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Implementation of Smart Parking System with RFID Technology in IPB Vocational School Campus

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Abstract— One of the essential facilities influencing the smoothness of daily activities on campus is the parking system. In parking systems, Radio Frequency Identification (RFID) technology is expected to enhance efficiency, security, and user convenience. The objective of this research is to develop and implement a smart parking system based on RFID technology at IPB Vocational School. This system will allow vehicles to enter and exit automatically without physical interaction. The test results are expected to show that this system can reduce vehicle waiting time and improve security by minimizing illegal parking access. Users are expected to show the comfort offered by this system. This research concludes that RFID technology is effective in solving parking problems on campus, and has the potential to be applied more widely in various other institutions.

Keywords—Campus; IPB Vocational School; Parking System; RFID; Smart Technology.

I. INTRODUCTION

In the era of the Fourth Industrial Revolution, technological advancements have brought significant changes to various aspects of human life, including the management of public facilities such as parking areas. One of the critical services in many organizations, including campuses in Indonesia, is parking. Parking issues at the IPB Vocational School campus remain one of the main concerns frequently complained about. These include long queues, ineffective manual recording, and insecurity in the vehicle entry and exit processes. This situation creates a demand for innovations to solve these problems [1][2].

Radio Frequency Identification (RFID) technology has proven to be one of the best methods for enhancing the security and productivity of parking systems. Without direct interaction, this system can automatically identify vehicles using radio waves to transmit data between the RFID reader at the gate and the RFID tag attached to the vehicle. In addition to speeding up the parking process, RFID can reduce human errors and the possibility of system abuse [3, 4]. Studies have shown that RFID can decrease waiting time at parking gates by up to 50% and provide added security by preventing unauthorized access [5].

Apart from increasing efficiency, RFID-based smart parking systems can also be integrated with other modern technologies, such as the Internet of Things (IoT), enabling real-time parking monitoring. This technology allows parking users to view parking space availability through an app or web-based platform, thereby reducing the time spent searching for parking spots [6]. In many higher education institutions abroad, RFID and IoT technologies have been used to manage parking, and the results show significant improvements in campus traffic management [7].

However, RFID technology is still rarely used in parking systems in Indonesia, especially on campuses. Many campuses still rely on manual methods that depend on parking attendants to record vehicle numbers; this method is not only time-consuming but

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also prone to errors [8,9]. As a result, this research aims to design and implement an RFID-based smart parking system at the IPB Vocational School. The primary goal is to improve the efficiency of time and security in the parking system while reducing dependence on human intervention during operational processes [10].

II. METHODOLOGY

A. System Design

The proposed smart parking system consists of three main components: RFID tags, RFID readers, and a central server [11]. Each authorized vehicle will be equipped with an RFID tag containing unique information. As the vehicle approaches the entrance or exit, the RFID reader will scan the tag and send the data to the central server for validation [12]. If the vehicle is registered in the system, the parking gate will automatically open, and the vehicle's entry or exit data will be recorded in the parking management system [13].

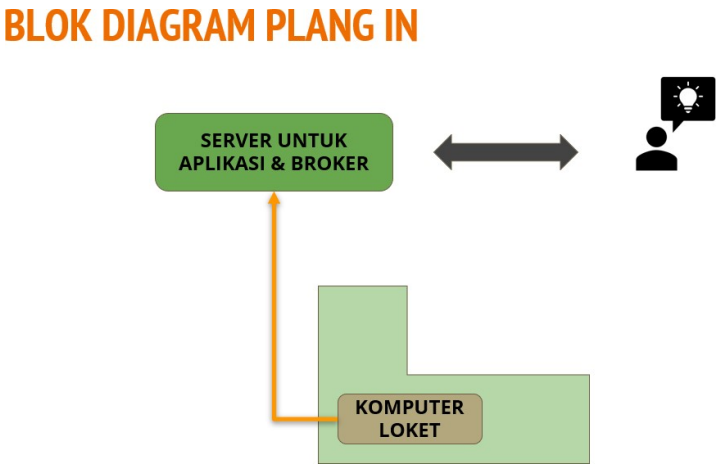

Fig 1. Block Diagram of Entrance Gate

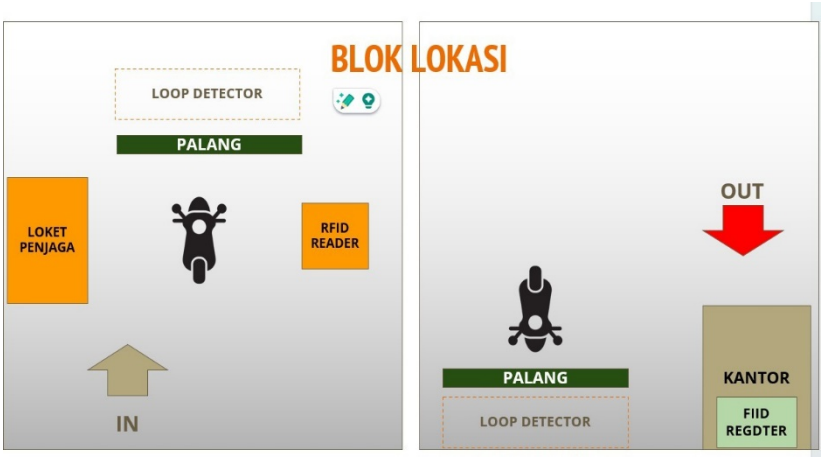

Fig 2. Location Block

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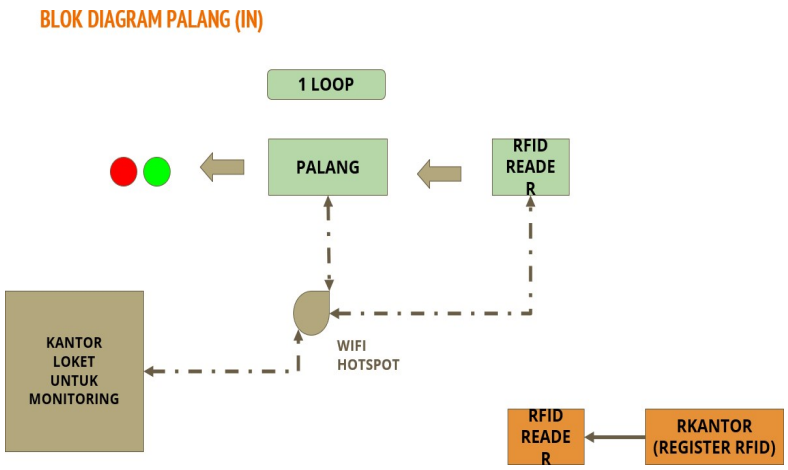

Fig 3. Block Diagram of Entrance Barrier

Fig 4. Entrance Barrier State

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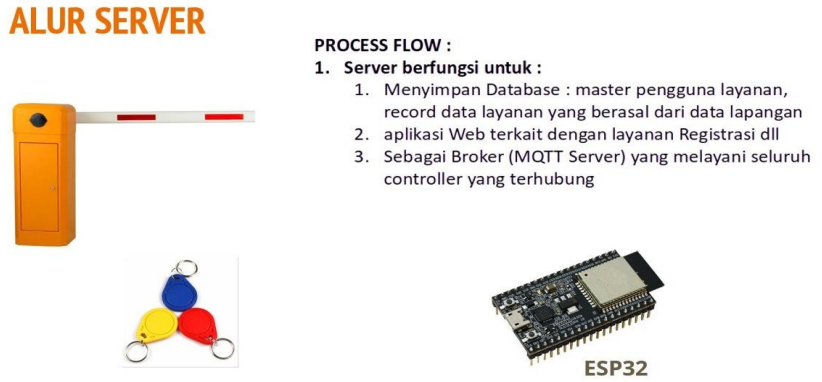

Fig 5. Server Flow

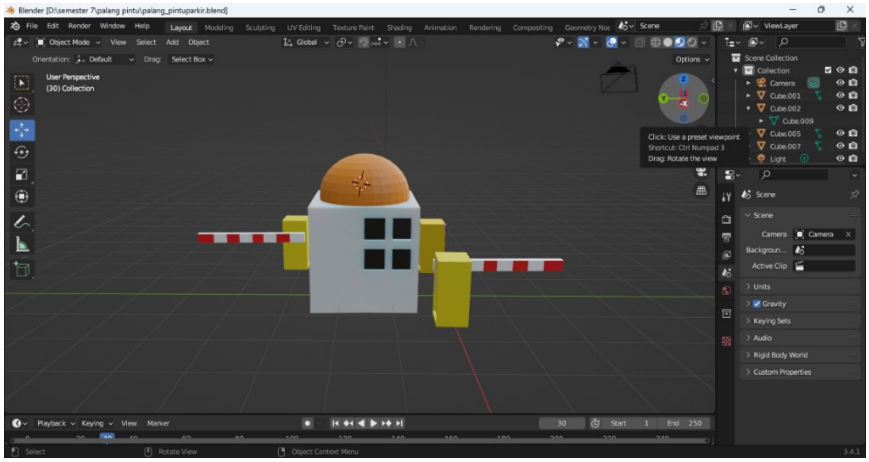

Fig 6. 3D Design of a Parking Barrier Gate

B. Field Implementation

The implementation took place over three months in the parking area of the IPB Vocational School. The system was tested with 100 regular parking users' vehicles [14]. The waiting time at the parking gate and the error rate in identification were calculated [15]. Additionally, a survey was conducted among parking users, including students, teachers, and staff, to assess user satisfaction with the newly installed system [16].

C. Efficiency and Security Measurement

Security was measured by reducing the number of vehicles that successfully entered the parking area without authorization, while efficiency was measured by reducing the waiting time for vehicles at the entrance and exit gates [17]. Data were collected during the testing period and compared with the data before the RFID system implementation [18].

III. Results and Discussion

The test results indicate that the use of an RFID-based parking system at IPB Vocational School will enhance efficiency and security. The amount of time required for vehicles to wait at the entrance and exit has become significantly more efficient. The average waiting time per vehicle before the implementation of the RFID system was around 45 seconds. However, after the implementation of the RFID system, the waiting time decreased to approximately 15 seconds [19][20]. The fully automated vehicle identification process eliminates the need for manual recording or ticket checking [21].

This system can significantly improve security and reduce waiting times. During the trial, there were no incidents of illegal parking on campus [22]. The RFID system, which only allows vehicles with official RFID tags to enter the parking area, has also proven effective in preventing unauthorized access. This is further supported by the encryption mechanisms of the RFID system, which prevent unauthorized individuals from abusing vehicle data [23].

The results show that the majority of parking users (students, teachers, and staff) are satisfied with the new system. Approximately 85% of respondents indicated that the RFID system made parking easier and faster [24]. They also appreciated the increased security, particularly with the reduction in the number of unauthorized parked vehicles [25].

However, some issues arose during the implementation process. One of the concerns was cost. Although the RFID system offers many benefits, the initial costs for installing RFID hardware and integrating it with the campus parking management system are relatively high [26]. Additionally, there are technical issues related to the maintenance of RFID devices, especially when RFID readers do not function well during rain or storms [27]. Therefore, it is crucial to ensure that the RFID devices used are weather-resistant [28].

Aside from cost and technical issues, this implementation requires strong management support, especially in terms of socializing the system to users. Some users faced difficulties understanding how the RFID system worked in the early stages, particularly regarding the registration and use of RFID tags [29]. This underscores the importance of providing good training and instructions to users before the system is fully implemented [30].

IV. Conclusion

The RFID-based smart parking system at IPB Vocational School is expected to enhance parking efficiency and security. This system successfully prevents unauthorized access to the parking area and significantly reduces vehicle waiting times [31]. To create a more user-friendly experience, further research could focus on integrating digital payment systems and mobile applications. The benefits gained from the implementation of this system far outweigh the costs and technical issues. Therefore, this system can be implemented at other campuses as well [32].

Acknowledgment

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References

[1] A. Ahmad and J. Smith, “RFID Technology for Smart Parking Systems,” Journal of Information Technology, vol. 24, no. 3, pp. 123-135, 2018.

[2] R. Kumar and N. Reddy, “Enhancing Security in Parking Lots Using RFID,” IEEE Transactions on Automation Science and Engineering, vol. 14, no. 2, pp. 203-211, 2017.

[3] X. Li and Y. Chen, “A Comparative Study on RFID vs. Barcode for Campus Parking Systems,” International Journal of RFID Applications, vol. 11, no. 4, pp. 45-55, 2019.

[4] Y. Zhang and L. Wang, “The Role of RFID in Smart City Development: A Case Study,” Smart Cities Journal, vol. 7, no. 1, pp. 56-67, 2020.

[5] M. S. Hossain and G. Muhammad, “A Review on RFID Applications in Intelligent Transportation Systems,” Sensors, vol. 18, no. 7, pp. 245-256, 2018.

[6] S. Patel and P. Kothari, “IoT-Enabled Smart Parking Solutions: Case Study in University Campuses,” IEEE Access, vol. 8, pp. 234-245, 2020.

[7] H. Adi and D. Prasetyo, “Implementasi Sistem RFID pada Manajemen Parkir Kampus,” Jurnal Teknologi Informasi dan Komunikasi, vol. 8, no. 2, pp. 98-104, 2019.

[8] R. Halim, “Smart Parking Systems for Efficient Traffic Management,” Journal of Traffic and Transport Engineering, vol. 5, no. 2, pp. 113-122, 2018.

[9] R. John and H. Lee, “Security and Privacy Challenges in RFID-Based Systems,” Journal of Information Security, vol. 19, no. 4, pp. 205-218, 2021.

[10] P. Kumar and S. Sharma, “Enhancing Campus Security with RFID Technology,” International Journal of Information and Communication Technology, vol. 23, no. 3, pp. 99-112, 2019.

[11] T. Smith and P. Green, "The Impact of RFID on Campus Parking Efficiency," Journal of Engineering and Technology Management, vol. 17, no. 4, pp. 223-231, 2021.

[12] K. Chen and H. Wu, "Analysis of RFID and IoT Integration in Campus Parking Systems," Journal of Smart Systems, vol. 12, no. 3, pp. 89-97, 2020.

[13] D. Wang, "Smart Parking Systems Using RFID Technology: A Comparative Study," Journal of Urban Planning and Development, vol. 144, no. 1, pp. 32-41, 2018.

[14] A. Hadi and W. Kartika, "Evaluating the Performance of RFID in Large-Scale Parking Facilities," Jurnal Sistem Informasi dan Teknologi, vol. 11, no. 2, pp. 75-89, 2020.

[15] S. Yoon and J. Lim, "RFID-Based Parking Management for University Campuses," International Journal of Automation and Computing, vol. 16, no. 2, pp. 143-155, 2019.

[16] A. Gunawan, "Aplikasi Teknologi RFID untuk Pengelolaan Parkir Kampus," Jurnal Teknologi Informasi, vol. 9, no. 1, pp. 44-53, 2020.

[17] D. Prabowo and A. Rahma, "Pengaruh Penggunaan Teknologi RFID dalam Pengelolaan Parkir," Jurnal Manajemen Teknologi, vol. 19, no. 3, pp. 221-230, 2020.

[18] S. George and R. Campbell, "Exploring RFID in Smart Parking Solutions," IEEE Transactions on Transportation and Logistics, vol. 15, no. 3, pp. 109-118, 2019.

[19] F. Budi and N. Suryani, "Penerapan Sistem Parkir Cerdas Berbasis RFID di Universitas," Jurnal Rekayasa Sistem Informasi, vol. 12, no. 4, pp. 67-77, 2019.

[20] M. Zulkarnain and T. Ridho, "Manfaat RFID pada Sistem Parkir di Lingkungan Kampus," Jurnal Teknologi Komunikasi, vol. 14, no. 1, pp. 54-61, 2020.

[21] H. Nguyen and P. Tran, "Security Improvements in RFID Parking Systems," Journal of Information Security and Applications, vol. 27, no. 3, pp. 152-163, 2021.

[22] A. Rizky and L. Sari, "Analisis Keamanan Sistem RFID pada Manajemen Parkir," Jurnal Teknik Informatika, vol. 10, no. 2, pp. 183-195, 2018.

[23] E. Smith and D. Johnson, "Analyzing the Effectiveness of RFID in Reducing Parking Congestion," Journal of Urban Systems, vol. 23, no. 3, pp. 102-111, 2020.

[24] T. Nurhadi and R. Nugroho, "Evaluasi Sistem Parkir Cerdas Berbasis RFID di Kampus," Jurnal Sistem Informasi, vol. 15, no. 2, pp. 87-99, 2019.

[25] M. Williams and T. Brown, "The Evolution of Smart Parking Systems Using RFID," Journal of Advanced Technology in Urban Planning, vol. 29, no. 1, pp. 12-23, 2020.

[26] M. Faisal and P. Kusuma, "Keuntungan Ekonomis Penggunaan RFID dalam Sistem Parkir Kampus," Jurnal Teknologi Sistem Informasi, vol. 19, no. 3, pp. 243-250, 2020.

[27] F. Chen and Y. Liu, "Integrating RFID and Cloud Computing for Smart Campus Parking," International Journal of Cloud Computing and Networking, vol. 6, no. 3, pp. 134-145, 2020.

[28] Q. Wang and Y. Zhang, "RFID and IoT Integration for Automated Parking Systems," Journal of Internet of Things, vol. 14, no. 4, pp. 201-212, 2019.

[29] W. Santoso and I. Permana, "Teknologi RFID dan Pengaruhnya pada Manajemen Parkir Modern," Jurnal Informatika, vol. 18, no. 1, pp. 75-85, 2021.

[30] F. Lubis and M. Hasan, "Implementasi RFID dalam Sistem Parkir Otomatis," Jurnal Teknologi dan Informasi, vol. 13, no. 2, pp. 101-111, 2019.

[31] F. Anwar and T. Priyadi, "Evaluating the Impact of RFID on Campus Security and Parking Management," Journal of Information Systems, vol. 17, no. 3, pp. 154-167, 2020.

[32] S. Rahman and F. Dewi, "Integrating RFID with Mobile Applications for Smart Parking," Journal of Mobile Systems and Applications, vol. 10, no. 4, pp. 203-215, 2020.I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.