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Design and Construction of Employee Attendance Using a Facial Recognition System at PT. Astra Daihatsu Krakatau

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Abstract

The rapid advancement of information technology has transformed organizational operations, including human resource management systems, where accuracy and efficiency in employee attendance recording are crucial for maintaining discipline and supporting performance evaluation. However, traditional attendance systems such as manual recording or fingerprint scanning remain limited, especially for employees who are working remotely or traveling, leading to data inconsistencies and delays. This research aims to design and implement a machine learning–based facial recognition attendance system to improve the flexibility, accuracy, and reliability of attendance processes at PT Astra Daihatsu Krakatau. The study employs the Unified Modeling Language (UML) approach for system design and utilizes facial recognition algorithms to automate attendance verification through biometric analysis. The resulting system comprises several key modules—login, main menu, employee data, attendance statistics, and history tracking—providing real-time and integrated attendance monitoring accessible from various devices. The findings indicate that the system effectively addresses the inefficiencies of conventional methods by enabling accurate biometric verification, minimizing fraud, and supporting remote attendance logging. This innovation enhances organizational transparency, operational efficiency, and adaptability in line with digital transformation initiatives. The implication of this study highlights the strategic role of artificial intelligence in modernizing workforce management and optimizing administrative processes within industrial environments.

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1. Introduction

The rapid advancement of information technology has profoundly influenced digital transformation across various sectors, including human resource management (HRM) systems. This transformation encourages organizations to optimize operational efficiency and enhance the accuracy of administrative processes, particularly in employee attendance systems. Attendance management plays a crucial role in maintaining work discipline, monitoring employee presence, and supporting the smooth operation of organizational activities. According to Ahmad et al. (2022), the adoption of digital

technology in attendance management allows companies to obtain more accurate, real-time, and easily analyzable data to support strategic decision-making. In a large-scale industrial environment such as PT Astra Daihatsu Krakatau, the reliability of attendance systems is fundamental to ensure that attendance data are recorded accurately and promptly, considering the high level of operational complexity and employee mobility. An effective attendance system serves not only as a performance indicator for human resources but also as a reflection of the company's commitment to discipline and organizational accountability (Rahman & Suryani, 2021).

Attendance refers to a routine activity carried out by individuals to verify their presence or absence in an organization or institution. This activity is closely related to the implementation of work discipline policies established by each organization (Setiawan, 2020). Work discipline, in this context, is a behavioral indicator that reflects employees' commitment to their duties and organizational rules. In industrial settings, accurate attendance recording directly affects payroll processing, overtime calculations, and employee performance evaluations. However, conventional attendance systems that rely on manual methods such as signatures, magnetic cards, or fingerprint scanners often face technical and administrative challenges. Common issues include data entry errors, delays in reporting, and the potential for fraudulent practices such as proxy attendance. Hidayat and Nugroho (2022) emphasize that such weaknesses undermine the validity of attendance records, resulting in inefficiency and data inconsistency. Therefore, modernization of attendance systems is urgently needed to ensure accuracy, transparency, and efficiency in managing employee attendance data.

At PT Astra Daihatsu Krakatau, several challenges have been identified in implementing the conventional attendance system. One of the most significant issues is the difficulty experienced by employees who are traveling for work or assigned to different locations in recording their attendance accurately and on time. This limitation leads to inconsistencies in attendance data, delays in processing, and the potential loss of valid information. Such inconsistencies not only disrupt payroll accuracy but also affect the company's ability to evaluate employee performance fairly and objectively. As noted by Pratama and Hasanah (2021), manual attendance systems are heavily dependent on physical presence and fail to adapt to modern work patterns that demand flexibility and mobility. The lack of integration with centralized databases and real-time reporting systems further exacerbates inefficiencies. Therefore, organizations require a more adaptive technological solution that accommodates dynamic work environments, supports remote access, and integrates seamlessly with existing HR systems to ensure reliable data management in the era of digital transformation.

A promising solution to overcome these limitations is the implementation of machine learning-based facial recognition technology for employee attendance systems. Facial recognition allows automatic verification of employee identities through digital devices such as smartphones or laptops equipped with cameras. Zhang et al. (2020) highlight that facial recognition offers higher accuracy, efficiency, and security compared to traditional biometric methods such as fingerprints or magnetic cards. This technology reduces the risk of fraud and eliminates the dependency on physical attendance devices, enabling remote verification and attendance logging from any location. Moreover, it allows real-time synchronization with company databases, providing a more efficient and integrated approach to attendance management. According to Putri and Santoso (2023), integrating facial recognition into HR systems can improve both operational efficiency and employee satisfaction by minimizing administrative burdens while enhancing system reliability. The adoption of such intelligent systems marks a significant step toward digitalizing human resource operations, aligning with the global trend of smart workplace innovation.

Based on the aforementioned considerations, this research aims to design and implement a machine learning-based facial recognition attendance system as an innovative solution to address employee attendance issues at PT Astra Daihatsu Krakatau. The proposed system is expected to enhance efficiency, reliability, and flexibility in attendance management. By employing biometric verification through facial recognition, the system enables employees to record attendance in real time, regardless of their physical location, thereby accommodating modern work mobility. Furthermore, this study contributes to the broader development of human resource information systems (HRIS) by

demonstrating how artificial intelligence can be integrated into organizational processes to support digital transformation. As Chen and Kumar (2021) assert, the integration of AI in HR systems represents a strategic initiative that strengthens organizational competitiveness in the era of Industry 4.0. Therefore, the findings of this study are expected to provide valuable insights not only for PT Astra Daihatsu Krakatau but also for other organizations seeking to implement intelligent, adaptive, and secure attendance management systems.

2. Research Methodolgy

The methods used by the author in designing, writing, and developing this thesis consist of several interrelated and complementary sections, namely:

1. Analysis and Design Method
   The analysis and design method used in writing this thesis is the Object-Oriented Analysis and Design (OOAD) approach using Unified Modeling Language (UML) notation, which includes flowcharts, use case diagrams, and screen designs.
2. Interviews
   The researcher met directly with the distributor to obtain more comprehensive data and address any unclear issues through interviews. The interview process was conducted with Mr. Indrawan, a personnel representative. The questions asked were as follows:

Table 1. List of Questions

No	Questions	Answer
1	How was employee attendance handled before the facial recognition system?	Attendance is still done manually by signing a time book, making it prone to fake attendance and often inaccurate data.
2	How is employee attendance handled after the facial recognition system is implemented?	Employees simply stand in front of the camera, and the system detects their faces and matches them to the database, automatically recording attendance.
3	What are the advantages of a facial recognition system compared to manual methods or time cards?	This is faster, reduces fraud such as fake attendance, data is immediately stored digitally, and allows for more accurate clock-in and clock-out times.
4	How does the system ensure that the detected face is the employee's?	The system uses a machine learning algorithm to extract each employee's unique facial features and match them to the data stored in the database.
5	What happens if an employee's face is not detected by the system?	The system displays a "face not recognized" notification, directing employees to try again or report to the administrator for manual verification.
6	How does the system record employee clock-in and clock-out times?	The system automatically saves the time when an employee's face is successfully recognized, both when they clock in and out.
7	Can this system be used for monthly attendance recaps?	Yes, the system can generate daily, weekly, and monthly attendance reports that can be exported to Excel or PDF.
8	How is employee facial data secure within the system?	Facial data is stored as a numeric vector derived from feature extraction, rather than an actual photo, making it more secure and difficult to misuse.
9	What are the potential challenges in implementing facial recognition attendance?	Challenges can include poor lighting, incorrect facial positioning, or slow network connectivity.
10	What solutions can be provided if employees encounter difficulties while taking facial attendance?	The administrator provides alternative verification options such as temporary manual login or in-person verification, then updates facial data if necessary.
11	How is attendance handled if employees are out of town for business or other tasks?	The system can provide remote attendance features through a mobile app with online facial recognition, but still requires location verification (GPS) to ensure validity and prevent misuse.

3. Literature Study

This is a personal research conducted by the author to gather the best and most accurate theoretical foundation possible by reading, studying, and searching for books, various scientific and general papers and discussion topics, and literature related to the topic being developed. The author sought various sources, both physical (in-person visits, libraries, bookstores, borrowing books from friends/lecturers, the author's personal collection) and online information searches (via the internet, discussion forums, articles supporting the author's research, various supporting e-books, etc.). To analyze the above data, an analysis flow was used, structured in the form of a flowchart as shown below:

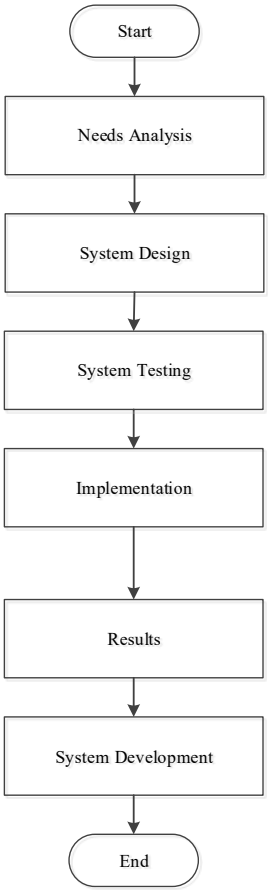

Figure 1. System Design Procedure

The development of the Fishbone Framework method involves several stages: requirements (needs analysis), system design, coding, program testing, and system maintenance.

2. Needs Analysis

Contains the elements that must be present in the design results to be able to solve the existing problems according to the objectives. The data required for system design is the Facial Recognition System Design for Employee Attendance at PT. Astra Daihatsu Krakatau Using Machine Learning Methods.

2. System Design

Generally, employee attendance at PT. Astra Daihatsu Krakatau uses the Unified Modeling Language design model.

2. Testing

In this stage, the researcher tested the system created using theoretical and practical testing. The researcher tested the theory using blackbox testing.

d. Implementation

This study implements the Facial Recognition System Design for Employee Attendance at PT. Astra Daihatsu Krakatau.

e. System Development

This stage is carried out for the system design process using UML, consisting of use case diagrams, class diagrams, sequence diagrams, and activity diagrams. The database design process uses Firebase and the interface design uses Android Studio.

3. Results and Discussion

Conventional attendance systems that still use manual methods such as fingerprints or manual recording often encounter various obstacles. One such issue faced by PT. Astra Daihatsu Krakatau is the difficulty for employees who are out of town or on business trips to record attendance. This leads to inconsistencies in attendance data, delays in recording, and the potential loss of valid attendance data.

To address these issues, a flexible, modern, and accessible attendance system is needed from anywhere. One solution is to utilize machine learning-based facial recognition technology. This technology enables the automated attendance process by verifying employees' faces using the camera on digital devices such as smartphones or laptops. In addition to increasing efficiency and accuracy, this system also reduces the risk of fraud in attendance because identity verification is carried out biometrically.

In developing a program, a data model in the form of a diagram is required to explain the process flow of the system to be built. In writing this thesis, the author used the UML method, which in this method the author applied the Use Case diagram. Therefore, a Use Case diagram is drawn, as can be seen in Figure III.4 below:

Figure 2. Use Case Diagram

This chapter will explain the resulting display of the application created. This display is used to clarify the displays in the employee attendance design using a facial recognition system at PT. Astra Daihatsu Krakatau. This allows the implementation results to be seen in accordance with the program's output. Each display in the program is explained below.

1. Login Menu Display

The Login Display is the first display to appear when the program is run. It serves as a username and password input form for the program administrator. A screenshot of the login display is shown in Figure 3:

Figure 3. Login Form Display

2. Main Menu Data Form Display

This form displays the main menu data options. Selecting a data item will display the main menu data. A screenshot of the main menu data form can be seen in Figure 4:

Figure 4. Main Menu Form Display

3. Work Shift Data Form Display

This form displays the work shift data options. Selecting a work shift data will display the work shift data. An image of the work shift data form can be seen in Figure 5:

Figure 5. Work Shift Form

4. Attendance Data Form

This display displays attendance data, which is used to track and display attendance data. The attendance display is shown in Figure 6:

Figure 6. Attendance Form

5. Attendance History Data Form

This display displays attendance history data, which is used to track and display attendance history data. The attendance history display is shown in Figure 7:

Figure 7. Attendance History Form

6. Employee Data Form

This display displays employee data, which is used to track and display employee data. The employee display is shown in Figure 8:

Figure 8. Employee Form

7. Attendance Statistics Data Form

This display displays attendance statistics data, which is used to track and display attendance statistics. The attendance statistics display is shown in Figure 9:

Figure 9. Attendance Statistics Form Display

8. About Data Form Display

This display is used to find and display data about the attendance. The About form display is shown in Figure 10

Figure 10. About Form Display

Discussion

The implementation of a machine learning–based facial recognition attendance system at PT. Astra Daihatsu Krakatau represents a significant advancement in addressing the limitations of conventional attendance systems that rely on manual processes such as fingerprint scanning or written records. The newly developed system successfully enhances accessibility, efficiency, and accuracy in recording employee attendance, particularly for those who are on duty outside the company premises or traveling on business. By integrating facial recognition technology, the system performs biometric verification automatically, ensuring that attendance data are both valid and fraud-resistant. The use of UML-based modeling, particularly through the Use Case Diagram, allows for a clear visualization of system interactions between administrators and users, improving the understanding of workflow and functionality. The resulting user interface—consisting of the login, main menu, work shift, attendance data, attendance history, employee data, attendance statistics, and about forms—demonstrates an intuitive and structured design that supports ease of use and operational efficiency. Each interface is designed to simplify administrative processes, from employee data management to attendance tracking and performance evaluation. Moreover, the attendance statistics form provides analytical insights that help management monitor discipline levels and employee performance trends more effectively. The ability to access and manage attendance data in real time also enables decision-makers to respond promptly to irregularities or absences, promoting transparency and accountability within the organization. From a technological perspective, this system exemplifies the integration of artificial intelligence in human resource management by combining automation, data analytics, and biometric verification in one cohesive framework. The application not only meets organizational needs for flexible attendance recording but also aligns with the broader goals of digital transformation in the industrial sector. Overall, the research demonstrates that a machine learning–based facial recognition attendance system can serve as a reliable, secure, and scalable solution for modern workforce management, supporting productivity enhancement and data-driven decision-making in large industrial environments.

4. Conclusion

The development and implementation of a machine learning–based facial recognition attendance system at PT Astra Daihatsu Krakatau mark a crucial milestone in the company's digital transformation

of human resource management. The results of this study demonstrate that the proposed system effectively overcomes the limitations of traditional attendance mechanisms, particularly in terms of accessibility, accuracy, and data reliability. By leveraging biometric facial recognition, attendance recording can be conducted automatically and in real time, reducing administrative errors and minimizing the potential for fraudulent practices such as proxy attendance. The integration of machine learning algorithms ensures adaptive recognition performance even under varying environmental conditions, thereby supporting employee mobility and flexible work arrangements. Furthermore, the use of Unified Modeling Language (UML) in the system design enables clear documentation of workflows, fostering structured development and maintainability. Overall, the system enhances organizational efficiency, strengthens accountability, and supports data-driven management decisions aligned with the principles of Industry 4.0. Based on these findings, several recommendations can be proposed for further enhancement and scalability. Future system development should focus on optimizing the facial recognition model using deep learning architectures to improve accuracy and processing speed under diverse lighting and pose variations. Integration with cloud-based human resource information systems (HRIS) is also recommended to facilitate seamless synchronization across departments and locations. To ensure data security and privacy, organizations should implement robust encryption and compliance with personal data protection regulations. Additionally, user training and change management strategies must accompany system deployment to maximize adoption and minimize operational disruptions. From a broader perspective, this research contributes to the growing body of knowledge on intelligent attendance systems and offers practical insights for industries seeking to digitalize workforce management processes. Hence, continued innovation and interdisciplinary collaboration between information technology and human resource management domains are essential to sustain efficiency, transparency, and competitiveness in modern organizational ecosystems.

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