		Voltage : 3,04 V Frequency : 1 KHz
Scanner QR Code (Tx)	When the Magnetic Door Lock is Closed		Voltage : 3,36 V Frequency : 4 KHz
Scanner QR Code (Rx)	When detecting Vaccine Certificate		Voltage : 3,44 V Frequency : 1KHz
Scanner QR Code (Rx)	When the Magnetic Door Lock is Open		Voltage : 3,68 V Frequency : 800 Hz
Scanner QR Code (Rx)	When the Magnetic Door Lock is Closed		Voltage : 3,36 V Frequency : 2 KHz

5 Conclusion

Based on the test results from several test points, it can be concluded that this circuit can work well and according to its function. The points tested are LCD, QR Code Scanner, and relay. The input voltage used from the Node MCU ESP8266 is 5 V in order to have a stable voltage. This test is carried out through three conditions, namely when scanning

the QR Code, the door is open, and the door is closed. For the test point on the LCD with the conditions at the time of scanning the QR Code that was tested on SDA and SCL had a voltage of 4.88 V and 4.64 V, when the door was open the test points SDA and SCL had a voltage of 4.88 V and 4.56 V, then when closed again, the SDA and SCL test points have a voltage of 5.80 V and 4.88 V. At the test point, the relay with the condition at the time of scanning the QR Code tested has a voltage of 2.72 V, when the door is open the relay has a voltage of 4.16 V, then when it is closed the relay has a voltage back to 2.72 V. Furthermore, at the QR Code test point, 2 points are tested, namely Rx and Tx with the conditions at the time of scanning the QR Code being tested having a voltage of 3.44 V and 3.04 V, when the condition of the door is open the relay has a voltage of 3.68 V and 3.04 V, then when closed the relay has the same voltage, which is 3.36 V on its Rx and Tx. However, there is an exception at the test point with the names of the owners Salwa Kamila and Widia Salsabila because they are not registered in the database so they cannot open the door which is controlled by Magnetic Door Lock so that when it is opened or closed it has a voltage of 80 mV and a frequency of 0. From some of these test points, there are several different output voltages, but they are still stable because they are in the same range as the input voltage using the ESP8266 Node MCU of 5 V.

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