ENHANCING WORKFORCE EFFICIENCY: BIOMETRIC INTEGRATION FOR ATTENDANCE AND PAYROLL ADMINISTRATION IN AN MSME FABRICATION INDUSTRY

Mr. Anand Vinod, Dept. Of Mechanical Engineering, NSS College of Engineering, Palakkad, Kerala, India.
Dr.N.Rajeev, Principal, NSS College of Engineering, Palakkad, Kerala, India.

ABSTRACT
Tracking attendance of employees ensures work force efficiency as well as accurate payroll. Manual systems with traditional methods tend to cause errors, lost hours, and administrative inefficiencies. This research investigates the effect of using a biometric attendance system at Uniq Enterprises, a fabrication division in Palakkad, Kerala, as a replacement for the manual register system. A comparative study of five weeks prior to and following implementation demonstrated a 27.8% decrease in late arrivals and 44.1% reduction in lost work time. While the extreme delays (7+ minutes) decreased, minor tardiness (1 to 3 minutes) slightly improved, suggesting increased punctuality but the necessity of further fine-tuning. The biometric system also increased payroll accuracy and cut administrative workload, promoting transparency and accountability. The research concludes that biometric attendance monitoring is a trustworthy and effective solution to manage the workforce. It should be adopted by organizations to increase efficiency, and future research could examine its wider long-run implications.
Keywords: Biometric Attendance, Workforce Efficiency, Payroll Accuracy, Employee Punctuality, ERP.

I.   Introduction
The human resources (HR) division serves a pivotal function in every industry by coordinating personnel-related functions such as staff monitoring and processing of payroll. Precise employee work hour monitoring, including shift hours and overtime, is fundamental in ensuring equity in compensation, adhering to legal requirements, and sustaining a functional workplace. This research targets a Micro, Small, and Medium Enterprise (MSME), which is companies that operate on a small scale but have a large impact on employment, industrial production, and economic development. As per the Ministry of Micro, Small and Medium Enterprises (Government of India), msmes are categorized according to their investment and turnover in a year: micro enterprises have up to ₹1 crore investment and up to ₹5 crore turnover, small enterprises have up to ₹10 crore investment and up to ₹50 crore turnover, and medium enterprises have up to ₹50 crore investment and up to ₹250 crore turnover. Although crucial, numerous msmes continue to make use of manual systems for tracking employee attendance and payroll, resulting in inefficiency, inaccuracies, and administrative burdens. In that regard, the paper investigates the effects of implementing a biometric attendance system within an MSME fabrication facility with the view of boosting employee punctuality, payroll accuracy, and overall workforce management efficiency.

II.   Literature Review
The paper provides an effective solution for enhancing payroll and attendance systems in the hospitality sector. With the integration of biometric systems into Human Resource Management Systems (HRMS), it overcomes issues related to manual processes, minimizing errors and maximizing efficiency. The use of real-world data, like the research on the Taj Yeshwantpur hotel, enhances its applicability and practicality. Although the paper identifies important benefits, including automation and precision, further examination of privacy issues and wider uses across sectors might make it more

effective. Generally, it offers a useful model for using biometric technology in attendance management[1].

The paper discusses how combining biometric technologies can improve payroll and attendance systems. Through the utilization of face recognition for precise attendance monitoring and automating payroll, the study counters frequent problems such as payroll errors and inefficiencies. It sheds light on the positive impact on staff satisfaction in terms of fairness, transparency, and dealing with data in real time. The study offers pragmatic guidelines for implementation, such as training users and maintaining data privacy. In general, the study provides valuable insights into how to utilize technology to maximize workforce management[2].

The paper investigates the importance of payroll systems within organizations. The paper emphasizes the way combining technology such as payroll management software will simplify processes involving salary calculation, attendance management, and statutory adherence. The study focuses on advantages of such systems, including efficiency, accuracy, and enhanced worker performance appraisals. The paper also delves into the shortcomings of conventional methods, such as mistakes in manual calculations, and touches upon the benefits of automation in optimizing HR and accounting functions. Although offering useful insights, the research can be enriched further by considering limitations like data privacy issues and the expense of installing payroll software[3].

The research concentrates on solving the inefficiencies of manual payroll systems, especially in developing countries such as the Kurdistan Region of Iraq. It suggests a web-based payroll management system (WPMS) that calculates salaries, deductions, allowances, and generates reports automatically. The system also includes features such as real-time data storage, responsive layout, and user control. The research proves the usability and efficiency of the system with a very high satisfaction rate of 87.8% using system usability scale (SUS) testing. In addition to highlighting automation and security advantages, the study identifies flexibility and scalability as essential characteristics, enabling WPMS to fit different organizational requirements[4].

The article is an innovative model of automating payroll and attendance functions in organizations. Using technologies like PHP, Bootstrap, and CSS, the suggested system provides functionalities such as tracking employee attendance, generating payroll, managing overtime, and printing pay-slips, among others. The integration of biometric systems helps to ensure accuracy, eliminate time fraud, and improve the accountability of employees. The emphasis of the system on minimizing manual errors, enhancing the trustworthiness of data, and automating workplace regulations presents evidence that it has the ability to enhance organizational efficiency and productivity. Yet, the paper is designed for small businesses with fewer than 50 employees, implying that scalability should be addressed for larger companies. Generally, it offers useful information on utilizing web-development languages to automate human resource operations[5].

The paper discusses Employee Management Systems (EMS) as a mechanism to automate main HR functions like payroll processing, attendance recording, and employee data administration. It points out the benefits of EMS, such as improved efficiency, user interaction, and better employer-employee relationships, especially for small enterprises in India. The paper also explains the incorporation of emerging technologies like AI, machine learning, and IoT, providing future directions for predictive analytics and monitoring workplace safety. While keeping data security and mobile optimization in mind, the study proposes the necessity of adaptable interfaces to accommodate various organizational requirements. Overall, it offers insightful tips on how to utilize contemporary EMS technologies to increase productivity and staff satisfaction[6].

The article presents a novel method of automating attendance and payroll processing within organizations. It uses Android-based image capture and GPS tracking for accuracy and convenience. The system allows employees to log in and out with their smartphones, recording their image and GPS coordinates, which are sent to the admin. It eliminates manual errors and reinforces security during payroll operations. Features such as multi-user usage, centralized database benefit, and dynamic

payroll configurability are promoted through the recommended system, presenting the system to be user-centric and efficient. In spite of presenting practical merits, additional insight regarding scalability issues as well as information privacy requirements can extend the functionality of the system. Nevertheless, it represents an important employee management technology addition[7].

The reviewed literature highlights the effectiveness of integrating biometric systems into workforce management to enhance attendance tracking and payroll accuracy—key concerns addressed in this study. Various implementations, such as biometric attendance in hospitality and small businesses, demonstrate significant reductions in manual errors and improved efficiency through automation. Technologies like fingerprint and face recognition have been shown to increase transparency, real-time data handling, and employee accountability. Studies also emphasize the role of biometric systems in reducing time fraud and streamlining administrative tasks, especially in smaller organizational setups, which aligns closely with the context of this paper focused on an MSME fabrication unit. While privacy and scalability are noted as challenges in broader applications, the consensus supports biometric integration as a practical and efficient solution for improving punctuality and operational efficiency in workforce management.

III. Methodology

The first thing in undertaking the research was the choice of a proper industry. Following consideration, Uniq Enterprises, which is a fabrication unit located within the Palakkad industrial region, Kerala, was selected. The key focus was to scrutinize the existing attendance tracking system utilized in the organization. In order to accomplish this, the company's present attendance monitoring procedure was comprehensively analyzed. The process used by the company was based on a manual register entry procedure, whereby the staff marked their attendance in a logbook. Nevertheless, this process had certain drawbacks, as it only recorded if an employee worked on a certain day but could not account for the precise time of sign-up or sign-out.

In order to better understand the process, the attendance tracking method was monitored closely over time. This provided a clear understanding of the inefficiencies and challenges of manual record-keeping, which pointed towards the necessity of a more accurate and automated solution. Data was gathered on a weekly basis, with each week having six working days. The firm utilized eight employees per day, accounting for a total of 48 employee workdays per week. Tardiness was documented and grouped into time intervals according to the delay: 1 to 3 minutes, 4 to 6 minutes, 7 to 9 minutes, and 10 or more minutes.

The five-week data reveal patterns of employee lateness at the organization. There were 151 instances of late arrival, adding up to a total of 889 minutes (14.82 hours) of lost time. This reveals a chronic punctuality problem that may affect productivity.

Table 1: Tardiness Study During Register Entry

Late By (minutes)	Week 1	Week 2	Week 3	Week 4	Week 5	Average Employees Late	Average Minutes Late
1 to 3	4	6	7	5	3	25	50
4 to 6	12	16	9	11	15	63	315
7 to 9	7	9	14	12	11	53	424
10 +	3	2	2	1	2	10	100
SUM	26	33	32	29	31	151	889

The breakdown places tardiness into four intervals: 1 to 3 minutes, 4 to 6 minutes, 7 to 9 minutes, and 10 or more minutes. Most of the late arrivals were within the 4 to 9-minute interval and constituted 116 cases (77% of total cases). The 4 to 6-minute category experienced the greatest number of late arrivals (63 instances), followed by the 7 to 9-minute category (53 instances). While these longer delays were not as prevalent, these delays of 10 minutes or greater (10 instances) still accounted for

100 minutes of lost work time. While fewer in frequency, these longer delays caused greater detriments to productivity overall. Also, it was noted that the majority of these instances included employees who had received prior authorization for their late arrival.

The amount of time wasted because of delayed arrivals was 889 minutes for five weeks. The largest loss of time occurred in the 7 to 9-minute group (424 minutes), followed by the 4 to 6-minute group (315 minutes). Although the 1 to 3-minute group had 25 occurrences, it only translated to 50 minutes of lost time, which suggests that small delays are not as problematic as delays that take a longer time. The result indicates that staff tardiness is most focused in brief delays of 4 to 9 minutes, combined which causes extensive loss in productivity. In order to counteract these issues a biometric system was implemented in place of the conventional manual register entry process.

Figure 1: Biometric Machine

The new biometric system provided an improved and accurate way of monitoring employee attendance. By making the employees scan their fingerprints at assigned entry and exit points, the system automatically recorded sign-in and sign-out times. This minimized errors and potential manipulation that would be possible in manual records and provided real-time monitoring and accurate data
.

IV.   Results And Discussions

After the introduction of the biometric system, a new dataset was obtained for evaluating the effect of the system on tracking employee attendance. This dataset was captured over the same period of five weeks and encompassed the same set of employees to provide comparative consistency and support direct comparison with the earlier manual tracking system.

The objective of this second data collection was to analyze differences in punctuality, accuracy, and general behavior of attendance following the switch to an automated system. Through the preservation of the same time period and personnel, the research intended to establish whether the biometric system successfully minimized cases of lateness, enhanced accuracy of records, and offered better understanding of employee attendance behaviors.

Upon the implementation of the biometric attendance system, additional data were obtained to measure its effect on employees' punctuality. The results show improvement in behavior in terms of attendance as there was a considerable decrease both in the number of late arrivals and in the minutes lost as a result of late arrivals.

Table 2: Tardiness Study After Biometeric Implementation

Late By (minutes)	Week 1	Week 2	Week 3	Week 4	Week 5	Average Employees Late	Average Minutes Late
1 to 3	13	9	10	11	8	51	102
4 to 6	6	7	5	4	7	29	145
7 to 9	4	5	3	6	2	20	160
10 +	1	2	2	1	3	9	90
SUM	24	23	20	22	20	109	497

The number of late instances, overall, decreased from 151 to 109, representing an improvement in punctuality of 27.8%. The minutes lost due to tardiness as a whole dropped from 889 minutes to 497 minutes, representing a loss of 44.1% in work time lost. These results indicate employees became more responsible about their clocking times post-installation of the biometric system, given the added level of accuracy and accountability it achieved.

Although the total number of late arrivals fell, there was a change in the pattern of lateness. The 1 to 3-minute late category rose from 25 to 51 occurrences, indicating that although extreme delays were fewer, slight delays became a little more common. But as these delays only accounted for 102 minutes of lost time, they had a relatively minor effect on productivity.

Conversely, the 4 to 6-minute late group experienced a drastic fall from 63 to 29 occurrences, with the related minutes lost decreasing from 315 to 145 minutes. Likewise, the 7 to 9-minute group fell from 53 to 20 occurrences, drastically cutting down lost time from 424 to 160 minutes. The 10+ minute delay category saw a decline from 10 to 9 cases, with lost time reducing by 100 to 90 minutes. These decreases show that the biometric system efficiently stifled extended delays while promoting improved compliance with planned work times.

With a decrease of virtually 6.5 hours of wasted time in five weeks, the biometric system directly affected workplace productivity. Workers were less apt to come in ridiculously late, minimizing disruptions and smoothing overall work flow. Having the capability to monitor precise sign-in and sign-out times also added to greater accountability, likely deterring workers from exploiting the former manual system's loopholes.
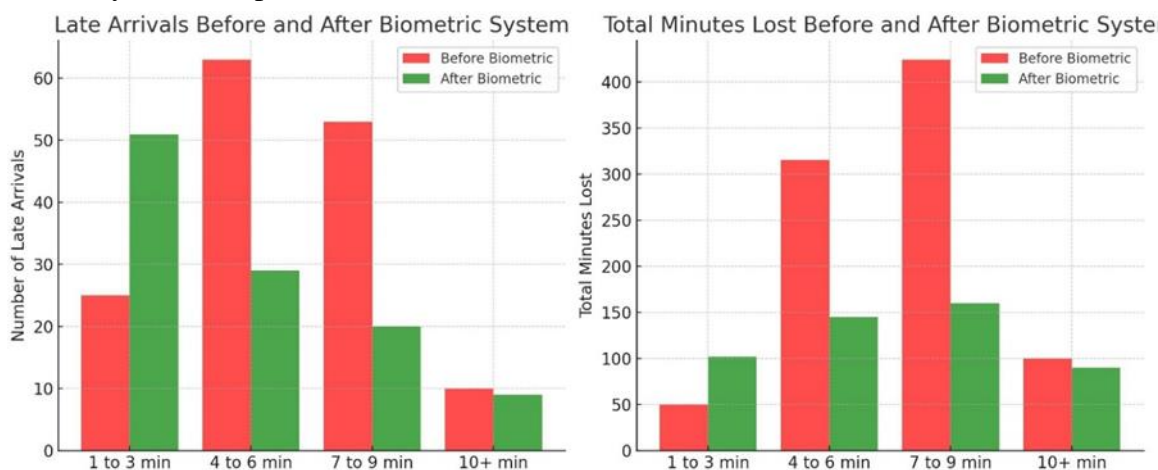

Figure 2: Before and After Biometric Implementation

In addition, the biometric solution offered automated reporting features, enabling the management to create attendance reports, trend analysis, and enforce corrective action where necessary. Not only did the installation of the technology enhance workplace discipline and responsibility but also optimized administrative procedures, lightening the load of manually recording attendance.

V. Conclusion

The adoption of a biometric attendance system has been a very effective remedy for enhancing workforce punctuality and operational efficiency. By replacing the conventional manual register approach, the new system not only ensured proper monitoring of employee attendance but also drastically minimized cases of late arrivals and lost work hours. The comparison of statistics prior to and after the implementation of the biometric system proved a 27.8% reduction in delayed arrivals and a 44.1% decrease in overall minutes lost through lateness, showing its effectiveness in elevating employee discipline and time management.

In addition, the research indicated a change in patterns of lateness, with excessive delays (7+ minutes) reducing significantly, but slight delays (1 to 3 minutes) increasing marginally. This indicates that while the biometric system successfully reduced excessive tardiness, other interventions—such as awareness campaigns, rewards for being on time, or light punishment for repeated small delays—could further improve compliance with planned working hours.

In addition to enhancing attendance, the biometric system also improved payroll management by delivering accurate records of working hours, eliminating conflicts, and minimizing administrative work. This technological integration not only enhanced organizational efficiency but also brought about a culture of accountability and transparency among workers.

In summary, the results of this research confirm that biometric attendance monitoring is a dependable and effective method of managing the workforce, especially in industries where precise timekeeping is important. Further studies may examine its wider applications, such as its impact on productivity, staff satisfaction, and payroll processing cost savings. Organizations that seek to increase efficiency and decrease attendance-related inefficiencies should give serious thought to implementing similar biometric technologies for long-term advantages.

References

[1]   A. Gupta1, A. Kundu2, and R. Das3, "IJRTBT AUTOMATED ATTENDANCE SYSTEM FOR EFFICIENT EMPLOYEE MANAGEMENT: A BIOMETRY BASED APPROACH," 2019.

[2]   John Ric C. Jalaman and Riah E. Encarnacion, "Employee Satisfaction on Compensation System: Basis for an Improved Payroll Management System with Face Recognition and Attendance Monitoring Technology," *International Journal of Advanced Research in Science, Communication and Technology*, pp. 516–524, Jun. 2024, doi: 10.48175/ijarsct-19070.

[3]   P. R. Teja and R. Patra, "A Study on PayRoll-Management System Introduction 3." [Online]. Available: www.ijfmr.com

[4]   A. M. Ahmed, C. N. Mohammed, and A. M. Ahmad, "Web-based payroll management system: design, implementation, and evaluation," *Journal of Electrical Systems and Information Technology*, vol. 10, no. 1, Mar. 2023, doi: 10.1186/s43067-023-00082-5.

[5]   D. wadatkar, H. Gadigone, P. Wakodikar, R. Mandavagade, and P. Gumgaonkar, "International Journal of Research Publication and Reviews Attendance & Payroll Management System Using Web-Development Languages," 2022. [Online]. Available: www.ijrpr.com

[6]   S. Khandait, S. Dafade, D. Amnerkar, P. Khanorkar, D. Gupta, and A. Dhabale, "EMPLOYEE MANAGEMENT SYSTEMS: A COMPREHENSIVE REVIEW OF MODERN SOLUTIONS", [Online]. Available: www.irjmets.com

[7]   S. A. Chavan, N. D. Gaikwad, V. Sakpal, J. Bilakhia, and R. Pashte, "Employee Attendance and Payroll System Using Image Capturing and GPS Tracking," vol. 2, no. 2, pp. 857–861, 2017.