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AI BASED STUDENT ENGAGEMENT DETECTION IN ONLINE LEARNING

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MACHINE LEARNING

- Machine learning, a subset of AI, empowers computers to learn from data, discern patterns, and make decisions autonomously. By developing algorithms and statistical models, it enables predictive analysis and problem-solving without explicit instructions, relying on inference from data.

ABSTRACT

- Student engagement detection involves AI to detect the student engagement levels.
- Using mutlimodal engagement detection technique the level of engagement of the student is detected.
- Send the report of each student to the server for the teacher to view and analyse the report and give attendance to the student according to their participation in the online class.

INTRODUCTION

- In this era of online learning, monitoring student engagement has become a major challenge for educators.
- In traditional classrooms, teachers can gauge attention through body language and facial expressions, but these signals are harder to capture in virtual settings.
- Student engagement is crucial for effective learning, so finding ways to track it accurately in online platforms is important.
- Our project introduces a system that uses computer vision and deep learning to automatically detect student engagement by analyzing facial expressions, eye movements, and head position during online classes.
- The goal is to provide real-time feedback to educators to improve learning outcomes.

OBJECTIVE

- Student Engagement detection aims to encourage the students to stay in-front of the screen in time of online classes and enables the teacher to monitor the student's focus on learning as done in real class.
- It helps to teacher to give reward to the students in the form of attendance.
- It also provides a place for teachers to provide online class link to students
- Also enables the teachers to evaluate their class based on the engagement level of the students

- As many educational institutions are providing online classes these days even in technical degree it is necessary to check whether the students are listening to these lectures or not.
- Attendance of the students can be monitored as it is done real classroom conditions.
- Time taken to take attendance during the online class can be saved by making the process automatic by the help of machine learning.
- It protect privacy of the students.In online classes the video of the students can be seen by teachers as well as other known and unknown students in the classroom it can be prevented as machine learning model works on the student's system and only the result is send to the server.

PROBLEM DEFINITION

- In online learning, it is difficult for educators to evaluate student engagement, as signs like facial expression and eye movements are harder to observe.
- This can lead to reduced participation and lower learning outcomes. Current methods of tracking engagement, such as self-reports or quizzes, are often slow and unreliable.
- There is a need for an automated system that can accurately detect student engagement during online classes, helping instructors improve teaching effectiveness and student success.

- Automatic Detection of Students' Engagement During Online Learning: A Bagging Ensemble Deep Learning Approach
- Multimodal Engagement Recognition From Image Traits Using Deep Learning Techniques
- Privacy-Preserving On-Screen Activity Tracking and Classification in E-Learning Using Federated Learning
- Decoding Student Emotions: An Advanced CNN Approach for Behavior Analysis Application Using Uniform Local Binary Pattern
- Student Recognition and Activity Monitoring in E-Classes Using Deep Learning in Higher Education

Multimodal Engagement Recognition From Image Traits Using Deep Learning Techniques

PROBLEM STATEMENT

- The paper presents a system for automatically recognizing student engagement in online learning environments using deep learning model.
- By analyzing visual traits like facial expressions, gaze direction, head pose, and eye blinks captured via a camera, the system identifies engagement levels such as "Highly Engaged," "Confused," "Boredom" or "Sleepy".

TECHNOLOGY USED

- Haar Cascade Algorithm
- Dlib's Shape Predictor
- Eye Aspect Ratio (EAR)

Multimodal Engagement Recognition From Image Traits Using Deep Learning Techniques

ADVANTAGES

- Real-Time Processing
- Comprehensive Engagement Analysis
- Automation and Objectivity
- Actionable Insights for Teachers

DISADVANTAGES

- Overfitting Issues
- Inaccuracy with Occlusion
- Dependence on Lighting and Camera Quality

Automatic Detection of Students' Engagement During Online Learning: A Bagging Ensemble Deep Learning Approach

- PROBLEM STATEMENT

Automatically detecting student engagement during online learning. The challenge is to assess students' involvement, which is crucial for learning effectiveness, especially in remote settings where direct teacher-student interaction is limited. The goal is to classify students' engagement levels as very low, low, high, or very high based on their facial features during online learning sessions.

- TECHNOLOGY USED

- 1D Convolutional Neural Networks (1D CNN).
- 1D Residual Networks (1D ResNet)
- OpenFace Library
- Averaging Soft Voting.

Automatic Detection of Students' Engagement During Online Learning: A Bagging Ensemble Deep Learning Approach

- ADVANTAGES

- High Accuracy through Ensemble Learning
- Comprehensive Feature Extraction
- Application to Real-world Problems
- Soft Voting for Improved Predictions

- DISADVANTAGES

- Computational Complexity and Time
- Limited Generalization to Diverse Data
- Facial Feature Dependence
- Potential Ethical Concerns

Privacy-Preserving On-Screen Activity Tracking and Classification in E-Learning Using Federated Learning

- PROBLEM STATEMENT

The paper addresses the issue of students getting distracted by entertainment while using digital devices for online learning. The proposed solution uses federated learning to classify student activities (educational or entertainment) without sending data to a central server, ensuring privacy.

- TECHNOLOGY USED

- Federated Learning
- Deep Learning Models
- Transfer Learning

Privacy-Preserving On-Screen Activity Tracking and Classification in E-Learning Using Federated Learning

- ADVANTAGES

- High Accuracy
- Privacy-Preserving
- Data Homogeneity
- User-Friendly

- DISADVANTAGES

- Complex Implementation
- Limited to Certain Devices
- Potential for False Alerts

Student Recognition and Activity Monitoring in E-Classes Using Deep Learning in Higher Education

- PROBLEM STATEMENT

This study aims to develop a deep learning-based approach to continuously track and monitor student behavior, mood, and engagement during online classes. The system proposed uses convolution neural networks (CNN) to identify students and monitor their activities, including facial expressions and emotional states like happiness, sadness, fear, and surprise. The goal is to enhance student engagement and improve learning outcomes in e-class settings by providing educators with insights to offer individualized support.

- TECHNOLOGY USED:

- Convolutional Neural Networks (CNNs)
- OpenCV (Computer Vision Library)
- Dropout Regularization and Batch Normalization

Student Recognition and Activity Monitoring in E-Classes Using Deep Learning in Higher Education

- ADVANTAGES

- Real-Time Monitoring
- Improved Student Engagement
- Automation of Attendance and Monitoring
- Scalability

- DISADVANTAGES

- Privacy Concerns
- Computational Requirements
- Limited Dataset Generalization

Decoding Student Emotions: An Advanced CNN Approach for Behavior Analysis Application Using Uniform Local Binary Pattern

- PROBLEM STATEMENT

The problem is that traditional methods of tracking student engagement are slow and inaccurate. The solution is a computer vision system that uses CNNs and uLBP feature extraction to automatically recognize student emotions in real-time, helping teachers adjust their teaching methods on the spot.

- TECHNOLOGY USED

Convolutional Neural Networks (CNNs), Uniform Local Binary Pattern (uLBP), Data Augmentation

Decoding Student Emotions: An Advanced CNN Approach for Behavior Analysis Application Using Uniform Local Binary Pattern

- ADVANTAGES

1. Real-time Feedback 2. More Accurate 3. Better Engagement

- DISADVANTAGES

1. Privacy Issues 2. Expensive 3. Limited Understanding

Consolidated Table

PAPER	PROBLEM STATEMENT	TECHNOLOGY USED	ADVANTAGES	DISADVANTAGES
Multimodal Engagement Recognition From Image Traits Using Deep Learning Techniques	Presents a system for automatically recognizing student engagement in online learning environments using deep learning model.	Haar Cascade Algorithm, Dlib's Shape Predictor, Eye Aspect Ratio (EAR), Engagement Indicator (EI)	Real-Time Processing Comprehensive Engagement Analysis	Overfitting Issues Inaccuracy with Occlusion.
Automatic Detection of Students' Engagement During Online Learning	Automatically detecting student engagement during online learning	1D CNN, 1D ResNet, Singular Value Decomposition (SVD)	High Accuracy, Comprehensive Feature Extraction.	Facial Feature Dependence: Potential Ethical Concerns.
Privacy-Preserving On-Screen Activity Tracking and Classification in E-Learning Using Federated Learning	Classify student activities without sending data to a central server, ensuring privacy.	Federated Learning, Transfer Learning	High Accuracy Privacy-Preserving	Complex Implementation Limited to Certain Devices.
Student Recognition and Activity Monitoring in E-Classes Using Deep Learning in Higher Education	Track and monitor student behavior, mood, and engagement during online classes	CNNs, OpenCV	Real-Time Monitoring Improved Student Engagement	Privacy Concerns Computational Requirements.
Decoding Student Emotions: An Advanced CNN Approach for Behavior Analysis	To use modern techniques for feature extraction to automatically recognize student emotions in real-time	CNNs, uLBP	Real-time Feedback, More Accurate, Better Engagement	Privacy Issues, Expensive

- NON-FUNCTIONAL REQUIREMENT

- **Performance:** Ensure that real-time detection works with minimal lag.
- **Security and Privacy:** Handle video data securely, complying with data privacy regulations
- **Scalability:** The system should be able to handle multiple students at the same time.
- **Usability:** The UI should be easy for both students and teachers to use.

- FUNCTIONAL REQUIREMENT

- **Webcam Activation and Video Capture :** The system shall activate the student's webcam at the start of an e-learning session.
- **Real-Time Engagement Detection :** Analyze video frames to detect the student's level of engagement.
- **Real-Time Feedback Display:** The system shall display real-time engagement feedback.
- **Report generation:** Provide the overall report to the teacher and student.

The proposed system consist of two application one for the student and other for the teacher

- Student App

- Students can login using their user-id and password in the student app and view the links to the online classes upload by the teacher.
- The app will start monitoring the student from the beginning of the online class.
- The application will make prediction every one second and average of this prediction is taken in 60 seconds and the engagement state for that time will be recorded.
- Engagement score are generated considering the head pose, facial expression, eye status Each facial feature have EI score according to its importance in detection the engagement

Faculty Application

- Link to the online class,date,time and details of the class can be updated by the teacher in the application.
- The faculty can view the report after when the online class is over.
- Live report of the students presence in front of the camera will be reported to the faculty.

- Technical Feasibility:

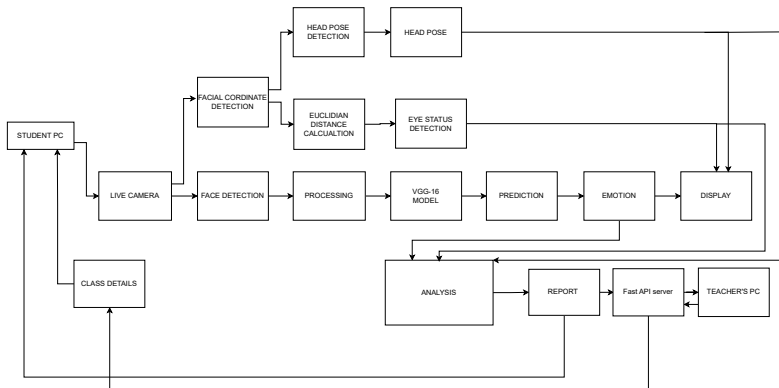
- As the current laptops, mobiles and pc are pre equipped with web cams also webcams are now available at low price systems without cameras are very less
- The proposed program requires only less amount of storage to run hence less hardisk space will be utilized to store the program

- Operational Feasibility:

The system is user-friendly, can be maintained, integrated with existing systems, and has sufficient support mechanisms.

- Architecture diagram
- Use case diagram
- Data flow diagram

ARCHITECTURE DIAGRAM



USE CASE DIAGRAM

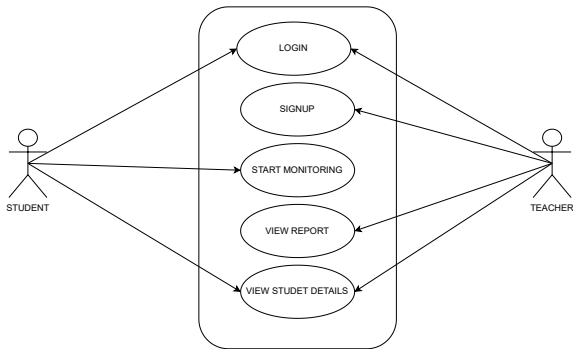
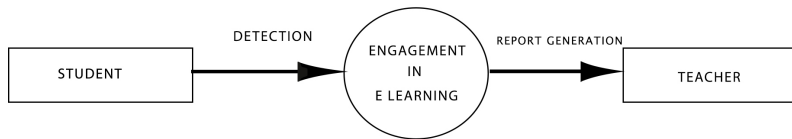


Figure: Use case diagram

DATA FLOW DIAGRAM



DATA FLOW DIAGRAM

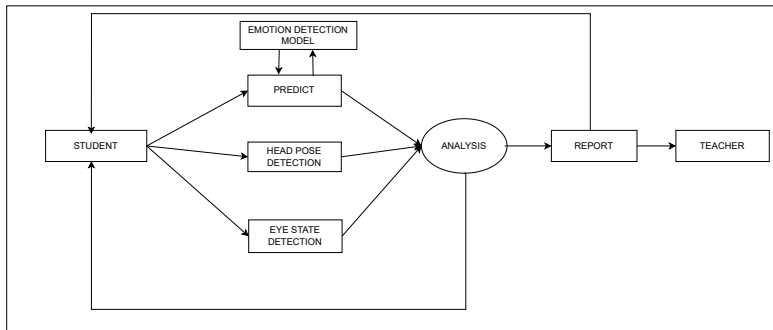


Figure: Level 1

DATA FLOW DIAGRAM

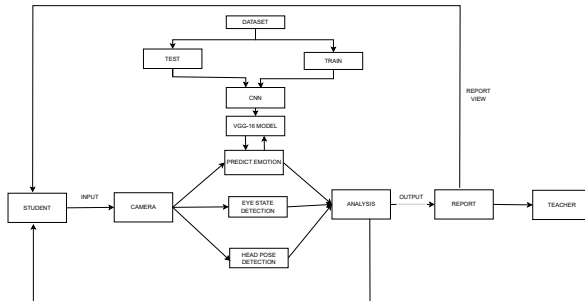
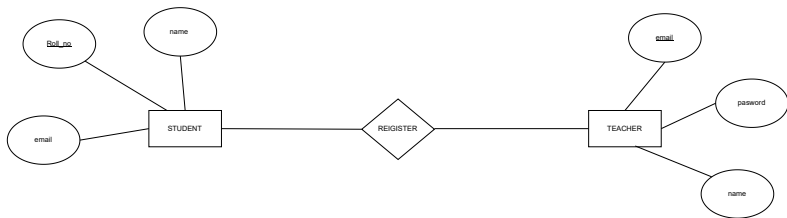


Figure: Level 2

ER DIAGRAM



IMPLEMENTATION

- Eye status detection
- Emotion detection
- Head Pose detection

IMPLEMENTATION

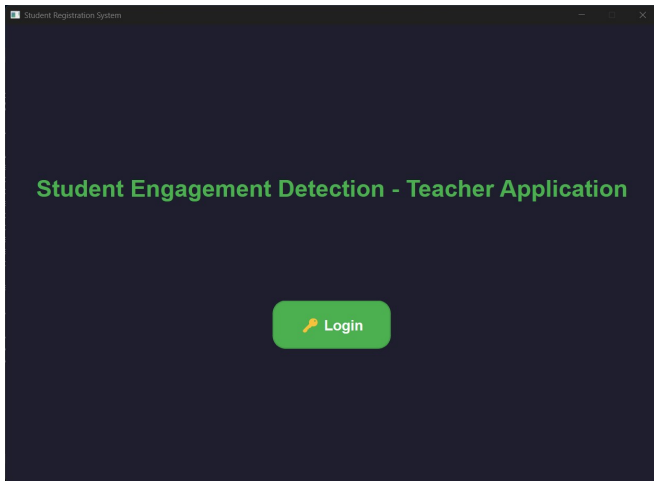
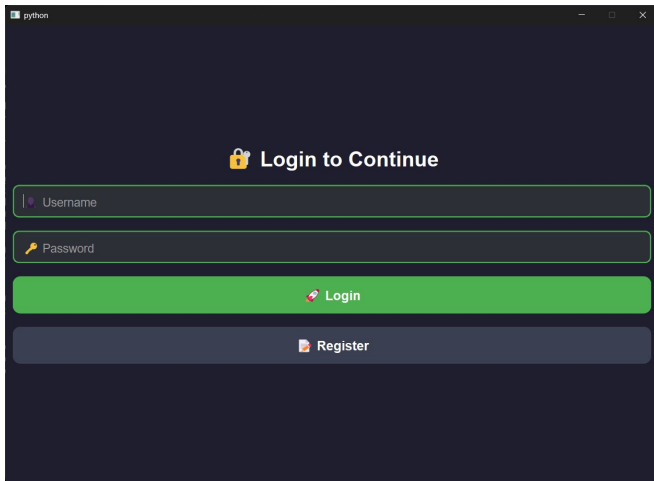


Figure: Login Page

IMPLEMENTATION



A screenshot of a web application window titled "python". The page has a dark blue background and features a login form. At the top center, there is a yellow padlock icon followed by the text "Login to Continue". Below this, there are two input fields: the first is labeled "Username" with a purple user icon, and the second is labeled "Password" with a yellow key icon. Under the password field, there are two buttons: a green "Login" button with a red rocket icon, and a grey "Register" button with a document icon.

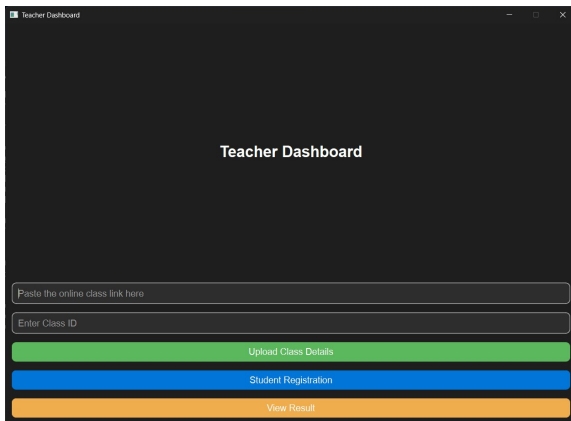
Figure: Login Page

IMPLEMENTATION

The image shows a Python application window titled 'python' with a dark theme. A 'Teacher Registration' dialog box is open, featuring four input fields: 'Name' (with a person icon and placeholder 'Full Name'), 'Email' (with an envelope icon and placeholder 'Email Address'), 'Password' (with a key icon and placeholder 'Password'), and 'Institute' (with a building icon and placeholder 'Institute Name'). Below these fields is a prominent green 'Register' button with a red rocket icon. To the left of the dialog, a sidebar contains labels for 'Username' and 'Password' next to their respective input fields, and a green button below them. The background of the application window is dark blue.

Figure: Teacher Registration

IMPLEMENTATION



The screenshot shows a web application window titled "Teacher Dashboard". The main heading "Teacher Dashboard" is centered. Below it are two input fields: "Paste the online class link here" and "Enter Class ID". At the bottom, there are three large, colored buttons: a green button labeled "Upload Class Details", a blue button labeled "Student Registration", and an orange button labeled "View Result".

Figure: Teacher Dashboard

IMPLEMENTATION

The screenshot displays a web application interface with a dark theme. A modal window titled "Student Registration" is centered on the screen. The modal contains three input fields: "Name" with a placeholder "Full Name", "Roll No." with a placeholder "Roll Number", and "Email" with a placeholder "Email Address". Below these fields is a green button labeled "Register" with a small red icon. In the background, a sidebar is visible with three buttons: "Upload Class Details" (green), "Student Registration" (blue), and "View Result" (orange). Above the sidebar, there are two input fields labeled "Paste the online class link" and "Enter Class ID".

Figure: Student Registration

IMPLEMENTATION

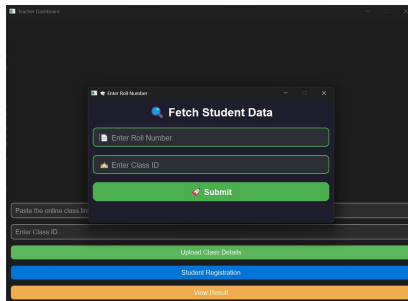
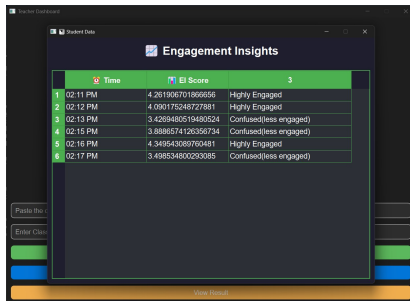


Figure: Fetching Student Data

IMPLEMENTATION



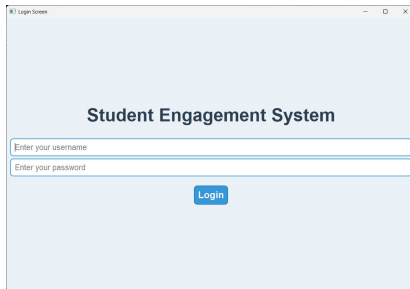
The screenshot shows a 'Teacher Dashboard' window with a 'Student Data' tab selected. The 'Engagement Insights' window is open, displaying a table with student engagement data. The table has three columns: 'Time', 'EI Score', and a status label. The data is as follows:

	Time	EI Score	Status
1	02:11 PM	4.261906701866656	Highly Engaged
2	02:12 PM	4.090175246727881	Highly Engaged
3	02:13 PM	3.4269480519480524	Confused(less engaged)
4	02:15 PM	3.8886574126356734	Confused(less engaged)
5	02:16 PM	4.349543089760481	Highly Engaged
6	02:17 PM	3.498534800293085	Confused(less engaged)

Below the table, there are buttons for 'Paste the c...', 'Enter Class...', and a 'View Result' button at the bottom.

Figure: Engagement Insights

IMPLEMENTATION



A screenshot of a web browser window titled "Login Screen". The page has a light blue background. In the center, the text "Student Engagement System" is displayed in a bold, dark blue font. Below this text are two input fields: the first is labeled "Enter your username" and the second is labeled "Enter your password". Both fields have a light blue border. Below the password field is a blue button with the word "Login" in white text. The browser window has standard window controls (minimize, maximize, close) in the top right corner.

Figure: Student Login

IMPLEMENTATION

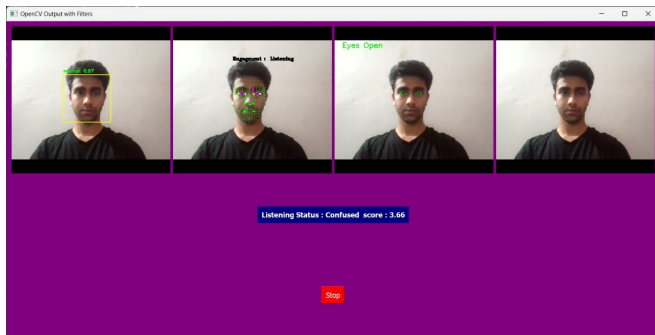







Figure: Displaying the score

CONCLUSION

- Student engagement detection involves two AI model to detect the student engagement levels and a facial recognition system to detect the presence of the registered student
- It is very much useful system in today's world as many educational institutions conduct their class online
- Teachers duty to check whether the students is listening to class can be done automatically by AI models.It helps in improve the quality of the online class
- The presence to AI model to detect two different aspects of the learning will provide more precise information towards the students attention in the class
- Send the report of each student to the server for the teacher to view and analyse the report and give attendance to the student according to their participation in the online class

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PAPER PUBLICATION STATUS



RAET CSE

to me ▾

Thu 27 Feb, 13:53



Dear Vivek Rajeev,

Thank you for your submission to the National Conference on Recent Advancements in Engineering and Technology (RAET'25) at St. Thomas College of Engineering and Technology, Mattanur, Kannur, Kerala.

After a thorough review by our technical committee, we are pleased to inform you that your paper titled "Student Engagement Detection in E-Learning" has been accepted for presentation at RAET'25. Congratulations!

Your registration has been completed.

For any further queries, please feel free to contact us at [\[raetcse@stthomaskannur.ac.in\]](mailto:raetcse@stthomaskannur.ac.in).

We appreciate your interest in RAET'25 and thank you for your contribution.

Best regards,
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On Mon, Feb 24, 2025 at 10:01 AM Vivek Rajeev V <yivekrajeev2002@gmail.com> wrote: