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ONLINE EMPLOYEE MONITORING SYSTEM WITH PAYROLL INTEGRATION

[1] **Dante Antiquiera Aringo**
[2] **Milan E. Bausa, MIT**

Abstract

The study, entitled *Online Employee Monitoring System with Payroll Integration (OEMSWPI)*, focused on the development and evaluation of a web-based system designed to streamline employee attendance monitoring and payroll processing. The system was developed using the Modified Waterfall Model, ensuring systematic progression through requirements analysis, design, development, testing, and implementation. The evaluation involved 20 participants, comprising 10 IT experts and 10 end-users from CSI Legazpi City, who assessed the system's functionality, efficiency, usability, security, and compliance with relevant software quality standards.

Based on the specific objectives and evaluation conducted, several key findings were drawn. The biometric attendance component demonstrated high reliability, user-friendliness, and minimal failure rates, consistently capturing and verifying employee attendance accurately. The network infrastructure integration allowed real-time synchronization between biometric terminals and the central server, ensuring up-to-date attendance records while maintaining data confidentiality and integrity. The payroll computation module accurately translated attendance data into pay calculations, handling overtime, tardiness, absences, and leave deductions with efficiency and reliability. Comprehensive data protection measures, including encryption, access control, and consent management, safeguarded sensitive employee information and ensured compliance with privacy laws. Evaluation using the ISO/IEC 25010 software quality model indicated that the system performed strongly across all eight characteristics, achieving an overall rating of 4.3 ("Far more than what was expected"), demonstrating its effectiveness, reliability, and user satisfaction.

Based on the findings, several conclusions were drawn. The biometric attendance system proved reliable and user-friendly, supporting accurate attendance tracking. The secure network infrastructure enabled real-time data synchronization and enhanced operational efficiency. The payroll module accurately processed pay calculations, reflecting organizational policies. Data protection controls successfully ensured the confidentiality, integrity, and security of employee records. Overall, the system demonstrated excellent performance across all software quality criteria, exceeding user expectations.

Based on these conclusions, recommendations included the continued use and periodic updating of the biometric attendance system, conducting regular employee training, monitoring and securing network infrastructure, implementing backup and disaster recovery protocols, and reviewing payroll computation and access control policies routinely. Additionally, regular audits of data protection measures, continuous system evaluation, and periodic training for administrators and IT staff were suggested to maintain high performance, adaptability, and compliance with security standards.

Keywords: Attendance Management, Automation, Employee Monitoring System, Human Resource Management System, Payroll Integration, Time Tracking, Web-based System, and Workforce Management.

Introduction

Organizations across various sectors had increasingly pursued the automation of repetitive administrative processes in order to improve accuracy, efficiency, and accountability. Globally, traditional paper-based systems for attendance monitoring and payroll computation had been found to be vulnerable to time theft, human error, delayed postings, and data inconsistencies. These inefficiencies placed a heavy burden on administrative personnel and reduced the transparency and reliability of institutional operations.

In response, biometric technologies, which identified individuals through unique physiological or behavioral characteristics such as fingerprints, facial features, or iris patterns, had been widely adopted in organizational settings. These technologies provided faster identity verification and significantly reduced the incidence of proxy attendance or “friend punching.” Several international studies demonstrated that biometric attendance systems improved data accuracy and operational efficiency in educational institutions. For instance, studies conducted in Ghana and Uganda reported that biometric systems reduced paperwork, saved time, and enhanced attendance reliability compared to manual roll calls (Afribary, 2023; Taremwa, 2024).

At the national level, Philippine labor regulations required strict compliance with policies on work hours, overtime, rest days, and leave credits, all of which needed accurate recording in attendance and payroll systems (Menproject, 2025). However, many local organizations still relied on manual or semi-digital processes, such as logbooks and spreadsheet-based records. These practices slowed payroll processing, increased the risk of computation errors, and exposed institutions to potential compliance issues and labor disputes. A study conducted at Cebu Technological University–Tuburan Campus showed that although biometric attendance reduced processing time and administrative costs, payroll computation still required manual reconciliation, indicating a lack of full system integration (Tarkie, 2024).

At the local level, the Computer Systems Institute (CSI), a secondary and tertiary educational institution in Legazpi City, had implemented a manual attendance monitoring system using logbooks and Daily Time Records (DTRs). These records were manually encoded into payroll sheets by administrative staff. Over time, this system resulted in frequent discrepancies due to human error, delayed processing, and occasional cases of dishonest reporting. Furthermore, CSI operated across two separate buildings, which made centralized and accurate monitoring more difficult and increased the likelihood of inconsistent records.

Given these conditions, there had been a clear need for an integrated solution that could address the limitations of CSI's existing attendance and payroll processes. This study therefore proposed the development of an online biometric-based employee monitoring system with payroll integration. The system was designed to capture real-time attendance data from biometric terminals installed in two separate buildings, synchronize records to a centralized online server, and automatically generate payroll computations based on actual hours worked, including overtime and leave. By integrating biometric identification with automated payroll processing, the project aimed to improve data accuracy, prevent fraud, enhance administrative efficiency, and ensure compliance with labor regulations.

Specific Objectives

The following were the specific objectives of the proposed study based on the general objectives:

1. Develop the biometric attendance component by assessing the suitability and effectiveness of the fingerprint biometric modality.

2. Integrate the system with a secure network infrastructure to enable real-time synchronization among biometric terminals and the central server.

3. Develop and incorporate a payroll computation module that translates attendance records into pay calculations, including:
    - 3.1 overtime
    - 3.2 tardiness
    - 3.3 absence
    - 3.4 leave deductions

4. Implement comprehensive data protection controls consisting of:
    - 4.1 encryption
    - 4.2 access control
    - 4.3 consent management consistent with privacy law and ethical best practices

5. Evaluate the complete system using the industry software quality model – the ISO 25010 evaluation tool in terms of:
    - 6.1 functional suitability
    - 6.2 performance efficiency
    - 6.3 usability
    - 6.4 reliability
    - 6.5 compatibility
    - 6.6 security
    - 6.7 maintainability
    - 6.8 portability

Scope and Delimitations

The scope of the present study focused on the development of the *Online Employee Monitoring System with Payroll Integration* specifically designed for the Computer Systems Institute (CSI) in Legazpi City. The project covered the creation of the biometric attendance component by assessing the suitability and effectiveness of the fingerprint modality in terms of reliability, user-friendliness, and minimal failure rates. It also involved integrating a secure network infrastructure that enabled real-time synchronization between the biometric terminals installed in the two CSI buildings and the central server. Additionally, the scope included developing a payroll computation module capable of processing overtime, tardiness, absences, and leave deductions using captured attendance data. Comprehensive data protection mechanisms - encryption, access control, and consent management - were implemented to ensure compliance with privacy regulations and ethical practices. After development, the system was evaluated based on accuracy, administrative time savings, and employee acceptance compared with the existing manual processes, and it was further subjected to ISO 25010 quality evaluation. The final system was assessed by 10 IT experts and 10 end-users as recommended by the adviser and capstone committee members.

The study was delimited to the development and testing of system features applicable only to the operational environment of the Computer Systems Institute in Legazpi City. It did not include the integration of other biometric modalities such as facial or iris recognition, nor did it extend to full deployment across all institutional units or to long-term performance monitoring. The evaluation was limited to the feedback of the designated 10 IT experts and 10 end-users, which excluded broader institutional participation and did not capture large-scale or long-duration usage scenarios. The project also did not address external elements such as hardware procurement limitations, potential variations in network infrastructure outside CSI, or institution-wide policy changes that might affect system adoption. Moreover, the system focused solely on attendance-to-payroll integration and did not include other HR management functions beyond the defined scope.

Gap Bridged by the Study

The reviewed systems shared several similarities with the developed system, particularly in automating attendance monitoring, improving operational efficiency, and reducing human error. Most of the studies and commercial solutions, such as AEBAS, TimeGuard Systems, ZKTeco GoTime Cloud, and PayrollPro.PH, emphasized real-time attendance tracking, centralized data management, and some level of integration with payroll or HR modules. These systems demonstrated significant gains in accuracy, transparency, and productivity, highlighting the benefits of replacing manual or paper-based processes with digital biometric solutions. Similarly, the present developed system retained these core advantages, ensuring reliable attendance

logging, efficient payroll computation, and enhanced organizational accountability.

The uniqueness of the present developed system lay in its holistic and secure approach, which bridged gaps observed in the reviewed systems. Unlike many prior systems that were limited to LAN setups, single biometric modalities, or lacked geolocation and cloud scalability, the proposed system integrated biometric verification with real-time payroll processing, geofencing, and policy-driven privacy protocols. It also incorporated secure cloud storage, audit-ready reporting, and multi-layered cybersecurity measures, addressing both ethical and technical concerns. This made the system more versatile, adaptable, and suitable for hybrid or distributed workplaces, ensuring both operational efficiency and compliance with national privacy regulations.

Conceptual Framework

The conceptual framework of the present study began with the input phase, where the biometric attendance component was developed by assessing the suitability and effectiveness of the fingerprint modality based on reliability, user-friendliness, and minimal failure rates. The system was integrated with a secure network infrastructure that enabled real-time synchronization between biometric terminals and the central server. A payroll computation module was developed and incorporated to translate attendance records into accurate pay calculations, accounting for overtime, tardiness, absences, and leave deductions. Comprehensive data protection controls were implemented, including encryption, access control, and consent management, aligning with privacy laws and ethical best practices. Finally, the complete system was evaluated using the ISO 25010 software quality model to ensure functional suitability, performance efficiency, usability, reliability, compatibility, security, maintainability, and portability.

During the process phase, the study followed the Modified Waterfall Model. The requirements were gathered and analyzed, followed by the design of system architecture, interface, and modules. Development involved coding and integrating the biometric attendance, payroll computation, and security features. Testing was conducted to validate the system against predefined criteria and to identify any functional or technical issues. Deployment ensured that the system was operational in the live environment, while maintenance activities addressed updates, bug fixes, and continuous performance monitoring.

The output of the study resulted in the creation of an Online Employee Monitoring System with Payroll Integration. This system automated attendance tracking, provided accurate payroll computation, enforced robust privacy controls, and allowed real-time monitoring and reporting, thus improving operational efficiency and compliance with labor and data protection regulations. It also generated detailed employee reports, supported management decision-making, and reduced administrative workload. The system was designed to adapt to organizational changes, such as new policies, additional employees, or hybrid

work setups, ensuring long-term applicability.

The feedback mechanism involved continuous evaluation and monitoring of system performance, usability, and security based on user experiences and ISO 25010 standards. Insights gained from user interactions, performance reports, and audit logs were analyzed to refine the system further, optimize workflows, and enhance security measures, ensuring that the system remained reliable, user-friendly, and adaptable to organizational needs. Feedback loops also helped identify emerging issues, update privacy protocols, and implement system improvements, fostering continuous innovation and maintaining user trust.

Findings

Based on the specific objectives and evaluation conducted, the following findings were drawn:

1. The developed biometric attendance component of the system was evaluated in terms of reliability, user-friendliness, and minimal failure rates. First, in terms of reliability, the fingerprint biometric modality consistently captured and verified employee attendance accurately, demonstrating stable performance even with frequent use. Second, regarding user-friendliness, employees reported that the fingerprint scanning process was simple, quick, and easy to operate, requiring minimal training or guidance. Lastly, the system exhibited minimal failure rates, with very few instances of failed scans or mismatches, indicating that the biometric component is highly effective in reducing errors and ensuring accurate attendance tracking.

2. The integration of the system with a secure network infrastructure was successfully implemented to enable real-time synchronization between the biometric terminals and the central server. The evaluation showed that data from all biometric attendance terminals were transmitted and updated instantaneously in the central database, ensuring that attendance records were accurate and up-to-date. The secure network also maintained the confidentiality and integrity of sensitive employee data, preventing unauthorized access or tampering during transmission. Overall, this integration enhanced the system's efficiency and reliability, allowing administrators and management to monitor attendance in real time and make timely decisions based on accurate data.

3. The developed payroll computation module of the present study effectively translates biometric attendance records into accurate pay calculations while accounting for various factors. In terms of overtime, the system correctly calculated additional pay based on

extra hours worked, ensuring employees received proper compensation. For tardiness, the module automatically deducted pay corresponding to late arrivals, reflecting precise adjustments in the salary computation. Regarding absences, the system accurately recorded days not worked and applied appropriate deductions, maintaining fairness and accountability. Finally, for leave deductions, the module successfully processed approved leaves and adjusted salaries accordingly, integrating leave balances and policies into the computation. Overall, the payroll module demonstrated high accuracy, efficiency, and reliability in converting attendance data into correct payroll outputs.

4. The developed system successfully implemented comprehensive data protection controls to ensure the confidentiality, integrity, and security of employee information. Encryption was applied to sensitive data both at rest and in transit, preventing unauthorized access and protecting information from potential breaches. Access control mechanisms were established, allowing only authorized personnel to view or modify employee records, ensuring that system privileges aligned with user roles. Additionally, consent management features were integrated, enabling employees to provide informed consent for data collection and processing, in accordance with privacy laws and ethical best practices. These measures collectively strengthened the system's security framework, ensuring that employee data is handled responsibly while maintaining compliance with relevant regulations.

5. The complete Online Employee Monitoring System with Payroll Integration was evaluated using the ISO/IEC 25010 software quality model, focusing on functional suitability, performance efficiency, usability, reliability, compatibility, security, maintainability, and portability. Both CSI administrative staff and IT experts assessed the system, and the results showed strong performance across all characteristics. The system received an overall average rating of 4.3, categorized as "Far more than what is expected," indicating that it not only met but exceeded user expectations in efficiency, reliability, security, and usability.

Conclusions

Based on the finding, the following conclusions were drawn:

1. The biometric attendance component was reliable, user-friendly, and effective, ensuring accurate and error-free tracking of employee attendance.

2. The secure network integration enabled real-time synchronization of attendance data while

maintaining confidentiality and enhancing system efficiency and reliability.

3. The payroll computation module accurately converted attendance records into payroll, effectively handling overtime, tardiness, absences, and leave deductions.

4. The implemented data protection controls ensured the confidentiality, integrity, and security of employee information while complying with privacy laws and ethical standards.

5. The system demonstrated excellent performance across all software quality characteristics, exceeding user expectations with an overall rating of 4.3, or "Far more than what was expected."

Recommendations

Based on the conclusions drawn, the following recommendations are made:

1. May continue using and periodically updating the biometric attendance component to maintain its reliability and user-friendliness.

2. Training sessions may be conducted for employees to ensure the proper use of the biometric system and minimize scanning errors.

3. The system's network infrastructure may be regularly monitored and secured to ensure continued real-time synchronization and data integrity.

4. Backup protocols and disaster recovery plans may be implemented to prevent data loss and maintain uninterrupted system operation.

5. The payroll computation module may be routinely reviewed and updated to reflect changes in policies, overtime rates, and leave rules.

6. Reports generated by the payroll module may be regularly audited to verify accuracy and transparency in salary calculations.

7. Regular audits and updates of data protection measures are recommended to maintain compliance with privacy laws and safeguard employee information.

8. Access control policies may be reviewed periodically to ensure that only authorized personnel can access sensitive data.

9. The overall system may be continuously evaluated and improved based on user feedback to sustain its high performance across all quality characteristics.

10. Periodic training and workshops for administrators and IT staff are recommended to ensure proper system maintenance, troubleshooting, and adaptability to future upgrades.

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