

Design, Build, and Implement Monitoring Applications Student Grades and Violations

Puteri Nurul Ma'rifah
Electrical Engineering
University Trunojoyo of Madura
Bangkalan, Indonesia
puteri.marifah@trunojoyo.ac.id

Achmad Zain Nur
Electrical Engineering
University Trunojoyo of Madura
Bangkalan, Indonesia
azain.nur@trunojoyo.ac.id

Luthfi Awwalia
Mechatronics Engineering
University Trunojoyo of Madura
Bangkalan, Indonesia
luthfi.awwalia@trunojoyo.ac.id

Wildan Surya Wijaya
Electrical Engineering
University of PGRI Adi Buana
Surabaya, Indonesia
wildansurya@unipasby.ac.id

Puteri Nurul Magfirah
Defense Strategic Installation Agency
Ministry of Defence of the Republic of Indonesia,
Jakarta, Indonesia
puteri.nurul@kemhan.go.id

Abstract— Information and communication technology development has entered the era of Industry 4.0, requiring the educational sector to adapt more rapidly and efficiently. Thus, information technology has been integrated into various learning activities. However, the monitoring of information on students' learning progress is mostly carried out by the schools, while parents typically receive report cards at the end of the term. This does not provide effectiveness, as it limits parental involvement in early supervision. This research is designed to help both teachers and parents in supervising students more directly. This research utilizes NFC (Near Field Communication) technology for recording student attendance at school. Based on the results of application testing, users gave high ratings to the system in terms of interface design, NFC card reading accuracy, ease of managing student permissions, recording student behavior and academic grades, as well as the tool's completeness and functionality. The average success rate of horizontal NFC card reading reached 100%, while vertical reading achieved 90%. The maximum reading distance was 4 cm for Samsung A50s (version 10.0) and Samsung A30s (version 10.0), and 3 cm for the Redmi Note 8 Pro (version 9.0).

Keywords— *Student behavior, student achievement, teacher-parent communication, NFC, Firebase*

I. INTRODUCTION

Students are one of the human components that play a central role in the teaching and learning process [1]. Up to now, the task of monitoring students' learning progress, their behavior, and academic grades has mostly been the responsibility of the school. However, academic achievement reflects the level of success that students achieve in learning at school [2], and this moral behavior is greatly influenced by the parenting upbringing as well as the behavioral environment surrounding the student. Additionally, moral development is closely related to the child's cognitive and emotional development [3].

Parents typically receive updates about students' behavior and achievements only once per semester, during

report card distribution. If a student commits a violation, the school will inform the parents by sending a formal summons. This certainly does not work effectively because it excludes parents from the early stages of supervision. Such conditions are often found in school settings, including elementary level.

The current approach to supervising and guiding students does not align with the principles outlined in Article 3 of Law Number 20 of 2003 on the National Education System. Therefore, the collaboration of all parties is needed to achieve the intended functions and objectives of national education. In addition to schools, parents also share responsibility in supporting the national education functions and objectives.

Nowadays, NFC (Near Field Communication) technology plays an increasingly important role in daily life. NFC is a technology developed based on RFID (Radio Frequency Identification) [4], which integrates additional technologies such as internet connectivity and smart card systems [5]. Several studies have demonstrated the effectiveness of NFC technology in many fields, including healthcare. Numerous successful implementations, such as applications for tracking items. [6]–[8] and smart home security system utilizing machine-to-machine communication [9]–[11], etc.

In addition to NFC technology, this study also utilizes Firebase as a cloud database to facilitate communication between the smartphones of teachers and parents. Firebase serves as a central storage system for all data information, which can be accessed by users [12][13]. Provided by Google, Firebase offers tools and services that simplify the building, managing, and expanding of mobile applications. There are several services provided by Firebase. These services are divided into three primary functions: app development, app growth, and app enhancement. Among its key services are Firebase Authentication, Firebase Real-time Database, Firebase Storage, etc. The Firebase Real-time Database, a NoSQL database, stores data in JavaScript Object Notation (JSON), enabling developers to manage real-time data efficiently [14][15].

Based on the presentation, it is evident that technology plays an important role in building effective communication between educational institutions, teachers and parents, which indeed becomes one of the efforts to achieve better educational progress in Indonesia. Therefore, the author is interested in developing an application that enables both parents and teachers to monitor the progress of students' learning, including their behavior and academic grades.

II. METHODS

A. Research stages

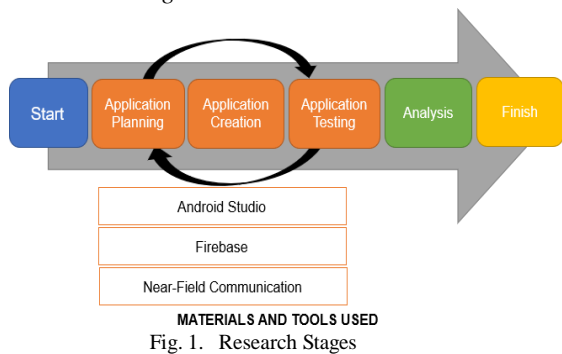


Fig. 1. Research Stages

Figure 1 illustrates the research stages to be carried out. The first stage involves planning the application. The application was developed using Android Studio, while Firebase was selected as the database platform. Android Studio is a development environment tailored for Android-based applications and officially supported by Google. It fully supports programming in Java. Meanwhile, Firebase serves as a cloud-based database service provided by Google, featuring tools such as the Firebase Real-time Database, which is a NoSQL type database. NFC is a technology developed upon RFID, integrating internet connectivity and smart cards to enable fast and secure communication between different devices. This system uses NFC technology for recording student attendance.

B. System Block Diagram

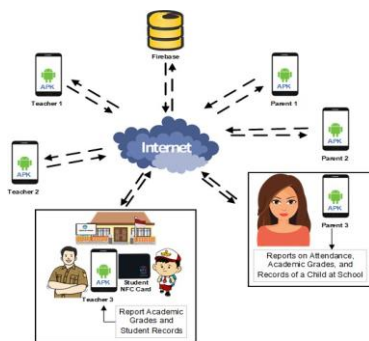


Fig. 2. Application's Block Diagram

Figure 2 illustrates the application's block diagram used in this research. The functions of each system are as follows:

1) Firebase serves as the central database, storing all information input by the teacher's application so that parents can access real-time information via the corresponding application.

2) The teacher's smartphone functions as a platform for placing applications, enabling the recording of student attendance through reading NFC cards and reporting student grades and behavior while at school.

3) Students confirm their attendance by tapping their NFC cards on the teacher's smartphone as a record of the school's attendance.

4) The parents' smartphone hosts an application that allows them to monitor their children's activities at school.

5) The internet connection links the Firebase database with both the teacher's and parents' smartphones.

C. Data Flow Diagram (DFD)

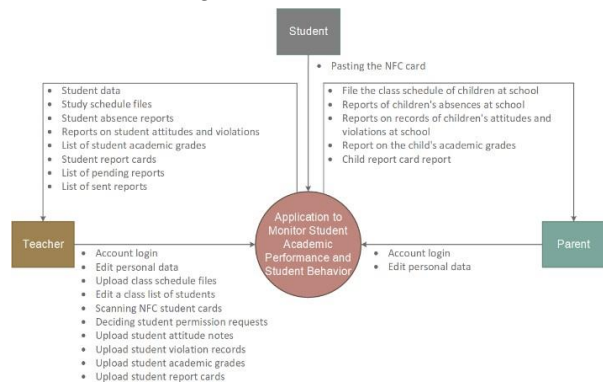


Fig. 3. DFD level 0 for Application

Figure 3 explains the Level 0 DFD for the student academic behavior monitoring application, detailing the roles of its users as follows:

1. Teachers

Teachers are responsible for adding or removing student ID numbers specific to their classes via the student list menu. They also record behavioral notes or violations, scan student NFC tags, and make decisions on student permissions as part of the attendance system. Additionally, they input students' academic scores and upload students' report cards in PDF format.

2. Parents

Parents use this application to monitor their children's school attendance, behavioral or violation records, academic grades, and digital report cards.

II. RESULT AND DISCUSSION

A. Application Design Result



Fig. 4. Application Design Results

Figure 4(a) displays the initial screen when the application is opened. The homepage contains two main user options: one for the teacher and another for the parent. Figure 4(b) shows the menu that appears after a teacher selects a class from the home screen. The menu includes the Lesson Schedule menu, Student List, Attendance, Notes, Academic Grades, and Report Card. Figure 4(c) illustrates the NFC reader interface, which includes two buttons: the Scan NFC Tag and the history. The Scan NFC Tag button is used to read the students' NFC cards for attendance logging, while the history button is used to view a record of all scanned NFC cards and IDs.

B. Application Testing

Table 1. Application Testing

No	Questions	Application Usability		
		Samsung A50s Version 10.0	Samsung A30s Version 10.0	Redmi Note 8 Pro
1.	Display	Good	Good	Good
2.	The level of efficiency in reading student NFC cards	Good	Good	Good
3.	The level of convenience in handling student permissions	Good	Good	Good
4.	The level of convenience in recording student behavioral data	Good	Good	Good
5.	The level of convenience in documenting student disciplinary violations	Good	Good	Good
6.	The level of efficiency in entering students' academic achievement records	Good	Good	Good
7.	The level of convenience in submitting student academic reports	Good	Good	Good
8.	The level of simplicity in accessing student attendance summaries	Good	Good	Good
9.	The level of clarity in viewing student grade record	Good	Good	Good
10.	The level of readability in reviewing students' academic score sheets	Good	Good	Good
11.	Supplied information	Good	Good	Good

12.	Tool functionality	Good	Good	Good
13.	Tool comprehensiveness	Good	Good	Good

Based on the results of the application testing using three different smartphone models, Samsung A50s (version 10.0), Samsung A30s (version 10.0), and Redmi Note 8 Pro (version 9.0), the survey results as shown in Table 1 indicate that users responded positively in terms of system's appearance, accuracy in reading student NFC cards, convenience in managing student permissions, documentation of student behavior/violations and academic grade, as well as the tool's functionality, completeness, etc.

C. The accuracy of smartphones in reading NFC horizontally and vertically

Table 2. Results of NFC Card Reading Accuracy Testing

NF C	NFC Card Position	Number Successfully Detected after 5 Attempts	Number Unable to Detected after 5 Attempts	Success Rate (%)	Failure Rate (%)
1	Horizontal	5	0	100%	0%
	Vertical	5	0	100%	0%
2	Horizontal	5	0	100%	0%
	Vertical	4	1	80%	20%
3	Horizontal	5	0	100%	0%
	Vertical	4	1	80%	20%
4	Horizontal	5	0	100%	0%
	Vertical	5	0	100%	0%
5	Horizontal	5	0	100%	0%
	Vertical	4	1	80%	20%
6	Horizontal	5	0	100%	0%
	Vertical	5	0	100%	0%
7	Horizontal	5	0	100%	0%
	Vertical	4	1	80%	20%
8	Horizontal	5	0	100%	0%
	Vertical	5	0	100%	0%
9	Horizontal	5	0	100%	0%
	Vertical	5	0	100%	0%
10	Horizontal	5	0	100%	0%
	Vertical	4	1	80%	20%
Average NFC reading rate horizontally				100%	0%
Average NFC reading rate vertically				90%	10%

The accuracy test of NFC card reading using the Samsung A30s smartphone (version 10.0) was conducted five times for each NFC card ID. The test results, as shown in Table 3, indicate that horizontal NFC card positioning achieved an average reading success rate of 100% with a 0% failure rate. Meanwhile, the average success rate of reading NFC cards vertically was 90%, while the average failure rate stood at 10%.

D. Result of NFC Card Detection Accuracy Evaluation

Table 3. Results of Smartphone Testing for Maximum NFC Reading Distance

Smartphone Models	Distance (cm)	Number Successfully Detected after 5 Attempts	Number Unable to Detected after 5 Attempts	Success Rate (%)	Failure Rate (%)
Samsung A30s version 10.0	1	5	0	100%	0%
	2	5	0	100%	0%
	3	5	0	100%	0%
	4	5	0	100%	0%
	5	0	5	0%	100%
Samsung A50s version 10.0	1	5	0	100%	0%
	2	5	0	100%	0%
	3	5	0	100%	0%
	4	5	0	100%	0%
	5	0	5	0%	100%
Redmi Note 8 Pro	1	5	0	100%	0%
	2	5	0	100%	0%
	3	5	0	100%	0%
	4	0	5	0%	100%
	5	0	5	0%	100%

The NFC card reading distance test was conducted in three smartphone models: Samsung A50s (version 10.0), Samsung A30s (version 10.0), and Redmi Note 8 Pro (version 9.0). Each device was tested five times at varying distances, 1cm, 2cm, 3cm, 4cm, and 5cm. Based on the test results shown in Table 4.4, which indicates the maximum reading distance of 4 cm for the smartphone brands Samsung A50s (version 10.0) and Samsung A30s (version 10.0). Both smartphones demonstrated a consistent 100% success rate and a 0% failure rate in reading NFC cards for distances ranging from 1cm to 4cm. However, at a distance of 5cm, both models were unable to read the NFC cards, resulting in a 0% success rate and a 100% failure rate. In contrast, the maximum reading distance on the Redmi Note 8 Pro smartphone was 3cm. It successfully read NFC cards at 1 cm, 2 cm, and 3 cm with a perfect success rate of 100% and no failures. At distances of 4 cm and 5 cm, however, the device failed to read the NFC cards entirely, recording a 0% success rate and a 100% failure rate.

IV. CONCLUSION

Based on the results of the testing and discussion, the conclusion is as follows:

1. The results of the survey conducted after users interacted with the application, the feedback was generally positive. The convenience covers managing student permissions, recording student behavior/violations and academic grade, tool functionality, and tool completeness, etc.
2. The accuracy of NFC card reading using the Samsung A30s (version 10.0), tested five times for each NFC card ID, showed an average horizontal NFC card reading success rate of 100% with an average horizontal NFC card reading failure rate of 0%. In contrast, the vertical NFC card reading showed a 90% success rate and a 10% failure rate on average.
3. The maximum range for NFC card detection was

found to be 4 cm on Samsung A50s (version 10.0) and Samsung A30s (version 10.0). Whereas the Redmi Note 8 Pro, was only able to detect NFC cards up to 3 cm.

V. ACKNOWLEDGEMENT

This research is supported by University Trunojoyo of Madura and Defense Strategic Installation Agency Ministry of Defence of the Republic of Indonesia. The authors express their gratitude for the invaluable support and contributions that have facilitated the completion of this study.

REFERENCES

- [1] L. T. Tran, "Teaching and engaging international students: People-to-people connections and people-to-people empathy," *J. Int. Students*, vol. 10, no. 3, pp. xii–xvii, 2020, doi: 10.32674/jis.v10i3.2005.
- [2] I. B. Suleiman, O. A. Okunade, E. G. Dada, and U. C. Ezeanya, "Key Factors Influencing students' academic performance," *J. Electr. Syst. Inf. Technol.*, vol. 11, no. 41, 2024, doi: 10.1186/s43067-024-00166-w.
- [3] R. Ferguson, L. Kaufmann, A. Brown, and X. de la Piedad Garcia, *Influences of past moral behavior on future behavior: A review of sequential moral behavior studies using meta-analytic techniques*, vol. 150, no. 6. 2024. doi:10.1037/bul0000441.
- [4] E. Raso, G. M. Bianco, L. Bracciale, G. Marrocco, C. Occhiuzzi, and P. Loreti, "Privacy-Aware Architectures for NFC and RFID Sensors in Healthcare Applications," *Sensors*, vol. 22, no. 24, pp. 1–21, 2022, doi: 10.3390/s22249692.
- [5] R. D. Kulkarni, *Near Field Communication (NFC) Technology and Its Application*, vol. 1. 2021. doi: https://doi.org/10.1007/978-3-030-69921-5_74.
- [6] K. Shibano, T. Nakajima, and G. Mogi, "Wood traceability system using blockchain and zero-knowledge proof," *Blockchain Cryptocurrency Congr. (B2C' 2022)*, no. November, pp. 9–11, 2022.
- [7] T. Erlina and B. Ramadeza, "Real-time Product Availability Information with Passive NFC Tag System for Offline Shops," *Komputika J. Sist. Komput.*, vol. 13, no. 1, 2024, doi: 10.34010/komputika.v13i1.9810.
- [9] M. Rahayu and A. I. Irawan, "Autentikasi Ganda pada Sistem Smart Security Home Menggunakan Sidik Jari dan Near Field Communication," *JTERA (Jurnal Teknol. Rekayasa)*, vol. 5, no. 2, p. 294.
- [10] S. Klee, M. Maass, A. Roussos, and M. Hollick, "NFCGate: Opening the door for NFC security research with a smartphone-based toolkit," *WOOT 2020 - 14th USENIX Work. Offensive Technol. co-located with USENIX Secur. 2020*, 2020.
- [11] G. W. Erwinda, S. Adi Wibowo, and D. Rudhistiar, "Implementasi Face Recognition Dan Rfid Sebagai Fitur Security Pada Smart Home," *JATI (Jurnal Mhs. Tek. Inform.)*, vol. 6, no. 2, pp. 1123–1130, 2022, doi: 10.36040/jati.v6i2.5350.

- [12] A. B. Semma, M. Ali, M. Saerozi, Mansur, and Kusri, "Cloud computing: google firebase firestore optimization analysis," *Indones. J. Electr. Eng. Comput. Sci.*, vol. 29, no. 3, pp. 1719–1728, 2023, doi: 10.11591/ijeecs.v29.i3.pp1719-1728.
- [13] Khairun Nisa Meiah Ngafidin, A. Arista, and R. Nisa Sofia Amriza, "Implementasi Firebase Realtime Database pada Aplikasi FeedbackMe sebagai Penghubung Guru dan Orang Tua," *J. RESTI (Rekayasa Sist. dan Teknol. Informasi)*, vol. 5, no. 2, pp. 327–334, 2021, doi: 10.29207/resti.v5i2.2909.
- [14] A. Asvin, M. Suradi, A. Syam, S. Alam, A. Bahtiar, and A. Ridow, "Pemanfaatan Firebase Realtime Database Dalam Perancangan Aplikasi Penilaian Siswa SMK Negeri 2 Pangkep Secara Realtime," vol. 6, pp. 146–154, 2024.
- [15] Ilham Firman Maulana, "Penerapan Firebase Realtime Database pada Aplikasi E-Tilang Smartphone berbasis Mobile Android," *J. RESTI (Rekayasa Sist. dan Teknol. Informasi)*, vol. 4, no. 5, pp. 854–863, 2020, doi: 10.29207/resti.v4i5.2232. 287, 2020, doi: 10.31544/jtera.v5.i2.2020.287-

