Design and Development of an Employee Attendance and Performance Evaluation Application Based on Mobile and Web with Face Recognition, Geolocation, and the SAW Method at Toll Road Company PT XYZ

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Abstract— This research aims to design a mobile-based attendance app for the toll road company in East Java, PT XYZ.Using Face Recognition and Geolocation to simplify employee attendance. The app features an employee performance evaluation system based on the Simple Additive Weighting (SAW) method via a web admin interface. Employees can clock in using real-time facial recognition and location validation, while admins can monitor attendance and performance. Developed using Extreme Programming (XP) and tested through User Acceptance Testing (UAT), the app enhances efficiency, accuracy, and transparency in managing attendance and performance across multiple locations.

Keywords— Mobile Attendance, Face Recognition, GPS, UAT, Extreme Programming (XP), Simple Additive Weighting (SAW)

I. INTRODUCTION

Technology is rapidly advancing and has a significant impact across various sectors, including human resource management. One of the technological advancements affecting managerial systems is the use of smartphones as tools for employee attendance. In many companies, the traditional attendance system that relies on fingerprint attendance machines is becoming less effective, especially in companies with employees spread across field locations [1], such as PT XYZ. The use of fingerprint machines has limitations in mobility, requiring employees to return to the office to clock in, which reduces time efficiency and affects operational smoothness. Additionally, damage to fingerprint machines can result in the loss of valuable data, further complicating the management of employee attendance [2].

Face Recognition and GPS technologies address attendance issues by enabling automatic clock-ins through facial identification and location verification. This system allows employees to clock in directly at work sites, improving efficiency and accuracy while reducing the potential for data manipulation, common in traditional systems[3];[4]. A mobile-based attendance system also offers flexibility and practical management for the company.

Employee performance evaluation is crucial for effective management, and the Simple Additive Weighting (SAW) method is a widely used approach for ranking performance based on set criteria. PT XYZ, in the Toll Road Business Entity sector, needs an efficient and accurate system to evaluate field employees [5], particularly at toll booths. A mobile-based attendance system integrating Face Recognition and GPS technology, combined with a performance evaluation system using the SAW method, can enhance operational efficiency, attendance accuracy, and evaluation objectivity[6].

This research aims to analyze the inefficiency of the fingerprint attendance system at PT XYZ, as well as to design and develop a mobile-based attendance system

that integrates Face Recognition and GPS technology to improve the accuracy of field employee attendance. In addition, this study also aims to implement the SAW method in the employee performance evaluation system to improve the efficiency and accuracy of the evaluation process. With a more flexible attendance system and an objective evaluation system, it is hoped that the company can obtain more accurate and efficient data, which can be used for better operational planning and more precise decision-making.

This research contributes to both theoretical and practical aspects. It expands knowledge on applying Face Recognition and GPS technology in attendance systems and advances information technology. Practically, it improves PT XYZ's attendance system efficiency and accuracy, simplifies management, and enhances performance evaluation using the SAW method. The findings are expected to aid human resource management in companies with widespread employees, especially in high-mobility industries like toll road management. [7].

II. METHOD

A. Extrime Programming Method

Extreme Programming (XP) is a software development methodology that emphasizes efficiency, adaptability, and flexibility. XP focuses on collaboration, simplicity, and continuous feedback, aiming to quickly respond to changing requirements [8]. This method uses iterative cycles, small teams, and close communication between developers and users to produce software that meets user needs.

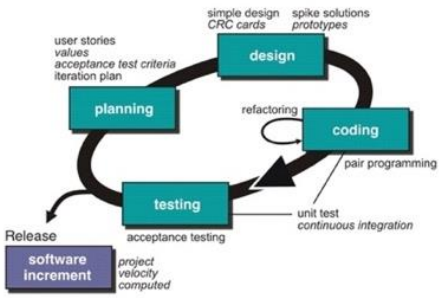

Figure 1 Extrime Programming Method

1. Planning: The planning stage begins by identifying the needs and issues of the existing system, as well as analyzing the desired features and functionalities. In this stage, the development team and users collaborate to ensure a clear understanding of the expected outcomes and development priorities, with effective communication being key to the success of the Extreme Programming (XP) methodology [9].
2. Design: In the design phase, system modeling is created based on the requirements analysis, including a database model to illustrate data relationships. The system modeling follows Unified Modeling Language (UML), with diagrams such as Use-Case, Activity, Component, and Deployment Diagrams [10]. The database model uses Logical Record Structure (LRS).
3. Coding: This phase involves implementing the system design into program code, resulting in a software prototype. For the development of the mobile-based attendance application with a web administration system, the backend uses PHP, CSS, and JavaScript, while the mobile app uses Dart. MySQL is used as the Database Management System for implementation.
4. Testing: The system that has been built must be tested first to ensure that its functionality meets the user's needs and the specifications that have been established [11]. The testing method used for the mobile and web attendance application is User Acceptance Testing (UAT), where inputs and outputs generated by the system are tested by at least 60-100 end users [12].
5. Softwere Increment This phase involves the gradual development of the system after its implementation in the company, adding services or content that enhance the system's functionality.

B. Simple Additive Weighting (SAW)

Employee performance assessment is carried out using the Simple Additive Weighting (SAW) method. In this stage, the performance assessment of employees is detailed, with the values for each alternative referring to data from the company and the parties/supervisors who determine those values [13].

$$r_{ij} = \begin{cases} \frac{X_{ij}}{\text{Max}_i(X_{ij})} & \text{if j is the benefit criteria} \\ \frac{\text{Min}_i(X_{ij})}{X_{ij}} & \text{if j is the cost criteria.} \end{cases} \quad \textbf{(1)}$$

Information:

r_{ij} = Normalized performance rating value
x_{ij} = Attribute value by each criteria
$\text{Max}_i\ x_{ij}$ = The maximum value of each criteria i
$\text{Min}_i\ x_{ij}$ = The mimimum value of each criteria i
Benefit = If maximum value is best
Cost = If minimum value is best

Where rij is the normalized performance rating of alternative Ai and attributes Cj; i =1, 2, ..., m and j = 1, 2,..., n.
The preference value for each alternative (Vi) as given as:

$$V_i = \sum_{j-1}^{n} w_j r_{ij} \quad \textbf{(2)}$$

V_i = Ranking for each alternative
w_j = The weight value of each criteria

r_{ij} = Normalized performance rating value

III. RESULTS AND DISCUSSION

The design and development of a mobile-based attendance application and an admin website will be carried out using two methods: the Extreme Programming methodology and the Simple Additive Weighting method. The following are the stages to be undertaken.

A. Planning

The planning starts with interviews with stakeholders to gather data and information for the system's requirements. These results are then used to define the system's functional requirements, which outline the processes the system can perform and identify its users. The following are the system's functional requirements:

1. System Administration
   a. The admin cannot register themselves, the username and password for the admin login role will be created by the super admin (developer) first.
   b. The admin can access the system through the login form by entering the username and password provided by the super admin (developer).
   c. In the administrative system, it is built based on a website, where only the admin can log in or access the system.
   d. The admin can create usernames and passwords for employees to access the attendance system.
   e. The admin can view the overall attendance of all employees.
   f. The admin can view the overall attendance of employees, including check-in time, check-out time, shifts, ,coordinat and status (late or on time).
   g. The admin can generate attendance reports by exporting to excel and can filter the data based on year, month, and day.
   h. The admin can create permission categories and set quotas for each type of permission. Additionally, the admin has the authority to approve permission requests from employees.
   i. The admin can create employee evaluations based on criteria that have been agreed upon in the system development planning.
2. System Mobile Attandance
   a. Employees can access the system through the login form by entering the username and password provided by the admin.
   b. The system can detect the employee's face as a validation for attendance.

c. The system can capture the employee's location by utilizing geolocation.
d. The attendance system can record both check-in and check-out times for employees by detecting their faces and capturing their location.
e. The system can facilitate employees in submitting leave requests, such as sick leave or vacation, by filling out the provided form.
f. The system can record attendance when employees work overtime.
g. The system can display the attendance history of employees.

B. Design

At this stage, the researcher designs the system, such as the design of the employee attendance system based on mobile and web administration. The system design is carried out using UML. UML diagrams provide an approach to the interaction between the system and user actors [14]. Below is the system flowchart as an overview of the entire system design.

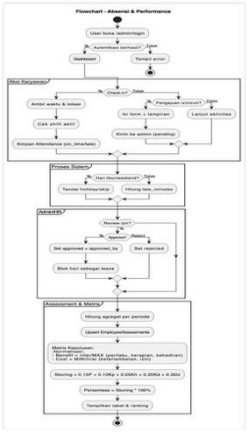

Figure 2 Flowchart System

C. Coding

After the design is completed, the next step is the implementation in the form of source code. The coding will use two programming languages PHP for web programming (backend), MySQL for the database, and Dart for Android programming (mobile attendance). Before starting the website and Android application, users are required to log in first to access the system.

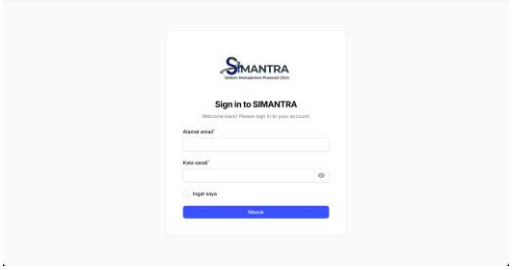

Figure 3 Admin attendance system login website

Login on the website is only intended for the admin role, employees cannot access the website because its functions are designated for managing employee attendance. After successfully logging in, the admin will be directed to the dashboard page.

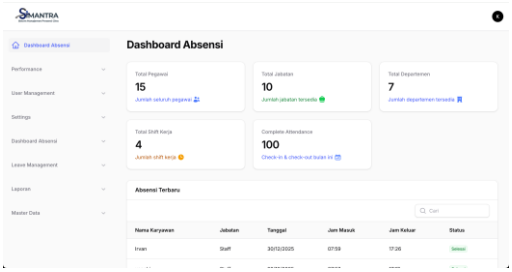

Figure 4 Page dashbord website

On the dashboard page, the admin can view the latest attendance and a section displaying the total number of employees, total job positions, total departments, total work shifts, and completed attendance. To manage employee attendance data, the admin can access the attendance report page. On this page, the admin can monitor employee attendance and download the attendance data for reporting purposes, with the option to filter the period by year, month, or day according to their needs.

In the web-based admin system, admins can manage attendance, leave requests, public holidays, attendance radius, working hours, and employee evaluations. Employees can record attendance via an Android app developed in Dart, which connects to the web admin system backend. Users must log in with a username and

password created by the admin in the web system.

Figure 5 login page attendance

After employees log in, they are directed to the dashboard page, where they can access check-in, check-out, leave requests, and overtime features. To perform check-in and check-out, users are required to register their face first so that the backend system can record it for validation during attendance.

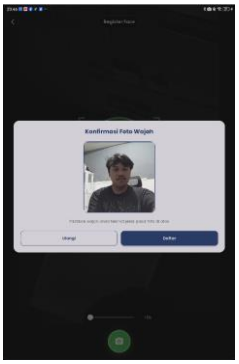

Figure 6 Face detection registration

Figure 6 shows the face registration process, where the facial image is sent to the backend for processing. When an employee attempts to record attendance, the system will request the processed result from the backend to validate the employee's face, matching it with the corresponding employee ID.

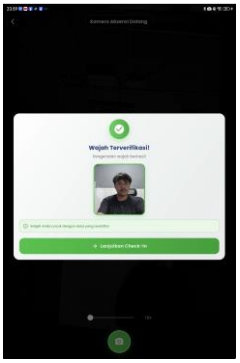

Figure 7 Registered Face

Figure 7 shows that the registered face has been successfully verified during the attendance check-in. After that, the employee will be asked to continue the check-in process. After that, the employee will be directed to a page confirming that the attendance has been successfully recorded, and the employee will then be redirected back to the application's home screen.

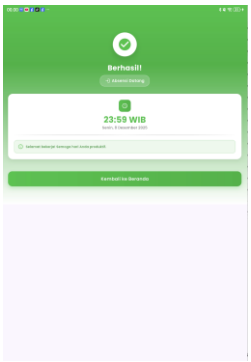

Figure 8 Success Screen

During check-out, the employee follows the same steps as check-in. Once both are recorded, the system saves the data to the database and displays it on the web admin interface. The app also allows leave, sick leave, and overtime requests, which the admin can approve through the web-based management system.

Before proceeding with testing the two systems, the web-based attendance management system and the mobile-based attendance system, the researcher also applies employee performance evaluation using the Simple Additive Weighting

(SAW) decision support method on the web-based attendance management system. The following are the stages involved.

1. determine the weight of each criterion.
   a. Integrity criteria
      This criterion is obtained from the supervisor's direct observation of the behavior in the tasks assigned, such as adherence to deadlines, accuracy in reports, and how they handle challenges or pressure.
   b. Communication criteria
      This criterion is obtained from feedback from colleagues and supervisors regarding how well the employee communicates, both in groups and in one-on-one communication.
   c. TeamWork Criteria
      This criterion is obtained from feedback from supervisors who assess the quality of the employee's teamwork.
   d. Initiative
      This criterion is obtained from feedback from supervisors regarding the extent to which employees show initiative in their work, whether they frequently propose ideas or take actions without needing to be asked.
   e. Achievment Orientation
      This criterion is obtained from feedback from supervisors who observe the extent to which employees strive to achieve high goals and standards in their work.
   f. Attandance
      These criteria are derived from the recapitulation of daily attendance records over a one-year period.
   g. Late
      These criteria are based on the annual recapitulation of daily attendance tardiness.

Table 1 Criteria data.

Criteria	Code	Weight	Attribute
Integrity	C1	20%	Benefit
Communication	C2	10%	Benefit
TeamWork	C3	15%	Benefit
Achievment Orientation	C4	25%	Benefit
Initiative	C5	15%	Benefit
Presence	C6	8%	Benefit
Late	C7	7%	Cost

2. Data Crips

The crisp data represents the threshold values for each criterion that are determined and will be processed in the calculation using Simple Additive Weighting (SAW). Below is Table 2, which presents the crisp table for each criterion.

Table 2 Data crips

Criteria	Crips	Code	Mark
C1	Very Good	VG	5
C1	Good	GD	4
C1	Sufficient	ST	3
C1	Poor	P	2
C1	Very Poor	VP	1
C2	Very Good	VG	5
C2	Good	GD	4
C2	Sufficient	ST	3
C2	Poor	P	2
C2	Very Poor	VP	1
C3	Very Good	VG	5
C3	Good	GD	4
C3	Sufficient	ST	3
C3	Poor	P	2
C3	Very Poor	VP	1
C4	Very Good	VG	5
C4	Good	GD	4
C4	Sufficient	ST	3
C4	Poor	P	2
C4	Very Poor	VP	1
C5	Very Good	VG	5
C5	Good	GD	4
C5	Sufficient	ST	3
C5	Poor	P	2
C5	Very Poor	VP	1
C6	=100%	VG	5

C6	≥90% and≤100%	GD	4
C6	≥ 80% and ≤90%	ST	3
C6	≥ 70% and ≤80%	P	2
C6	≤ 70%	VP	1
C7	≤ 1 time and total ≤ 15 minutes	VG	1
C7	≤ 3 times and total ≤ 30 minutes	GD	2
C7	≤ 5 times and total ≤ 60 minutes	ST	3
C7	≤ 7 times and total ≤ 90 minutes	P	4
C7	≥ 7 time and total ≥ 90 minutes	VP	5

The values used for the SAW method are those determined based on the Crips values. The following values have been adjusted based on data obtained from the human resources division of PT XYZ.

Table 3 Alternative value

Emp-loyee	Alternatif Value						
	C1	C2	C3	C4	C5	C6	C7
YK	4	4	4	4	5	5	2
FJ	3	5	5	3	3	4	2
GC	4	3	5	3	3	4	3
KD	4	4	5	5	4	4	4
IA	2	5	3	4	5	5	1

3. Data Processing

From the employee performance assessment data obtained from the human resources division of PT XYZ, the researcher produced a normalization value using formula (1) for each employee performance criterion as shown in table 3.

Table 4 Normalized value

Emp-loyee	Normalized Criteria Value						
	C1	C2	C3	C4	C5	C6	C7
YK	1,00	0,80	0,80	0,80	1,00	1,00	0,50
FJ	0,75	1,00	1,00	0,60	0,60	0,80	0,50
GC	1,00	0,60	1,00	0,60	0,60	0,80	0,33
KD	1,00	0,80	1,00	1,00	0,80	0,80	0,25
IA	0,50	1,00	0,60	0,80	1,00	1,00	1,00

After that a decision matrix is made which is formed from the suitability rating table of each normalized on each criteria as follows:

$$X = \begin{pmatrix} 1{,}00 & 0{,}80 & 0{,}80 & 0{,}80 & 1{,}00 & 1{,}00 & 0{,}50 \\ 0{,}75 & 1{,}00 & 1{,}00 & 0{,}60 & 0{,}60 & 0{,}80 & 0{,}50 \\ 1{,}00 & 0{,}60 & 1{,}00 & 0{,}60 & 0{,}60 & 0{,}80 & 0{,}33 \\ 1{,}00 & 0{,}80 & 1{,}00 & 1{,}00 & 0{,}80 & 0{,}80 & 0{,}25 \\ 0{,}50 & 1{,}00 & 0{,}60 & 0{,}80 & 1{,}00 & 1{,}00 & 1{,}00 \end{pmatrix}$$

4. The Final Result

The final result is obtained from ranking the sum of the matrix multiplication R by theweights using the formula (2), which can be seen in table 5.

Table 5

Emp loyee	C1	C2	C3	C4	C5	C6	C7
YK	0,20	0,08	0,12	0,20	0,15	0,08	0,04
FJ	0,15	0,10	0,15	0,15	0,09	0,06	0,04
GC	0,20	0,06	0,15	0,15	0,09	0,06	0,02
KD	0,20	0,08	0,15	0,25	0,12	0,06	0,02
IA	c	0,10	0,09	0,20	0,15	0,08	0,07

From the calculation using the SAW method, the highest value is 0,865 and the lowest is 0.737 can be shown in Table 6.

Table 6 The Final Result

Employee	Rank	Presentase
YK	0,865	86,50%
FJ	0,739	73,90%
GC	0,737	73,73%
KD	0,882	88,15%
IA	0,790	79,00%

Calculations and calculation results are implemented into the web admin system with the results in the figure 9.

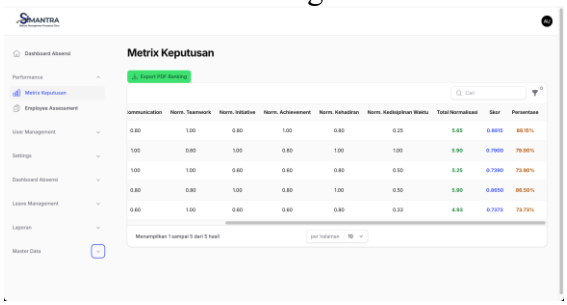

Figure 9 results of implementation into the system

D. Testing

The system test is conducted using the User Acceptance Test (UAT) method, which involves end-users filling out a questionnaire with four categories of questions: system functionality, user experience and interface design, system performance, and efficiency & productivity, Each category contains 5 questions, with a total of 20 questions [15] . Table 7 is the conclusion of the results from the UAT questionnaire calculation

Table 7 The results of the UAT questionnaire calculation.

No	Variabel	Weight value (%)	description
1	System functionality	81,27%	Very Good
2	User experience and interface design	77,20%	Good
3	System performance	78,00%	Good
4	Efficiency & Productivity	79,13%	Good

IV. CONCLUSION

The researcher has developed an employee attendance system along with a data management and performance evaluation system by integrating two different system platforms, namely an Android application and a website. The planning and development of both the application and the website, using the Extreme Programming (XP) method, resulted in a system that meets user requirements. The application of the Simple Additive Weighting (SAW) method to support the employee performance evaluation decision-making system has been effectively implemented in the attendance management system. Additionally, the use of the User Acceptance Testing (UAT) method further confirmed that the system aligns with user needs by allowing end-users to interact and provide feedback. Overall, the mobile-based attendance system and the website-based attendance management system are in accordance with user requirements.

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