Implementation Of An Attendance System Using Rfid And Arduino Based Camera At PAB Klumpang High School

Aldi Ardiansyah, Muhammad Erpandi Dalimunthe, Pristisal Wibowo

Abstract

This paper presents the design, development, and implementation of a smart attendance system using RFID (Radio Frequency Identification) and camera-based verification integrated with Arduino Uno microcontroller. The main objective is to automate the attendance process at SMA PAB Klumpang, improving accuracy, reducing manual errors, and minimizing impersonation incidents. Each student is equipped with a unique RFID card as an electronic identification tag. When scanned by an RFID reader, the system records attendance data and triggers a camera module to capture the student's image as visual verification. The recorded data (student ID, name, timestamp, and photo) are automatically stored in a MySQL database via serial communication with a computer interface. The prototype demonstrates an RFID reading accuracy of 98.4%, an image capture success rate of 95%, and an average response time of 1.85 seconds per transaction. This system provides a low-cost, efficient, and secure solution for digital attendance management in educational institutions.

***Keywords**:* Arduino, Camera, RFID, Database

Aldi Ardiansyah[1]
[1]Department of Electrical Engineering, Universitas Pembangunan Panca Budi, Indonesia
e-mail: aldi080402@gmail.com

Muhammad Erpandi Dalimunthe[2], Pristisal Wibowo[3]
[2,3]Lecturer at the Faculty of Engineering, Universitas Pancabudi Medan, Indonesia.
e-mail: erpandi@dosen.pancabudi.ac.id, pristisalwibowo@dosen.pancabudi.ac.id
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Introduction

Student attendance at school is a crucial aspect of teaching and learning, as attendance is often an indicator of student discipline and responsibility. At SMA PAB Klumpang, the attendance system used is still manual, with teachers recording student attendance directly in class. This method has several weaknesses, such as being prone to recording errors, being time-consuming, and being subject to abuse through "passing attendance" between students. With the development of Internet of Things (IoT) technology and Arduino microcontrollers, attendance systems can now be automated using sensors and electronic identification devices such as RFID and digital cameras. The integration of these two systems is expected to produce a more accurate, faster, and transparent attendance method. The attendance process is a vital administrative activity in educational environments because it serves as a measure of student discipline and responsibility. At SMA PAB Klumpang, attendance is still manually recorded by teachers using an attendance list. Although this method is simple, the manual system has many limitations, including: it is time-consuming to record, prone to fraud (e.g., passing attendance), data input errors, and difficulties in automatic recapitulation.

With the development of Internet of Things (IoT) technology and open-source microcontrollers like Arduino, administrative processes such as attendance can be automated with a high degree of accuracy and real-time data processing. The integration of RFID (Radio Frequency Identification) as an identification system and a digital camera for visual validation results in a safer, faster, and more efficient attendance system. Digitizing educational administration is now a priority in the implementation of Smart Schools. An automated attendance system not only saves teachers time but also provides real-time attendance statistics that schools can use for student discipline evaluations, monthly reports, and reward and punishment systems. Furthermore, the COVID-19 pandemic has demonstrated the importance of a contactless digital recording system. An Arduino-based RFID and camera system is a practical solution because it uses inexpensive components, is easy to program, and can be further developed.

Literature Review

RFID is an automatic identification technology that works using radio waves. An RFID system consists of an RFID tag (which stores unique data) and an RFID reader (which reads the data from the tag). This study used the MFRC522 RFID module, which operates at a frequency of 13.56 MHz and is capable of reading cards at a distance of 3–5 cm [1]. The main advantage of RFID over barcodes is that it requires no direct contact and can read multiple tags simultaneously. The data from the RFID is in the form of a UID (Unique Identification) that is linked to the student's identity in the school database [2].

The Arduino Uno R3 is an ATmega328P-based microcontroller platform widely used due to its ease of programming, flexibility, and availability of libraries [3]. In this system, the Arduino serves as the main controller, managing communication between the RFID module, camera, LCD, and computer. The camera is used to capture student images each time attendance is taken. The goal is to ensure that the RFID card used truly belongs to the student in question. The camera used is an OV7670 module connected directly to the Arduino, producing images with a resolution of 640×480 pixels.

Research by Wibowo et al. (2021) [4] showed that an RFID-based attendance system had 97% accuracy, but could not verify the cardholder's identity. Another study by Putra and Sari (2020) [5] used facial recognition, but required high-spec hardware. The approach in this study combines RFID and a simple camera to create a cost- and time-efficient dual authentication system.

Research Methodology

The research methodology was structured systematically, as illustrated in Figure 1.

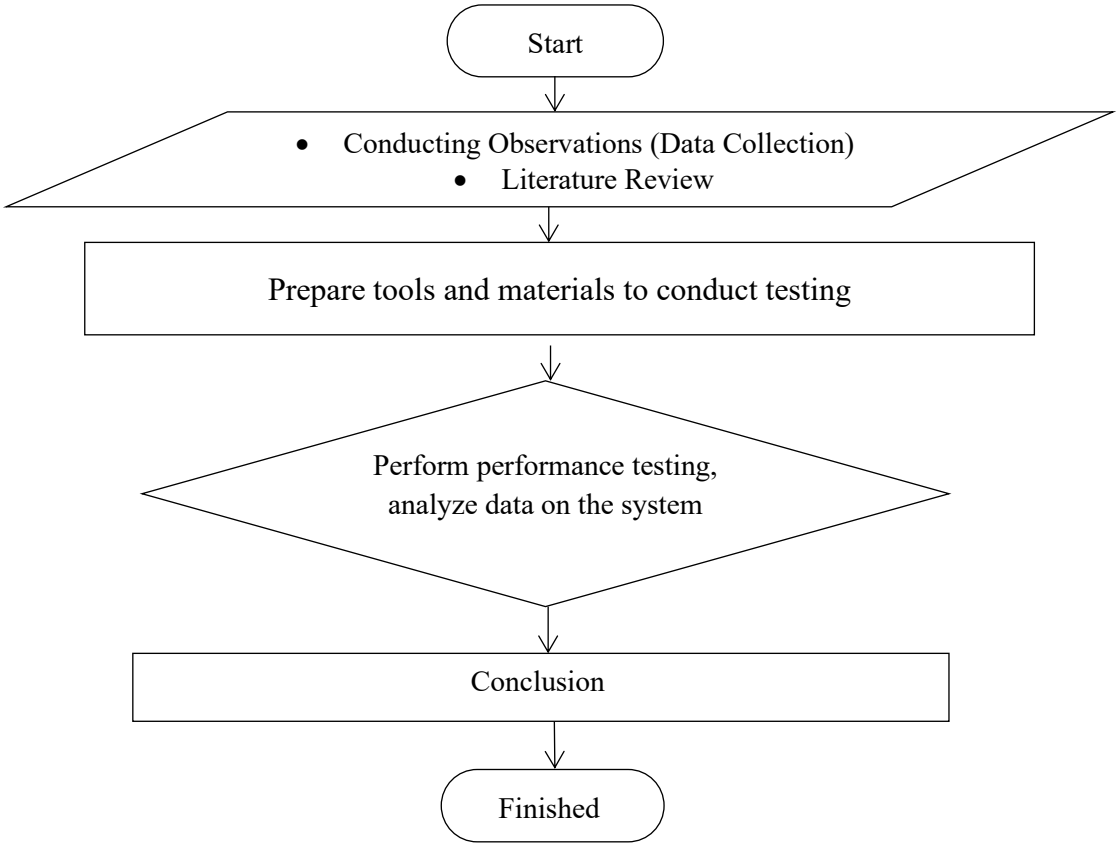

Figure 1. Flowchart Methodology

Table 1. Main components

Komponen	Spesifikasi	Fungsi
Arduino Uno	ATmega328P	Pengendali utama sistem
RFID Reader MFRC522	13.56 MHz	Pembaca UID RFID
Kamera OV7670	VGA 640×480	Pengambil gambar siswa
LCD 16x2	5V	Tampilan status sistem
Power Supply	5V DC	Sumber daya
PC/Database	MySQL + Python	Penyimpanan data absensi

Software Architecture

a) Arduino IDE for RFID reading logic and camera control.
b) Python (PySerial) for serial communication to the PC.
c) MySQL Database for storing attendance data.
d) Tkinter GUI for the admin interface.

The design and construction of the Arduino-based attendance device at the PAB Klumpang private high school used the following methodology:

1. The structure of the Arduino-based attendance device at the PAB Klumpang private high school consists of:
    a. RFID reader/detector
    b. Buzzer output device that beeps when detecting an RFID tag
    c. LCD output device for displaying text.
2. The design and creation of the program algorithm were carried out using Arduino Uno software. This section involves processing the RFID tag.

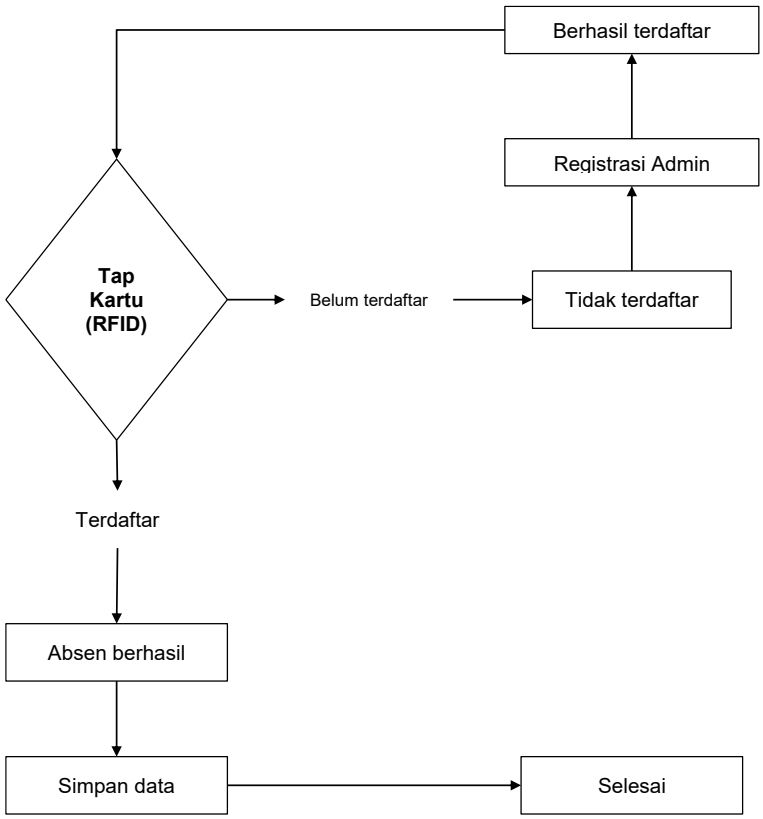

Figure 2. Arduino Attendance Flowchart

Block Diagram

1. Sensor: A representation of the sensors or detection devices used in the project. These sensors can be RFID tags.
2. Input/Output: This section includes all inputs and outputs directly connected to the Arduino Uno. Inputs can be signals from sensors or the user (e.g., buttons), while outputs can be signals sent to actuators or displays.
3. Arduino Uno: This is the brain of the system, housing the Arduino Uno microcontroller. The Arduino Uno is responsible for data processing, controlling inputs and outputs, and executing the written program code.
4. Program Code: This section includes all instructions or program code written in the Arduino programming language (usually using the Arduino IDE). This program code instructs the Arduino Uno on how to respond to inputs, process data, and control outputs according to predetermined logic.

5. Actuator: A representation of the device that responds to outputs from the Arduino Uno. This actuator can be a motor, an LED light, a buzzer, or any other device that performs a physical action based on instructions given by the Arduino Uno.
6. User Monitoring/Interaction: This section includes the user interface, if any, that allows the user to interact with the system. This could be an LCD screen, control knobs, or other device that allows the user to provide input or receive information from the system.

Results and Discussion

Testing was conducted at PAB Klumpang High School over five days on 100 students. Each student clocked in five times. Test parameters included RFID accuracy, image capture accuracy, and system response time.

Table 2. Test Scenarios

No	Parameter	Rata-rata Hasil	Standar Deviasi	Keterangan
1	Akurasi Pembacaan RFID	98.4%	±1.1%	Berhasil pada 492 dari 500 uji
2	Akurasi Kamera	95%	±2.3%	Gagal pada kondisi pencahayaan rendah
3	Waktu Respon Sistem	1.85 s	±0.3 s	Dari deteksi kartu → foto tersimpan
4	Kapasitas Database	500 entri	-	Stabil, tanpa delay signifikan
5	Konsumsi Daya	5.2 W	±0.4 W	Dalam kondisi operasi penuh

Performance Evaluation

a) Accuracy Evaluation
   RFID reading accuracy reached 98.4%, meaning only 1.6% of attempts failed due to the card being positioned too far or the antenna being misaligned. The camera demonstrated a 95% success rate, primarily dependent on lighting and the position of the student's face.
b) Speed Evaluation
   The average system response time was 1.85 seconds, consisting of :

- 0.4 seconds for RFID reading,
- 0.9 seconds for camera activation and image capture, and
- 0.55 seconds for data transmission to the PC.

   This speed is still adequate for use in classes with up to 40 students.

c) System Reliability
   During testing over five consecutive days, the system demonstrated 99% operational stability, with no crashes in serial communication.
   The system could be used continuously for six hours without overheating.
d) User Experience
   Teachers and operators stated that the system accelerated the attendance process by up to 70% compared to manual methods and almost completely reduced data errors.

The results show that the integration of RFID and an Arduino-based camera is an effective solution for an attendance system in secondary schools.
System advantages:

- High accuracy (≥95%)
- Fast response time (<2 seconds)
- Photographic evidence for validation
- The system can be expanded with Wi-Fi or the IoT cloud.

However, there are several limitations:

- The standard camera is not optimal in low light.
- The system does not yet support multi-location attendance.
- The Arduino Uno has limited memory, so facial recognition integration cannot be implemented directly.

Conclusion

This research successfully designed and implemented an automated attendance system based on RFID and an Arduino-based camera, with a success rate of 98.4% for RFID reading and 95% for image capture. The system delivered an average response time of 1.85 seconds, suitable for schools with large student populations. The camera integration adds a layer of security with visual evidence, thus minimizing attendance fraud. This system is capable of digitally storing data and generating automatic attendance summaries through a MySQL database.

References

[1] D. M. Dobkin, *The RF in RFID: Passive UHF RFID in Practice*, 2nd ed. Elsevier, 2012.
[2] M. Banzi and M. Shiloh, *Getting Started with Arduino*, 4th ed., Maker Media, 2020.
[3] R. S. Hidayat, "Desain Sistem Identifikasi Menggunakan RFID dan Arduino," *Jurnal Teknologi Elektro Indonesia*, vol. 8, no. 2, pp. 43–52, 2021.
[4] S. Wibowo, A. Kusuma, and T. Hidayat, "Sistem Absensi Mahasiswa Berbasis RFID dan Mikrokontroler Arduino," *Jurnal Teknologi Informasi dan Komunikasi*, vol. 9, no. 2, pp. 55–62, 2021.
[5] R. Putra and A. Sari, "Penerapan Sistem Absensi Menggunakan Face Recognition dan QR Code," *Jurnal Teknologi Elektro dan Komputer*, vol. 12, no. 3, pp. 122–130, 2020.
[6] D. Setiawan, "Perancangan Sistem Absensi Online Berbasis Arduino dan ESP8266," *Jurnal Teknologi Informasi dan Ilmu Komputer*, vol. 9, no. 1, pp. 80–86, 2022.
[7] P. Purnama, "Penerapan Teknologi RFID untuk Sistem Kehadiran Otomatis," *Jurnal Sistem Informasi Indonesia*, vol. 8, no. 2, pp. 102–110, 2021.
[8] H. Supriyadi, "Analisis Kinerja Sistem Absensi Digital di Lingkungan Pendidikan," *Jurnal Rekayasa Elektronika dan Komputer*, vol. 7, no. 4, pp. 200–209, 2023.
[9] S. Anwar, "Integrasi Kamera dan Mikrokontroler dalam Sistem Identifikasi Otomatis," *Jurnal Teknologi dan Rekayasa*, vol. 11, no. 1, pp. 14–21, 2022.
[10] A. Gupta, "Smart Attendance System Using RFID and GSM Technology," *International Journal of Engineering Research and Applications*, vol. 10, no. 4, pp. 32–38, 2021.
[11] Sijabat, Mardi, Muhammad Erpandi Dalimunthe, and Rahmaniar Rahmaniar. "An Analysis Of Electric Energy Monitoring And Protection Based On Smart Interface Systems." *Jurnal Scientia* 13.03 (2024): 1212-1221.
[12] Habeahan, Melki Andreas, Siti Anisah, and Muhammad Erpandi Dalimunthe. "Analysis of the Development of Control Algorithms for Artificial Intelligence-Based Manipulator Robots on Industrial Environment." *International Conferance Of Digital Sciences And Engineering Technology* (2025): 514-524.
[13] NS, Muhammad Faqih Fathurrahman, and Muhammad Erpandi Dalimunthe. "Air Quality Control System With Gas Leak Detection In Rooms With Fuzzy." *INFOKUM* 13.02 (2025): 420-431.
[14] Hutapea, Marshal, Mhd Erpandi Dalimunthe, And Yuliarman Saragih. "Rancang Bangun Trainable Robot Arm Berbasis Arduino Mega 2560 Sebagai Media Praktikum Di Laboratorium Teknik Elektro Universitas Pembangunan Pancabudi Medan." *Aisyah Journal Of Informatics And Electrical Engineering (Ajiee)* 6.2 (2024): 151-159.

[15] Muhardiansyah, Rahmaniar, and M. Erpandi Dalimunthe, “Wireless Sensor Network Performance Analysis for Indoor Air Quality Monitoring”, *ICDSET*, pp. 523–534, Jun. 2025.