Designing a Web-Based and Mobile Attendance Information System to Improve Operational Efficiency at CV Bengkel Teknologi Indonesia

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ABSTRACT
The conventional attendance system at CV Bengkel Teknologi Indonesia leads to administrative inefficiencies and is vulnerable to fraud. To address these challenges, this study develops an integrated web and mobile-based attendance information system. The system incorporates photo validation and geofencing capabilities, implementing the haversine method to ensure data validity. The system was developed using the Rapid Application Development (RAD) methodology to accelerate the system development process through short iterative cycles. The results demonstrate significant efficiency improvements, particularly in the data recapitulation process, which was reduced from 3-5 hours to 1-5 seconds. Additionally, employee attendance validation now requires only two steps per data entry. The system delivers a centralized solution, connecting employee mobile applications with administrative web dashboards via API integration to enhance operational efficiency.

Keywords: Attendance System, Web and Mobile, Rapid Application Development, Geofencing

INTRODUCTION

Digital transformation requires organizations to adapt, including CV Bengkel Teknologi Indonesia in Pontianak, which still uses a conventional attendance system. The current system has significant weaknesses, such as time inefficiency in data recapitulation and vulnerabilities to fraud, where employees can manipulate attendance records. Although various studies have offered digital attendance solutions, the specific needs of the research object have not been fully resolved.

In response to the weaknesses of conventional systems, various digital solutions have been developed. Several studies, such as those done by Maulidiyani and Dana, (2023) and Amir et al., (2023), have successfully designed web-based attendance systems to simplify the process of recording and summarizing attendance data. However, many solutions still focus on recording arrival and departure times without a strong validation mechanism to ensure data authenticity. The use of features such as photo verification via camera or GPS-based location restrictions (geofencing) has not been widely implemented, making the attendance systems that have been developed vulnerable to potential fraud. The combination of geofencing technology with photo validation features to improve data efficiency and validity is an area that is worth to explore further.

This study offers a new approach to digital attendance systems by integrating real-time attendance recording, visual verification through photos, and location tracking based on the haversine method when within the organization's environment. The authors combine three layers of authentication: time, location, and visual identity to minimize potential data manipulation. This approach improves the verification process in previous studies that relied on a single dimension of validation. The system architecture is based on two cross-platform

applications (Android and Web) connected via an Application Programming Interface (API) (Setiawan & Ghiffari, 2022), enabling accurate and efficient synchronization of attendance data between users and system administrators, such as simplifying the attendance process and accelerating validation.

The main challenge in developing this application not only lies in the completeness of its features. The system must also be able to guarantee data accuracy and have high flexibility so that it can be easily developed in the future. Therefore, a dynamic and adaptive development approach is needed to respond to these needs. This study adopts the Rapid Application Development (RAD) methodology, which focuses on rapid prototyping. The RAD approach allows the system to be built in stages through clear development cycles.

This study provides several contributions, such as:

1. Integrating mobile applications and web dashboards into a centralized system..
2. Implementing multi-layered validation through photo verification and geofencing based on the haversine method to reduce potential fraud.
3. Using the RAD methodology to provide an adaptive and rapidly developed solution.

The objective of this research is to automate the process of recording and summarizing attendance efficiently, while also improving the integrity of attendance data.

LITERATURE REVIEW

This literature review examines the development of attendance systems and their development methodologies. The review focuses on several studies, which are: hardware-based systems, software-based systems, and comparisons of relevant development methodologies.

Research have shown that hardware-based attendance systems improve data accuracy. For example, Mundzilin et al., (2024) successfully used RFID cards, while Mamuriyah and Novianto, (2022) utilize portable fingerprint devices. but still have limitations in the form of dependence on physical devices that are vulnerable to damage or loss and are less efficient in centralized data recapitulation.

Further research on software-based attendance systems. Studies by Maulidiyani and Dana, (2023) as well as Amir et al., (2023) successfully created a web-based system that facilitates report recapitulation. Studies by Siregar, (2024) and Niklas et al., (2024) began to integrate GPS, camera technology, and applying geofencing for location validation. However, the challenge with this approach is the lack of good integration between the mobile platform (for employees) and the web platform (for system administrators), so choosing the right methodology is a key factor in ensuring that the system built can function optimal.

Many previous studies have used the waterfall method, which is rigid and less adaptive to changes in user needs. Another method used is the agile method. This method offers a more flexible iterative approach, as applied by Niklas et al., (2024) to a Google Forms-based attendance system. Although effective, agile can be complex, time-consuming, and expensive due to its repetitive cycles, as well as requiring a highly experienced team.

For the context of this research at CV Bengkel Teknologi Indonesia, the RAD methodology was chosen as a more appropriate alternative. RAD not only offers speed through interactive prototypes, but is also well suited to projects with clear requirements that require rapid validation from end users. The RAD method is more efficient for small to medium-sized projects compared to agile methods. The RAD method reduces the risk of misunderstandings in identifying requirements through shorter feedback cycles and focuses on the core functionality of the system being developed.

METHODS

The methodology for developing the attendance system is divided into several stages, starting with data collection. This is followed by the development of the RAD system, which consists of requirements design, user design, and construction. After the system development stage has been completed, an evaluation of the achievement of objectives is carried out. This flow can be seen in Figure 1.

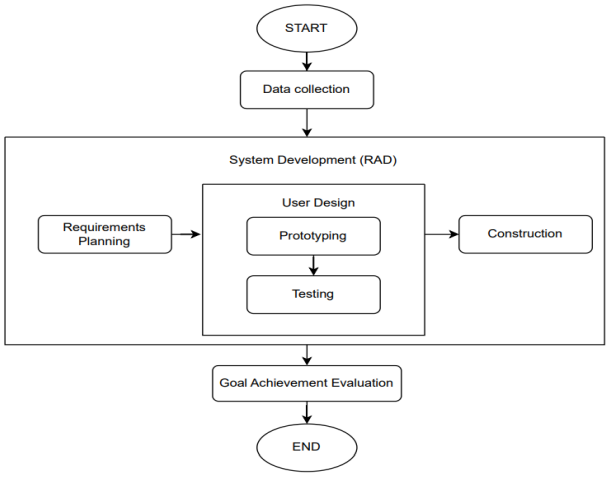

Figure 1. Research Stages

Data Collection

To gain a deep understanding of the existing problems and system requirements, data was collected through the following methods:

Table 1. Data Collection Methods

Methods	Goals	Output
Observation	Identifying the flow and duration of the conventional attendance process directly at CV Bengkel Teknologi Indonesia.	Estimated time required to complete the attendance process conventionally.
Interview	Explore system problems and needs from the administrator's perspective through semi-structured interviews.	System requirements such as validation processes, attendance recapitulation processes, and information requirements needed to generate reports.

System Development Method

The system was developed using a modified RAD method to emphasize rapid prototyping and minimal planning. The study stages were based on the main phases in the RAD model, which were adapted to the system development requirements as described below.

1. Requirements Planning
   At this initial stage, problems are identified and functional requirements for users and organizations.
2. User Design
   This stage focuses on designing the user interface (UI) and user experience (UX) through prototyping (Wahyudin and Arianti, 2024). The system design process contains two stages,

the initial prototyping stage, which includes workflow and interface, and then testing with users to obtain feedback.

3. Construction
   The construction phase begins after the design is approved, transforming the prototype into the final product. This process includes building the basic architecture, database, API, and login system for web and mobile, followed by the implementation of key features such as check-in/out, photo capture, GPS validation, and a real-time attendance dashboard. Supporting features such as attendance history, holiday calendar, and report summaries are also added.

Goal Achievement Evaluation

To measure the success of the system in achieving the research objectives, which is to improve operational efficiency, the author will use a method in usability testing called Contextual Inquiry (CI). CI was chosen as the usability testing method because the research focuses on the efficiency of the attendance process in a real work context. CI is implemented in usability testing through activities such as interviews and direct observation of users to explore their real experiences. The use of usability testing methods is more relevant to the research environment than other evaluation methods. The results of the system evaluation focusing on efficiency are described in Table 2.

Table 2. Efficiency-Focused Measurement Scenario

Measurement Metric	Measurement Method & Tools	Research Objective
1. *Task Completion Time*	Using logs to monitor the duration of attendance management. An example scenario is when the system administrator opens the application and successfully validates employee attendance.	Automate the attendance recording process efficiently and resolve the weaknesses of conventional systems that are vulnerable to fraud.
2. *Report Recap Time*	Using logs to record the time taken to compile attendance reports by system administrators via a web application, then comparing this with observations of the estimated duration on conventional systems.	Solving challenges related to operational efficiency. Identifying and resolving inefficiencies in the data recapitulation process.
3. *Number of Steps for Completing Tasks*	Calculate the number of clicks required for users to complete the task scenario.	Ensuring the system is easily accessible to optimize time consumption.

RESULTS

Data Collection Result

The initial stage of the research was data collection through observation and interviews at CV Bengkel Teknologi Indonesia. Based on direct observation of the conventional attendance process, several key findings were discovered, as follows:

1. Time Inefficiency
   The observation results show that the conventional attendance recapitulation process for all employees at the end of the month is estimated to take 3-5 hours of effective working time.

3. Fraud Potential
   Observations discovered a chance for fraud, where employees reported their attendance on time even though they were late, because recording was still based on trust and conventional recording.
4. Overload in Administrative
   The interview results showed that the data validation and recapitulation process was very burdensome for system administrators and vulnerable to human error, especially when calculating total attendance.

System Requirements Design Results

Based on the analysis of issues from the data collection stage, a series of functional requirements that must be met by the system were defined. These requirements define the essential capabilities of the system to address the challenges of data efficiency and validity at CV Bengkel Teknologi Indonesia, such as:

1. The system must allow for flexible and independent attendance recording for employees.
   The requirement for self-recording that is stored in a centralized system is a solution to the limitations of conventional methods, encouraging the development of mobile applications that are adaptive to changes in the way people work today.
2. The system must be able to verify the authenticity and integrity of attendance data.
   The system must have a better identity validation process, such as location recording using the haversine method and equipped with employee photo capture. Such a validation process can reduce the potential for fraud that occurs in conventional systems.
3. The system must be able to automate the process of generating attendance summary reports and managing employee attendance submissions.
   The system must be able to generate employee attendance reports in a shorter time and reduce the workload of system administrators.

Prototype Development

The prototype was subsequently designed to have an appearance and interaction flow that was as similar as possible to the final application. The aim was to provide CV Bengkel Teknologi Indonesia with a realistic picture of the system to be developed, so that feedback could be obtained as early as possible. The main focus of the prototype covered the essential workflows that had been identified during the requirements design stage, namely:

1. Flow of Employee Attendance
   Starting from the login page, the main dashboard display, the process of pressing the check-in button, the photo capture interface, to the notification of successful or failed attendance.
2. Flow of System Administrator
   Includes the system administrator dashboard display, a list of employee attendance records awaiting validation (pending), and a simulation of the process of approving or rejecting attendance data.

Prototype Testing and Feedback

The completed prototype was then demonstrated in a trial session to key users, who were employee representatives and system administrators. During the session, users were asked to try out the main workflow while providing direct feedback. From the trial results, important input was obtained from users, specifically employees and system administrators, which was essential for improving the system design.

1. Feedback from Employees
   In the initial prototype design, the “Overall Attendance” and “Absence Request” menus were placed on the “Profile” page. Employees felt that this placement was not user-friendly

and difficult to find. Based on this feedback, the final design moved both menus to the "Home" page under the "Other Menus" category for easier access.

2. Feedback from System Administrator
   The system administrator suggested that to speed up the validation process, it would be more efficient if the system administrator could view the check-in and check-out proof photos simultaneously in a single view for comparison. This feedback was very valuable and was implemented in the validation pop-up design on the admin dashboard, where the proof photos are displayed side by side before the administrator presses the "Approve" or "Reject" button.

Once the design iterations based on this feedback have been approved, the system design is considered validated. The process can then proceed to the construction phase to turn the prototype into a functional software product.

Construction

Once the system requirements have been defined, the next step is to design and implement a prototype in accordance with the RAD methodology. The results of this stage include workflow modeling, database design, and a functional application interface.

System Modelling with Use-Case Diagram

This diagram describe the relation or interaction between procedures in the system and the actor that related to the software development. (Zasmadyansyah et al., 2023). The actors in this study are 'employees' and 'system administrators'.

System administrators, who can access the system through a web-based application on localhost, have a greater role in data management. System administrators can register or generate new employee accounts and ensure the validity of daily attendance data. System administrators also process absence or attendance proposal submitted by employees and then approve or reject the requests in accordance with applicable regulations. System administrators are also responsible for calculating and accumulating the total attendance of each employee.

This use case diagram illustrates the relationship between actors and procedures that happen within the system. Employees interact with the system via mobile devices to enter attendance data, which is verified by the system. Employees can track their daily attendance status and submit absences by attach supporting documents. In addition, employees can also manage their respective account profiles. A use case diagram illustrating the designed system is presented in Figure 2.

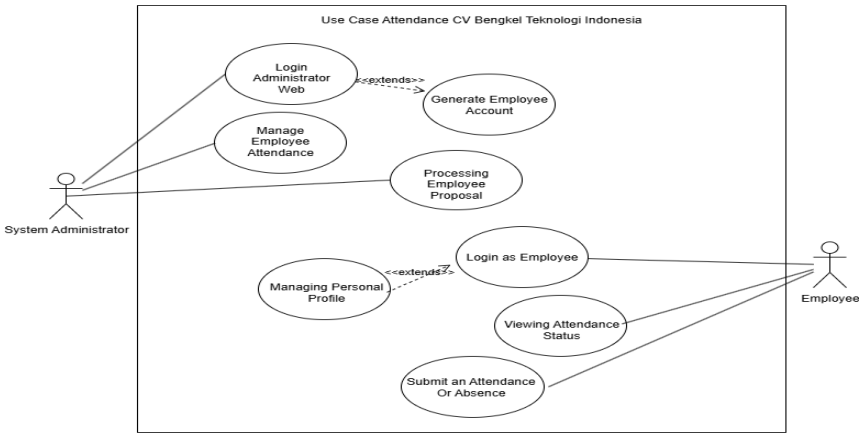

Figure 2. Use-Case Diagram

System Modelling with *Sequence Diagram*

A sequence diagram is a visual representation used to show in detail the flow of interactions between various objects in a system (Mohara and Gata, 2020). This diagram also displays messages or instructions sent during the process, complete with the sequence of their execution.

Sequence Diagram Submit an Attendance or Absence

The process starts when employees open the "UserMenu" which is android-based, the system displays real-time clock from "AttendanceManager" as a reference for recording. To submit attendance, employees press the check-in button so that "UserMenu" calls "openFrontCamera" and "captureCoordinates" to take photos and location points. After the preview appears, the employee confirms and "UserMenu" sends "saveChanges" to "AttendanceManager". There, the system verifies the location: if it does not match, "UserMenu" displays a rejection notification; if it matches, "AttendanceManager" saves the data (employee_id, photo, coordinates, attendance_time) to the Attendance entity and sends a storage notification to "UserMenu" and "AdminMenu".

To submit an absence, employees select the absence submission menu in MenuUser, then fill in the type of absence, date range, description, and attachments. MenuUser processes it with "processInput", forwards it to "AttendanceManager", then saves it to the "Attendance" entity. Finally, PresensiManager sends an absence submission notification to "AdminMenu".

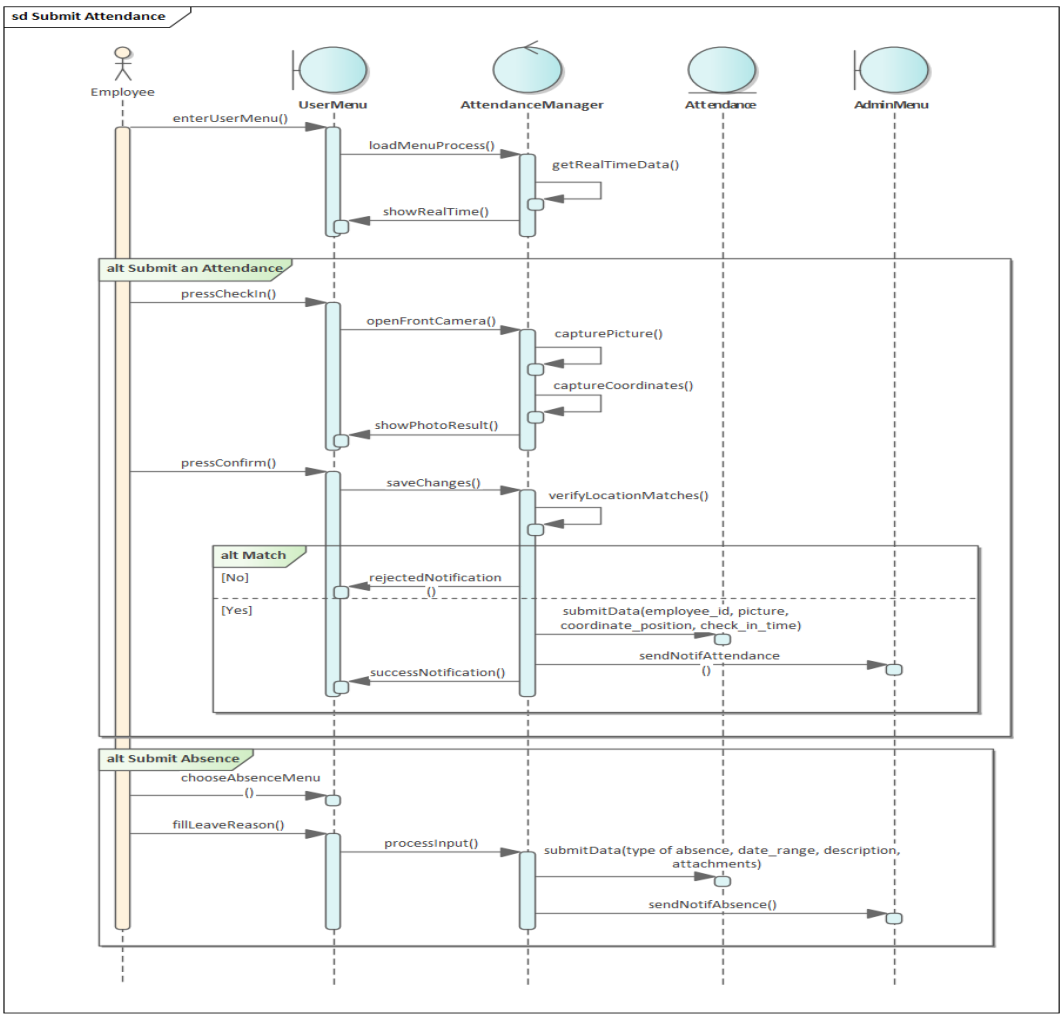

Figure 3. *Sequence* Diagram Submit an Attendance or Absence

Sequence Diagram Manage Employee Attendance

The employee attendance management process begins when the system administrator enters the main dashboard. The author has named this dashboard "AdminMenu." "AdminMenu" retrieves real-time date data and attendance data in the form of employee names, arrival times, departure times, and photos. The system administrator verifies the accuracy of attendance based on photo and arrival time matching. If the attendance is correct, the "Approve" button is pressed to change the status from "pending" to "approved." If it is incorrect, the "Reject" button is pressed and the system administrator must provide a reason for rejecting the attendance approval. "MenuAdmin" sends the status change to the controller, which updates the attendance status to "rejected" and saves it in the "attendance" entity.

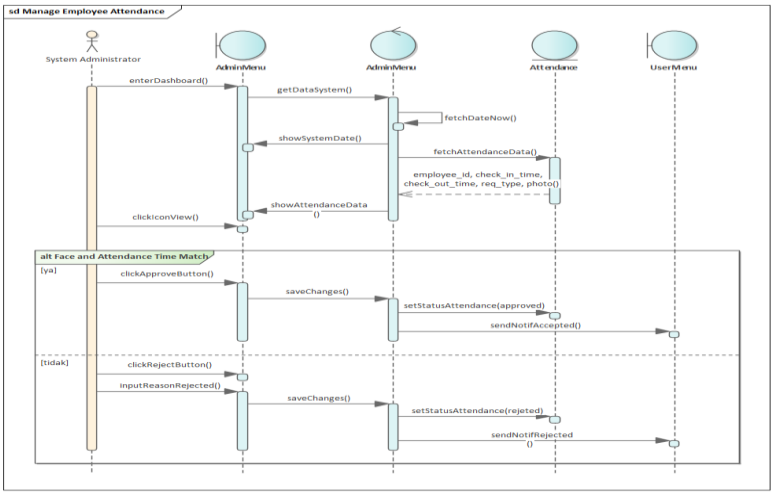

Figure 4. *Sequence* Diagram Manage Employee Attendance

Database Design

In designing a database, one of the necessary activities is system requirements analysis. System requirements analysis includes identifying users and applications that require data, perform interviews and document analysis, reviewing the operational environment and business processes, and determining the types of data or transactions that will occur (Setyadi et al., 2022). The author uses MySQL as a database management system to manage and store data.

The database design consists of seven tables which are "attendance", "account", "employees", "absence_request", "job_schedule", "department", "app_configuration". The "employees" table is the main table that references the primary key attribute "employees_id" to various tables, as shown in Figure 5.

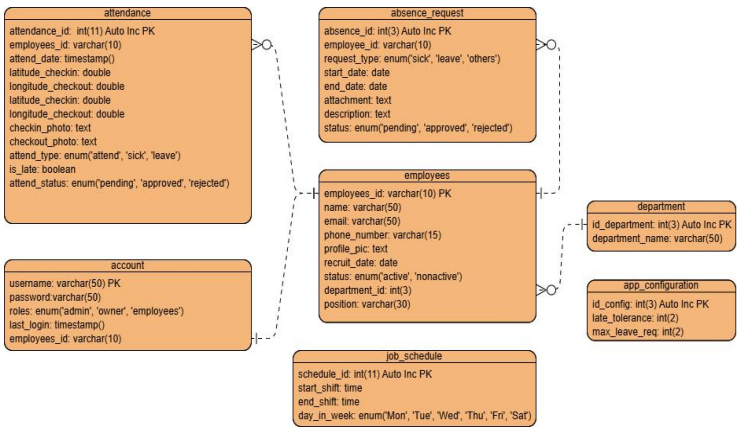

Figure 5. Structure of the Database Design

Employee Application Interface

This page is specifically designed for use by employees. There are three menus on the bottom navigation bar. Each menu displayed on the navigation bar directs employees to a specific page. This application has three main menus, which are “Home” for checking in/out (submitting attendance), viewing daily attendance records, and submitting absences; “Work Calendar”, which is integrated with an external API to display national holidays; and “Profile” for account management.

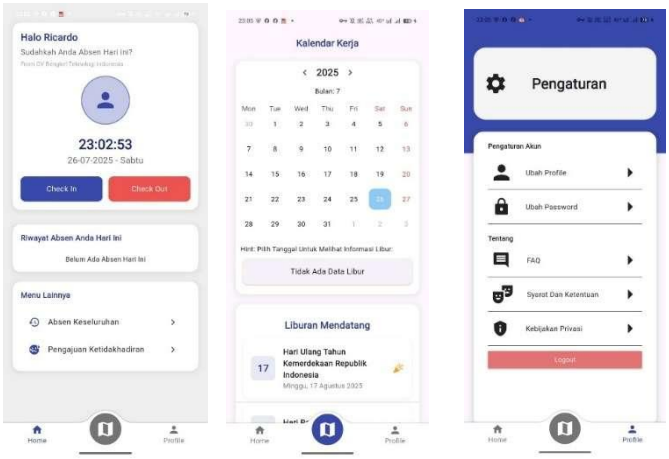

Figure 6. Interface of Employees Application

Attendance Data Collection Process

At this stage, the author utilizes real-time data, employee photos, and location coordinates as the main information sent from the employee-side application to the system administrator's web application. This approach determines the actual position of employees when they clock in, supported by timestamps and visual documentation in the form of photos. Figure 7 displays attendance data, including the time of arrival and the location of employees in latitude and longitude format.

The author used the haversine method. The advantage of this method is that it provides the great-circle distance, which is the shortest distance on the surface of the earth and is more relevant for calculating the distance between two locations (Kusnadi et al., 2024)

When employees are outside the organization's coverage area, the system automatically rejects attendance submissions that are outside the radius, which reduces the workload for system administrators.

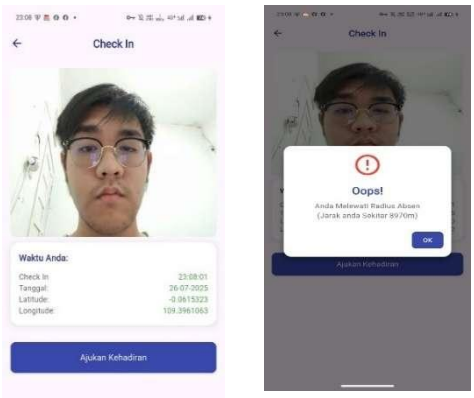

Figure 7. Interface of Attendance Data Collection Process

Administrator Application Interface

This section is the interface of the system administrator. The web application is divided into three menus on the sidebar, namely dashboard, account management, and system configuration.

1. *Dashboard*
   This interface displays a detailed summary to achieve efficiency so that there is no need for many processes. It consists of the total number of employees, pending submissions, the number of absent employees, and an attendance list that can be filtered by date and then downloaded as an attendance recap.

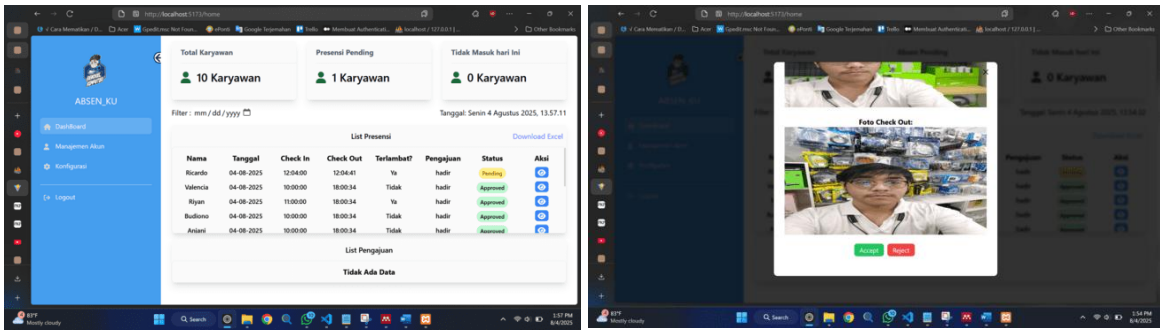

Figure 8. Interface of Administrator's Dashboard While Validate Attendance Requests

2. Account Management
   This interface displays all employee data such as employee personal data, account data, and department data where employees are placed.

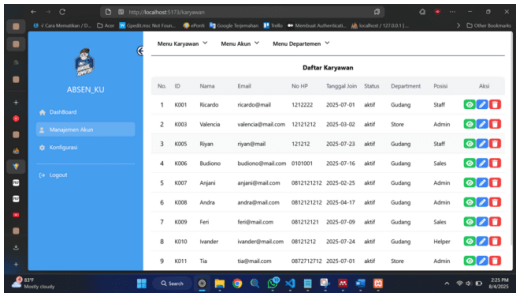

Figure 9. Interface of Account Management

3. System Configuration
   This interface manages configurations such as the maximum delay tolerance for employees and the maximum number of leave days allowed.

Figure 10. Interface of System Configuration

System Efficiency Evaluation

To prove that the designed system successfully achieved its goal of improving efficiency, an evaluation was performed based on a pre-defined measurement scenario. This test compared

the processes in the new system with the estimated processes in the conventional system that had previously been running at CV Bengkel Teknologi Indonesia. The author conducted a contextual inquiry, which is a usability testing method, to obtain information about the users direct experiences.

Table 3. Before and After Comparison Regarding System Efficiency Evaluation

Measurement Metrics	Conventional System	Proposal System
Attendance Validation	There is no validation process and it is entirely trust-based, so there is no guarantee of the authenticity of attendance data. This opens up a huge possibility for potential fraud, such as time manipulation.	It takes 1-4 seconds per employee to perform real-time validation. The system is equipped with accurate photo and location evidence, significantly reducing the risk of fraud and maintaining data integrity from the outset.
Report Recap Time	It takes 3-5 effective working hours at the end of each month. The process is carried out conventionally by compiling attendance data using Microsoft Excel. This process is highly prone to human error and burdens the system administrator.	It takes 1-5 seconds (shown in Figure 11) to download the automatic summary report in .xlsx format. This process eliminates human error and drastically reduces administrative workload.
Number of Steps	The workflow is not digitally defined and depends on conditions (time/busyness). It has the potential to involve a long and repetitive process, starting from verification, data input, to time-consuming end-of-month recapitulation.	It takes three steps for employees to fill in their attendance (Check-in -> Take photo -> Submit attendance), and two steps for system administrators to generate attendance summary reports (Select Action -> Approve/Reject). The more concise completion steps improve efficiency in the attendance recording and validation process. The system becomes simpler and easier to use.

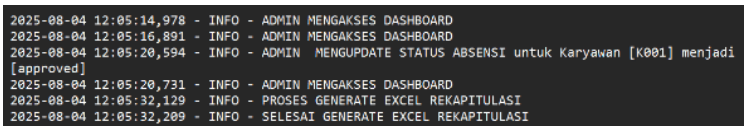

Figure 11. L*og* Results while doing processes

Novelty from this study indicate that the web-based and mobile attendance system that was designed has significantly improved operational efficiency at CV Bengkel Teknologi

Indonesia. The most significant improvement was seen in the time required to compile reports, which was reduced from 3-5 hours to just a few seconds. These results are in line with previous studies by Maulidiyani and Dana, (2023) as well as Amir et al., (2023), which also found that web-based systems can simplify the recapitulation process.

However, this study makes a further contribution by addressing a weakness identified in previous systems, namely their vulnerability to data manipulation. These findings reinforce Niklas et al., (2024) argument regarding the importance of geofencing technology to ensure real-time presence at the correct location. The simplified workflow (2-3 steps for the main task) also proves that the user-friendly interface design, which is the focus of the RAD methodology, has been successfully achieved and can be quickly adopted by users.

CONCLUSION

Based on the results of the system design and implementation, it can be concluded that this study has successfully designed and implemented a web-based and mobile attendance information system that effectively addresses inefficiencies and potential fraud in the conventional system at CV Bengkel Teknologi Indonesia. By utilizing the Rapid Application Development (RAD) methodology, the system was developed quickly and responsively to user needs.

This study used a layered validation approach, which combines real-time photo verification with geofencing technology using the Haversine method. This approach has been proven to not only automate the attendance process but also significantly improve data integrity. The time required to recap reports has been drastically reduced from 3-5 hours to just a few seconds, while the daily validation process has become much more efficient for system administrators. The proposed system provides a solution to improve operational efficiency and employee discipline.

LIMITATION

The author acknowledges several limitations in this study. First, testing of the system's functionality and efficiency was conducted on a small scale, involving only a few representative users at CV Bengkel Teknologi Indonesia. Second, testing depended on internet connectivity and the GPS capabilities of employees' mobile devices, the performance of which can vary. These limitations should be taken into consideration when interpreting the results of this study.

SUGGESTION

For future development, several areas can be explored further. First, strengthen anti-fraud validation by detecting location spoofing/mock GPS. Second, integrate with AI for face recognition of each employee's face to lighten the workload of system administrators so that the system can immediately validate both location and facial matching.

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