

# Website-Based Anecdotal Information System at TK Wonoayu with RFID Login as Student Attendance and IoT–Telegram Integration

Cholifatul Sheila Nurinsani<sup>1</sup>, Chandrasena Setiadi<sup>2</sup>, Moh. Abdullah Anshori<sup>3</sup>

<sup>1, 2, 3</sup> Study Program of Digital Telecommunication Network, Department of Electrical Engineering, State Polytechnic of Malang, 65141, Indonesia

[cholifatulsheilanurinsani@gmail.com](mailto:cholifatulsheilanurinsani@gmail.com), [chandrasenasetiadi@polinema.ac.id](mailto:chandrasenasetiadi@polinema.ac.id), [anshori\\_ma@polinema.ac.id](mailto:anshori_ma@polinema.ac.id)

**Abstract**—The attendance recording, anecdotal note-taking, and student development monitoring processes at TK Wonoayu Kindergarten are still carried out manually, which requires additional time for data management, retrieval, and storage. This study aims to design and implement a website-based information system integrated with Radio-Frequency Identification (RFID), a fingerprint sensor, Internet of Things (IoT), and Telegram to support attendance recording and student monitoring activities. The developed system employs an ESP32 microcontroller integrated with a PN532 RFID module and a fingerprint sensor as an authentication medium for student attendance, connected in real time to a MySQL database through a Laravel-based REST API. The system also provides features for managing anecdotal records and student development data through a website, and automatically sends attendance and dismissal notifications to parents through a Telegram bot. Testing on eight students showed that RFID card reading and fingerprint authentication achieved a 100% success rate over 160 trials, while Telegram notification delivery also achieved a 100% success rate. All website features for administrators, teachers, and parents functioned properly based on black-box testing, indicating that the system supports a more structured and digitally documented attendance and monitoring process.

**Keywords**—Anecdotal Record, ESP32, Fingerprint Sensor, Internet of Things, RFID, Telegram Bot, Website

## I. INTRODUCTION

Kindergarten (TK) education is a form of guidance directed at children aged four to six years, provided through educational stimulation to support physical and spiritual growth so that children are prepared to enter further education. The curriculum emphasizes activities that build moral, social, emotional, language, cognitive, physical, and artistic potential from an early age [1]. At this stage, children are highly active and curious, so learning approaches are commonly delivered through play-based activities that require close observation from teachers [2].

TK Wonoayu, located in Wonoayu Village, Pilangkenceng Sub-district, Madiun Regency, East Java, is one such early-childhood institution that, besides delivering learning activities, is also responsible for monitoring student attendance and development. Based on observations and interviews with teachers, the attendance process is still performed by calling each student's name one by one and recording it manually in an attendance book. This process requires considerable time and direct teacher involvement before learning activities can begin. In addition, anecdotal notes and development assessments—used as the basis for preparing student progress reports—are still written and archived in physical form, making retrieval slow and the documents vulnerable to damage, loss, or fading.

Several studies have addressed related problems using RFID, IoT, and messaging-bot technologies. An RFID-based

student attendance system integrated with Telegram notifications has been shown to automatically record attendance and deliver real-time alerts to guardians [3]. An IoT-based lecture-attendance monitoring system has likewise demonstrated that microcontroller-based sensing combined with a centralized database can reduce the time required for manual attendance recapitulation in an educational institution [4]. A related IoT-based monitoring approach for student attendance has likewise been shown to reduce dependence on manual recapitulation of attendance records [5]. RFID has also been applied to library information systems as an efficient means of identifying users through Internet-of-Things connectivity [6]. A smart attendance-detection system built around an RFID card and an ESP32 microcontroller has likewise been reported to achieve reliable card identification with straightforward hardware integration and low deployment cost [7]. A similar prototype combining RFID identification with WhatsApp notifications reported a high real-time delivery success rate for informing parents of student arrival [8]. while a biometric attendance system integrating fingerprint sensing with academic-information-system data has shown that combining a card-based identifier with a biomKepala Sekolah factor increases resistance to identity misuse compared with single-factor identification [9].

On the messaging side, Telegram Bot services have been reported as an effective medium for delivering time-critical, automated notifications because messages are pushed directly

to the recipient's device without requiring the user to actively open an application [10]. A Telegram-bot architecture built on top of an IoT sensing layer has further shown that bot-based messaging can be embedded directly into a device-to-server pipeline, allowing notifications to be triggered automatically whenever new sensor data arrives at the server [11]. These studies indicate that the combination of RFID or biometric identification, microcontroller-based data acquisition, and bot-based messaging can substantially reduce the manual workload associated with attendance and monitoring tasks. However, most of the reviewed systems focus solely on attendance recording and do not address the accompanying documentation of anecdotal behavioral notes and developmental assessments that are central to early-childhood education under Indonesia's Merdeka Curriculum [12], which motivates the broader scope adopted in this study.

Building on these findings, this study designs and implements a website-based information system for TK Wonoayu that integrates RFID card and fingerprint authentication for student attendance, an ESP32 microcontroller for real-time data acquisition, a MySQL database for centralized storage, and a Telegram bot for automated parental notification. Beyond attendance recording, the system also provides digital anecdotal note-taking and student development documentation accessible to teachers and parents according to their respective access rights.

Specifically, this study aims to: (1) design and build a website-based information system for managing attendance, anecdotal notes, and student-development data at TK Wonoayu; (2) develop an ESP32-based RFID attendance mechanism connected to the database in real time; (3) develop a digital anecdotal-note and development-recording feature that can be managed by teachers through the website; (4) design a parent-facing access mechanism that allows guardians to view attendance, anecdotal, and development information according to their assigned access rights; and (5) integrate the website, database, RFID/ESP32 device, and Telegram to jointly support student-data management and automatic delivery of attendance and dismissal notifications to parents. The remainder of this paper is organized as follows: Section II describes the research method and system design, Section III presents the implementation results and testing discussion, and Section IV concludes the paper.

## II. METHOD

### A. Research Type

This study applies the Research and Development (R&D) method to design and build a web-based anecdotal and student-development information system integrated with RFID, IoT, and Telegram. The developed system covers RFID/fingerprint-based attendance, anecdotal note recording, student-development management, and automatic attendance/dismissal notifications sent to parents via Telegram.

### B. Research Stages

The research stages, illustrated in the flowchart in Fig. 1, begin with problem identification, in which interviews and direct observation were conducted with teachers and staff at TK Wonoayu to confirm that attendance recording, anecdotal

note-taking, and student-development documentation were still performed manually, causing data retrieval and archiving to take longer than necessary.

After the problem was identified, a literature study was carried out covering RFID technology, the PN532 reader module, the ESP32 microcontroller family, IoT communication concepts [13], REST API design, the MySQL relational database, the Laravel web framework, the Telegram Bot API, and anecdotal-assessment concepts under the Merdeka Curriculum [14], so that the technology choices made in later stages were grounded in established practice.

Data collection was then performed to determine the functional and non-functional requirements of both the hardware and the software subsystems. On the hardware side, this included the RFID card, the PN532 module, the ESP32-C6 board, the FPM10A fingerprint sensor, the I2C LCD, the buzzer, and the battery/UPS power components; on the software side, it included the Laravel-based website, the MySQL database, the REST API, and the Telegram bot. These requirements were used to produce the system flowchart, the application flowchart, and the hardware and application block diagrams referred to in Section II-D.

The hardware-assembly and website-development stage covered assembling the RFID/fingerprint attendance device around the ESP32-C6, developing the Laravel-based website, integrating the REST API with a VPS hosting server, implementing the student-attendance, anecdotal-note, and daily-development-assessment features, configuring the Telegram bot as the attendance/dismissal notification channel, and applying role-based access control for the teacher and parent accounts.

System testing was then conducted to confirm that every component functioned correctly, covering RFID-card reading, fingerprint reading, ESP32-to-server data transmission, Telegram notification delivery, website functionality, and role-based data access, with any defects found during testing corrected and re-tested before proceeding.

Once the system was confirmed to operate correctly, data were collected on the success rate of RFID reading, fingerprint reading, database transmission, Telegram delivery, and website access by teachers and parents, and the resulting data were analyzed to assess the overall performance of the system from card reading through to notification delivery, leading to the conclusions summarized in Section IV.

Finally, the overall system was evaluated based on functional performance, data accuracy, and successful communication between all integrated components. The evaluation considered the consistency of RFID and fingerprint identification, real-time synchronization with the database, website accessibility according to user roles, and successful delivery of Telegram notifications. The final results were then interpreted to determine whether the developed system fulfilled the objectives of providing a digital attendance, anecdotal-record, and student-development management system for TK Wonoayu.

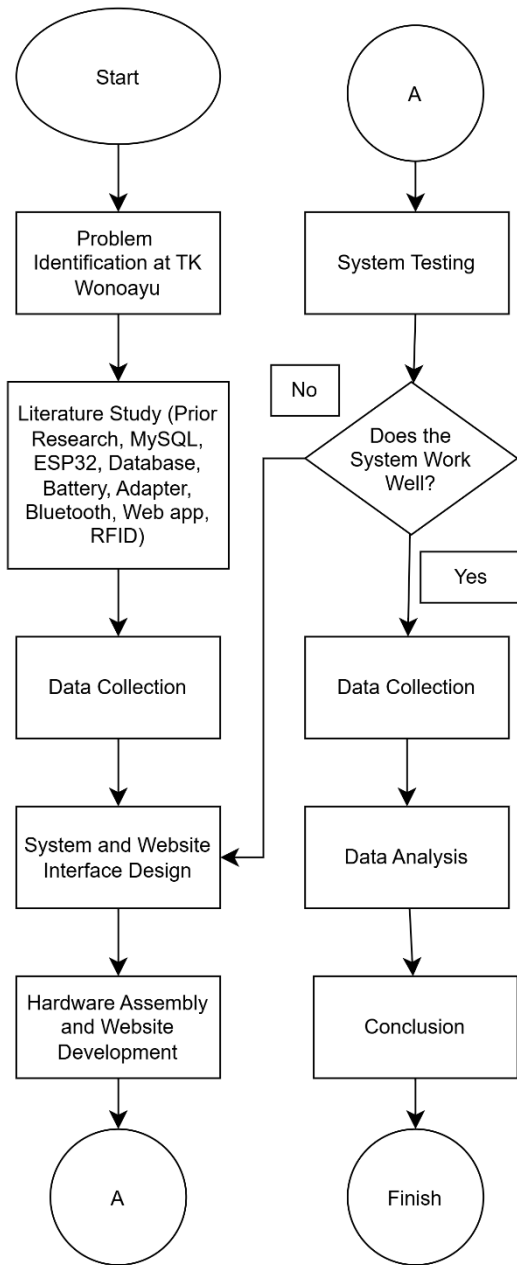


Figure 1 Research flowchart, from problem identification to conclusion.

### C. System Requirements

The hardware requirements consist of an RFID card as the student identity medium, a PN532 RFID reader module, an ESP32-C6 microcontroller, an FPM10A fingerprint sensor, a 16x2 I2C LCD, a buzzer, dual 18650 Li-Ion batteries [15], and a 2S UPS module for power backup. The software requirements consist of a Laravel-based website, a MySQL database, a REST API for device-to-server communication, and the Telegram Bot API for notification delivery. Table I summarizes the main hardware and software components together with their functions.

TABLE I.  
SYSTEM HARDWARE AND SOFTWARE COMPONENTS

| Component               | Function                                                                    |
|-------------------------|-----------------------------------------------------------------------------|
| PN532 RFID Module       | Reads the student RFID card as attendance identity                          |
| ESP32-C6                | Main controller; processes sensor data and sends it to the server via Wi-Fi |
| FPM10A Fingerprint      | Performs biometric verification of student identity                         |
| LCD 16x2 I2C            | Displays attendance status and system information                           |
| Buzzer                  | Provides audible success/failure feedback                                   |
| Li-Ion 18650 (2S) + UPS | Supplies backup power to the device                                         |
| Laravel Website         | Manages users, attendance, anecdotal notes, and development data            |
| MySQL Database          | Centrally stores all system data                                            |
| REST API                | Bridges the ESP32 device and the web server in real time                    |
| Telegram Bot            | Delivers automatic attendance/dismissal notifications to parents            |

The choice of each component was guided by the literature review in addition to the school's operating constraints. A 13.56 MHz high-frequency RFID card was selected together with the PN532 reader because this combination meets the attendance system's requirements for fast, accurate, and secure user identification while remaining widely available and inexpensive [16]. For biometric verification, the FPM10A fingerprint module was chosen over more expensive alternatives because it can be interfaced with the ESP32 through a simple UART connection, consumes relatively little power, and offers more than sufficient capacity for the limited number of users found in a kindergarten setting, making it a cost-effective choice. The ESP32-C6 was selected as the main controller over boards such as the Arduino Uno or the ESP8266 because it integrates Wi-Fi connectivity without requiring an additional communication module, simplifying the overall hardware design while keeping power consumption manageable. The LCD status display communicates with the ESP32-C6 over I2C rather than a parallel interface because I2C requires only two signal lines (SDA and SCL), which reduces pin usage on the microcontroller and simplifies integration with the other peripherals on the same bus. On the software side, MySQL was selected as the database engine and Laravel as the web framework because prior performance comparisons report that a Laravel-based web application paired with MySQL provides adequate throughput compared with configuring an equivalent stack manually [17]. Laravel's built-in MVC architecture was also reported to simplify development compared with configuring an equivalent stack manually [18].

### D. System Design and Architecture

The system design stage produced four main diagrams: a hardware block diagram describing how the PN532 module,

the FPM10A fingerprint sensor, the LCD, and the buzzer are wired to the ESP32-C6 and how the ESP32 communicates with the server; a website block diagram describing the modules accessible to each of the three user roles; a flowchart describing how a student's RFID unique identifier (UID) is registered into the database before the card can be used for attendance; and a flowchart describing the overall workflow of the website, beginning at the login page, where the system directs the user to the administrator, teacher, or parent dashboard according to the selected account type and the credentials entered. Once a teacher or parent successfully logs in, the flowchart directs them to a dashboard summarizing the information relevant to their role: a teacher is shown class-wide statistics and quick access to the data-input menus, while a parent is directed to a dashboard summarizing their own child's attendance, anecdotal notes, development records, and upcoming school agenda, together with any Telegram notifications already sent.

Table II lists the wiring configuration between the ESP32-C6 GPIO pins and the LCD, the PN532 module, the buzzer, and the FPM10A fingerprint module, derived directly from the assembled device shown in Fig. 2 and Fig. 3.

TABLE II.  
WIRING CONFIGURATION OF THE ATTENDANCE DEVICE

| Component    | Pin  | ESP32-C6 Pin | Function           |
|--------------|------|--------------|--------------------|
| LCD 16x2 I2C | SDA  | GPIO 5       | I2C data           |
| LCD 16x2 I2C | SCL  | GPIO 6       | I2C clock          |
| LCD 16x2 I2C | VCC  | 5V           | Voltage input      |
| LCD 16x2 I2C | GND  | GND          | Ground             |
| PN532        | GND  | GND          | Ground             |
| PN532        | VCC  | 5V           | Voltage input      |
| PN532        | SDA  | GPIO 2       | Data line          |
| PN532        | SCL  | GPIO 3       | Clock line         |
| Buzzer       | PIN+ | GPIO 0       | Voltage input      |
| Buzzer       | GND  | GND          | Ground             |
| FPM10A       | TX   | RX0          | UART communication |
| FPM10A       | RX   | TX0          | UART communication |
| FPM10A       | VIN  | 5V           | Voltage input      |
| FPM10A       | GND  | GND          | Ground             |

In operation, each student is issued an RFID card as their identity for attendance. The card is scanned using the ESP32-based device, which is connected to a Wi-Fi network so that attendance data can be transmitted automatically to the database through the REST API. Fingerprint verification is used as a secondary authentication factor on the same device. Once the ESP32 confirms a valid read, the LCD and buzzer provide immediate feedback to the student, the record is written to the MySQL database in real time, and the Telegram bot

sends an attendance or dismissal notification to the parent linked to that student's registered phone number.

The REST API acts as the communication bridge between the ESP32 device and the Laravel application hosted on a VPS server: each successful RFID or fingerprint read is packaged by the ESP32-C6 as a JSON payload and sent over HTTPS to a dedicated attendance endpoint, which validates the student identifier against the MySQL database before writing the timestamped record and triggering the corresponding Telegram notification. This request-response pattern keeps the device firmware lightweight, since the ESP32 only needs to perform sensor reading, local feedback, and payload transmission, while all business logic—such as determining whether a scan corresponds to an arrival or a dismissal, and which parent account should receive the notification—is handled centrally on the server. Teachers manage anecdotal notes and development assessments through the website, while parents may only view the information relevant to their own child through role-based access control enforced at the application layer, preventing unauthorized modification of stored records. System testing focused on four parameters: (1) success of RFID card reading as student identity; (2) success of fingerprint reading and matching; (3) reliability of attendance-data transmission from the ESP32 device to the database; and (4) reliability of Telegram notification delivery to parents. Website functionality for the admin, teacher, and parent roles was evaluated using black-box testing.

### III. RESULTS AND DISCUSSION

#### A. Research Site and Period

This research was conducted at TK Wonoayu, located on Jl. Poros, Wonoayu Village, Pilangkenceng Sub-district, Madiun Regency, East Java 63152, an early-childhood education institution currently serving 19 registered students across its groups. The literature study and requirement analysis were carried out in April 2025, while the assembled hardware and the completed website were tested directly on-site in June 2026. Conducting both hardware and software testing at the actual school site, using the students' real RFID cards and registered fingerprints, allowed the evaluation in the following subsections to reflect conditions close to the system's intended daily operating environment rather than a purely laboratory setting.

#### B. Hardware Implementation

The attendance device was assembled by integrating the PN532 RFID module and the FPM10A fingerprint sensor with the ESP32-C6 microcontroller, an I2C LCD for status display, a buzzer for audible feedback, and a dual 18650 Li-Ion battery pack managed by a 2S UPS module [19] to keep the device operational during short power interruptions. The ESP32-C6 was selected over alternatives such as the Arduino Uno or the ESP8266 because it integrates Wi-Fi connectivity without requiring an additional communication module, while still providing sufficient GPIO pins for the LCD, the RFID reader, the fingerprint sensor, and the buzzer simultaneously. The LCD

communicates with the microcontroller over I2C, which was chosen because it requires only two signal lines (SDA and SCL), simplifying pin allocation and easing integration with the other peripherals connected to the same bus. Fig. 2 shows the assembled device, while Fig. 3 shows the LCD and fingerprint sensor used for on-device authentication feedback.

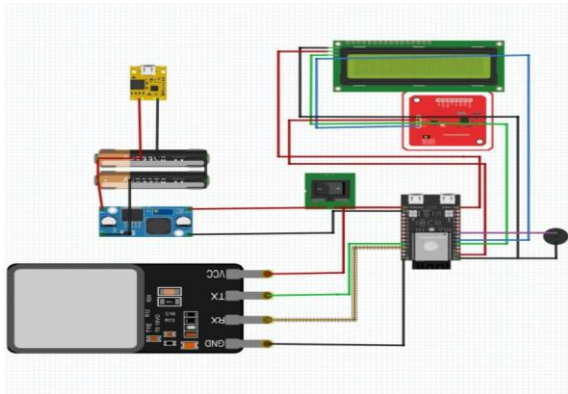


Figure 2. Assembled RFID/fingerprint attendance device.

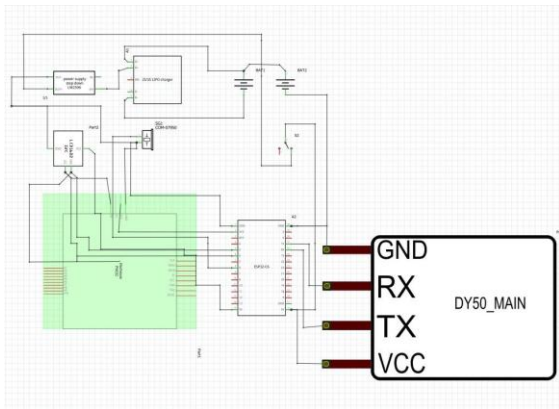


Figure 3. LCD status display and fingerprint sensor module.

### C. Website Implementation

The website was developed using the Laravel framework with three access levels: administrator, teacher, and parent, each reached through a single shared login page where the user first selects the account type—Admin, Guru (teacher), or Wali Murid (parent)—before entering their credentials. The administrator manages user accounts—including searching, adding, editing, activating/deactivating, and deleting accounts—and monitors overall system activity through a summary dashboard that displays the total number of registered users, a recap of attendance across the school, and the most recent activity recorded by the system, giving the administrator a quick overview before drilling down into individual records. Fig. 4 shows an example of the resulting dashboard interface.



Figure 4. Example of the system dashboard interface.

The teacher role provides the widest set of features: a student database module for managing student profiles, identity, address, group, and guardian data; a school-agenda module for scheduling activities and holidays; an attendance module that records daily status (present, permitted, sick, or absent) together with automatically logged arrival and dismissal times; a daily-assessment module for recording each child's developmental progress per aspect; an anecdotal-note module for documenting specific behavioral events objectively, including time, location, and description; a semester development-narrative module summarizing each child's achievements as a report shown to parents; a feedback module for reading and replying to messages sent by parents; a settings module for account, password, RFID-integration, and Telegram-connection management; and a Telegram module for guiding parents through linking their phone number and monitoring bot connection status, as illustrated in Fig. 5. The parent role, by contrast, is restricted to a read-only view of attendance, anecdotal notes, and development information for their own child, together with a feedback channel to the teacher, so that data integrity is preserved while communication between the school and parents is maintained.

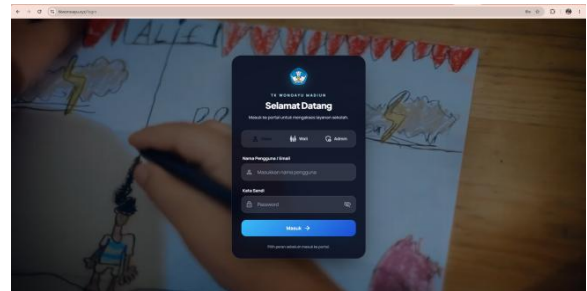


Figure 5. Example of a teacher-side management module.

### D. RFID and Fingerprint Reading Test

Reading tests were carried out on eight students—Arsha, Arsy, Niko, Rania, Ghina, Kinara, Yasna, and Ghalia—to confirm that each RFID card and each registered fingerprint could be read correctly and matched with the corresponding student identity stored in the database. Each student's card was tapped once on the PN532 reader and their finger placed once

on the FPM10A sensor, and the result displayed on the LCD together with the record written to the database were compared against the student's registered identity to determine whether the reading was correct. All eight students' RFID cards and fingerprints were successfully read, and the displayed data matched the registered identity in every case, as summarized in Table III.

TABLE III.  
RFID AND FINGERPRINT READING TEST RESULTS

| Student | RFID Status | Fingerprint Status | Remarks      |
|---------|-------------|--------------------|--------------|
| Arsha   | Success     | Success            | Data matched |
| Arsy    | Success     | Success            | Data matched |
| Niko    | Success     | Success            | Data matched |
| Rania   | Success     | Success            | Data matched |
| Ghina   | Success     | Success            | Data matched |
| Kinara  | Success     | Success            | Data matched |
| Yasna   | Success     | Success            | Data matched |
| Ghalia  | Success     | Success            | Data matched |

As a representative example, when the student Arsha arrives at school and taps her RFID card on the reader, the ESP32-C6 identifies her UID, prompts a fingerprint scan for secondary verification, and—once both checks succeed—immediately shows a success message on the LCD accompanied by a short buzzer tone, sends the timestamped record to the server through the REST API, and triggers the Telegram bot to deliver an arrival notification to the phone number registered under Arsha's parent account. The same sequence is repeated in reverse for dismissal, so that the parent receives a distinct notification when the child leaves school. This end-to-end flow, repeated consistently across all eight tested students, forms the basis of the accuracy results reported in the following subsection.

#### E. Reading Accuracy Test

Accuracy testing was performed with 20 trials per student for both RFID and fingerprint reading, totaling 160 trials for each parameter (8 students x 20 trials). As shown in Tables IV and V, all trials were completed successfully, giving a 100% accuracy rate for both RFID card reading and fingerprint authentication, with no failed attempts recorded during testing.

TABLE IV.  
RFID READING ACCURACY TEST

| Student | Trials | Success | Fail | Accuracy (%) |
|---------|--------|---------|------|--------------|
| Arsha   | 20     | 20      | 0    | 100          |
| Arsy    | 20     | 20      | 0    | 100          |
| Niko    | 20     | 20      | 0    | 100          |
| Rania   | 20     | 20      | 0    | 100          |
| Ghina   | 20     | 20      | 0    | 100          |
| Kinara  | 20     | 20      | 0    | 100          |
| Yasna   | 20     | 20      | 0    | 100          |
| Ghalia  | 20     | 20      | 0    | 100          |

TABLE V.  
FINGERPRINT READING ACCURACY TEST

| Student | Trials | Success | Fail | Accuracy (%) |
|---------|--------|---------|------|--------------|
| Arsha   | 20     | 20      | 0    | 100          |
| Arsy    | 20     | 20      | 0    | 100          |
| Niko    | 20     | 20      | 0    | 100          |
| Rania   | 20     | 20      | 0    | 100          |
| Ghina   | 20     | 20      | 0    | 100          |
| Kinara  | 20     | 20      | 0    | 100          |
| Yasna   | 20     | 20      | 0    | 100          |
| Ghalia  | 20     | 20      | 0    | 100          |

#### F. Telegram Notification Test

Telegram notification testing verified that arrival and dismissal notifications were delivered correctly to the parent account linked to each student. Across 160 delivery trials (8 students x 20 trials), all notifications were successfully sent and received consistent with the corresponding attendance records, giving a 100% delivery success rate as shown in Table VI.

TABLE VI.  
TELEGRAM NOTIFICATION ACCURACY TEST

| Student | Trials | Success | Fail | Success Rate (%) |
|---------|--------|---------|------|------------------|
| Arsha   | 20     | 20      | 0    | 100              |
| Arsy    | 20     | 20      | 0    | 100              |
| Niko    | 20     | 20      | 0    | 100              |
| Rania   | 20     | 20      | 0    | 100              |
| Ghina   | 20     | 20      | 0    | 100              |
| Kinara  | 20     | 20      | 0    | 100              |
| Yasna   | 20     | 20      | 0    | 100              |
| Ghalia  | 20     | 20      | 0    | 100              |

#### G. Website Functional (Black-Box) Testing

Functional testing covered user login, student-data management, attendance management, anecdotal-note management, development-data management, and information presentation for each of the three roles. All tested features—including login/logout, CRUD operations on student data, attendance recording, anecdotal-note input, development-assessment input, and role-restricted read-only access for parents—produced the expected results, as summarized in Table VII.

TABLE VII.  
WEBSITE BLACK-BOX TESTING SUMMARY

| Role          | Features Tested | Status     |
|---------------|-----------------|------------|
| Teacher       | 6               | All Passed |
| Parent        | 6               | All Passed |
| Administrator | 9               | All Passed |

#### H. Discussion

Taken together, the results in Tables III–VIII show a consistent pattern across every tested layer of the system: identity capture at the device level (RFID and fingerprint

reading), data transport between the device and the server (ESP32-to-database transmission), notification delivery to end users (Telegram), and application-level functionality (website black-box testing) all performed without a single recorded failure across the tested trials. This consistency suggests that the weakest link in the previous manual process—delays and errors introduced by repeated manual data handling—has been effectively addressed by automating identity capture and data transmission, while the remaining human-in-the-loop steps, such as writing anecdotal notes and development assessments, are now supported by structured digital forms rather than free-form paper records.

The overall test recapitulation in Table VIII shows that all three tested aspects—RFID/fingerprint reading accuracy, Telegram notification delivery, and website functionality—achieved fully successful results.

TABLE VIII.  
RECAPITULATION OF TESTING RESULTS

| Testing Type     | Parameter                             | Result  |
|------------------|---------------------------------------|---------|
| RFID/Fingerprint | Card and Fingerprint Reading Accuracy | Success |
| Telegram         | Notification Delivery Success Rate    | Success |
| Black-Box        | System Function Success               | Success |

From an operational standpoint, the main advantage observed during testing is the reduction in manual effort: teachers no longer need to call each student's name individually or search through physical archives to retrieve a child's attendance or developmental history, since every record is timestamped and searchable directly on the website. The dual-factor identification (RFID plus fingerprint) also reduces the likelihood of proxy attendance, an issue not addressed by single-factor RFID systems. From an operational standpoint, the main advantage observed during testing is the reduction in manual effort: teachers no longer need to call each student's name individually or search through physical archives to retrieve a child's attendance or developmental history, since every record is timestamped and searchable directly on the website. The dual-factor identification (RFID plus fingerprint) also reduces the likelihood of proxy attendance, an issue not addressed by single-factor RFID systems. At the same time, the current implementation has several limitations that should be acknowledged: the device relies on a stable Wi-Fi connection to transmit data in real time, so a network outage would delay both database updates and Telegram notifications until connectivity is restored; the battery and UPS module extend operating time during brief interruptions but have not been evaluated over a full multi-day power-loss scenario; and the evaluation involved a single cohort of eight students at one school, so performance under a larger and more diverse student population has not yet been established.

These results indicate that the ESP32-based RFID/fingerprint device communicates reliably with the

MySQL database over Wi-Fi, and that the Telegram bot delivers time-sensitive notifications without failure under the tested conditions. Compared with prior RFID-based attendance systems that rely solely on card identification, the addition of fingerprint verification in this study provides a secondary authentication layer that reduces the risk of a student's card being used by another person. In addition, unlike systems that only record attendance, the developed system also digitizes anecdotal notes and development assessments, which are essential components of early-childhood learning documentation under the Merdeka Curriculum.

### I. Comparison with Related Systems

Table IX qualitatively compares the feature coverage of the proposed system against three related RFID/IoT-based attendance systems reported in prior studies. The comparison shows that while single-factor RFID identification and real-time notification are common to most of the reviewed systems, the combination of dual-factor (RFID and fingerprint) identification with digital anecdotal-note and development-report management is unique to the system developed in this study.

In contrast, the proposed system integrates dual-factor authentication using RFID and fingerprint recognition with a web-based information system that supports attendance management, anecdotal-note recording, student-development assessment, and role-based access for teachers and parents. Furthermore, the system is integrated with a Telegram Bot to automatically deliver attendance and dismissal notifications to parents in real time. These additional features extend the functionality beyond conventional attendance systems, making the proposed system more suitable for early childhood education environments where continuous monitoring of student development is required. Therefore, the proposed system offers a more comprehensive solution by combining secure user identification, digital student-record management, and real-time communication within a single integrated platform.

TABLE IX.  
FEATURE COMPARISON WITH RELATED SYSTEMS

| System                   | RFID | Finger print | Real-Time Notification | Anecdotal/ Development Record |
|--------------------------|------|--------------|------------------------|-------------------------------|
| RFID–Telegram attendance | Yes  | No           | Yes                    | No                            |
| RFID–WhatsApp attendance | Yes  | No           | Yes                    | No                            |
| Biometric attendance     | No   | Yes          | No                     | No                            |
| Proposed system          | Yes  | Yes          | Yes                    | Yes                           |

Feedback obtained from TK Wonoayu indicated that the system was considered helpful in reducing the time teachers spend on manual attendance calling and in giving parents faster

access to their child's attendance status; teachers in particular noted that the RFID-based attendance feature simplified daily recording, while the Telegram notification feature was seen as making information delivery to parents noticeably faster than the previous verbal or paper-based communication. Nevertheless, the current evaluation was limited to eight students over a relatively short testing period; broader deployment across a larger number of students and a longer operational period is required to further validate the system's reliability, particularly regarding Wi-Fi network stability and battery endurance under continuous daily use.

#### **J. Limitations and Future Work**

Several limitations of the current implementation should be noted. First, testing was restricted to eight students and a single testing window in June 2026, so the 100% success rates reported in Tables IV–VI should be interpreted as evidence of correct operation under the tested conditions rather than a guarantee of long-term reliability at full school enrollment. Second, the RFID card in this study is used purely as an identity token and is not used to store any data locally, so the system depends entirely on a stable Wi-Fi connection to the server; a prolonged network outage would delay attendance recording until connectivity is restored. Third, the current notification channel is limited to Telegram, which requires each parent to install and register the Telegram application; parents unfamiliar with the platform may need additional guidance during onboarding. Building on the suggestions gathered from TK Wonoayu, future development can extend the system with additional features tailored to the school's evolving needs, evaluate system stability over a longer operating period, adapt the platform for larger student populations and other education levels beyond kindergarten, and add alternative or supplementary notification channels beyond Telegram, such as WhatsApp or SMS, to accommodate parents with different messaging-app preferences.

#### **IV. CONCLUSION**

The website-based information system developed for TK Wonoayu, integrated with RFID, a fingerprint sensor, an ESP32 microcontroller, a MySQL database, and a Telegram bot, successfully supports automatic student attendance recording, digital anecdotal note-taking, and student-development documentation, while automatically notifying parents through Telegram. Testing on eight students over 160 trials each showed a 100% success rate for RFID card reading, fingerprint authentication, and Telegram notification delivery, and black-box testing confirmed that all website features for the administrator, teacher, and parent roles functioned as designed. The RFID-based attendance feature was found to simplify daily record-keeping for teachers, while the Telegram integration made attendance information reach parents considerably faster than the previous manual, verbally communicated process. These results demonstrate that the integration of RFID/biometric identification, IoT-based data transmission, and bot-based messaging can transform a previously manual, paper-based attendance and monitoring process into a structured, reliable, and digitally documented system suitable for early-childhood education settings. For

future development, the system can be extended with additional features tailored to specific school needs, evaluated over a longer operating period to further confirm its stability, adapted for use by a larger number of users and other education levels beyond kindergarten, and expanded to support notification channels in addition to Telegram.

#### **ACKNOWLEDGEMENTS**

The authors would like to thank the principal, teachers, and staff of TK Wonoayu for their cooperation during the observation, implementation, and testing stages of this research, and the Department of Electrical Engineering, Politeknik Negeri Malang, for its support throughout this study.

#### **REFERENCES**

- [1] H. Pendidikan and T. Kanak-kanak, "Hakikat Pendidikan dan Pembelajaran di Taman Kanak-kanak," pp. 1–28.
- [2] R. Astria and S. Harahap, "Jurnal Pendidikan dan Konseling," vol. 4, pp. 625–630, 2022.
- [3] B. A. Prakosa et al., "Implementation of a Real-Time Wi-Fi Voucher Notification System Utilizing Telegram API," *Ingénierie des Systèmes d'Information*, vol. 28, no. 6, pp. 1587–1596, 2023.
- [4] M. B. Alwi, R. Medistarani, A. T. Kamila, and R. T. Sarwanti, "Pengembangan Sistem Absensi Mahasiswa Berbasis IoT dengan Integrasi RFID dan Telegram," vol. 14, no. 1, 2026.
- [5] T. A. Barokah, D. Setyawan, and N. H. Sudibyo, "Sistem Monitoring Kehadiran Mahasiswa Berbasis IoT," vol. 2, no. 3, pp. 834–843, 2024.
- [6] Z. Arifin, D. Rahmawati, and H. Sukri, "Rancang Bangun Sistem Informasi Perpustakaan Menggunakan Radio Frequency Identification Berbasis Internet of Things," *Semin. Nas. FORTEI Reg.*, vol. 7, pp. 1–7, 2020.
- [7] F. F. Asshiddiqi, A. Triayudi, and R. T. Aldisa, "Pembangunan Smart Detection Absensi Berbasis Kartu RFID dan ESP32," vol. 4, pp. 204–209, 2022, doi: 10.30865/json.v4i1.4912.
- [8] "Prototype Sistem Absensi Siswa Berbasis RFID dengan Notifikasi WhatsApp Real-Time," vol. 13, no. 3.
- [9] M. M. ESP32, "Implementasi Sistem Absensi Biometrik Mahasiswa Terintegrasi Data Kehadiran SIMAK Dosen Menggunakan Mikrokontroler ESP32."
- [10] F. Fitriansyah, "Telegram," *Cakrawala J. Hum. Bina Sarana Inform.*, vol. 20, p. 113, 2021.
- [11] Dept. of Elect. Eng., Univ. Jenderal Soedirman, "Aplikasi Bot Telegram pada Sistem Berbasis IoT," 2022.
- [12] Agency for Standards, Curriculum, and Educational Assessment, Ministry of Education, Culture, Research and Technology of Indonesia, 2022.
- [13] A. Syahfitri, "Internet of Things (IoT): Sejarah, Teknologi, dan Penerapannya," 2025.
- [14] Ministry of Education, Culture, Research and Technology of Indonesia, "Penilaian Pembelajaran," 2023.
- [15] F. A. Perdana, "Baterai Lithium," vol. 9, no. 2, pp. 103–109, 2020, doi: 10.20961/inkuiri.v9i2.50082.
- [16] H. Djamal, "Radio Frequency Identification (RFID) dan Aplikasinya," *TESLA J. Tek. Elektro*, vol. 16, no. 1, pp. 45–55, 2023.
- [17] R. Wodyk and M. Skublewska-Paszkowska, "Performance Comparison of Relational Databases SQL Server, MySQL and PostgreSQL Using a Web Application and the Laravel Framework," vol. 17, no. 9, pp. 358–364, 2020.
- [18] T. M. Sinaga, A. Zuhdi, and G. B. Santoso, "MVC Implementation in Laravel Framework for Development of Web-Based E-Commerce Applications," vol. 1, no. 1, pp. 37–42, 2021.
- [19] B. Hauke, F. Buck, and C. Power, "Basic Calculation of a Buck Converter's Power Stage," pp. 1–8, 2023.