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AI BASED STUDENT ENGAGEMENT DETECTION IN ONLINE LEARNING

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OUTLINE

AREA OF SELECTION

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

SCOPE

- 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.

LITERATURE SURVEY

- 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," "Boredem"or"Sleepy".

TECHNOLOGY USED

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

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.

- 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

- ADVANTAGES
  - High Accuracy
  - Privacy-Preserving
  - Data Homogeneity
  - User-Friendly
- DISADVANTAGES
  - Complex Implementation
  - Limited to Certain Devices
  - Potential for False Alerts

- 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

- 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

- 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

REQUIREMENT SPECIFICATION

- 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.

PROPOSED SYSTEM AND DESIGN

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.

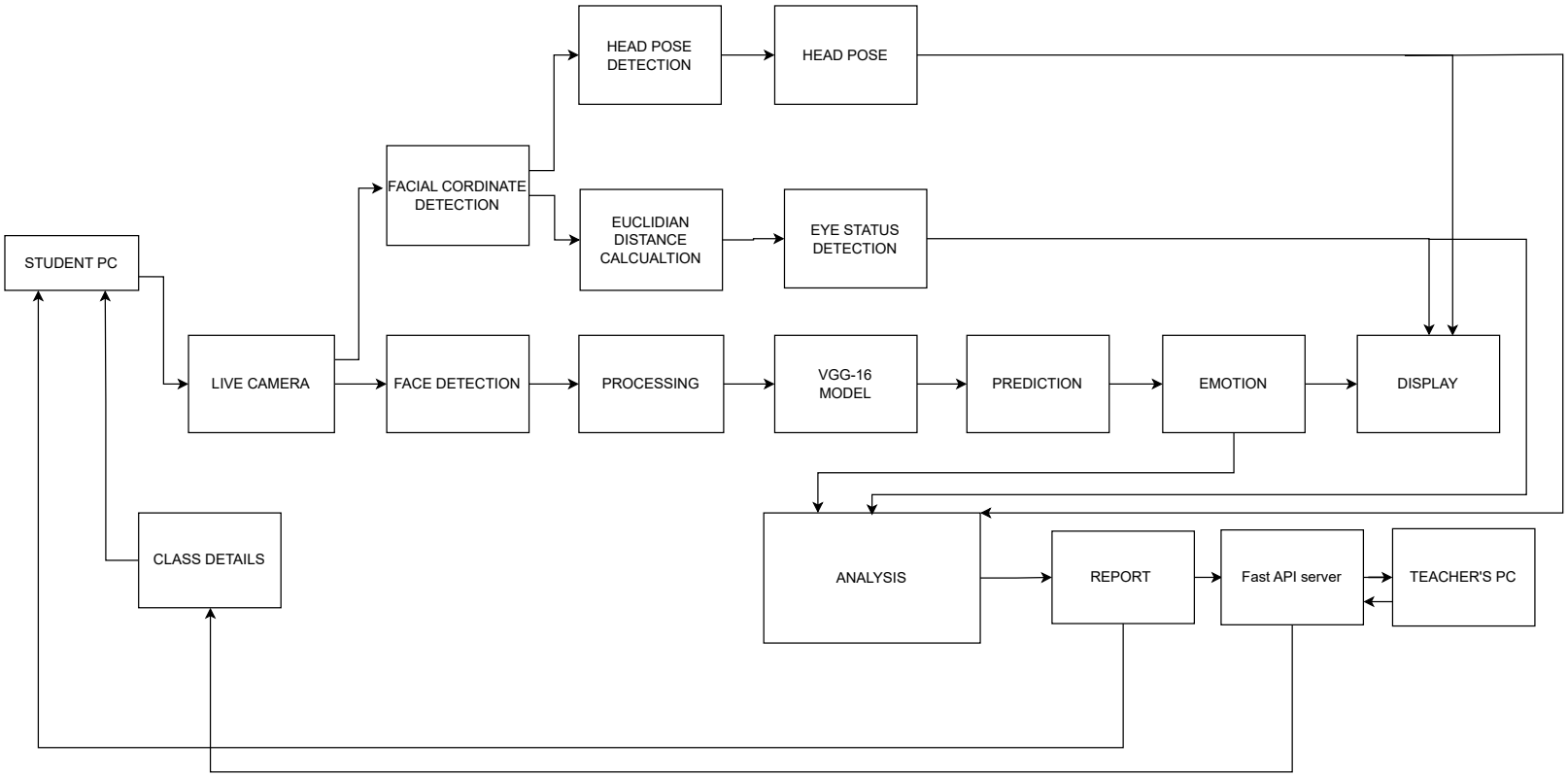
FEASIBILITY STUDY

- Technical Feasibility:
  - As the current laptops,mobiles and pc are pre equiped 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.

DESIGN

- Architecture diagram
- Use case diagram
- Data flow diagram

ARCHITECTURE DIAGRAM



USE CASE DIAGRAM

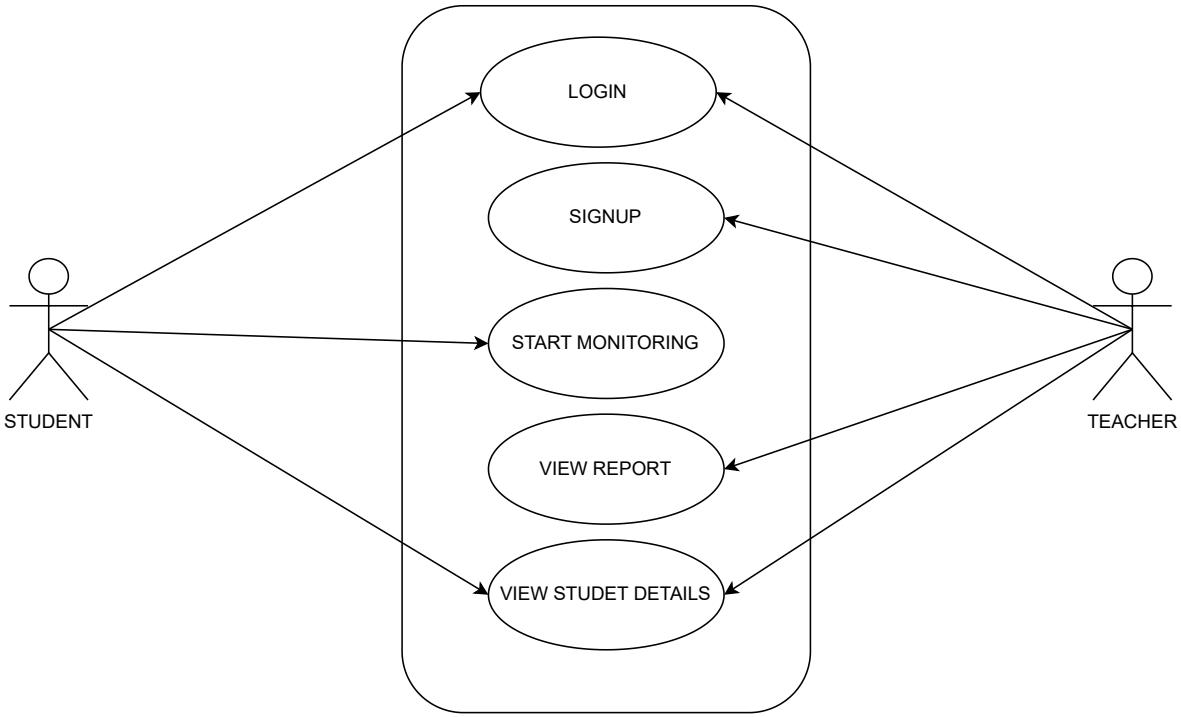
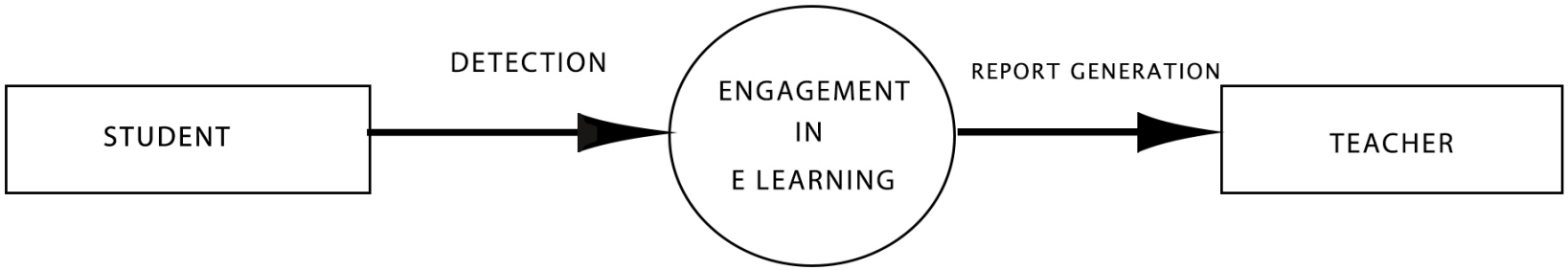


Figure: Use case diagram

DATA FLOW DIAGRAM



DATA FLOW DIAGRAM

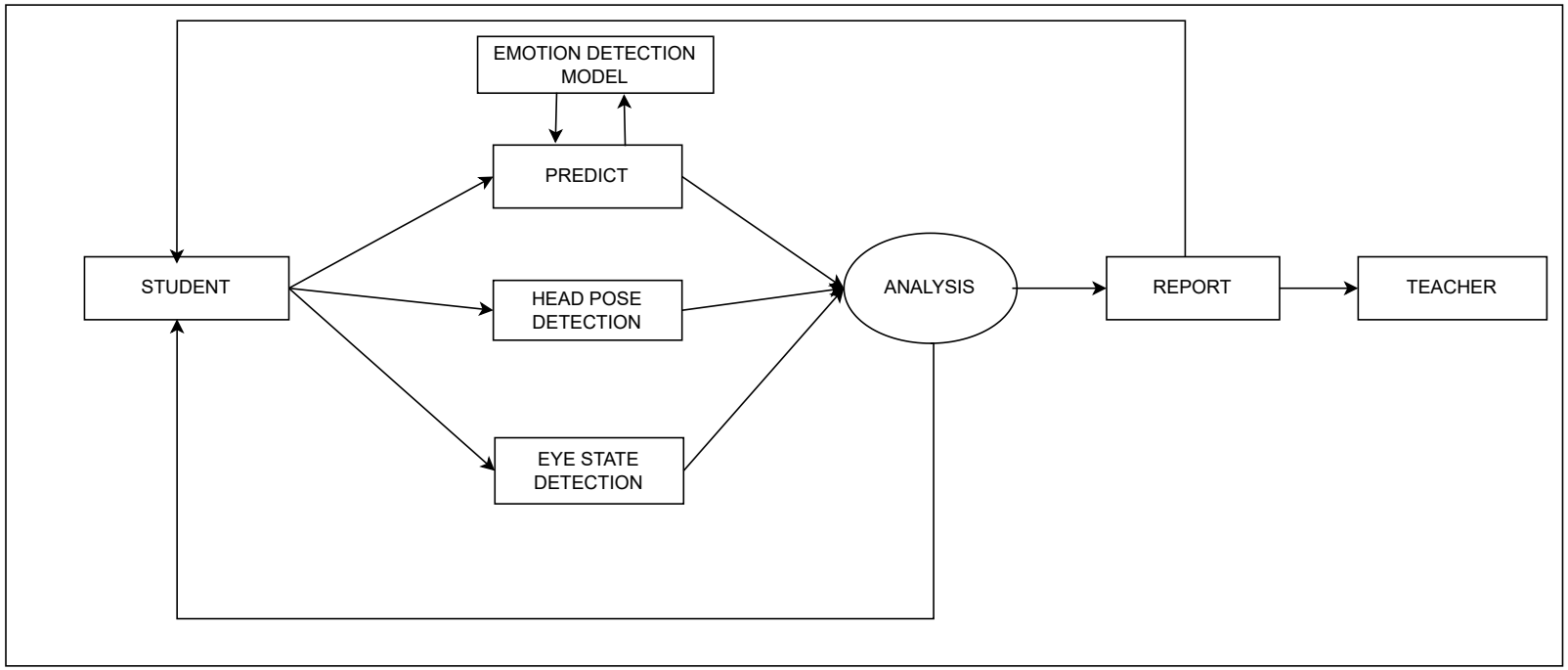


Figure: Level 1

DATA FLOW DIAGRAM

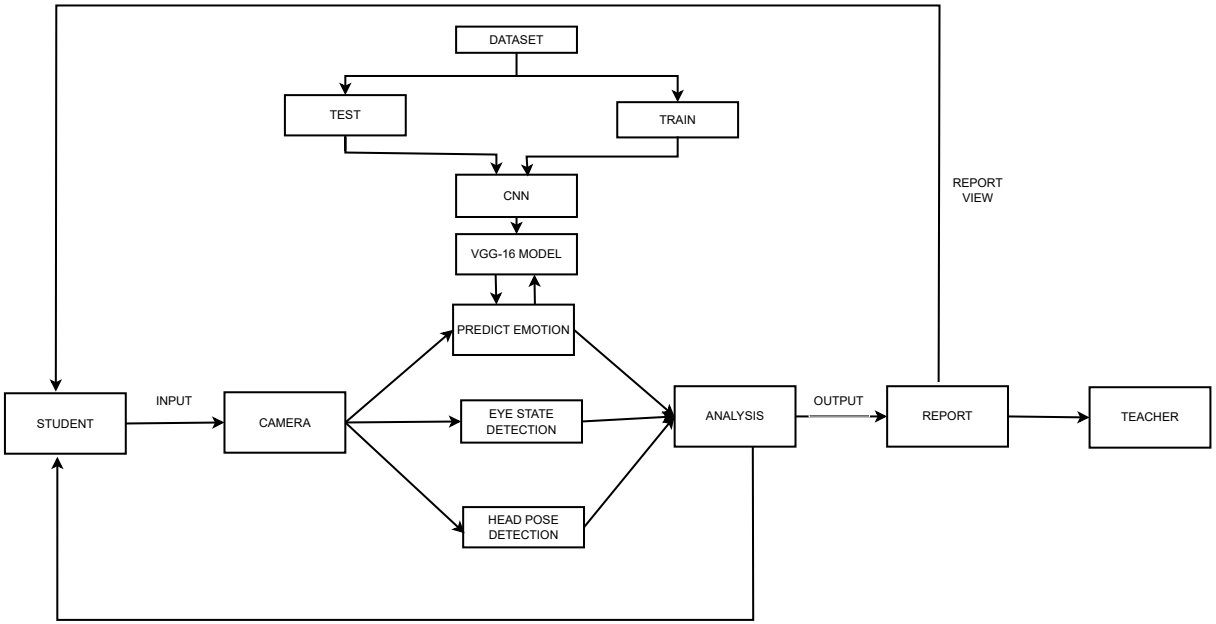
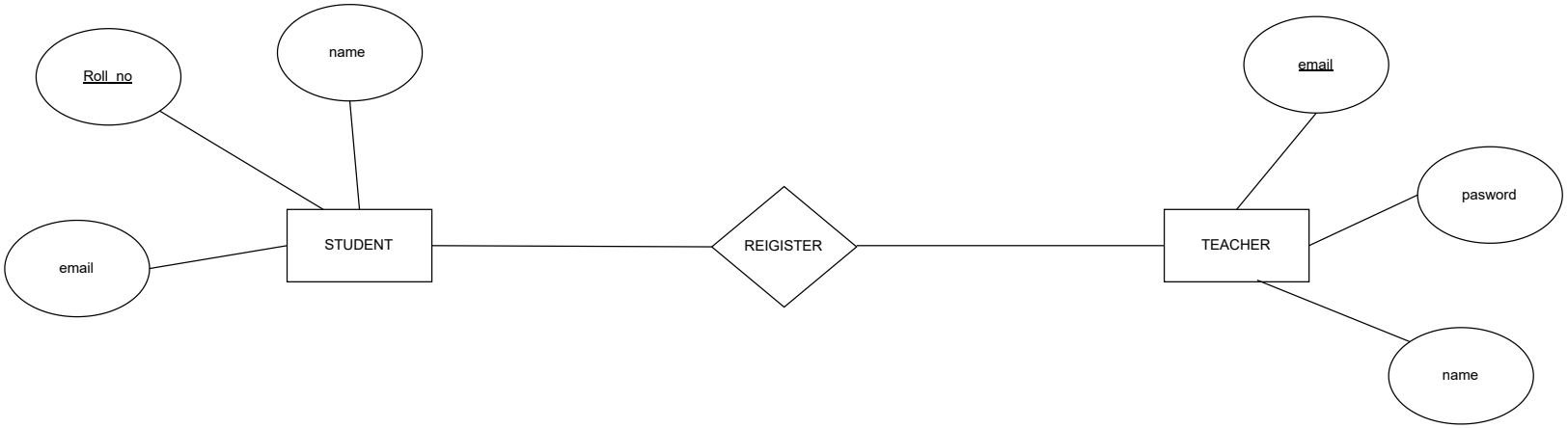


Figure: Level 2

ER DIAGRAM


Roll_no
name
email
STUDENT
REIGISTER
TEACHER
email
pasword
name

IMPLEMENTATION

- Eye status detection
- Emotion detection
- Head Pose detection

IMPLEMENTATION

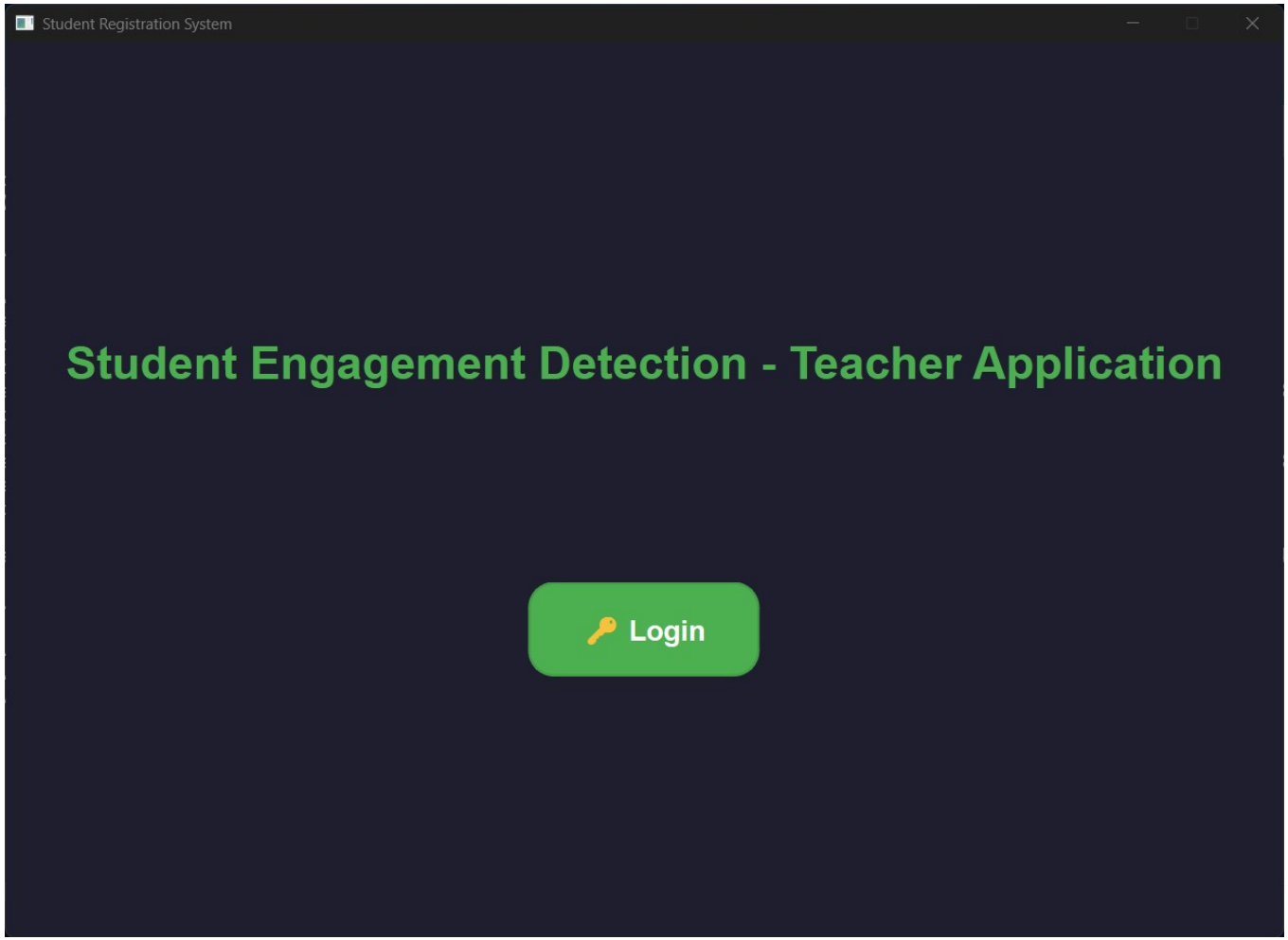


Figure: Login Page

IMPLEMENTATION

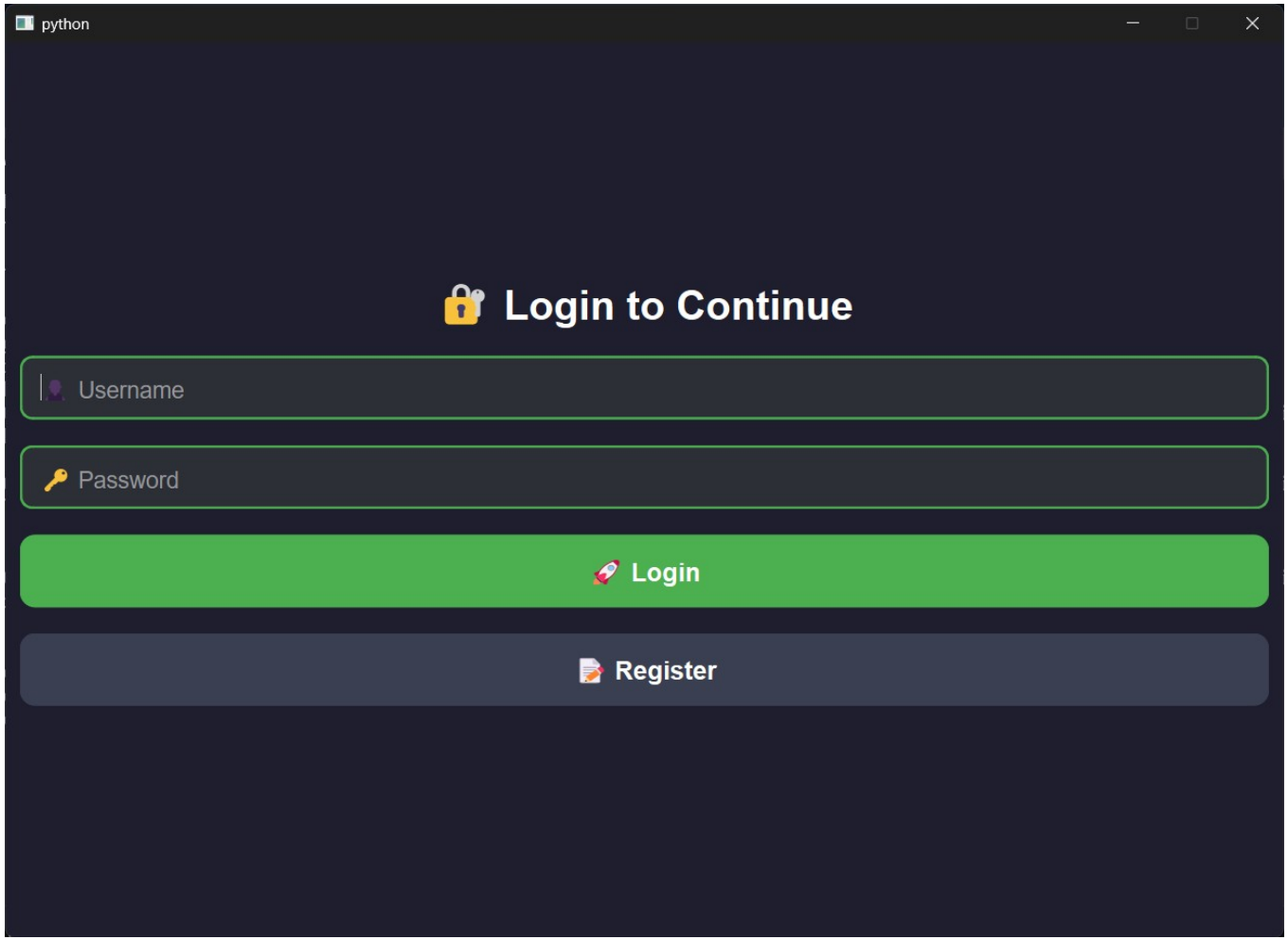


Figure: Login Page

IMPLEMENTATION

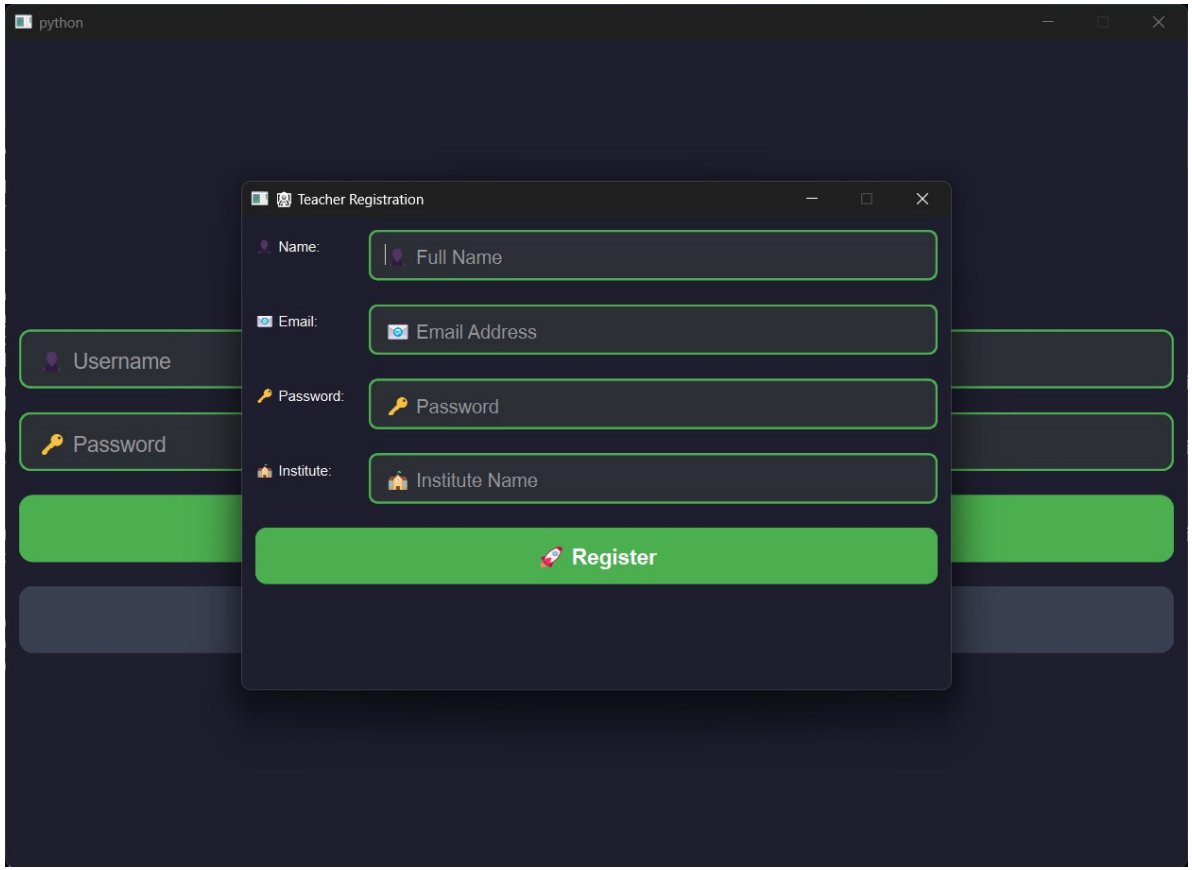


Figure: Teacher Registration

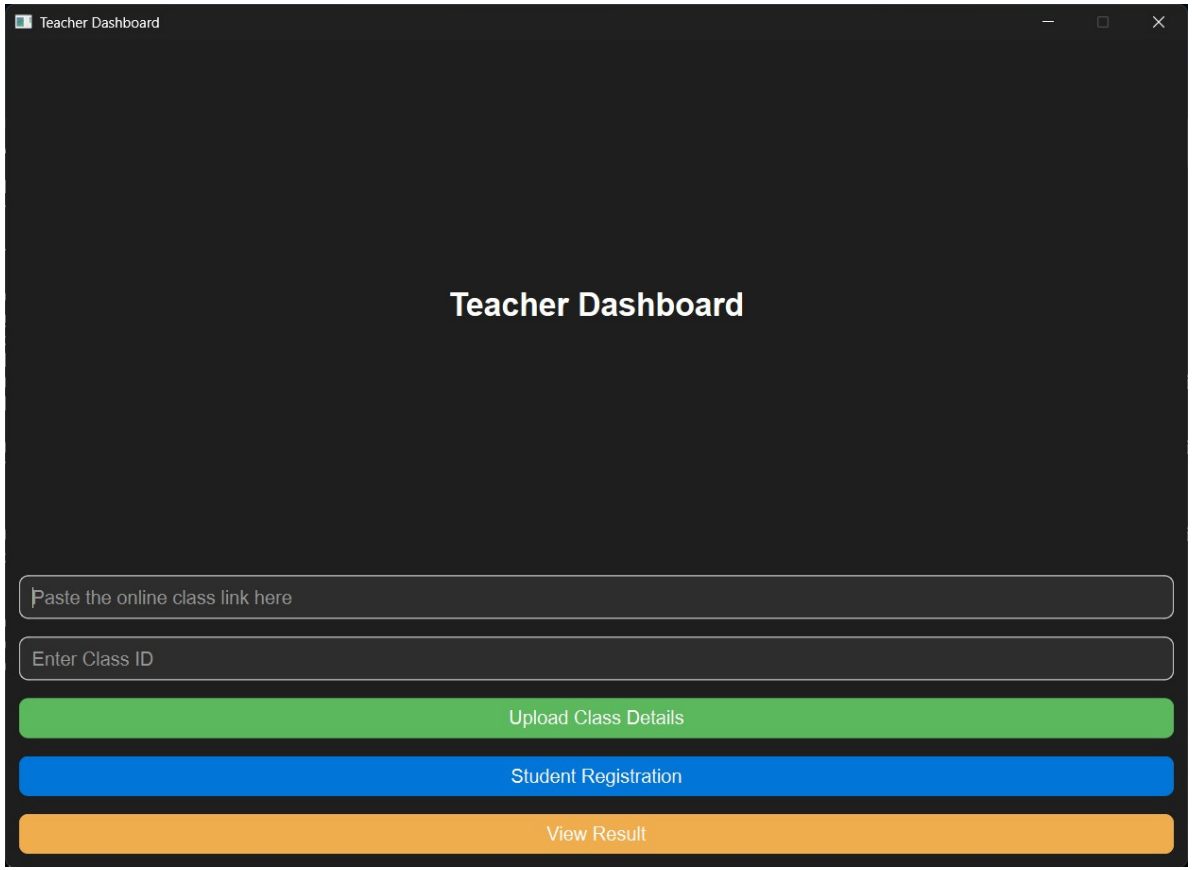


Figure: Teacher Dashboard

IMPLEMENTATION

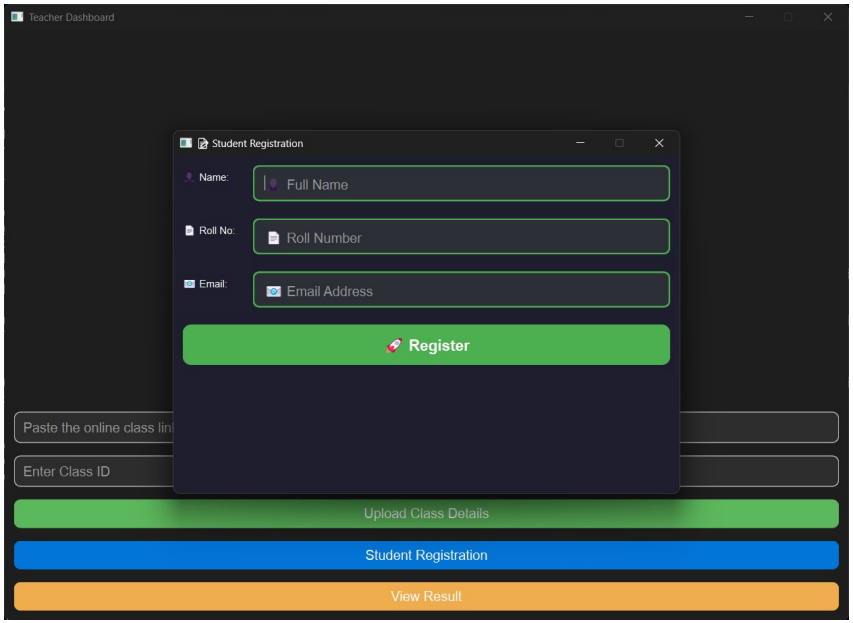


Figure: Student Registration

IMPLEMENTATION

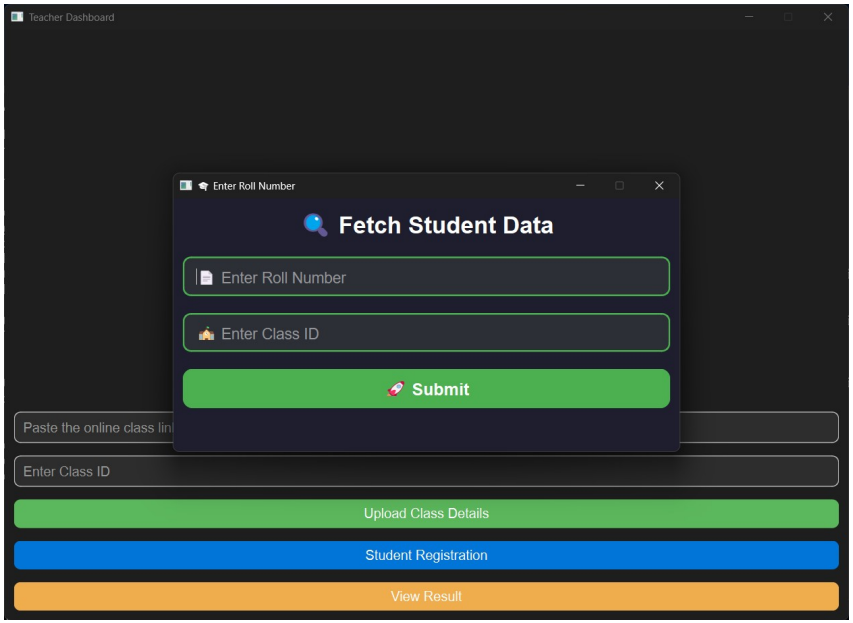


Figure: Fetching Student Data

IMPLEMENTATION

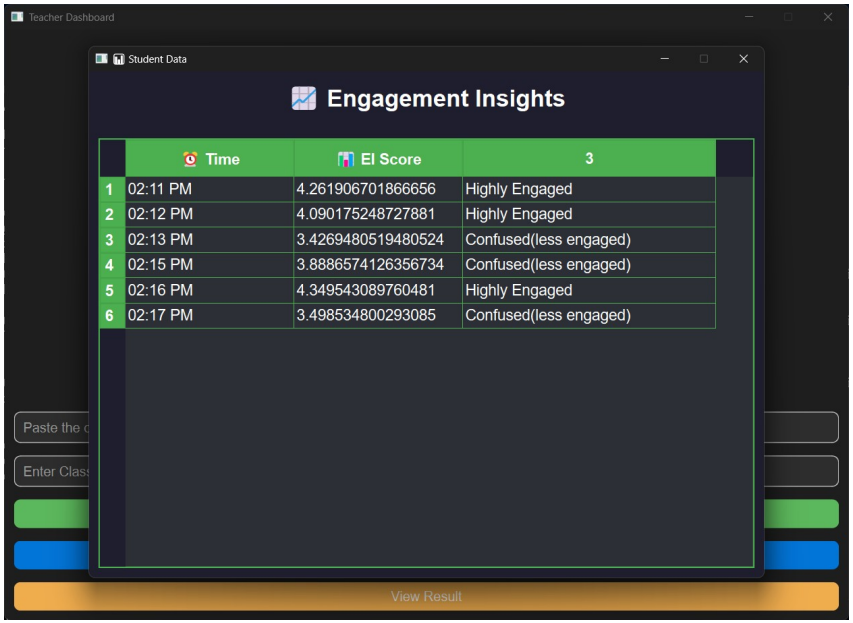


Figure: Engagement Insights

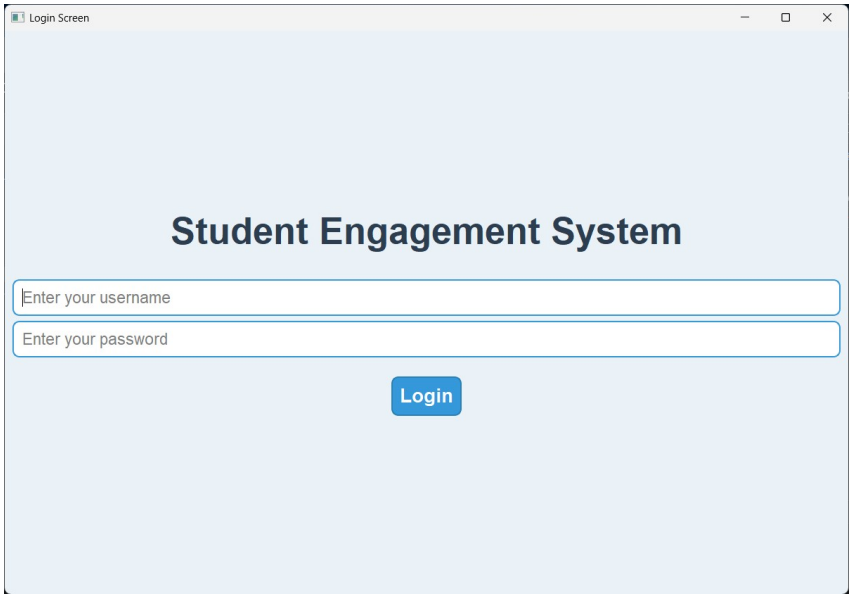


Figure: Student Login

IMPLEMENTATION

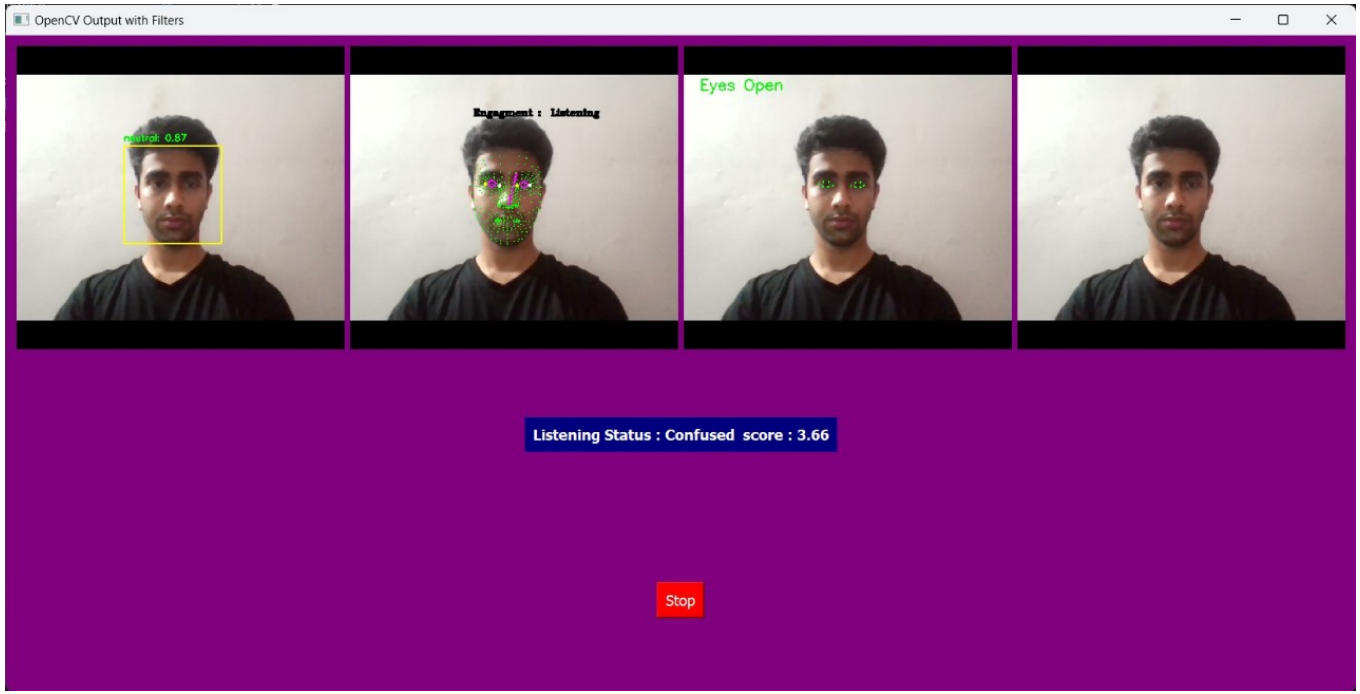


Figure: Dispalying the score

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

REFERENCES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A. Sukumaran and A. Manoharan, "Multimodal engagement recognition from image traits using deep learning techniques," *IEEE Access*, 2024.

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].

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 <vivekrajeev2002@gmail.com> wrote: