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IoT-BASED ACADEMIC MONITORING SYSTEM IN INTEGRITY ZONE IMPLEMENTATION

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ABSTRACT

The Internet of Things (IoT) based academic monitoring system is implemented at the Manado State Polytechnic to achieve an Integrity Zone where educational institutions have good governance, are accountable, and are free from corruption. This research aims to design and implement an Internet of Things (IoT) based presence monitoring system. The system was developed for lecturers and students to record attendance using a microcontroller and display a QR Code on an Internet of Things (IoT) based OLED screen. Implementing this system aims to increase transparency, accountability, and the effectiveness of using lecturer time in teaching. The results are that the presence of lecturers and students can be validated through CCTV camera monitoring to display image data in real-time and table data on web pages. An application developed using Android that can be used by students and lecturers in taking attendance and sending data to the server. The server has two primary purposes: record attendance data and generate attendance reports based on user requests. System testing is carried out in a local network. The research results show that the subsystems and integrated systems work well.

Keywords: attendance, students, QR Code, android.

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1. INTRODUCTION

The IoT-Based Academic Monitoring System is an innovative solution that can assist in implementing the Integrity Zone at the Manado State Polytechnic. This system utilizes Internet of Things (IoT) technology to monitor the academic performance of lecturers and students in real-time. Implementing the Integrity Zone is an effort by the Government of Indonesia to encourage the creation of sound and clean governance. One indicator of the Integrity Zone is the quality of good public services, including education.

The attendance system has an essential role in everyday life, especially in schools, universities, factories, offices, hospitals, and other places that use attendance as a sign of attendance. In line with the development of technology, the attendance system in the world of education, especially at the Manado State Polytechnic, is generally still carried out manually, including attendance at universities, where this is very inefficient because information about the technology is taught for the first time in the world of education. Therefore, it is essential to apply technology that can help process university attendance. So that it can improve the system's quality of student attendance services; absence is an attendance data collection that is part of reporting activities within an institution. Attendance is structured and managed so that it is easy to find and use when needed by interested parties.

The QR code is a matrix or two-dimensional bar code developed by Denso Wave, a division of Denso Corporation, a Japanese company, published in 1994. To read the QR Code, a reader or scanner is needed in software, namely the QR Code Reader or QR Code Scanner, which must be installed on the mobile device. QR stands for Quick Response or quick response, whose purpose is to convey information quickly and get a fast response. In contrast to barcodes, which only store information horizontally, QR codes can store information horizontally and vertically.

For this reason, an application is needed to facilitate attendance activities in learning activities. In this study, the authors will design an attendance system that can be done using an Android smartphone by utilizing the camera system to read the QR Code. The way it works is that the system will display a QR Code at every learning activity meeting, and students scan the QR Code shown by the teacher. It is hoped that making this application will make it easier to monitor lecture activities. By implementing an IoT-based academic monitoring system, it is expected that Polimdo can improve the quality of teaching conducted by lecturers and create an Integrity Zone in the education sector.

2. LITERATURE SURVEY

The previous study by Yin et al. discussed using the QR Code. They say Standard barcodes can only be read from top to bottom in one way. As a result, they can only hold a limited amount of data, often in alphanumeric format. But QR codes are read in two directions, from top to bottom and right to left. This allows it to hold significantly more data. The QR Code system has become popular outside the automotive industry because of its fast readability and greater storage capacity than standard UPC barcodes. A QR code consists of black modules (square dots) arranged in a square grid on a white background. Our website uses this QR code system to mark student

attendance instead of using pen and paper for the same. Most smartphones have a QR scanner, sometimes built into the camera [1].

Furthermore, by Yousaf *et al*., the presence of students in class is a critical task, and if done manually, it will waste a lot of time. There are many automated methods available for this purpose, namely biometric presence. These methods also waste time because students must queue to touch their thumbs on the scanner. This work describes an efficient algorithm that automatically marks presence without human intervention. This Attendance is recorded using a camera installed at the front of the classroom. It continuously captures student images, detects faces in the pictures, compares the caught faces with the database and marks their Attendance. This paper reviews related work in attendance systems and then describes the system architecture, software algorithms and results [2]. The research of Olaniyi *et al.* explained Attendance is one of the most significant aspects of business and education, and its significance has increased to the point where it now influences various activities. Meanwhile, organizations are rapidly moving away from conventional attendance tracking methods [3]. Rjeib *et al*., The current study proposes an RFID-based Attendance Management System (AMS) and an information service system for the academic domain using RFID technology in addition to programmable Logic Circuits (such as Arduino) and web-based applications. The proposed system aims to manage student attendance records and provide the ability to track student attendance and support information services, including student grades, daily schedules, lecture times and classroom numbers, and other student-related instructions provided by faculty department staff [4]. Cheng et al. discussed research on Quick Response (QR) codes widely used in data storage and high-speed machine reading applications. Anyone can gain access to the information stored in a QR code; therefore, they are not suitable for encoding confidential information without adding cryptography or other protection. This paper proposes a visual secret-sharing scheme to encode a secret QR code into parts [5]. Lukkarinen *et al.'s* research describes existing state-of-the-art attendance systems using equipment developed exclusively for those systems; therefore, implementing a robust attendance system may not be a cost-effective strategy. It took a long time to collect all the necessary information to create an individual student report at the end of the year. Skip all the distractions and automatically organise notes with the auto attendance tracker. The time that is so saved can be used for more critical managerial tasks [6]. Research by Čisar *et al.* introduced the Bologna system requiring class attendance. Recording attendance is inefficient and takes up too much class time, especially with larger groups of students. If a professor records student attendance manually, they have to look at the student, write it down and go to the next student. One possible solution for this is an app called Muffin. Muffin consists of a mobile application students have on their mobile devices, an Arduino Uno board with a Bluetooth module, and a desktop application [7]. Perjwed *et al.* explained several alternative device-based attendance solutions, such as an RFID (Radio Frequency Identification) based student attendance system and a GSM-GPRS-based student attendance system [8]. Furthermore, Yan and Han's research conducted research aimed at designing a face recognition attendance system based on real-time video processing. This article mainly sets out four directions for considering the problem: the accuracy rate of the facial recognition system in actual check-in, the stability of the facial recognition attendance system with real-time video processing, the truancy rate of the facial recognition attendance system with real-time video processing and the attendance system interface setting. Facial recognition uses real-time video processing [9]. Perwej *et al.* are also continuing research on absenteeism, and they say at the beginning and end of each session, attendance is an essential aspect of daily class evaluation. They feature a real-time Facial Recognition System to track student attendance in this work. The suggested method includes identifying a human face from a webcam using the Viola-Jones technique, resizing the recognized face to the desired size, and then processing the resized beginning using a basic Local Binary Pattern Histogram algorithm [10].

Furthermore, the latest research by Wadhwa et al. Explains that the conventional register-based attendance system for students in institutions is a time-consuming and tiring task for teachers, so we have developed and used an intelligent system based on a fingerprint scanner to replace the traditional attendance system that can acquire, store, and check student fingerprints. and export the data in the form of their attendance records to a centralized database which is used by the developed Android Application which helps administration and students to see their attendance in real-time, the whole system is cheap and reliable [11].

3. PROPOSED METHOD

We carried out stages in designing the system to get the expected results. This section will explain the steps of tool design and system design stages. The first part describes the design of a tool using NodeMCU V3 ESP 822, which functions as data storage and access and a medium for displaying QRCode. The second part describes the system design flow made for the attendance system.

3.1 System Design

This section will explain the system design described in the flowchart, as shown in Figure-1.

In Figure-1, the flowchart is shown, which starts at the input of the attendance schedule, the process of making absences in the form of a QR Code then processes attendance in the form of a QR Code. If successful, there will be a notification of successful attendance. Furthermore, the system will automatically make time attendance in real-time and then process it until it expires. If it's over then a notification will appear to the student's parents in the form of an SMS which will notify them that the student is not

attending. The last process is the attendance report from students.

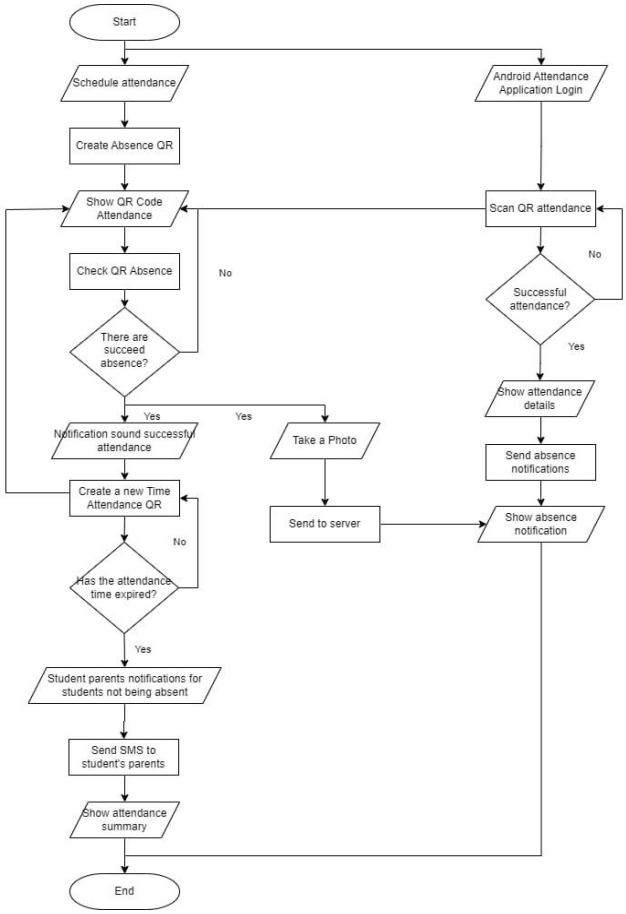

Figure-1. System flowchart.

The flowchart shows the student's process of taking absences on the Android system, with the first step being to scan the QR Code. If successful, a notification will appear notifying that the lack was successful.

3.2 Device Design

This section describes the design of the tool; the following are the tools and materials used:

a) NodeMCU V3 ESP 8266

b) 0.6-inch OLED screen

c) DF Player Mini + SD Card

d) Mini Speakers

The application used in this research is Arduino Editor V1.8.15 Genuino. Figure-2 shows the design of the tool using the tools that have been mentioned.

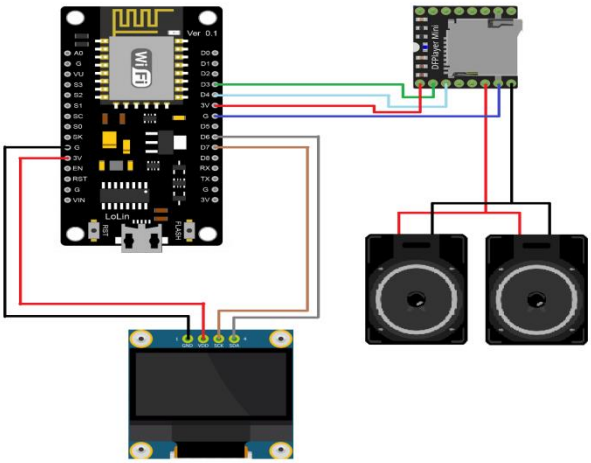

Figure-2. Tool design.

Figure-2 shows the design of a tool that has an Arduino plugin with the following functions:

a) **DFRobotDFPlayerMini.h:** Serves to play MP3 and output sound to the Mini Speaker
b) **QRcode.h:** Serves to create a QRCode
c) **SSD1306.h:** Serves to make the display on the OLED screen
d) **ESP8266WiFi.h:** Serves to capture Wifi signals and is used for data transfer paths.
e) **ESP8266HTTPClient.h:** Serves to access data via HTTP.

Next, there is a wiring that works for:

a) To activate the OLED screen, power is needed from NodeMCU and 2 GPIO ports as controllers so that the wiring becomes:

Table-1. Enabling the OLED display.

OLED Display	NodeMCU
GND	G
VCC	3V
SCK	D7
SDA	D6

a) To activate DFPlayer Mini, power is required from NodeMCU and 2 GPIO ports as controllers so that the wiring becomes:

Table-2. Activating DFPlayer Mini.

DFPlayer Mini	NodeMCU	Speaker
GND	G	
VCC	3V	
RX	D3	
TX	D4	
SPK_1		+
SPK_2		-

The algorithm in system design is described in more detail as follows:

a) Initial Wi-Fi settings with a connection to the mechanical-engineering SSID and password polimdo2023.

b) Try connecting to Wi-Fi. If you don't get a connection, keep repeating until you get a connection with the SSID and password that match the settings.

c) After a successful connection, initial the DFPlayer Mini with the Timeout setting of 500 and volume 10, and repeat until the DFPlayer Mini setting is successfully set; if it has been successfully placed, play the opening sound with the file name 002.

d) Initial OLED screen: display.init();

e) Make repeated loops:

a. Check if the Wi-Fi is connected; repeat the loop.

b. Make an HTTP connection to the Web server / API to get the Attendance token.

c. If you get an attendance token from the Web server, display it on the OLED screen and store the attendance token in a temporary variable.

d. Repeat Looping and repeat from point b and then continue to point e.

e. If the attendance token retrieved from the Web Server is the same as the token previously stored in a temporary variable, don't update the OLED screen display.

f. If the token differs from the one stored in the temporary variable, display the latest pass on the OLED screen.

g. Repeat Looping from point A again and repeat it as long as the device is on.

Data collection process (web and OLED):

a. Initialize the device with the code "RG01".

b. Connect the IOT device to the internet by searching for Wi-Fi with the SSID "mechanical engineering" If you don't get the appropriate Wi-Fi, repeat the search command every 1 second; if connected to the internet, proceed to the following command.

c. In the loop function, check the internet connection; if connected, do the following steps.

d. Initialize the Http Client process, then access the API to get the attendance token to the web API; for the Get Http process, also bring the code variable "RG01" as the identifier of the IOT device.

e. If the request is successful, check whether the token provided by the web API is the same as the last token / temporary token; if it is the same, give a 3-second delay before repeating the loop.

f. If the token differs, refresh the screen, display the latest pass, and save it.

4. DISCUSSIONS

This section describes the results of the system that has been designed and the results of testing the system. Figure-3 shows a tool that displays a QR Code.

Figure-3. QR Code.

Furthermore, the displayed QR Code will be scanned by each student to take attendance. The display of the Android application can be seen in Figure-4.

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Figure-4. Application Login Page.

If you have successfully logged in using the student username and password, the main menu page will appear, showing the logged-in student data as shown in Figure-5.

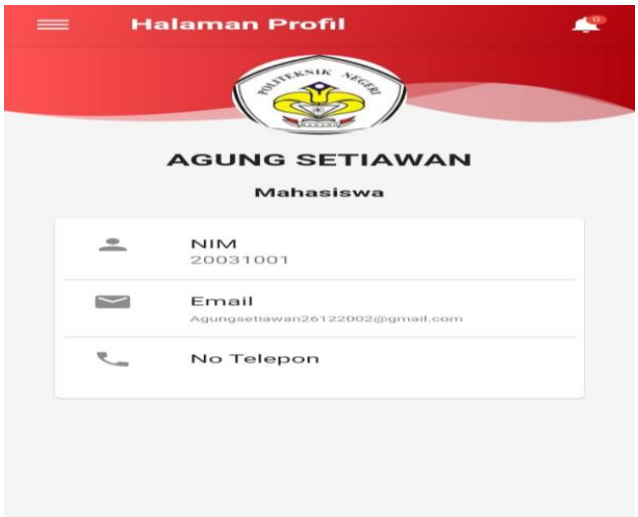

Figure-5. Main Page.

Next, to take student absences, click on the menu section at the far right next to the Profile Page and a display of attendance options will appear. After that, select attendance, and an attendance page will appear, as shown in Figure-6.

Figure-6. Absence page.

If you click scan, the system will scan the QR Code for the student attendance process.

The attendance system is also equipped with a duration for making absences only when the course is in progress. The term uses tokens, as shown in Figure-7.

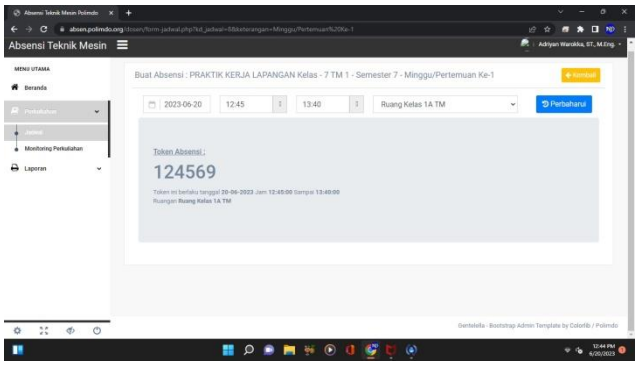

Figure-7. Absence Time Duration.

Furthermore, the attendance report is shown in Figure-8, where the system indicates the number of student absences, attendance targets and student attendance presentations.

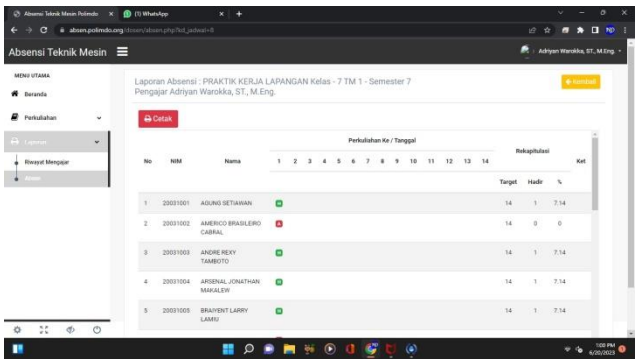

Figure-8. Student Absenteeism Report.

In the next section, the results of system trials will be shown for all the features made, shown in Table-3.

Table-3. System Testing Results.

Tested Module	Testing Procedure	Insert	Expected output	Results obtained	Conclusion
IoT device connection to Wi-Fi network	Turn on the IOT circuit	SSID and password according to the settings in the IOT code	NodeMCU is connected to the Internet and emits the opening sound from DFPlayer Mini.	NodeMCU is connected to the Internet and emits the opening sound from DFPlayer Mini	Succeed
		SSID and password do not match IOT code/no Wi-Fi available	NodeMCU repeats the process of searching for wifi continuously and does not carry out other activities until it finds a wifi that matches the settings.	NodeMCU repeats the process of searching for wifi continuously and does not carry out other activities until it finds a Wi-Fi that matches the settings	Succeed
DFPlayer Mini and Speakers	NodeMCU connected to the Internet and successfully initialized DFPlayer Mini	Successfully Initial DFPlayer Mini	Outputs the opening soundtrack to the speakers.	Outputs the opening soundtrack to the speakers	Succeed
0.96” OLED Display	There is an attendance process at the current hour and time	Attendance token obtained from the API	Displays QR Code on the OLED screen.	Displays QR Code on the OLED screen	Succeed
	There is no attendance process at the current hour and time	No value attendance token from API is null.	OLED screen off	OLED screen off	Succeed

The analysis of the system shows the following results:

a) Using NodeMCU as an IOT device to retrieve data on the internet is easier because the device already has a built-in wifi module.

b) NodeMCU also has many plugins to communicate, one of which is used in current research, namely the HTTP Client Plugin, which is used to retrieve data on the web API.

c) Use the QRCode plugin to display a QRCode that can be displayed on the viewing device.

d) NodeMCU can be communicated with other IOT devices, such as OLED screens, to display QR Codes.

5. SUMMARY AND CONCLUSIONS

Based on the trials' results, the academic monitoring system for lecturer and student attendance runs well on an Android smartphone. The application can read the QR Code within 5-10 seconds with a distance of 5 cm between the mobile device and the OLED screen that displays the QR code, which functions as a student attendance marker. The attendance application uses an Android-based QR Code that is real-time. In its implementation, this application can improve the quality of teaching at the Manado State Polytechnic and create an Integrity Zone in the education sector.

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