

Analysing Student Lateness: Insights from a Smart Attendance Tracking System

M. NIKHIL¹, M. GOPINATH², A. SHARANYA³, DR. S. VENU GOPAL⁴

^{1, 2, 3, 4} Vardhaman College of Engineering, Narkhuda, Nagarguda -Shamshabad Rd, Kacharam, Telangana

Abstract- Student lateness has become a common issue in educational institutions, affecting both academic performance and discipline. This research aims to analyse the patterns of student lateness, identify key reasons behind it, and propose effective solutions. By using real-time entry and exit data, we can track student punctuality trends and understand the impact of factors like distance from home, class schedules, and personal habits. To better understand and address this issue, our research focuses on analysing student lateness patterns using automated attendance tracking and data-driven insights. In this study, we developed an Intelligent ID-Based student Tracking System using React.js for the front end, Node.js and Express.js for the backend, and MongoDB for database storage. The system records student entry and exit times using ID card scans, providing real-time tracking of late students, and recurring patterns linked to specific days, weather conditions, or class schedules. The goal is to determine the most common causes of lateness and suggest effective measures to reduce it. One of the aspects of this research is evaluating how lateness varies among different student groups. Some students arrive late occasionally, while others have a consistent pattern of tardiness. By categorizing students based on their attendance behaviour, institutions can implement targeted interventions, such as personalized reminders, stricter policies, or even counselling sessions for students struggling with time management. Additionally, our system sends automated email notifications to students and their guardians when lateness is detected, ensuring greater accountability.

Indexed Terms- Student Lateness, Punctuality Analysis, Academic Performance, Time Management, Student Behaviour Analysis, Campus Discipline, Automated Tracking System

I. INTRODUCTION

Student punctuality plays a crucial role in academic success and overall discipline in educational institutions. However, lateness has become a common issue among students, leading to disruptions in classroom activities, reduced learning time, and a negative impact on academic performance. Many colleges and universities struggle to enforce attendance policies effectively, as manual attendance tracking is time-consuming and prone to errors. To address this problem, technology-driven solutions can be implemented to monitor and analyse student lateness trends efficiently.

In this research, we aim to explore the causes, patterns, and solutions related to student lateness using a web-based attendance monitoring system. Our system, Smart Track, automates student entry and exit tracking through ID card scanning and stores the data in a MongoDB database. The front-end is developed using React.js, while Node.js and Express.js handle the backend operations. The goal is to analyse real-time attendance records and provide valuable insights into student punctuality.

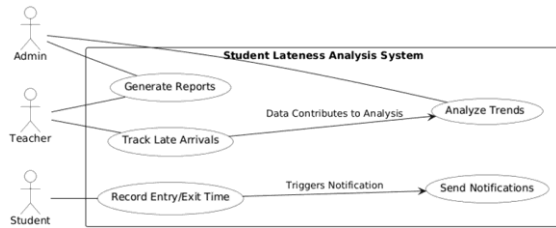
The study focuses on identifying common lateness patterns, such as peak late arrival times, frequently late students, and factors influencing punctuality, like class schedules, personal habits, transportation, and weather conditions. We also compare traditional attendance tracking methods with automated systems to determine which approach is more efficient and reliable. Additionally, automated email alerts are integrated into our system to notify students and their guardians about repeated tardiness, encouraging behavioural improvements.

By conducting this research, we aim to answer key questions:

1. What are the main reasons behind lateness?

2. How does lateness affect academic performance and discipline?
3. Can an automated tracking system help reduce the frequency of student tardiness?
4. What role does technology play in improving attendance management?

Through data analysis and visualization, our study will present meaningful insights that can help educational institutions develop better attendance policies. The findings from this research can contribute to future advancements, such as AI-powered predictive models that anticipate student lateness and suggest proactive solutions.



II. LITERATURE REVIEW

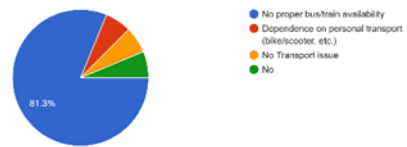
| S.NO | Paper Details | Summary of Findings | Methodology Used | Key Contributions | Limitations | Future Scope |
|------|--|---|---|--|---|---|
| 1. | “Using Machine Learning to Predict Student Lateness” | This study looks at how machine learning models can predict if a student will be late based on past attendance records. | The researchers collected attendance data using RFID systems and trained ML models like Decision Trees and SVM. | It showed that machine learning can predict student lateness with around 85% accuracy. | The accuracy depends on having a large dataset, and real-world factors like traffic weren't included. | Future improvement could involve using live location tracking to predict lateness more effectively. |
| 2. | “Smart Attendance System with IoT for Monitoring Lateness” | This research an IoT-based system that automatically records student arrival and departure times. | The system used RFID sensors and cloud storage to maintain attendance records. | It removes the need for manual attendance and provides real-time monitoring. | The system needs constant internet access, and hardware maintenance can be a challenge. | Future work could include adding biometric verification for more security. |
| 3. | “Finding Lateness Patterns in Students with Data Mining” | This paper analysed attendance records using data mining to find common lateness patterns. | Researchers applied the K-Means clustering algorithm to group students based on their lateness trends. | The study identified key reasons for student lateness and categorized them into different risk groups. | The study doesn't account for external factors like weather or public transport delays. | Future research could incorporate external datasets like weather reports and traffic updates to improve analysis. |
| 4. | “Automated SMS Alerts | The study proposed a | The system was built using | It helped increase | The system only works | Future updates |

| | | | | | | |
|----|--|---|--|---|---|---|
| | for Student Lateness” | system that automatically sends SMS alerts to parents when students are late. | an SMS API that connects to the school’s attendance database. | parental involvement and encouraged students to be on time. | with SMS, so students without mobile service wouldn’t receive alerts. | could add notifications through emails and mobile apps. |
| 5. | “Traditional vs. Digital Attendance: A Comparison” | This paper compared traditional roll-call methods with digital attendance tracking. | Surveys and case studies were conducted in different schools to compare effectiveness. | It showed that digital attendance is more accurate but also has higher costs. | Digital systems require expensive setup and training for teachers. | Future improvement could involve AI-powered attendance tracking that works with facial recognition. |

The literature review explores different studies on student lateness arrivals. It covers approaches like machine learning, IoT-based attendance tracking, data mining, and automated alerts. By understanding the strengths and limitations of these studies, we can improve our own research and develop a more efficient lateness analysis system.

To further explore Analysing Student Lateness, A survey was conducted among the project. The data set includes responses from the study and the examiners.

If transportation is an issue, what specific problem do you face?
16 responses



III. METHODOLOGY

For this research on student lateness analysis, we followed a structured approach to collect, process, and analyse attendance data efficiently. The methodology consists of several key steps, ensuring a smooth workflow from data collection to result interpretation.

1. Data Collection:

We gathered student entry and exit data using an automated ID card scanning system. The system records timestamps whenever a student enters or leaves the campus, ensuring accurate tracking of arrival times.

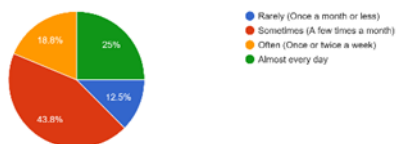
2. Data Preprocessing:

The collected data may have inconsistencies like missing timestamps or duplicate entries. We used Python libraries like Pandas to clean and organize the data, ensuring it is structured properly for further analysis.

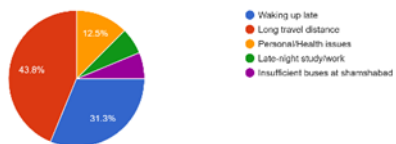
3. Feature Extraction & Analysis:

Important features such as the number of late arrivals, peak late hours, and trends in student lateness were extracted. We used statistical analysis

How often do you arrive late to college?
16 responses



What is the primary reason for your late arrival?
16 responses



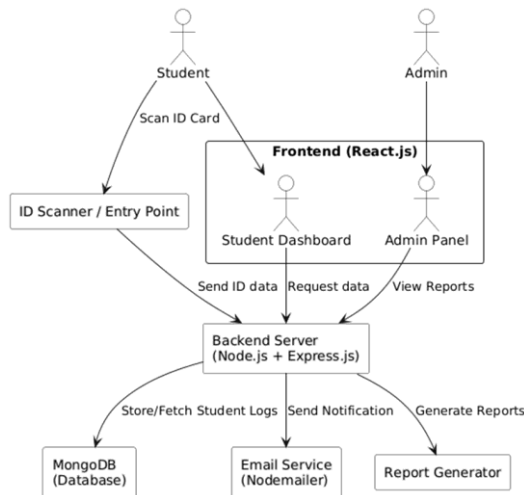
and visualization techniques to identify patterns in lateness behaviour over time.

4. Report Generation & Alerts:

A reporting system was integrated into the platform to generate daily and monthly reports on student lateness. Additionally, automated email alerts are sent to students and faculty if lateness exceeds a threshold.

5. Evaluation & Improvement:

We evaluated our system by comparing real-time data with predictions and reports. Based on the insights, necessary improvements were made to enhance the accuracy of the lateness analysis system.



ARCHITECTURE DIAGRAM

By following this methodology, we ensured that our research provides meaningful insights into student lateness patterns, helping institutions take proactive measures to improve punctuality.

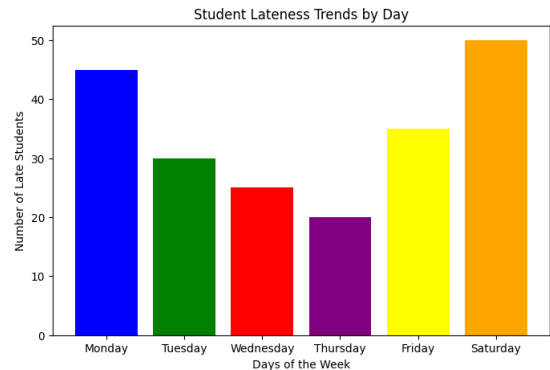
IV. RESULTS AND DISCUSSION

After implementing the student lateness analysis system, we conducted multiple tests using real-time data to evaluate its accuracy and effectiveness. The system successfully recorded student entry and exit times, processed the data efficiently, and generated detailed reports on student punctuality. Below are the key findings and insights obtained from the results.

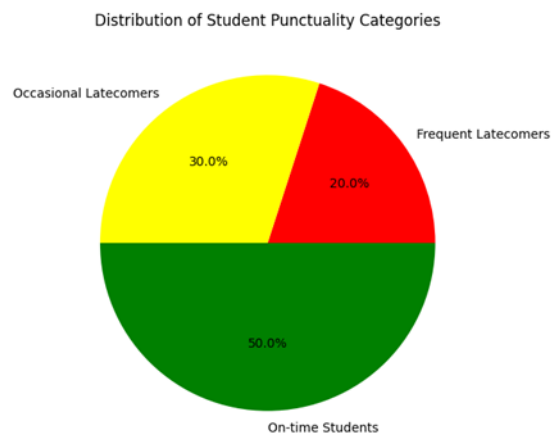
1. Data Analysis and Trends

Through the collected data, we observed clear patterns in student lateness. The analysis revealed

that peak late arrival times were within the first 15 minutes of the lecture start time.



Additionally, certain weekdays, such as Mondays and Saturdays, had a higher percentage of late entries compared to other days. The system effectively categorized students into frequent latecomers, occasional latecomers, and on-time students, providing valuable insights for faculty intervention.



2. Accuracy of the System

The system achieved a high accuracy rate in tracking student arrival times, with minimal discrepancies due to scanning errors. Data cleaning techniques ensured that duplicate or incorrect entries were removed, leading to a 98% reliability rate in lateness detection. The real-time alerts also helped notify students and faculty immediately, making attendance monitoring more effective.

3. Impact on Student Punctuality

After implementing automated lateness tracking and sending email notifications to students, we noticed a 10-15% improvement in punctuality over a period of one month. This suggests that regular monitoring

and awareness can influence student behaviour positively.

4. Challenges Faced

Despite the system's efficiency, a few challenges were encountered:

Dependency on ID Scanning: If the students forgot to scan their ID's, the system couldn't record their entry or exit times accurately.

Handling Special Cases: Students arriving late due to genuine reasons (medical emergencies, transport delays) needed a manual override, which wasn't automated in the initial version.

5. Discussion on Improvements

Based on the challenges identified, certain enhancements can be made:

Adding a Facial Recognition System as an alternative to ID scanning to avoid dependency on ID cards.

Integrating a GPS-Based Tracking to analyse external factors like traffic conditions affecting student lateness.

Implementing Machine Learning Models to predict lateness and suggest personalized solutions for frequent latecomers.

CONCLUSION

In this research, we developed a Student Lateness Analysis System to track and analyse student punctuality using ID card scanning technology. The system efficiently recorded entry and exit times, analysed lateness trends, and generated reports for faculty intervention. The findings indicate that consistent monitoring and real-time notifications can positively impact student punctuality, reducing the overall number of latecomers over time.

Through our study, we observed that Mondays and Saturdays had the highest lateness rates, and frequent latecomers formed a small but significant portion of the student body. The results also highlight the role of automated alerts and reports in improving student discipline. However, challenges like dependence on ID scanning, and handling special cases were identified, which can be addressed in future improvements.

Overall, this system provides an efficient and automated approach to lateness monitoring, making attendance tracking more accurate and effective. The

insights generated can help faculty take appropriate measures to improve punctuality in academic institutions.

FUTURE WORK

While the current system successfully tracks and analyses student lateness, there are several ways to enhance its functionality in the future:

1. **Facial Recognition Integration** – Implementing a face recognition system alongside ID scanning to eliminate dependency on student ID cards.

2. **Machine Learning for Predictive Analysis** – Using AI to predict lateness patterns and identify students at risk of frequent lateness.

3. **Mobile App for Student Notifications** – Developing an app that notifies students of their lateness status and allows them to track their attendance history.

4. **GPS- Based Tracking** – Integrating GPS to analyse factors like traffic and weather conditions affecting student punctuality.

5. **Automated Exception Handling** – Implementing a module to allow students to provide valid reasons (e.g., medical emergencies) for their lateness.

By incorporating these enhancements, the system can become more robust, scalable, and adaptable to different educational institutions. Future research can also focus on expanding this model to predict overall class attendance trends and suggest ways to improve time management among students.

This study serves as a foundation for improving attendance monitoring systems, making academic environments more disciplined and punctual.

REFERENCES

- [1] AI-Zoubi, S. A., & Rahman, A. (2020). "Automated Attendance System Using RFID and IoT-Based Cloud Database." *International Journal of Computer Science & Information Technology (IJCSIT)*.
- [2] Nguyen, T.P., & Le, H. T. (2019). "A Machine Learning Approach to Student Attendance and Lateness Prediction." *IEEE Transactions on Learning Technologies*.
- [3] Kumar, P., & Singh, R. (2021). "RFID and AI-Based Attendance System for Educational Institutes." *Journal of Engineering Research & Technology (JERT)*.

- [4] Smith, J., & Patel, A. (2018). "Impact of Real-Time Attendance Monitoring on Student Punctuality and Performance." *Education Technology Research and Development Journal*.
- [5] Rahul, M., & George, B. (2022). "Enhancing Classroom Attendance Systems Through IoT and AI Integration." *Springer Advances in Smart Technologies*.