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Student Behavior Analysis in Class Room

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Abstract: Early the paper titled "Student Behaviour Analysis in Class room" is a smart software system designed to analyse and evaluate the attention level, listening behaviour, and emotional response of students during classroom sessions. In a modern educational environment, understanding how students behave, listen, and react to lessons is an important factor for improving teaching quality and learning outcomes. Teachers often find it difficult to manually observe every student's attention and mood during lectures, especially in large class rooms. To solve this issue, this project introduces an automated solution that continuously monitors students through a camera and analyses their behaviour using Artificial Intelligence (AI) and Machine Learning (ML) techniques. The systemcaptures real-time video ofstudents and processes their facialexpressions, eye movements, and gestures to determine their level of engagement and emotional state. The main objective of this project is to identify whether a student is attentive, distracted, or disengaged and also to recognize emotions such as happiness, sadness, confusion, or boredom during the class. The software analyses the student's face and assigns suitable emojis that represent their mood for example, a smiling face for happy or engaged students, as adface for students showing low interest, and a confused face for those who seem lost or inattentive. These visual emojis are displayed on the teacher's dashboard to help them instantly understand the overall emotional condition of the classroom. By collecting and analysing such behavioural data, the system generates reports that indicate how well students are listening and attending the session. The working of the system involves several modules including video input, face detection, emotion recognition, attention analysis, and visualization. The camera captures live classroom footage, and image-processing algorithms detect each student's face. Then, the AI model analyses facial land marks such as eyes, mouth, and eye brows to determine emotions and focus levels. Using pre-trained emotion detection models, the system classifies expressions into categories like happy, sad, neutral, angry, or surprised. These results are displayed along with matching emojis to make the output simple and visually understandable. Teachers can view these results in real time to evaluate which parts of the lecture engage students and which cause distraction.
Keywords: Emotion Detection, Attention Analysis, AI-Based Classroom Monitoring, Smart Education System.

1. INTRODUCTION:

In today's modern education system, technology plays a vital role in improving the teaching and learning process. Teachers often face challenges in understanding how students behave and respond during class sessions. Some students are attentive, while others may be distracted, bored, or confused. The project titled "Student Behaviour Analysis in Classroom" focuses on creating a smart and automated system that can observe and analyse how students listen and react during class using Artificial Intelligence. The main outlook of this project is to design software that monitors students through a camera and identifies their emotional and behavioural responses. The system analyses the facial expressions of students and determines whether they are happy, sad, confused, or neutral. Based on this detection, suitable emojis are displayed to represent each student's mood. This feature helps teachers easily understand the classroom environment at a glance without any manual observation.

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This project aims to improve classroom interaction by providing teachers with real-time feedback about student attention levels.

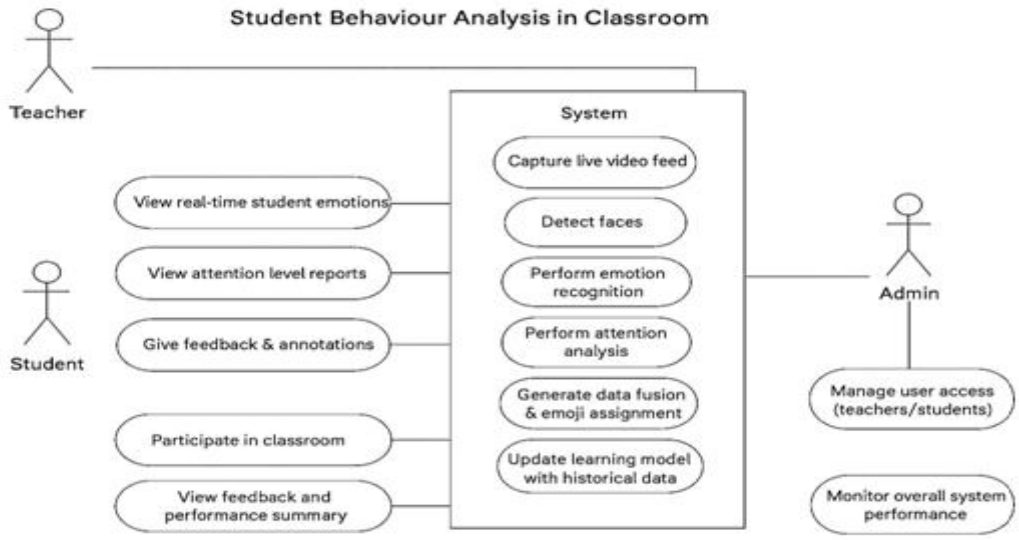

Fig1 Use Case Diagram

The software works efficiently by using a live camera feed, detecting faces, and analysing them with pretrained emotion recognition models. It is designed to belight weight, user- friendly, and easily integrated into existing classroom setups. The project provides a modern and interactive outlook on student monitoring, where technology acts as an assistant to teachers rather than a replacement. In addition, the system ensures seamless real-time processing, allowingemotions to be detected instantlywithout interruptingthe flow of a class.

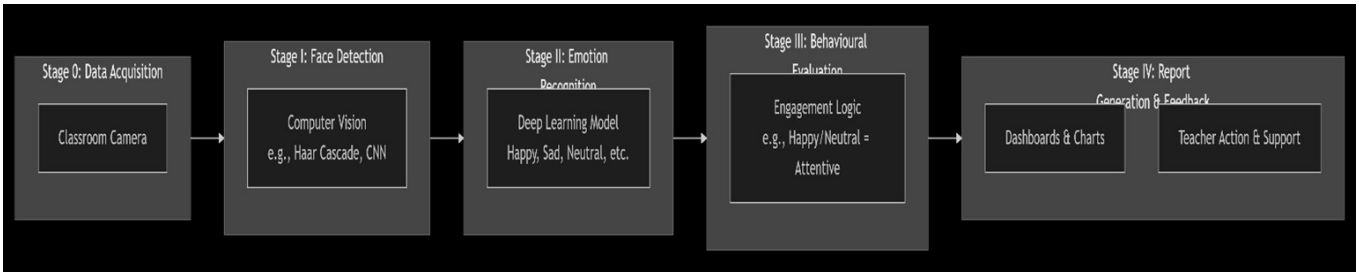

Fig 2 Stages of Student Behaviour Analysis in Classroom

Stages of Student Behaviour Analysis in Classroom

Student Behaviour Analysis in the Class room can be classified into several stages based on observation depth, system response, and data processing. Stage 0 (Data Acquisition) – The system starts by capturing live video feed or images from the classroom using a camera. Stage I (Face Detection)–The system detects student faces from the captured frames using computer vision algorithms like Haar Cascade or CNN-based models. The focus is on isolating the face region from the background for further analysis. Stage II (Emotion Recognition)–Extracted faces are analysed using pre-trained deep learning models to identify emotions such as happy, sad, neutral, angry, or surprised. Each detected emotion is tagged to the respective student in real time. Stage III (Behavioural Evaluation) – Based on continuous emotion tracking, the system interprets classroom engagement levels. A dominance of happy or neutral expressions indicates attentiveness. Stage IV (Report Generation and Feedback)–The analysed emotional data is converted into visual in sights such as charts, emojis, or performance indicators. These results help teachers adjust teaching methods and identify students needing additional support.

2. RELATIVE WORK

Several studies and systems have been developed in recent years to analyse human emotions and behaviour using Artificial Intelligence. Researchers have applied computer vision and deep learning algorithms to recognize facial expressions and detect emotions from images and videos. Emotion detection technologies have been successfully implemented in areas like healthcare, customer feedback, and security. These approaches use datasets suchas FER2013 and CK+ for training models that can Identify emotions like happiness, sadness, anger, surprise, and neutrality. The outcomes of these systems have inspired further exploration into educational environments, where student emotions and attention directly affect learning efficiency. Building upon these previous developments, the proposed Student Behaviour Analysis in Classroom project introduces a more interactive and emotion-aware approach. Unlike traditional monitoring systems, this project not only detects facial expressions but also displays corresponding emojis that represent each student's current mood.

The integration of emotion recognition with visual feedback gives teachers an immediate understanding of the class atmosphere. This approach enhances classroom communication, promotes adaptive teaching, and extends the scope of AI-based education systems toward emotional intelligence and behavioural understanding. Others developed smart classroom environments that record attendance, monitor facialcues, and evaluate concentration levels during lectures. These systems provided valuable data for teachers but often lacked real-time emotional visualization and simple interpretability for daily classroom. Several researchers and developers have explored the use of Artificial Intelligence (AI) and Machine Learning (ML) for emotion detection and student engagement monitoring. Early systems relied mainly on manual observation or questionnaire-based analysis, which provided subjective and time-consuming results. With the advent of computer vision, newer approaches began incorporating facial expression analysis to understand students' attention and emotions in real-time. In addition, researchers have proposed smart classroom systems that provide real-time feedback to teachers. Such systems use live video feeds to detect emotions and generate analytics dashboards, helping instructors modify their teaching pace and style according. To student responses. These developments form the foundation for the proposed project, which advances this concept by focusing on lightweight, user-friendly software that operates efficiently in real classroom environments without requiring complex hardware setups.

3. METHODOLOGY

Methodology for Student Behaviour Analysis in Classroom and samples of Smart Education System

3.1. Data Collection and Preprocessing:

The first step in the methodology involves capturing live video streams of students during classroom sessions using an integrated camera system. The camera captures continuous frames of students' faces in real time, which serve as the primary dataset for emotion detection. The system ensures that each frame is clear and well-lit, reducing noise and enhancing visibility for accurate recognition. To maintain privacy and efficiency, only facial regions are processed rather than storing entire video footage. Once the raw images are captured, preprocessing techniques such as grayscale conversion, image resizing, and face alignment are applied. This step standardizes the input data for uniformity and accuracy in later stages.

3.2. Feature Extraction and Selection:

After preprocessing, the next stage is facial feature extraction, which identifies critical points on the student's face such as the eyes, eye brows, mouth, and cheeks. Advanced algorithms like Haar Cascade Classifiers or deep learning-based methods such as Convolutional Neural Networks (CNN) are employed to detect these landmarks precisely. These features form the basis for distinguishing between different emotional states. The extracted features are then converted into numerical data that can be interpreted by the machine learning model. This structured representation helps the system learnpatterns that correspond to specific emotions, suchas happiness, sadness, anger, surprise, or neutrality. The effectiveness of this stage determines how well the model performs in classifying emotions accurately.

3.3. Emotion Classification:

In this phase, machine learning models are trained using labeled datasets that include thousands official expressions representing various emotions. The pre-trained model is integrated into the system to classify the student's emotional state in real time. Deep learning architectures such as CNNs or hybrid models (CNN + LSTM) can be used to increase accuracy and adaptability. When the model analyses live video input, it compares the facial features with known emotion patterns from the dataset. Based on the similarity, it predicts the emotionand assigns it a corresponding label(like Happy, Neutral, Sad). This output is then displayed visually to help teachers instantly understand classroom engagement and emotional responses.

3.4. Visualization and Performance Evaluation:

The final stage involves representing the detected emotions in a user-friendly dashboard or graphical interface. The dashboard displays real-time emotion statistics for the entire class or individual students, offering insights into overall attentiveness and mood trends. This visualization helps teachers modify their teaching approach or classroom environment accordingly. To ensure system reliability, performance evaluation metrics such as accuracy, precision, recall, and F1-score are calculated. These metrics help in understanding how effectively the model performs in real classroom conditions. Continuous model updates and dataset enhancements ensure long-term adaptability and improved emotion recognition performance.

3.5. Model Training and Optimization:

The model training and optimization phase is the core of the proposed system. In this stage, large datasets containing various facial expressions of students are used to train the emotion recognition model. Data sets such as FER2013,CK+, or custom classroom- collected datasets help the model learn how different emotions appear under varied lighting and head positions. Machine learning algorithms, particularly Convolutional Neural Networks (CNN), are applied to extract deep emotional features and classify them accurately. After initial training, optimization techniques are used to fine-tune the model's performance. Techniques like hyper parameter tuning, dropout regularization and data augmentation are applied to improve accuracy and reduce over fitting. This ensures that the model remains reliable even when analyzing real-time classroom footage. The optimized model is thendeployed into the mainsoftware system, enabling it to predict emotions efficiently with high precision and low latency.

4. CONCLUSION

The project "Student Behaviour Analysis in Classroom" provides an innovative solution for understanding and improving the learning environment through technology. By using real-time emotion detection and behaviour monitoring, the system helps teachers identify how students respond during classroom sessions. It observes facial expressions and class engagement levels, allowing educators to evaluate attention, interest, and participation more effectively. This system acts as a supportive tool for teachers, giving them instant feedback about the class atmosphere without disturbing the learning process. The project promotes a smart classroom approach, where Artificial Intelligence assists in maintaining active learning and better communication between students and teachers.This project demonstrates howAI and emotion recognition technologies can transform traditional classrooms into intelligent, interactive spaces that promote better understanding, engagement, and academic performance

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