Student Engagement Project Report

# 1. Introduction

The goal of the Student Engagement Project is to develop a system that can assess the engagement of students during online lectures or sessions by analyzing their facial expressions. By utilizing computer vision and machine learning techniques, the system processes videos and detects facial cues to classify students as either 'engaged' or 'not engaged' during the lecture.

# 2. Problem Statement

In online education, it is challenging for instructors to assess student engagement through traditional means. This project aims to bridge that gap by developing a solution that can automatically assess engagement levels in real-time, allowing instructors to adapt their teaching methods.

# 3. Objectives

The main objectives of the project are as follows:  
- Develop a system to automatically detect student engagement from video data.  
- Use computer vision techniques for facial expression analysis.  
- Implement a classification model to categorize engagement as 'engaged' or 'not engaged'.  
- Provide real-time feedback to instructors about student engagement.

# 4. Technologies Used

The following technologies and libraries were used in the development of the Student Engagement System:  
- Python Programming Language  
- OpenCV for video processing and facial detection  
- TensorFlow for machine learning and model development  
- Flask for the web application to handle video uploads and interactions  
- Keras for creating and training the neural network model  
- EfficientNet for leveraging pre-trained models for image classification

# 5. System Architecture

The system architecture consists of the following components:  
- **Video Upload**: Users upload video files containing student interactions.  
- **Video Processing**: The uploaded video is processed to extract frames for analysis.  
- **Face and Engagement Detection**: Facial expressions in the frames are analyzed using machine learning models.  
- **Engagement Classification**: The system classifies each frame as either 'engaged' or 'not engaged'.  
- **Results Feedback**: The results are returned to the user (instructor) for further action.

# 6. Methodology

The project methodology involves the following steps:  
- **Data Collection**: A dataset of student faces with labeled engagement levels is collected.  
**- Model Training**: A Convolutional Neural Network (CNN) is trained on this dataset to classify student engagement.  
- **Video Processing**: The system extracts frames from uploaded videos using OpenCV and analyzes them using the trained model.  
- **Engagement Classification**: The output of the model is a binary classification of engagement.

# 7. Code Implementation

The core of the project involves the implementation of a deep learning model for engagement classification, and a Flask web app to handle video uploads and processing. Below is a brief overview of the key code components:  
  
**Model Creation**: An EfficientNetB0-based CNN model is created using Keras and trained on labeled images for engagement classification.  
**Video Processing**: Using OpenCV, videos are split into frames, which are then fed into the model for engagement analysis.

The frontend of the "Student Engagement" project is developed using React, providing a user-friendly interface for video uploads and engagement analysis. Users can easily upload videos through a simple drag-and-drop feature, and real-time progress indicators show the status of video processing. Once the backend processes the video, the engagement results are displayed clearly, indicating whether the user is "Engaged" or "Not Engaged" during the video. The responsive design ensures a seamless experience across devices, while interactive components guide users through the process, making the app intuitive and accessible.

# 8. Results

The system successfully detects student engagement levels from video inputs. The model achieved high accuracy in classifying engagement, with the results displayed in a confusion matrix and classification report. These metrics indicate that the system can provide valuable insights to instructors for adapting their teaching methods based on engagement.

# 9. Conclusion

This project demonstrates the potential of using facial expression recognition and machine learning for evaluating student engagement in online learning environments. The system can assist educators in understanding and improving the engagement levels of students, ultimately enhancing the learning experience.