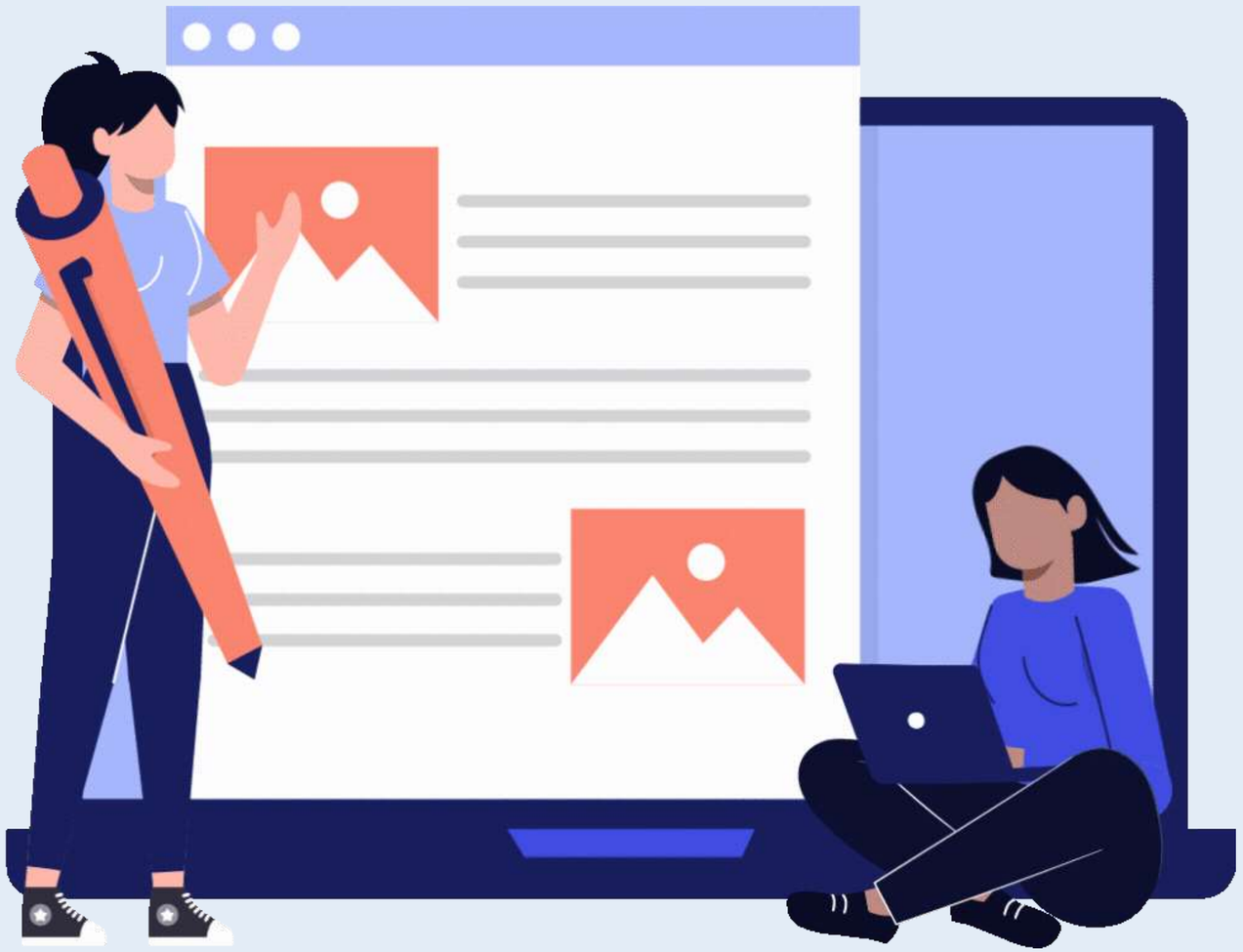


STUDENT ENGAGEMENT TRACKER

TEAM GLADIATORS

Divyansh Sharma

Shivam Vashishtha

PROBLEM STATEMENT

- The rapid growth in remote education, particularly during the pandemic, has resulted in an unprecedented surge in the utilization of e-learning platforms worldwide.

- Despite the widespread use of virtual classrooms, teachers continue to face obstacles in accurately gauging and understanding students' levels of enthusiasm and active involvement, hindering effective remote education.

- The demand for enhanced educational tools has intensified, emphasizing the need for innovative solutions that bridge the gap in providing real-time insights into student engagement. This real-time understanding is crucial for educators in optimizing their remote teaching strategies.

- The lack of immediate and accurate feedback on student engagement hampers the effectiveness of remote teaching, potentially impacting students' overall learning experiences and success rates.

APPROACH

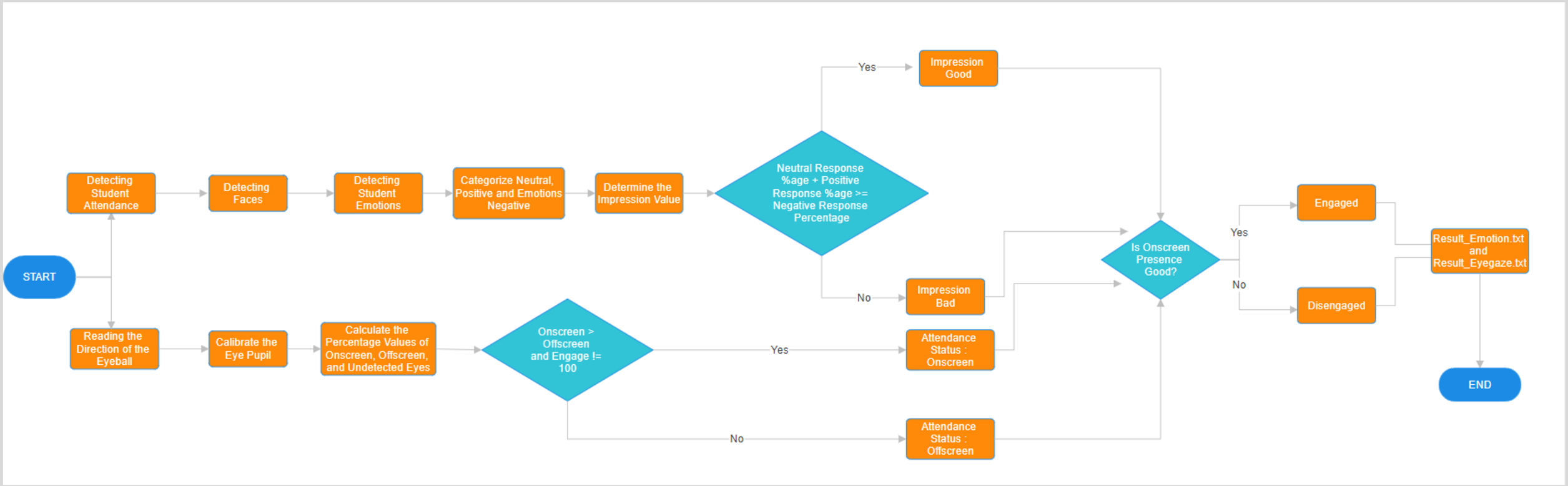
- *Engagement Detection System Implementation* : Implemented a robust system using OpenCV technology and CNN methods for real-time detection of student engagement in e-learning environments, analyzing eye movements and facial expressions.

- *Comprehensive Metrics for Engagement Evaluation* : Designed nuanced metrics, including screen time and facial expressions, to evaluate student engagement comprehensively in virtual classrooms.

- *Real-time Feedback Mechanism* : Established a real-time feedback mechanism categorizing students as "engaged" or "disengaged" based on positive or negative signals, such as eye contact and facial expressions.

- *Integration of Emotional Analysis* : Incorporated emotional analysis with the FER-2013 dataset to quantify students' emotional reactions, enhancing the system's capability to measure cognitive and emotional engagement.

ENGAGEMENT DETECTION SYSTEM WORKFLOW



EMOTION DETECTION MODEL

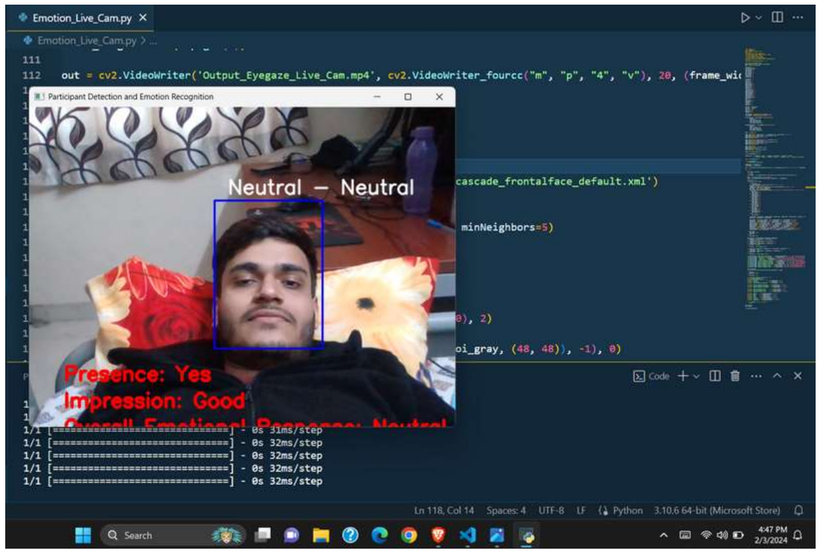
- *Facial Expression as Emotional Indicator* : Utilized OpenCV to capture and analyze facial expressions, recognizing changes in facial features such as forehead, eyebrows, eyelids, nose, cheeks, mouth, and lips as indicators of emotional expression during academic activities.
- *HAAR Feature-Based Object Recognition* : Implemented the HAAR feature-based object recognition in OpenCV, utilizing positive samples (images of the target object, e.g., faces) and negative samples (images of other objects or backgrounds) for effective training. This method allowed for robust and efficient detection based on specific features.

- *Integration of TensorFlow and CNN* : Utilized TensorFlow, a computational algebra library, and Convolutional Neural Networks (CNN) for machine learning. The CNN was specifically designed for two-dimensional data processing, making it well-suited for image-based emotion detection. The model underwent training through classification using feed-forward and learning stages with backpropagation.

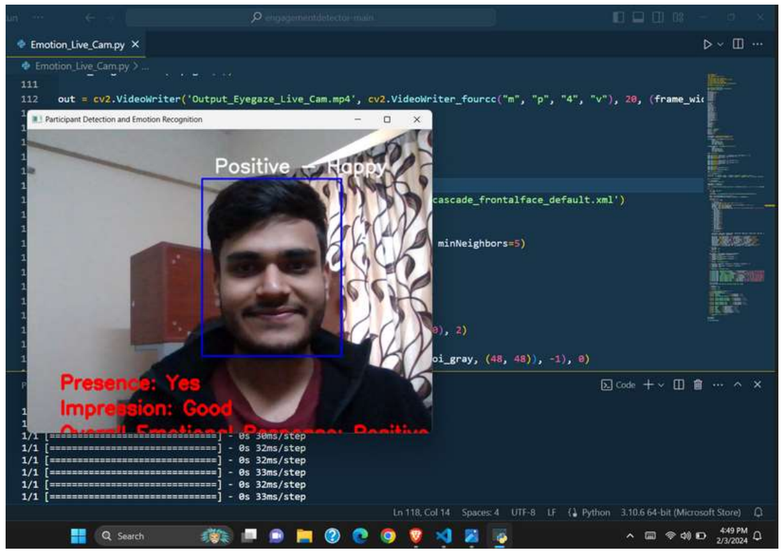
EYE GAZE ON SCREEN – OFF SCREEN DETECTION

- *Real-time Eye Tracking* : Employed the dlib library and shape_predictor_68_face_landmarks.dat to detect and track the position of the student's eyeballs during academic activities.
- *Behavioral Engagement Dimensions*: Analyzed the dimensions of behavioral engagement by distinguishing between on-screen focus, off-screen gaze, and undetected eyes, providing insights into the student's level of attention.
- *Attendance Monitoring:* Utilized eye gaze patterns to determine attendance status, classifying it into "On Screen," "Off Screen," or "No Attendance (null)."
- *Continuous Analytics*: The system processed video recordings, generating annotated videos and text documents with detailed metrics, including on-screen/off-screen percentages and emotional responses.

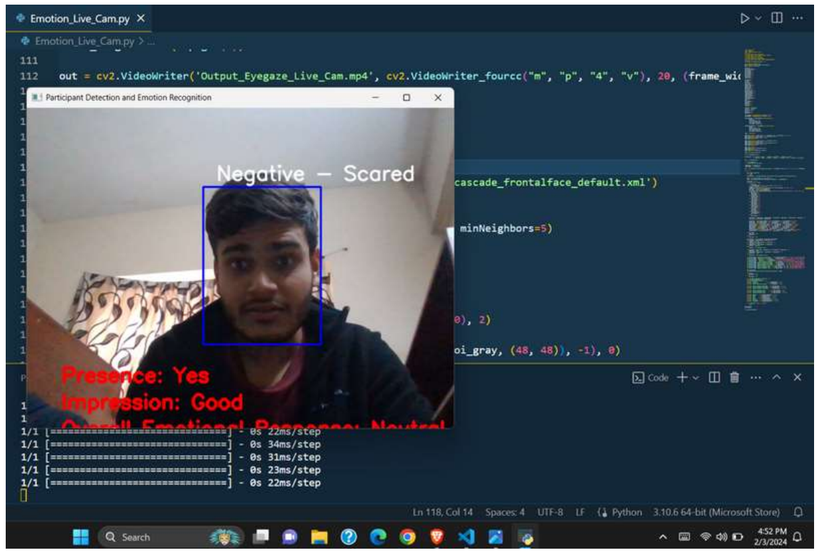
DEMONSTRATION : REAL TIME EMOTION DETECTION INPUTS



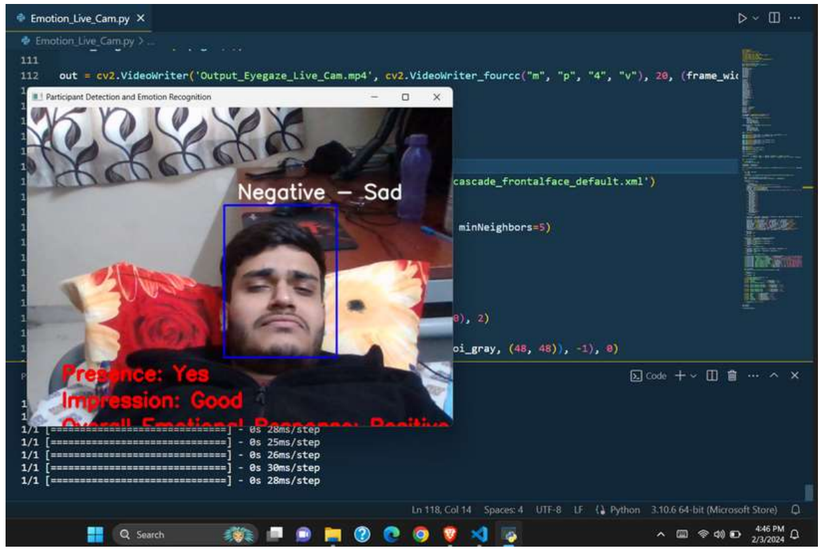
Students always look at the screen, students use laptops in a half-lying position, static body position, showing a neutral expression



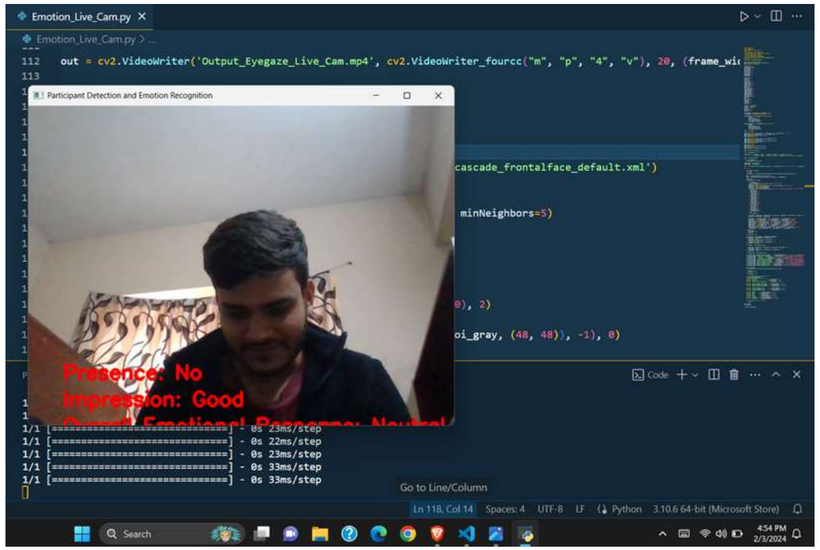
Students always look at the screen, sitting and sometimes moving, showing interested expressions, laughing and smiling



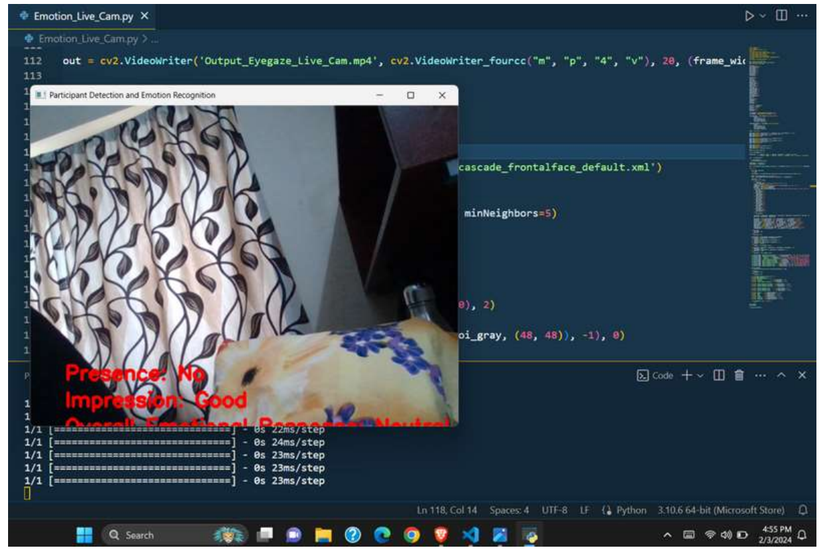
Students are present but occasionally unfocused. They maintain a sitting and static posture, exhibiting confusion and occasional frowns, especially when scared.



Students are present but often they are looking sad with negative impressions



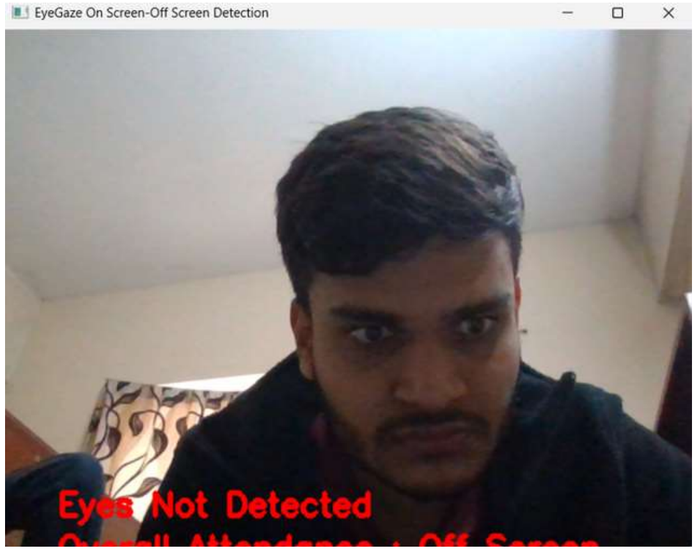
Students are present, but students are not looking at the screen at all, always looking down, body position sitting, static, neutral expression.



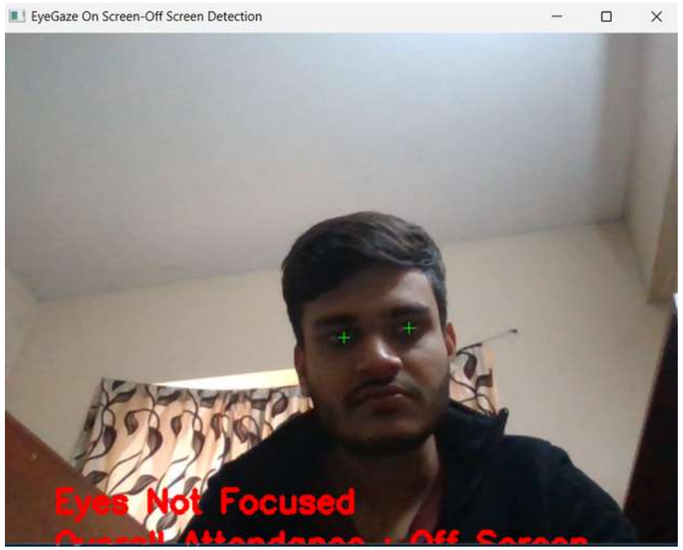
No students are present, just room

DEMONSTRATION : REAL TIME EYEGAZE DETECTION INPUTS

Students are focused and looking at the screen attentively.



Students are looking somewhere else that's why, eyes are not detected



Students are looking drowsy, frown or seem to be confused

TABULAR DATA INFERRED FROM INPUTS

Label	Types of Emotions	Amount
0	Angry	4593
1	Disgust	547
2	Scared	5121
3	Happy	8989
4	Neutral	6077
5	Sad	4002
6	Surprised	6198

Classification of Emotions
in FER-2013 Dataset

Inputs	On Screen (%)	Off Screen (%)	Eyes Detected (%)	Response Neutral(%)	Response Positive (%)	Response Negative (%)
1	75.8	24.2	4.60	69.00	0.00	31.00
2	77.68	22.32	4.70	13.68	48.98	37.34
3	92.61	7.39	4.28	32.74	12.22	55.04
4	61.43	38.57	20.78	36.68	3.06	60.26
5	0.00	100.0	97.7	20.47	4.72	74.8
6	0.14	99.86	98.83	0.00	0.54	99.46
7	0.00	0.00	100	0.00	0.00	0.00
MIN	0.00	0.00	4.60	0.00	0.00	0.00
MAX	92.61	100	100	69.00	48.98	99.46
AVG (%)	43.95	41.76	42.27	24.65	9.93	51.12

Engagement Output Data by
Detection System

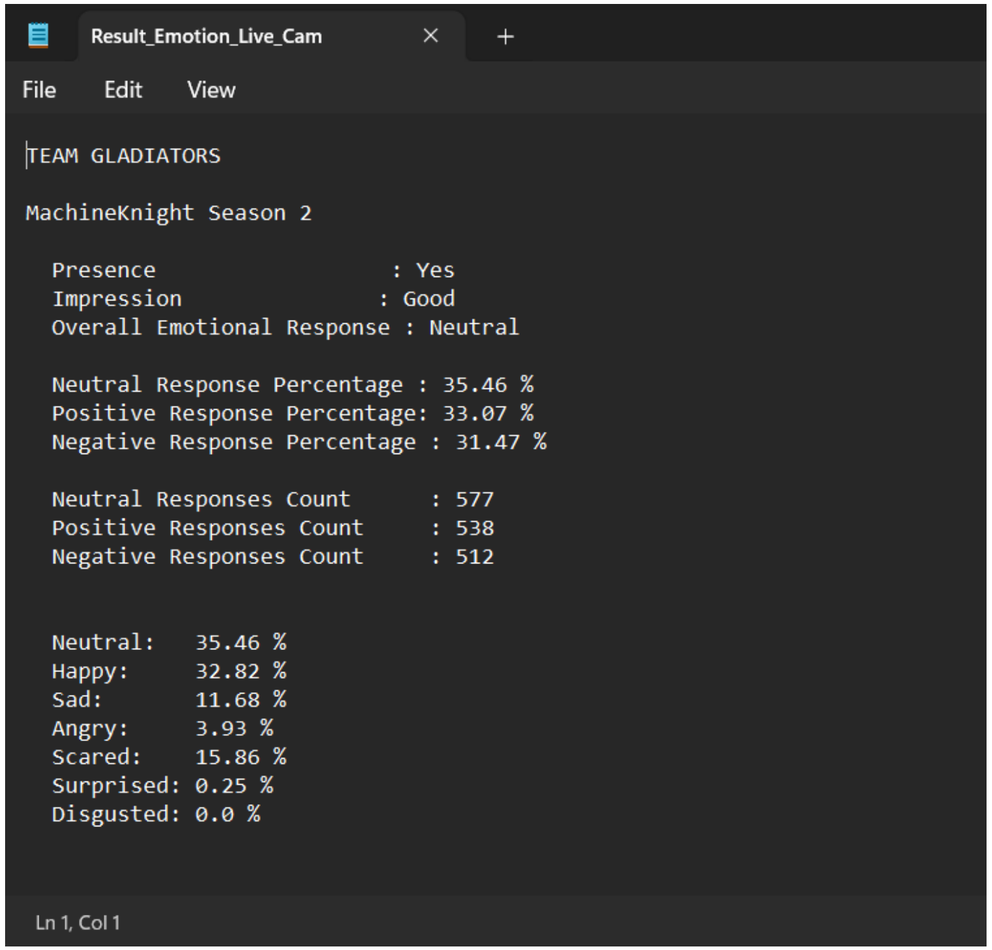
Input	Presence		Overall Response	Attendance	Impression	Status Engagement	
1	Yes	1	Neutral	on screen	Good	Engaged	1
2	Yes	1	Positive	on screen	Good	Engaged	1
3	Yes	1	Neutral	on screen	Good	Engaged	1
4	Yes	1	Negative	on screen	Bad	Disengaged	0
5	Yes	1	Neutral	on screen	Good	Disengaged	0
6	Yes	1	Neutral	Null	Good	Disengaged	0
7	No	0	Null	Null	Null	Null	

Analysis of Engagement by Detection System

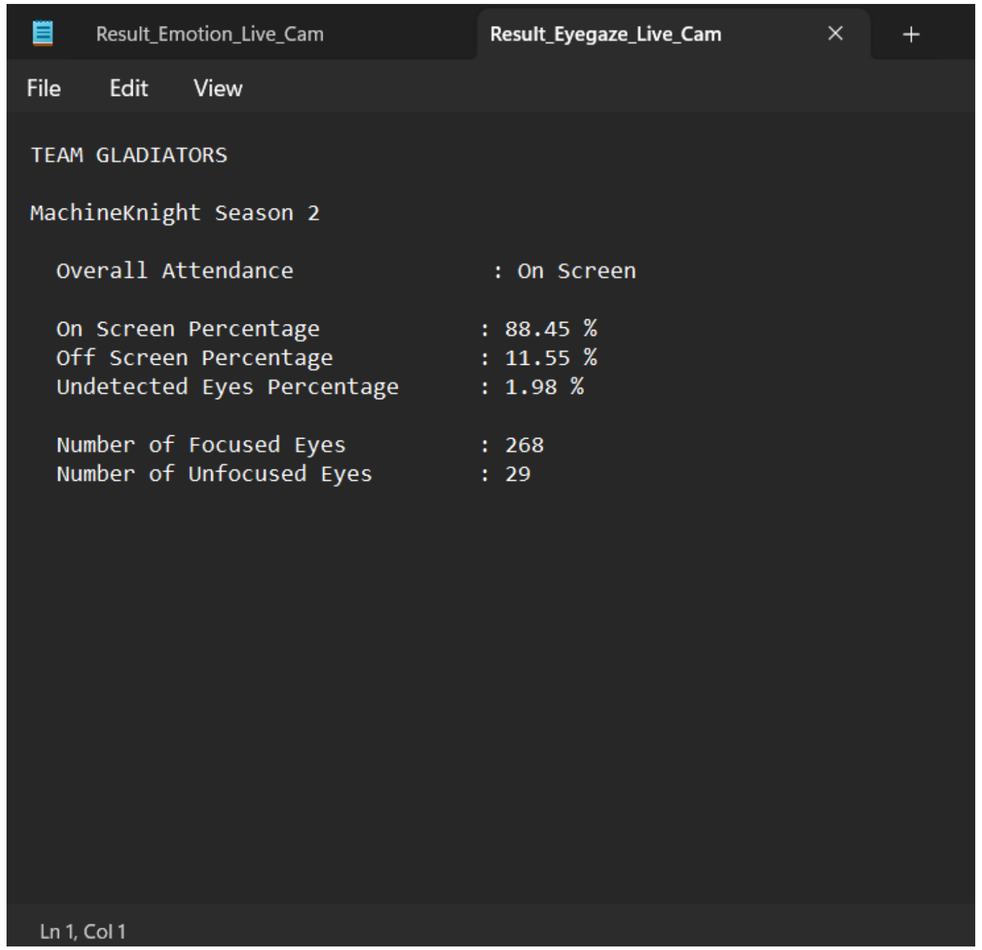
Evaluation Metrics Performance Student Detection Engagement System

Parameter	Accuracy	Precision	Recall	F1 score
Presentation	100.0	100.00	100.00	100.00
Status Attendance	100.00	100.00	80.00	89
Emotion	67	75.00	75.00	60.00
Impression	50.00	100.00	40.00	57
Engagement Status	83.33	100.0	67	80

TEST RESULTS

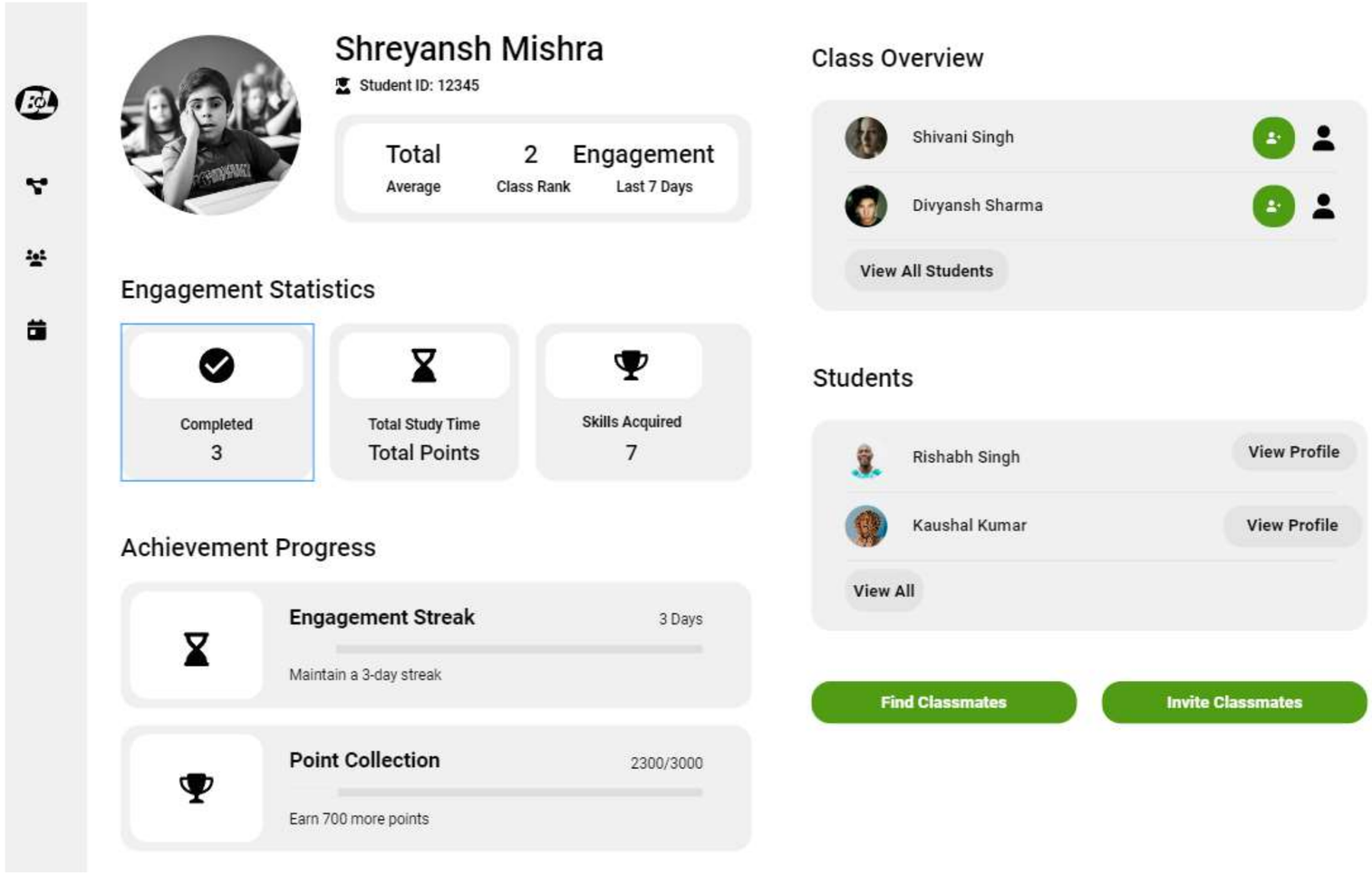


Results of Real Time
Emotion Detection Model

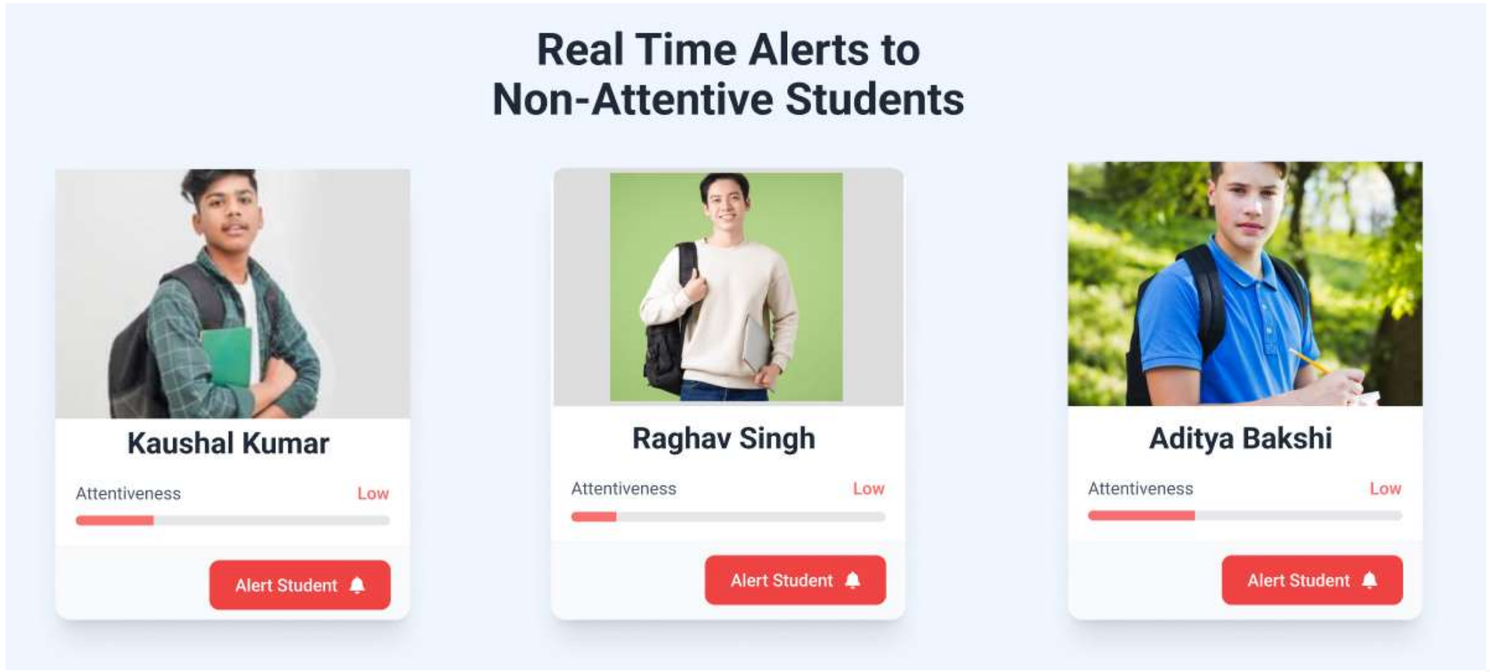


Results of Real Time
Eyegaze Detection Model

STRATEGIES FOR ENGAGING INATTENTIVE STUDENTS: INSIGHTS FROM STUDENT MONITORING DATA

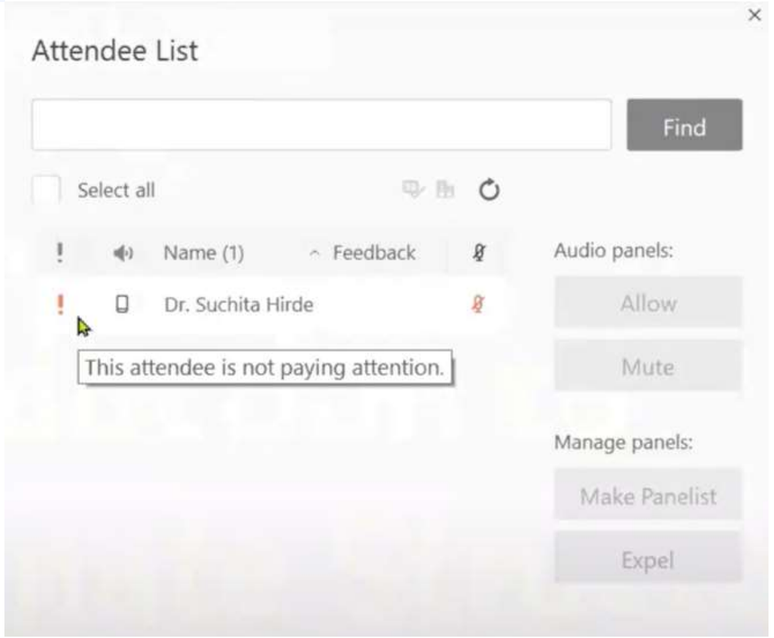


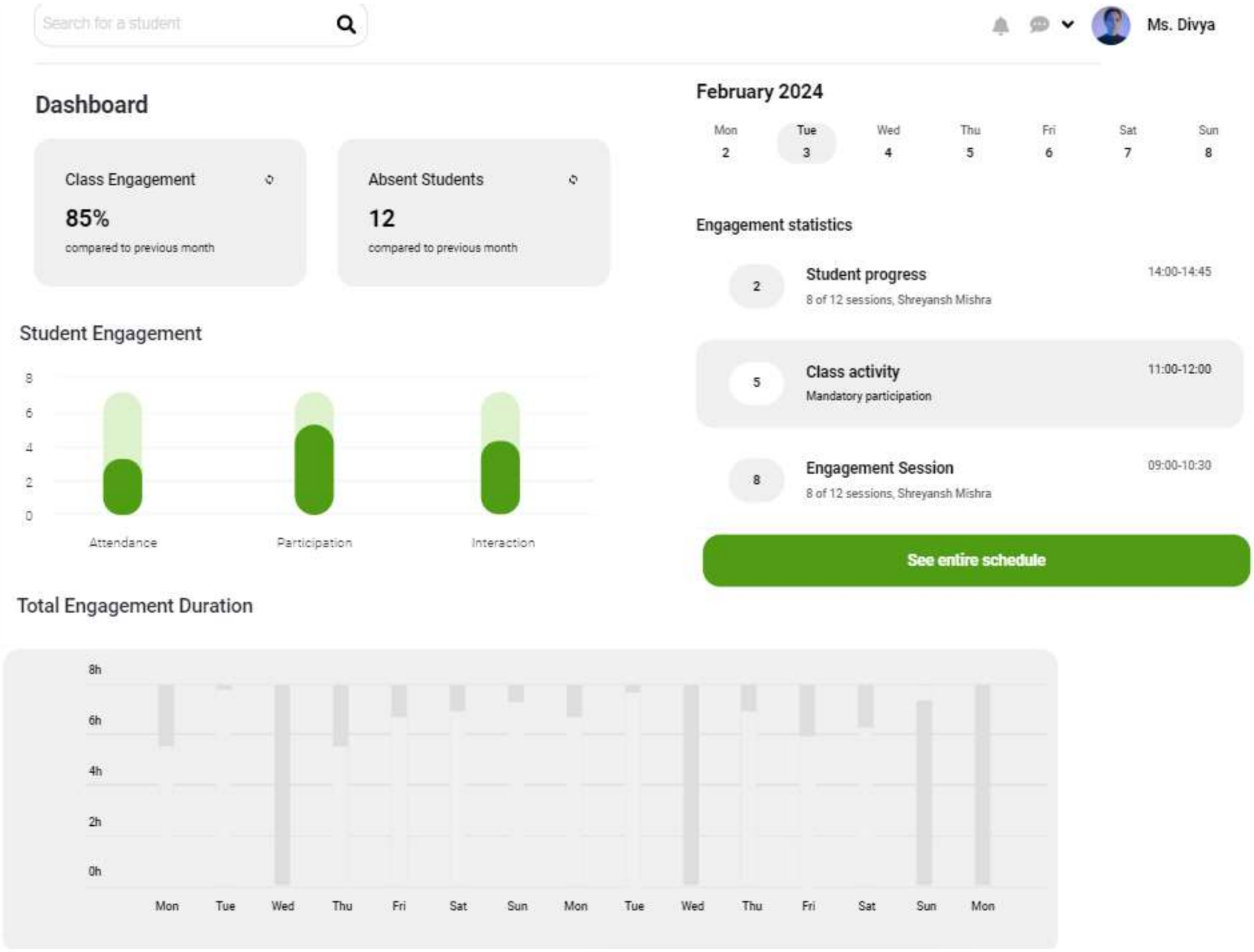
Incentive Program: Recognizing and Rewarding High Engagement Streaks in Online Classes. Rewarding students with outstanding engagement levels to inspire greater participation of non-attentive students



Empowering Educators: Receive instant notifications about students with low attention levels and send real-time alerts for timely intervention and support.

If any student is Switching Tabs / Minimizing E-Learning Platform, educator would be able to see the exclamation mark indicating that a particular student is inattentive.





Educator's Insights Hub: A dynamic dashboard providing comprehensive statistics on student engagement, showcasing the total engagement duration over the course of a month.

FUTURE ENDEAVORS: EXPANDING THE MODEL TO OFFLINE CLASSROOMS FOR ELEVATED STUDENT ENGAGEMENT

THANK YOU!