J-INTECH (Journal of Information and Technology)
Accredited Sinta 4 Ministry of Higher Education, Science and Technology Republic of Indonesia SK No. 10/C/C3/DT.05.00/2025
E-ISSN: 2580-720X || P-ISSN: 2303-1425

Web-Based Employee Meeting Attendance System Using SDLC and Laravel 11 at the Ministry of Higher Education, Science, and Technology

Franly Joshua Junior Ngantung[1*], Jay Idoan Sihotang[2]

[1,2]*Indonesian Adventist University, Faculty of Information Technology, Jl. Kolonel Masturi KM 3,5, Sukaresmi, Kec. Parongpong, Kabupaten Bandung Barat, Jawa Barat 40559, Indonesia.*

Keywords

Administrative Efficiency; Laravel 11; SDLC; Web-Based Attendance System

Corresponding Author:
jay.sihotang@unai.edu

Abstract

The rapid development of information technology has significantly transformed administrative practices within government institutions, encouraging the transition from conventional manual systems to integrated digital platforms. In many public sector environments, employee attendance is still recorded manually, which often results in inefficiencies, delays in data processing, and a higher risk of recording errors. This study aims to develop and implement a web-based employee attendance system at the Legal Bureau of the Ministry of Education, Research, and Technology using Laravel 11 as the development framework and applying the System Development Life Cycle (SDLC) method as a structured development approach. In addition to system development, this research also evaluates the system's functional performance through Black Box testing to ensure that each module operates according to the specified requirements and supports reliable administrative attendance management. The SDLC framework guides the development process through systematic stages, including planning, requirements analysis, system design, implementation, and testing, ensuring that the resulting system meets organizational needs effectively. The proposed system incorporates essential features such as secure user authentication, digital signature integration, and automated real-time attendance data recapitulation to enhance administrative accuracy and control. The improvement in administrative efficiency was evaluated by comparing the developed system with the previous manual attendance method, where employee data were recorded on paper-based forms, often causing delays in data collection and additional operational costs. The findings indicate that the developed system improves administrative efficiency, reduces manual data entry errors, enhances data accuracy, and accelerates reporting processes, thereby supporting administrative modernization and more effective digital governance.

1. Introduction

The implementation of information technology in government institutions has increasingly supported the development of digital employee attendance management systems to replace conventional manual recording methods. Manual attendance systems are still widely used in many public sector organizations, often resulting in data recording errors, delays in attendance reporting, and limited monitoring capabilities. Therefore, web-based attendance systems are increasingly adopted to improve administrative efficiency, data accuracy, and transparency in managing employee attendance within government institutions [1]. One area strongly affected by this shift is the employee attendance system. Studies conducted at the Siguntur Village Office indicate that web-based attendance applications can overcome common issues found in manual systems, including reporting delays, potential data manipulation, and limited monitoring capabilities [2]. Previous studies have reported that manual attendance systems often lead to recording errors, delays in data processing, and difficulties in monitoring employee attendance in real time. These limitations indicate that conventional attendance methods are less effective for managing administrative data in organizational environments, highlighting the need for digital systems that enable more efficient data management and improved administrative processes in institutional environments [3].

Implementing a web-based attendance system provides a relevant and effective solution for administrative digitalization. Through an integrated online platform, attendance data can be managed more transparently and accessed efficiently by authorized users [4]. Research on the Sibolga City Government demonstrates that online attendance systems enhance data accuracy and operational efficiency while enabling real-time monitoring [5]. The use of modern frameworks such as Laravel 11 further supports secure, structured, and efficient system development with improved authentication and automated data processing features [6].

Government institutions, including the Ministry of Education, Research, and Technology – Legal Bureau, require reliable administrative systems to support daily operations. Previous studies conducted in several government institutions in North Sumatra Province indicate that the implementation of web-based attendance systems can improve personnel data management and reduce administrative inefficiencies compared to manual procedures. Although these studies were carried out in different organizational settings, their findings provide relevant empirical evidence that digital attendance systems can support more accurate and efficient employee attendance management in public sector institutions [7], [8].

To ensure systematic development, this study applies the System Development Life Cycle (SDLC) method, which includes stages of analysis, design, implementation, and testing. Previous studies have shown that the application of the System Development Life Cycle (SDLC) method in information system development improves system reliability, data accuracy, and operational efficiency in organizational environments [9]. Although prior studies have examined administrative digitalization in government institutions, most focus on broader personnel or financial systems [10]. This study focuses on the digitization of employee attendance management at the Ministry's Legal Bureau by developing an event-based web attendance system that records participation in meetings and administrative activities in real time. Unlike conventional systems that mainly record daily attendance, the proposed system supports event-based monitoring with real-time data processing, enabling more transparent and efficient management of employee participation and administrative activities. This study contributes by proposing an event-based web attendance system integrated with digital signatures and automated reporting features to support transparent and efficient administrative monitoring in government institutions. The research aims to design and implement a web-based attendance system using the SDLC approach to improve administrative efficiency, data accuracy, and monitoring capabilities, as demonstrated in previous studies on digital attendance systems in government institutions [11].

2. Research Method

The Software Development Life Cycle (SDLC) method employed in this study adopts the Waterfall model, a systematic and sequential development approach in which each phase must be completed before moving to the next. The Waterfall model was selected for this study because the system requirements were clearly defined at the initial stage of the project, allowing the development process to follow a structured and

sequential approach. This model provides systematic phases, including requirements analysis, system design, implementation, testing, and maintenance, which facilitate organized documentation, project monitoring, and quality control throughout the development process [12].

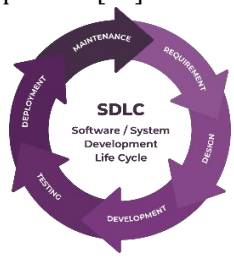

Figure 1. Software Development Life Cycle (SDLC) Method

The SDLC stages applied in this research consist of the following five steps:

a) Planning
Initial coordination with the Legal Bureau was conducted through interviews with the field supervisor to identify the requirements for a digital system capable of managing meeting attendance in real time and storing structured employee data, including bank account information. The information obtained from these interviews provided essential insights into the existing administrative workflow and helped define the functional requirements of the proposed attendance system. These findings formed the basis for defining the system's functional requirements.

b) Analysis
This phase involved mapping workflows and identifying functional requirements, including attendance management, employee data, banking information, and reporting features. Core entities such as Employee, Attendance, User, Institution, Account, Bank, and Digital Signature were defined to establish the system's data structure and logic.

c) System Design
The design stage produced the database schema, process flow, and user interface architecture using Laravel 11 and MySQL. The system was designed with emphasis on usability, data security, and real-time processing, including attendance recording, digital signature integration, and automated reporting.

d) Implementation
The system was developed using the Laravel 11 framework with XAMPP and a MySQL database. The system was then tested using the Black Box testing method to verify that each module—such as attendance management, employee records, account data, and reporting—functions correctly according to the specified requirements and can generate real-time attendance information.

e) Maintenance
The maintenance stage is planned for future system development after the implementation phase. This stage will include activities such as bug fixing, feature updates, and system adjustments based on institutional needs to ensure that the system remains reliable and adaptable to administrative and policy changes within the Legal Bureau.

2.1. System Design

The Use Case Diagram in Figure 2 illustrates the interaction between users and the Laravel 11–based web attendance system. Modern web frameworks such as Laravel provide a structured architecture, built-in security features, and efficient database management that support the development of scalable web applications. The system involves two primary actors: Admin and Employee. The Admin is responsible for managing employee records, meeting attendance data, banking information, and generating attendance reports, while Employees can record their attendance, provide personal and banking information, and view attendance summaries. User involvement in the system design process was conducted through discussions and requirement identification with several administrative staff and employees who represent the main system users. Their feedback was used to validate system functionalities, define user roles, and ensure that the designed features align with the administrative workflow within the Legal Bureau.

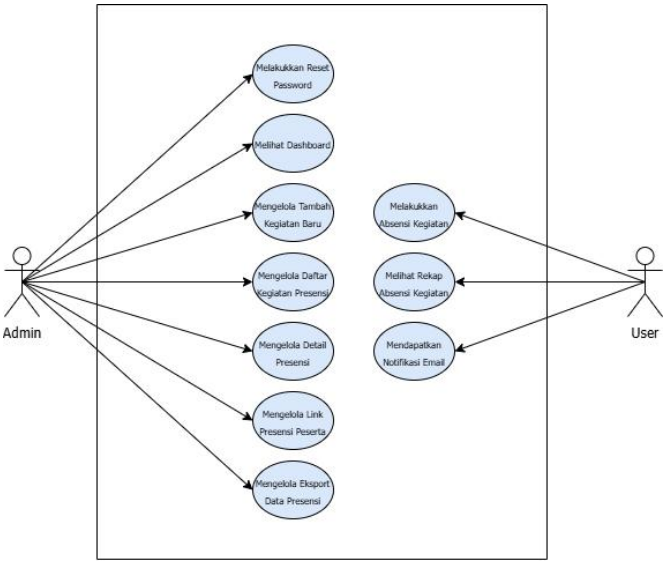

Figure 2. Use Case Diagram

2.2. Activity Diagram

The Activity Diagram is one of the modeling tools in Unified Modeling Language (UML) used to visualize the workflow or process within the Web-Based Employee Attendance System at the Ministry of Education, Research, and Technology – Legal Bureau developed using Laravel 11. This diagram illustrates the sequence of activities performed by system actors in executing system functions, as well as how the system responds to each action in a structured and systematic manner.

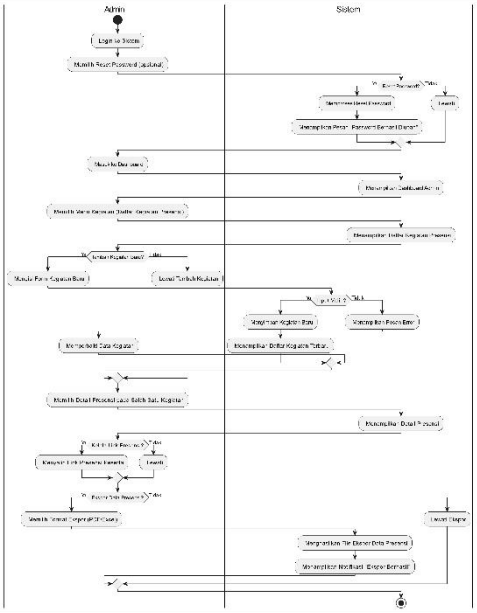

Figure 3. Activity Diagram Admin

The figure presents the administrator's workflow in the Laravel 11–based Employee Attendance System at the Ministry of Education, Research, and Technology – Legal Bureau. The process begins with admin authentication, followed by managing employee and banking data, monitoring and validating attendance records, and generating real-time attendance reports. The administrator also controls digital signatures and user access rights to ensure system security and data integrity. Overall, the diagram illustrates the structured flow of administrative activities that support efficient attendance management and improved data accuracy.

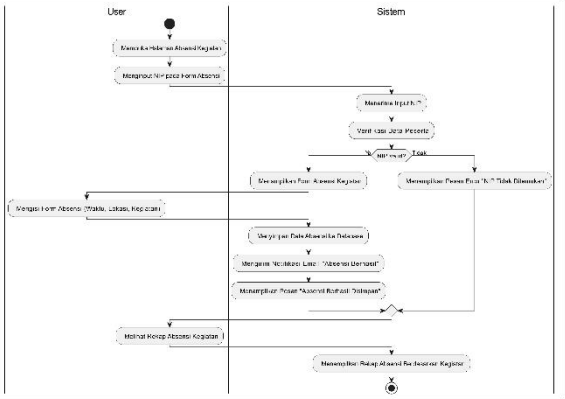

Figure 4. Activity Diagram User

2.3. Class Diagram

The Class Diagram models the static structure of the system using an Object-Oriented Programming (OOP) approach. It defines the main classes and their relationships within the Laravel 11–based Employee Attendance System at the Ministry of Education, Research, and Technology – Legal Bureau. Key entities include Employee, Attendance, User, Account, Bank, and Digital Signature.

In addition to illustrating class relationships, the diagram specifies attributes and methods that represent the data structure and system behavior. Thus, it provides a clear overview of how system components interact to support the digital attendance process. The Class Diagram is shown in Figure 5.

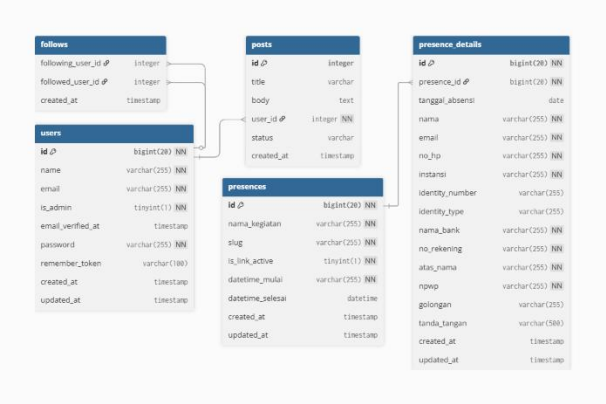

Figure 5. Class Diagram

2.4. Interface Design

The user interface in this study was developed using the User-Centered Design (UCD) approach, which places users at the core of the system development process [13]. This method emphasizes understanding user needs, work context, and behavior to ensure that the system aligns with daily administrative activities [14]. Preliminary analysis through discussions with prospective users (Admin and Employees) revealed that attendance management was still handled manually, with separate processes for recording, signature validation, and reporting. This condition highlighted the need for an integrated, real-time web-based system. Previous research on website-based interface design demonstrates that UCD enables designers to analyze user context, define requirements, develop prototypes, and evaluate usability to produce more effective interfaces [15]. Therefore, the system interface was designed with a simple layout, intuitive navigation, and a menu structure reflecting administrative workflows.

The implementation of UCD in this study follows ISO 9241-210:2019, consisting of four main stages: understanding the context of use, specifying user requirements, producing design solutions, and evaluating the design [16].

a) Understand and Specify the Context of Use
   Initial observations showed that attendance processes relied on manual records and separate recapitulations, leading to reporting delays and data inconsistencies [17]. This analysis served as the foundation for designing a system that supports administrative efficiency.
b) Specify the User Requirements
   Key functional requirements include real-time attendance recording, integrated digital signatures, and accessible attendance summaries. Non-functional requirements involve data security, system responsiveness, and responsive design compatibility across devices
c) Produce Design Solutions
   Low-fidelity prototypes were created using Balsamiq Wireframe to define workflow and interface structure, followed by visual mockups representing the final system. The design prioritizes clarity, consistency, and ease of navigation.
d) Evaluate the Designs
   User feedback sessions were conducted with three participants to evaluate the clarity of the interface layout and the usability of the developed system. Due to institutional considerations, the system has not yet been fully deployed; therefore, the evaluation was performed in a controlled demonstration setting involving two field supervisors and the system developer. Feedback was collected through guided discussions and direct observation during the system demonstration, which allowed participants to provide suggestions regarding menu placement, icon labeling, and report readability.

Overall, applying the UCD method ensures that the attendance information system is not only functionally effective but also user-friendly and aligned with the administrative context. Active user involvement throughout the design process supports improved efficiency, faster reporting, and more transparent administrative processes.

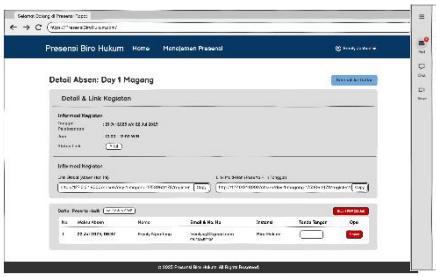

Figure 6. Event Detail Page

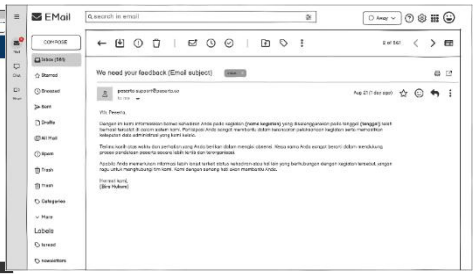

Figure 7. Email Notification Page

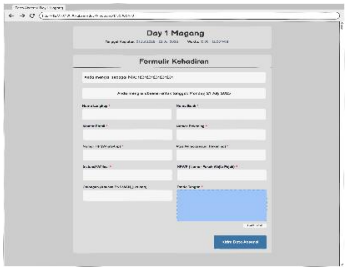

Figure 8. Employee Attendance Form Page

Figures 6–8 illustrate several key interfaces of the web-based attendance system developed in this study. Figure 6 presents the Event Detail Page, which provides comprehensive information about a specific meeting or activity, including the event schedule, participant data, and attendance status. This interface enables administrators to monitor participation, review event-related information, and manage attendance records efficiently within a single integrated page. By presenting structured event information, the page assists administrators in maintaining accurate documentation of attendance activities and supporting administrative verification processes. Figure 7 shows the Email Notification Page, which functions as an automated confirmation mechanism that informs participants that their attendance has been successfully recorded in the system database. Through this notification feature, participants receive confirmation messages containing relevant activity information, ensuring transparency and improving communication between the system and its users. This mechanism also reduces uncertainty regarding attendance submission and helps participants

verify that their participation has been properly registered. Figure 8 illustrates the Employee Attendance Form Page, which serves as the primary interface for employees to submit their attendance during an event by entering personal information and providing a digital signature as valid proof of participation. The system automatically stores attendance records in the database when users submit the attendance form. After the data are stored in the database, the system automatically updates the attendance summary displayed on the dashboard, allowing administrators to immediately access the most recent attendance information without requiring manual data processing. The form includes several structured input fields designed to capture participant data accurately and ensure proper documentation of attendance records. In addition, the interface is designed with a clear and intuitive layout to simplify the data entry process, minimize potential input errors, and support efficient real-time attendance data collection within the administrative system.

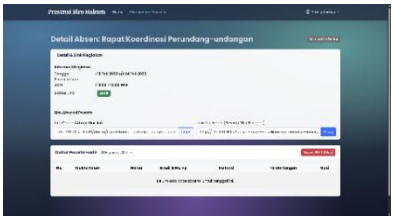

Figure 9. Implementation of Event Detail Page

Figure 10. Implementation of Email Notification Feature

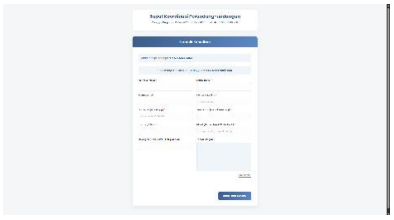

Figure 11. Implementation of Employee Attendance Form

3. Result and Discussions

Figures 9–11 present several functional interfaces resulting from the implementation of the web-based attendance system developed in this study. Figure 9 illustrates the Event Detail Page, which allows administrators to review comprehensive information about a specific event, including the activity schedule, participant data, and attendance status. Through this interface, administrators can monitor event participation and verify attendance records efficiently within the system. Figure 10 shows the Email Notification Page, which automatically sends confirmation messages to participants once their attendance has been successfully recorded. This notification mechanism supports transparent communication between the system and its users by informing participants that their attendance submission has been processed and stored in the system database. The use of automated email notifications in information systems has been widely implemented to facilitate timely communication and ensure that users receive immediate confirmation of completed system activities, thereby improving workflow efficiency and coordination within organizations [18]. Figure 11 presents the Employee Attendance Form Page, which functions as the primary interface for employees to record their attendance during meetings or administrative activities. Through this form, users submit personal identification data and provide a digital signature as valid proof of participation. The structured layout of the interface helps ensure accurate data entry, reduces the risk of input errors, and enables the system to record attendance information in real time for administrative monitoring and reporting. The implementation and workflow of the developed web-based attendance system can be further observed through a system demonstration video available at the following link https://youtu.be/tehV0kdjEQE?si=TjTKkeFjL1Sh_Z2Z.

The purpose of conducting the Testing Table for this system is to ensure that the developed application meets the specified requirements and user needs. Testing was conducted using the Black Box testing method to evaluate the functional aspects of the application. This approach focuses on verifying whether each system feature operates according to the specified requirements, such as attendance recording, event management, user authentication, and report generation. The testing process involved software testers and staff from the Legal Bureau who interacted directly with the system to ensure that the main functionalities worked correctly and supported the intended administrative processes.

Table 1. Black Box Testing Results

No	Tested Page	Test Data	Expected Result	Output	Test Results	User Feedback / Usability
1	Authentication (Login)	Administrator enters valid username and password	System allows administrator to log in and access the dashboard	Administrator successfully logged into the system	Valid	Login process works smoothly and the response time is fast. The form is simple and easy to understand.
2	Authentication (Invalid Login)	Administrator enters incorrect username or password	System displays an error message and denies login access	Error message displayed and login access rejected	Valid	The warning message appears clearly so users immediately know that the login data is incorrect.
3	Reset Password Feature	Administrator requests password reset through reset form	System allows administrator to change the password securely	Password successfully updated and account can be accessed again	Valid	The reset process is straightforward and helps when users forget their password.
4	Dashboard Page	Administrator accesses dashboard after login	System displays navigation menu and attendance summary information	Dashboard page displayed with navigation menu and activity summary	Valid	The dashboard layout is clear and the information is easy to read. Important menus are easy to find.
5	Manage Activity Page (Create Event)	Administrator fills event creation form and submits data	System saves event data and displays it in the activity list	Event successfully created and stored in the system	Valid	The form is easy to complete and the required fields help prevent mistakes when entering data.
6	Manage Activity Page (Event List)	Administrator views list of created attendance events	System displays the list of available events	Event list displayed correctly	Valid	Event list is organized clearly and makes it easy for administrators to monitor activities.
7	Participant Identification	Participant enters NIK to access attendance form	System validates NIK and directs participant to attendance form	Participant successfully redirected to attendance form	Valid	The identification process is quick and the instructions are easy to follow.
8	Attendance Form	Participant fills personal information and digital signature	System records participant information and signature in database	Attendance data successfully recorded	Valid	The form layout is simple and the digital signature feature works well.
9	Attendance Submission	Participant submits completed attendance form	System updates attendance status and stores the data	Attendance status successfully updated	Valid	Submission process works without errors and confirmation appears quickly.
10	Email Notification	Participant completes attendance form submission	System sends confirmation email automatically	Confirmation email successfully received	Valid	The email notification helps confirm that attendance was recorded successfully.
11	Export Attendance Data	Administrator downloads attendance report	System generates downloadable attendance report file	Attendance report successfully downloaded	Valid	Export feature is very useful for administrative reporting and documentation.
12	Attendance Recap Page	User accesses attendance recap page	System displays attendance history based on recorded activities	Attendance recap displayed correctly	Valid	The recap table is easy to read and helps users review their attendance history.
13	Security Testing	System processes sensitive user data	System protects user data using encryption mechanisms	Data stored securely in the system	Valid	Authentication and access control testing confirmed that the login process and user permissions functioned correctly.
14	Ease of Use Testing	Users navigate system menus and features	System interface is easy to understand and operate	Users successfully operate the system features	Valid	Overall the system is easy to use even for users who are not familiar with technical systems.

Based on the black box testing results, all system functions operate according to the expected requirements. Authentication mechanisms successfully validate user credentials, while attendance recording functions correctly store user data and digital signatures in the database.

These results indicate that the developed system is functionally reliable and suitable for supporting administrative attendance processes in government institutions.

Based on the system design analysis and requirements identified in the previous sections, the development of the employee attendance application at the Ministry of Education, Research, and Technology – Legal Bureau has been successfully completed through a structured system development process. Previous studies have shown that digital attendance systems can improve organizational data management and transparency in administrative monitoring processes [19]. The system was designed to support administrative efficiency using a user-centered approach, where all core features—including attendance recording, employee data management, digital signature validation, report generation, and attendance recap—operate according to the defined requirements. The system ensures accurate data processing, real-time updates, secure access control, and more efficient management of administrative attendance activities. Previous studies have shown that integrated web-based information systems can improve the efficiency of employee data management and support faster reporting and decision-making processes within organizations. Similar findings are also reported in previous studies, where web-based information systems were shown to improve administrative efficiency and support more structured data management in organizational environments [20], [21]. The findings of this study support these results by demonstrating that the implementation of a web-based attendance system also enhances administrative efficiency and data accuracy. Furthermore, this study extends previous research by introducing an event-based attendance management approach with real-time data processing, which enables more transparent monitoring of employee participation in administrative activities. Based on the testing results presented in Table 1, all tested system functions produced valid outputs according to the expected results, indicating that the developed application meets the specified functional requirements and operates reliably within the institutional environment. The development process applied in this study also follows the principles of the System Development Life Cycle (SDLC), which provides systematic stages of analysis, design, implementation, and testing in information system development [22].

4. Conclusion

Based on the research findings and discussion, it can be concluded that the Web-Based Employee Attendance System at the Ministry of Education, Research, and Technology – Legal Bureau, developed using the Laravel 11 framework, has successfully provided an effective solution to improve administrative efficiency in personnel management. Through the implementation of the System Development Life Cycle (SDLC) method and a User-Centered Design–based interface approach, the evaluation of user needs was conducted through system demonstrations and discussions with prospective users who will operate the system in the Legal Bureau. Although the system has not yet been fully deployed due to several institutional considerations, the users have reviewed the system workflow and confirmed that the proposed web-based attendance system aligns with their administrative processes and operational needs, with critical features such as NIK validation, digital signature functionality, and automatic attendance recapitulation performing according to specifications. Therefore, the system is considered suitable to support transparency and improve the timeliness of employee attendance reporting. Unlike the previous manual method, where attendance records could potentially be filled in by individuals using another employee's identity, the developed system requires each participant to enter their own National Identification Number (NIK) and verify their personal data before submitting attendance. In addition, the system provides real-time access to attendance data, allowing administrators to immediately monitor participation records and ensuring that attendance information is recorded accurately and transparently.

5. References

[1] F. Assyifaurrohmah, A. F. Mubin, and A. T. Tabrani, "Development of a Web-Based Teacher Attendance System in Government Agencies: A Case Study at the Ministry of Religious Affairs," Intechno Journal: Information Technology Journal, vol. 7, no. 1, 2025, https://doi.org/10.24076/intechnojournal.2025v7i1.2233.

[2] A. Triawan, V. E. Putri, and A. Zahmi, "Aplikasi Absensi Pegawai Berbasis Website: Studi Kasus: Kantor

Wali Nagari Siguntur," Ekasakti Jurnal Penelitian dan Pengabdian, vol. 5, no. 2, pp. 343-359, 2025, https://doi.org/10.31933/ejpp.v5i2.1319.

[3] C. Mutia, F. Fauziah, I. Meiditra, F. Yuda, and R. Rahmansyah, "Designing a Web-Based Laundry Service Application For Strala Laundry," *J-INTECH*, vol. 13, no. 01, pp. 78–85, Jun. 2025, https://doi.org/10.32664/j-intech.v13i01.1820.

[4] I. Mergel, N. Edelmann, and N. Haug, "Defining digital transformation: Results from expert interviews," *Gov. Inf. Q.*, vol. 36, no. 4, p. 101385, Oct. 2019, https://doi.org/10.1016/j.giq.2019.06.002.

[5] dan M. A. Sitorus, P. A., Arpan, "Perancangan Sistem Absensi Online Pegawai Berbasis Web (Studi Kasus Pemko Sibolga),", doi: 10.51544/jurnalmi.v9i2.5625.

[6] P. A. Pratama, S.Kom, M.Kom., "Pengembangan Sistem Arsip Digital Berbasis Website Dengan Framework Laravel Untuk Efisiensi Penyimpanan dan Keamanan Data," *KOMTEKS*, vol. 3, no. 2, pp. 9–12, Jan. 2025, https://doi.org/10.37637/komteks.v3i2.2167.

[7] B. Nugroho, M. S. Hasibuan, and M. H. Annabil, "Perancangan Aplikasi Absensi Pegawai Berbasis Web Dengan Blackbox Testing pada DISPORA Sumatera Utara," *J. Comput. Sci. Informatics Eng.*, pp. 199–209, Dec. 2023, https://doi.org/10.55537/cosie.v2i4.714

[8] R. A. Nugroho, "Efektivitas Sistem Informasi Presensi terhadap Disiplin Pegawai Biro Sumber Daya Manusia di Komisi Pemilihan Umum Republik Indonesia (KPU RI)".

[9] H. J. Christanto and Y. A. Singgalen, "Analysis and Design of Student Guidance Information System through Software Development Life Cycle (SDLC) dan Waterfall Model," *J. Inf. Syst. Informatics*, vol. 5, no. 1, pp. 259–270, Mar. 2023, doi: https://doi.org/10.51519/journalisi.v5i1.443.

[10] Z. Z. and S. Hartati, "MANAJEMEN KINERJA APARATUR SIPIL NEGARA MELALUI APLIKASI SISTEM APLIKASI PENILAIANKINERJA PEGAWAI (SASIKAP EVO 6.0) DI BADAN KEPEGAWAIAN DAN PENGEMBANGAN SUMBER DAYA MANUSIA KABUPATEN BANDUNG PROVINSI JAWA BARAT".

[11] J. D. W. Panjaitan, A. M. Rifa'i, and A. Suprianto, "Web-Based Attendance Information System At Diskominfosantik Bekasi District With Prototype Method," *J. Comput. Networks, Archit. High Perform. Comput.*, vol. 7, no. 3, pp. 2021–2031, Aug. 2025, https://doi.org/10.47709/cnahpc.v7i3.6753.

[12] P. (Dr. . P. S. Kayande and M. S. Phadnis, "A Study on the Software Development Life Cycle–Waterfall Model at a Aviation Management Consultant," *Indian J. Softw. Eng. Proj. Manag.*, vol. 4, no. 1, pp. 1–20, Jan. 2024,https://doi.org/10.54105/ijsepm.A9019.014124.

[13] F. Natsir and R. A. Sihombing, "Penerapan Metode User Centered Design pada Rancangan User Interface Marketplace Pemasaran Produk Olahan Perikanan," *J. Pract. Comput. Sci.*, vol. 2, no. 2, pp. 56–63, Dec. 2022,https://doi.org/10.37366/jpcs.v2i2.1472.

[14] N. Alnahdi and R. Alnanih, "A Novel Information Model for Software Interface Reliability in the Software Development Life Cycle," *Procedia Comput. Sci.*, vol. 251, pp. 116–123, 2024, https://doi.org/10.1016/j.procs.2024.11.091.

[15] B. Szabó and K. Hercegfi, "User-centered approaches in software development processes: Qualitative research into the practice of Hungarian companies," *J. Softw. Evol. Process*, vol. 35, no. 2, Feb. 2023,https://doi.org/10.1002/smr.2501.

[16] A. Ghifari and J. Haikal, "Perancangan Desain UX dan Model 3D Reverse Vending Machine menggunakan Pendekatan User-centered-design Pada Platform Sampahmas".

[17] C. SM, "Analisis Pelaksanaan Sistem Absensi Elektronik Dalam Menetapkan Single Salary Aparatur Sipil Negara Pada Biro Humas, Protokol dan Kerjasama di Sekretariat Daerah Provinsi Riau".

[18] A. K. Dalal *et al.*, "Design and implementation of an automated email notification system for results of tests pending at discharge," *J. Am. Med. Informatics Assoc.*, vol. 19, no. 4, pp. 523–528, Jul. 2012, https://doi.org/10.1136/amiajnl-2011-000615.

[19] Z. Fauziah, H. Latifah, U. Rahardja, N. Lutfiani, and A. Mardiansyah, “Designing Student Attendance Information Systems Web-Based,” *Aptisi Trans. Technopreneursh.*, vol. 3, no. 1, pp. 23–31, Feb. 2021, https://doi.org/10.34306/att.v3i1.114.

[20] S. Aisyah and Wahyat, "Web-Based Video Conference Equipment Borrowing Application (Case Study: Department of Communication, Informatics, and Statistics of Bengkalis Regency)," in Seminar Nasional Industri dan Teknologi (SNIT), Dec. 2025, pp. 691-696.

[22] N. Fajriati and K. Budiman, “Web-Based Employee Attendance System Development Using Waterfall Method,” *J. Adv. Inf. Syst. Technol.*, vol. 3, no. 2, pp. 8–20, Sep. 2022, https://doi.org/10.15294/jaist.v3i2.52942.