International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 13 Issue: 11 | Nov 2026 www.irjet.net p-ISSN: 2395-0072

AI – Based Classroom Activity Recognition System

Prof. Divya Patil[1], Deepali J S[2], Gowrika D M[2], Sakshi Shankar Tasildar[2], Swarna Gowri S[2]

[1]Assistant Professor, Dept. of Computer Science and Business Systems, Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India

[2]Student, Dept. of Computer Science and Business Systems, Bapuji Institute of Engineering and Technology, Davangere, Karnataka, India

---

Abstract - *Monitoring student activities in a classroom is challenging because teachers cannot continuously observe every student. This paper presents an AI-Based Classroom Activity Recognition System designed to assist classroom monitoring through Artificial Intelligence and Computer Vision. The proposed system processes live video captured using a webcam and identifies mobile phone-related activities and sleeping students. A pre-trained YOLOv8 object detection model is integrated with OpenCV for video processing and object detection, while sleeping detection is performed using the image-processing logic implemented in the application. The detected activities are recorded in an SQLite database and displayed through a web-based dashboard developed using Flask. Email notifications are generated when the system identifies specified activities. The proposed system demonstrates how existing AI models and software technologies can be integrated to support automated classroom monitoring. The current implementation is evaluated through functional testing of its detection, database, dashboard, and notification components.*

Key Words: Artificial Intelligence, Computer Vision, Classroom Monitoring, YOLOv8, OpenCV, Flask, SQLite, Activity Recognition, Email Notification

1. INTRODUCTION

Classroom monitoring is an important responsibility of teachers, especially in large classrooms where observing every student continuously can be difficult. Activities such as mobile phone usage and sleeping during lectures may affect students' attention and classroom discipline. Traditional monitoring methods mainly depend on manual observation, which requires continuous effort from teachers.

To overcome these challenges, this project introduces an AI-Based Classroom Activity Recognition System that uses computer vision techniques to identify selected student activities automatically. The system processes live video input, detects mobile phones and identifies sleeping-related behaviour using the implemented detection logic. The detected events are stored in a database and displayed through a web dashboard. Email notifications are generated to inform teachers.

The proposed system provides a software-based approach to classroom monitoring and supports the development of smart educational environments.

2. LITERATURE SURVEY

Previous research has explored the application of computer vision and deep learning for classroom behaviour recognition. Liu et al. [1] presented a systematic review of computer vision-based classroom behaviour recognition. Their research analysed existing studies related to physical activities, student engagement, attention, and emotional behaviour. The study highlighted the importance of deep learning and object detection techniques, including the YOLO family, for recognizing classroom activities. It also discussed challenges such as poor lighting, object occlusion, camera resolution, and real-world implementation. This research provides a foundation for developing automated classroom monitoring applications.

Ashwin and Guddeti [2] proposed a method for analysing student behavioural engagement using non-verbal visual information. Their approach considered facial expressions, hand gestures, and body postures to understand student engagement levels. A convolutional neural network was used to classify student engagement in classroom environments. The study demonstrated how visual information can be used to analyse student behaviour without interrupting normal classroom activities.

Kale et al. [3] proposed a computer vision-based system for detecting mobile phone usage among students during classroom lectures. Their approach used CCTV recordings and fine-tuned YOLOv8 models to identify mobile phones and their users. The system also analysed cellphone usage patterns to understand student distraction. This research is closely related to the proposed project because both systems focus on identifying mobile phone-related activities in classrooms.

These studies demonstrate the potential of an AI-based

classroom monitoring.

3. SYSTEM DESIGN

The proposed system follows a modular software The proposed AI-Based Classroom Activity Recognition System follows a modular software architecture consisting of five major stages: video acquisition, video processing, activity detection, data management and user notification. The system is designed to monitor classroom activities automatically by analyzing live video captured through a webcam.

The video input is processed using OpenCV, and the processed frames are passed to the AI-based detection modules. YOLOv8 is used for object detection, including student and mobile phone detection, while MediaPipe is used for facial landmark analysis to identify sleeping-related behaviour. The detection results are processed using Python and stored in an SQLite database for future reference.

A Flask-based backend manages communication between the detection modules, database and frontend dashboard. The dashboard is developed using HTML, CSS and JavaScript to display live classroom statistics, activity analytics, recent alerts and historical records. An SMTP-based email notification module is integrated to notify the configured teacher when specified activities are detected.

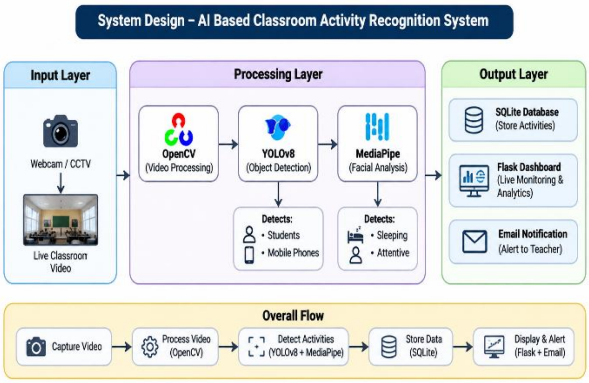
The modular architecture makes it easier to maintain individual components, update detection algorithms and extend the system with additional classroom monitoring features.

Overall workflow: Camera Input → OpenCV Processing → Activity Detection → SQLite Database → Flask Dashboard → Email Notification.

3.1 Software Architecture

The system is implemented as a pure software application using the following components:

- Video Input: Webcam or supported CCTV video stream.
- Processing Module: OpenCV processes incoming video frames.
- Detection Module: YOLOv8 detects supported objects, including mobile phones.
- Sleeping Detection: Implemented visual detection logic identifies sleeping-related behaviour.
- Database: SQLite stores detected activity records.
- Backend: Flask manages application operations and communication.
- Frontend: HTML, CSS and JavaScript provide the dashboard interface.
- Notification: SMTP is used to send email alerts.



3.2 Software and Algorithms

The implementation consists of the following modules:

A. Video Capture and Processing

OpenCV is used to capture video from the camera and process individual frames. The frames are passed to the detection modules for analysis.

B. Mobile Phone Detection

The pretrained YOLOv8 model is used to identify mobile phones in the video frames with pretrained YOLOv8 use.

The detection results are processed by the application to identify relevant phone-usage events.

C. Sleeping Activity Detection

The sleeping detection module analyses visual information using the project's implemented detection logic. It identifies sleeping-related behaviour based on configured visual conditions and generates an activity event when the required conditions are satisfied.he TRANAM prototype features a casing created to house all embedded parts while maintaining a lightweight and portable feature.

D. Database Management

SQLite is used to store detected classroom activities along with relevant information such as activity type and timestamp. This information is retrieved for displaying activity history.

E. Web Dashboard

Flask is used to develop the backend web application.

The dashboard displays detected activities and their recorded information, allowing teachers to monitor system outputs.

F. Email Notification

The SMTP protocol is used to send email notifications to the configured teacher whenever the application detects an activity that satisfies the alert conditions.

4. SYSTEM TESTING AND ANALYSIS

Testing is performed to verify the functionality and integration of the different modules. The testing process covers video capture, phone detection, sleeping detection, database storage, dashboard display and email notification.

4.1 Performance Analysis

The system is evaluated based on the following parameters:

- Mobile phone detection under different classroom conditions.
- Identification of sleeping-related behaviour.
- Processing of live video frames.
- Correct storage of detected activity records.
- Display of activity information on the dashboard.
- Successful generation of email notifications.

4.2 Unit Testing

Individual modules are tested independently to verify their functionality.

- **Video capture module:** Checks whether video frames are captured correctly.
- **Phone detection module:** Checks whether mobile phones are detected.
- **Sleeping detection module:** Checks whether configured sleeping-related conditions are identified.
- **Database module:** Verifies activity record storage and retrieval.
- **Dashboard module:** Checks activity recorded.

5. RESULTS

The developed system demonstrates the integration of artificial intelligence and computer vision for automated classroom activity monitoring.

The system processes video input and identifies selected classroom activities. Detected events are recorded in the SQLite database and displayed on the Flask dashboard. The email notification module provides an additional method of informing teachers about detected activities.

5.1 Mobile Phone Detection

The mobile phone detection module processes video frames using the pretrained YOLOv8 model and identifies supported mobile phone objects. Detection results are displayed through the video processing interface.

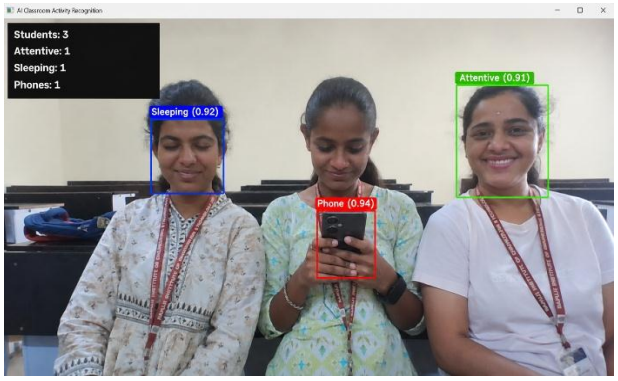


Figure 1: Mobile Phone Detection Output

5.2 Sleeping Activity Detection

The sleeping detection module analyses student behaviour using the implemented visual detection logic. When the configured conditions are satisfied, the system identifies and records the corresponding sleeping-related activity.

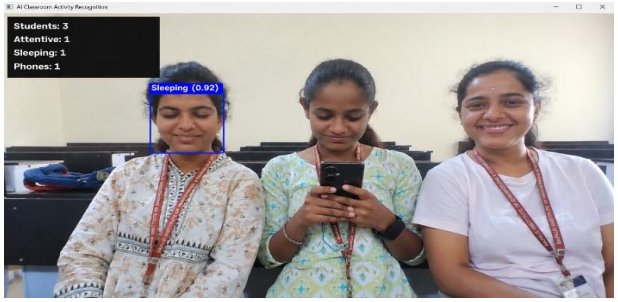


Figure 2: Sleeping Activity Detection Output

5.3 Dashboard

The Flask dashboard provides a centralized interface for viewing detected classroom activities. SQLite maintains the activity records, while the SMTP-based notification module sends alerts to the configured teacher.



Figure 3: Flask Dashboard

5.4 Email Notifications

The Flask dashboard provides a centralized interface for viewing detected classroom activities. SQLite maintains the activity records, while the SMTP-based notification module sends alerts to the configured teacher.

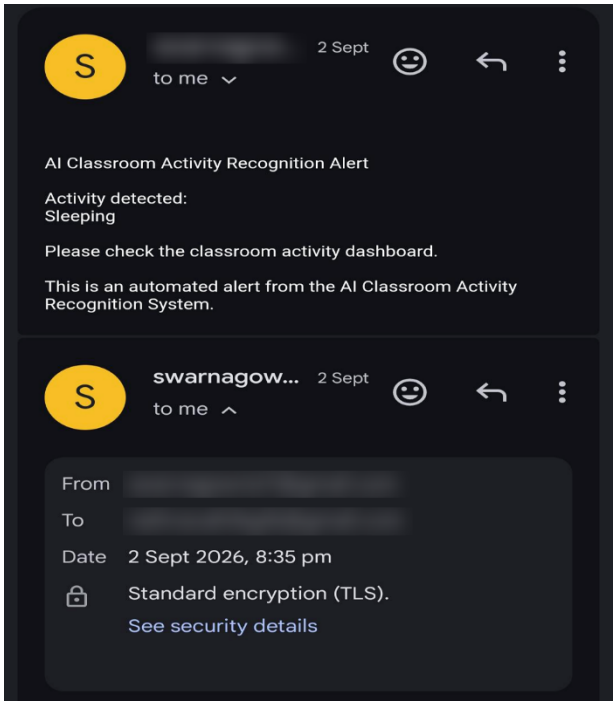


Figure 4: Sleeping Detection Email Alert

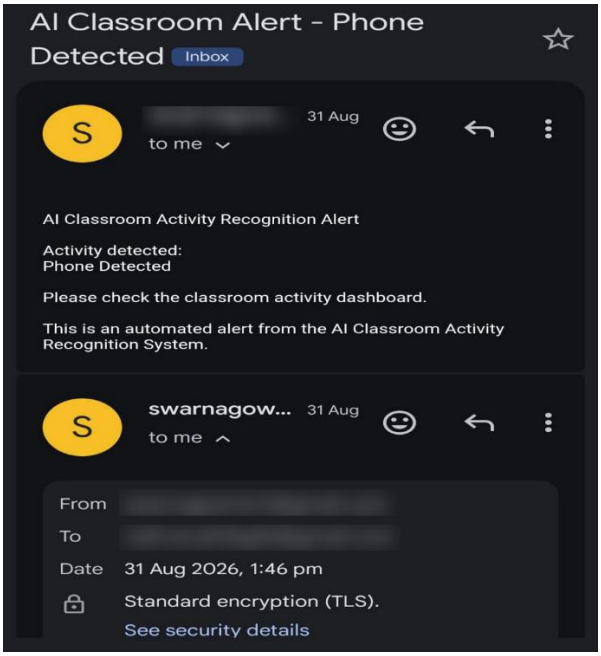


Figure 5: Phone Detection Email Alert

6. CONCLUSION AND FUTURE SCOPE

The AI-Based Classroom Activity Recognition System demonstrates the application of artificial intelligence and computer vision in automated classroom monitoring. By integrating video processing, mobile phone detection, sleeping-related activity detection, database management, a web dashboard and email notifications, the system provides a unified software-based monitoring solution.

The project reduces the need for continuous manual observation and helps teachers monitor selected classroom activities more efficiently.

In the future, the proposed AI-Based Classroom Activity Recognition System can be further enhanced by incorporating advanced technologies and additional features. In the future, the system can be extended to detect more classroom activities such as talking, standing, walking and group discussions. Advanced AI models and classroom-specific datasets can be used to improve detection accuracy and reliability. Multiple webcams and IP CCTV cameras can be integrated to monitor larger classrooms. Automatic attendance management can also be introduced using suitable student identification techniques. Furthermore, a mobile application can be developed to help teachers access classroom information and receive notifications remotely. Cloud integration can support centralized monitoring, while advanced analytics can generate daily, weekly and monthly

activity reports. These improvements can make the system more accurate, scalable and efficient for modern educational institutions.

ACKNOWLEDGEMENT

We express our sincere gratitude to our Head of Department, **Dr. Vinutha H P**, for her valuable support and encouragement throughout this project. We extend our heartfelt thanks to our Project Guide, **Mrs. Divya Patil**, for her invaluable guidance, continuous support and suggestions during the development of our project. We are also thankful to our Project Coordinator, **Prof. Priyanka R Navale**, for her motivation and timely guidance. We extend our gratitude to **Dr. Aravind H B**, Principal, and **Prof. Y Vrushabhendrappa**, Director, Bapuji Institute of Engineering and Technology, Davangere, for providing the necessary infrastructure and resources to complete this project successfully. Finally, we thank all the faculty members of the Department of Computer Science and Business Systems for their valuable suggestions and support. We also thank our friends and family members for their encouragement and cooperation throughout the successful completion of this project.

REFERENCES

1) Q. Liu, X. Jiang, and R. Jiang, "Classroom Behavior Recognition Using Computer Vision: A Systematic Review," Sensors, vol. 25, no. 2, Art. no. 373, 2025, doi: 10.3390/s25020373.

2) X. Sheng, S. Li, and S. Chan, "Real-Time Classroom Student Behavior Detection Based on Improved YOLOv8s," Scientific Reports, vol. 15, Art. no. 14470, 2025, doi: 10.1038/s41598-025-99243-x.

3) G. V. Kale, A. Choudhari, R. Balapure, S. Sarode, and M. S. Wakode, "Real-Time Detection of Students' Cellphone Usage During Lectures and Behavioral Analysis," in Proc. 2024 International Conference on Computational Intelligence and Computing Applications (ICCICA), 2024, pp. 536–540, doi: 10.1109/ICCICA60014.2024.10584944.

4) Q. Jia and J. He, "Student Behavior Recognition in Classroom Based on Deep Learning," Applied Sciences, vol. 14, no. 17, Art. no. 7981, 2024, doi: 10.3390/app14177981.

5) Y. Zhang, T. Zhu, H. Ning, et al., "Classroom Student Posture Recognition Based on an Improved High-Resolution Network," EURASIP Journal on Wireless Communications and Networking, vol. 2021, Art. no. 140, 2021, doi: 10.1186/s13638-021-02015-0.

6) Y. Zeng et al., "A Video Analytic In-Class Student Concentration Monitoring System," IEEE Transactions on Consumer Electronics, vol. 67,

7) no. 4, pp. 294–304, 2021, doi: 10.1109/TCE.2021.3126877.

8) T. S. Ashwin and R. M. R. Guddeti, "Unobtrusive Behavioral Analysis of Students in Classroom Environment Using Non-Verbal Cues," IEEE Access, vol. 7, pp. 150693–150709, 2019, doi: 10.1109/ACCESS.2019.2947519.

9) G. Jocher, A. Chaurasia, and J. Qiu, "Ultralytics YOLOv8," Version 8.0.0, 2023. Available: https://doi.org/10.5281/zenodo.7867787.

10) C. Lugaresi et al., "MediaPipe: A Framework for Building Perception Pipelines," in Proc. 3rd Workshop on Computer Vision for AR/VR at IEEE CVPR, 2019. Available: https://arxiv.org/abs/1906.08172.

11) G. Bradski, "The OpenCV Library," Dr. Dobb's Journal of Software Tools, vol. 25, no. 11, pp. 120–125, 2000.