

EMOTION-DRIVEN PERSONALIZED LEARNING FRAMEWORK FOR ONLINE EDUCATION

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ABSTRACT

The Considerable effect of covid-19 epidemic has led to discontinuous of offline classroom and the teaching methods are changed to virtual learning. To make the online learning atmosphere satisfactory similar to conventional offline learning classroom, it is very important to make sure of active participation of students during the online classes. This Paper put forward a deep learning-based technique by using the facial emotions to catch the real-world participation of the students in the online classroom. All this is done by the interpreting the student's facial expressions to differentiate their emotion in all over the session. In spite the hike in the Previous year admission percentage of the student as compared to previous year are continuously leading to the decrease of student holding ratio. To bring down the detrition and make sure the ongoing progress of the online courses, it is essential to carry on with judging and continuously analysing the latest updated text to realize the switching of the reaction of the students & faculty members participating online during the 21st century and also to inspect how they interlock as an interpreted learning community

KEYWORDS: *Emotion-Aware Learning, Facial Emotion Recognition, Machine Learning, Computer Vision, Real-Time Emotion Detection*

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INTRODUCTION

In Today's generation virtual courses making the ground breaking trend in educational innovation. The rapid growth in virtual courses enrollment becoming uneasy for high dropout rates in virtual courses and sessions. Heyman (2010) Highlights that the becoming unease in virtual learning distinguish from the extremely high turnover in fully virtual programs. Contrast with traditional classes. Virtual courses have a 5% to 15% increased dropout rates than conventional teaching. (Herbert, 2006) Completely 35% to 75% virtual learners attrition of digital learning. (B. Smith, 2010). Evaluation of current research indicates that virtual courses have various motivational, social and technological problem faced from the participant's and the faculty's viewpoints. In academia, the incorporation of AI (artificial intelligence) has revolutionized in which education is provided, retrieved, and tailored. However, Traditional personalized education systems are usually only stemmed on fixed data of results for Personalized content and ignore the nuances of student performance, sentimental and dynamic scenario. This research evolves and unfolds a latest edition customized learning environment that integrate. Artificial intelligence with awareness of the resources which can understand the perceptive. Breaking the mould, this is hybrid learning frameworks that perform in immediate by adjusting the resources and instant

response rate, sentiment analysis. Sentiments and influencer aspects, such as guilt, achievement, irritation, uncertainty are recognized as significant factor in gaining knowledge (Immordino-Yang and Damasio, 2007). Despite the progress in artificial intelligence, Human Computer interface and immersive tech. Virtual learning environment are trying to read emotion and sentiment analysis (Calvo and D'Mello, 2012). The nonexistent implementation of sentiment analysis tool and meaningful response hinder both faculty and students from harvesting the advantage of sentiment aware virtual learning environment. In Overview. The combination of sentiment aware intelligence into the virtual learning environment symbolizes a major move in boosting virtual classroom more engaging, responsive and people focused. By integrating the instant sentiment identification with smart tutoring suggestion, the suggested sentiment aware virtual learning assistant deals with crucial obstacles in digital classrooms and enhance to the evolution of intelligent, adaptive and student centric learning environment. The enhancement of learning platforms has created possibilities for more adaptive and customize learning platform systems. As mentor, university and student target take benefits of this evolution there is a expanding demand for futuristic investigative approach to update selecting and enhance learning experiences. Lecture hall is a venue where learner experience many types of sentiment during tasks such as finishing projects, giving test and building networks. Sentiment such as fun, nosiness, achievement, stress, perplexity, disappointment, dullness, curiosity, desire, irritation and guilt usually appear while studying. Sentiment is a key element in the centration, choosing, productivity of learning and broad attraction. This type of sentiment neutral setup inclines to offer rigid, adjustable engagement which effect in reduced the contentment and uncertainty.

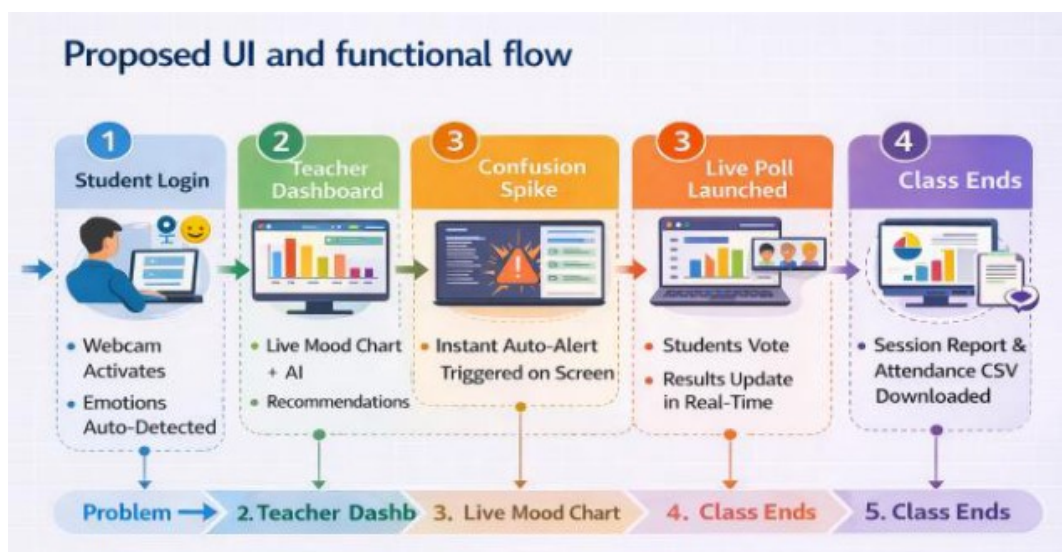


Figure 1: Functional Flow of the Model.

LITERATURE REVIEW

The rapid growth of online learning platforms has encouraged researchers to explore intelligent systems that can enhance learner engagement and improve instructional effectiveness. While virtual classrooms provide flexibility and accessibility, several studies highlight the absence of emotional awareness as a major limitation of online education. This has led to increasing research interest in emotion recognition, affective computing, and adaptive learning systems [5]. In recent literature, there has been more focus on the application of machine learning and deep learning to the construction of personalized learning trails. Deep learning-based model that adjusts to user behaviour patterns has been introduced by Zhang and Dang (2022) and AI driven the recommendation engine which dynamically recommends the content has been presented by Luo and Lin (2022). But infrequently are these systems accompanied with a built-in system that tracks

emotion in the moment or that it will even be ethically used for good [11]. The Educational Technology Enhanced Learning (ETEL) discipline as exemplified by Song & Wang (2025) that incorporated automatic learner motivational emotion detection to enhance learner engagement. However, there have been limited ‘successes’ in the successful deployment of such systems in classrooms today. Additionally, research conducted by Park and Kim (2021) as well as Mahmood and Rasheed (2023) further proved that feedback mechanisms in most adaptive learning systems are weak and provide minimal understanding of the system to students and instructors [12]. We aim to build a system that enables the personalization of the learning experience based on students’ emotions.[4].

PROBLEM STATEMENT

The rapid adoption of online learning platforms has transformed the education system by enabling remote and flexible access to learning resources. However, a significant limitation of existing virtual classroom environments is the lack of real-time emotional awareness. In traditional physical classrooms, instructors can observe students’ facial expressions, body language, and engagement levels to assess understanding and adjust teaching strategies accordingly. This essential emotional feedback is largely absent in online learning settings, making it difficult for instructors to identify disengaged, confused, bored, or frustrated students during live sessions. Even though AI technologies have gained a significant ground in education, current adaptive learning systems are mainly predicated on inflexible performance-based criteria that do not cater to the complex and evolving demands of each learner. Much of the time these platforms neglect important things like emotional engagement, cognitive diversity, cultural flow and real-time behavioral responses. In addition, issues such as ethical considerations on data privacy, transparency, and lack of genuine engagement from educators undermine trust and effectiveness with AI powered education tools. Current online learning platforms primarily rely on indirect indicators such as attendance records, chat participation, and assessment scores to evaluate student engagement. These indicators do not accurately represent students’ real-time emotional and cognitive states while learning. As a result, instructors often fail to recognize learning difficulties at an early stage, leading to delayed intervention, reduced student interaction, and lower learning effectiveness. Students experiencing confusion or frustration may hesitate to communicate their difficulties in a virtual environment, further widening the communication gap between learners and instructors. Therefore, there is a need for an intelligent, scalable, and non-intrusive online learning system that can automatically detect students’ emotional states in real time, aggregate emotional data at the classroom level, and provide instructors with clear insights and adaptive teaching recommendations. Facial expression recognition systems use deep learning models such as CNNs, autoencoders, and GANs to extract features and classify emotions, improving accuracy and enabling emotion-aware intelligent systems. Addressing this problem is essential to improving student engagement, enhancing instructional effectiveness, and creating more interactive, responsive, and learner-centric online education environments

Emotion in Learning

The field of education in the present time is confronted with various challenges and possibilities, which reflect the ever-changing nature of teaching methods, technology, and societal expectations. Emotions play a pivotal role in learning by shaping attention, memory, motivation, and self-regulation. Achievement emotions—such as anxiety, curiosity, boredom, and frustration—can either facilitate or hinder cognitive processing, depending on how they are experienced and addressed (Pekrun, 2006). A learner who feels overwhelmed may disengage despite being cognitively capable, whereas a curious learner may persist through challenging material. The interplay between affect and cognition has been well documented in educational psychology and is increasingly operationalized in affect-aware technologies. Academic emotions are defined

as emotions experienced by students in a learning environment [33]. Academic emotions have a strong correlation with students' achievement in the learning process [34]. Achievement emotions are emotions related to the activities or outcomes based on competency set by certain standards.

Facial Emotion Thermal Features

The main goal of feature extraction is to obtain the most relevant information from the original data and represent the information in a lower dimensionality shape [32]. For the computational process, when the data to be input to an algorithm are too large and have potential to be reduced, transforming them into a reduced representation set of features is necessary.

Table 1

S No.	Emotion Recognition Performances		
	Emotion	Precision	Recall
1.	Engaged	91.8%	90.4%
2.	Thinking	89.3%	88.7%
3.	Bored	87.6%	86.9%
4.	Distracted	86.7%	85.9%
5.	Confused	85.4%	84.8%

OBJECTIVE

The primary objective of this project is to design and develop an Emotion-Aware Online Learning Assistant that enhances the effectiveness of virtual classrooms by enabling real-time detection and analysis of students' emotional states during live online sessions. The system aims to bridge the emotional and communication gap between students and instructors in online learning environments. Facial expression recognition technology is becoming more and more mature, but there are still some problems: (1) The types of facial expressions are not rich enough, human expression is more than five basic emotions, which also leads to the poor recognition effect of facial expression recognition in natural and complex scenes. (2) Lack of data sets. Most of the current data sets are collected in the laboratory and other scenes, and these expressions are not natural enough. The types and quantity of data sets are not enough, and deep learning requires a lot of data for training. Rich data can make the trained network have better performance [22]. To detect students' emotions in real time during live online classes using facial emotion recognition techniques based on machine learning and computer vision. To classify emotional states into meaningful categories such as engaged, confused, bored, frustrated, angry, and neutral for effective analysis of student behaviour. To aggregate individual student emotions and generate classroom-level emotional insights that reflects overall engagement and learning effectiveness. To develop an interactive teacher dashboard that visually presents real-time emotional statistics, trends, and engagement levels in an intuitive and user-friendly manner. To provide intelligent teaching recommendations based on the dominant emotional state of students, enabling instructors to adapt teaching strategies dynamically. To improve student engagement and learning outcomes by facilitating timely instructor intervention when negative emotional patterns such as confusion or boredom are detected. To ensure a non-intrusive and scalable solution that operates using standard webcams without requiring specialized hardware or disrupting the learning process. To maintain ethical standards and data privacy by processing emotional data in an anonymized and aggregated form. To evaluate the performance of the system based on emotion recognition accuracy, real-time processing efficiency, and instructor usability feedback.

METHODOLOGY

The propound Emotion Aware Online Learning Assistant is developed to perpetually detecting the student's emotional condition whether they are feeling engaged, bored, frustrated etc., at the time of live virtual sessions and also help the faculties and teachers to ameliorate the teaching efficacy by means of real-time critique and also from brilliant endorsements. The methodology act in accordance with an organized pipeline that consists of video recording, facial expression analysis, facial expression integration, information dashboard and the brilliant teaching endorsement propagation. This system seeks to recreate the emotional intelligence (EQ) of an offline classroom inside an online learning platform.

To inspect the impact of the occurrence of every features of face over the multiple traits of the face, we require a collection of faces appraised by multiple spectators with regard to the multiple traits of the face (facial traits) to be examined .In contrast the facial features are categorized on the basis of the similarities in the appearance of the faces [17].Technology-enhanced learning that integrates face to face and virtual learning enhances the student participation and knowledge acquisition as both the methods go together and increase the complete academic results [18]. Our performance of deep learning systems is to ensure the model performance along with maintaining the ability of examining the model behaviour [20].

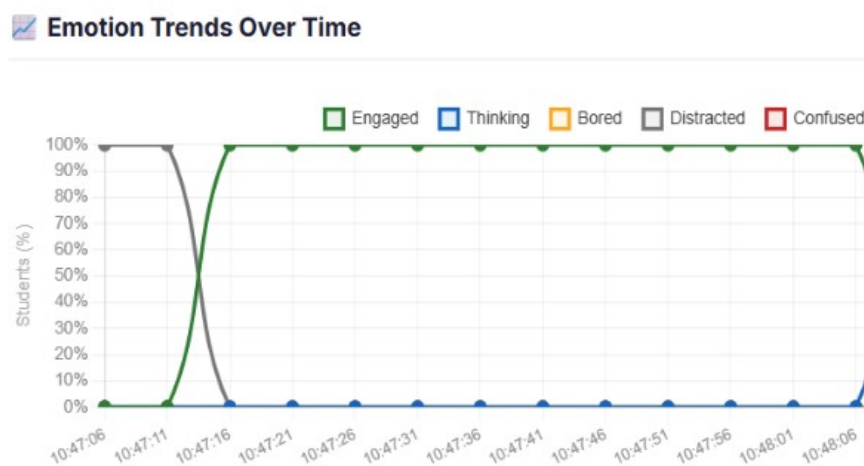


Figure 2: Students Emotion Trends Over Time During Session.

Complete System Design

The complete system is executed by using a web-based client server system, where both students and teachers communicate through the virtual education environment. Students engage in the virtual sessions using the webcams and teachers obtain the real-time emotional data of all the students over the dashboard. This model guarantees the uninterrupted blending between the video capturing, machine learning algorithms and the user interfaces. Our emotion scanning intellectual system, concentrated on technology enhanced learning conditions. This model uses an extension of the Activity Theory (AT) in a scenario where both students and teachers unite and communicate along with the specific objects (text and dialog) via specific analysis tools of sentiment to execute result-oriented action (building wiki, bulletin boards, chatting) [19].

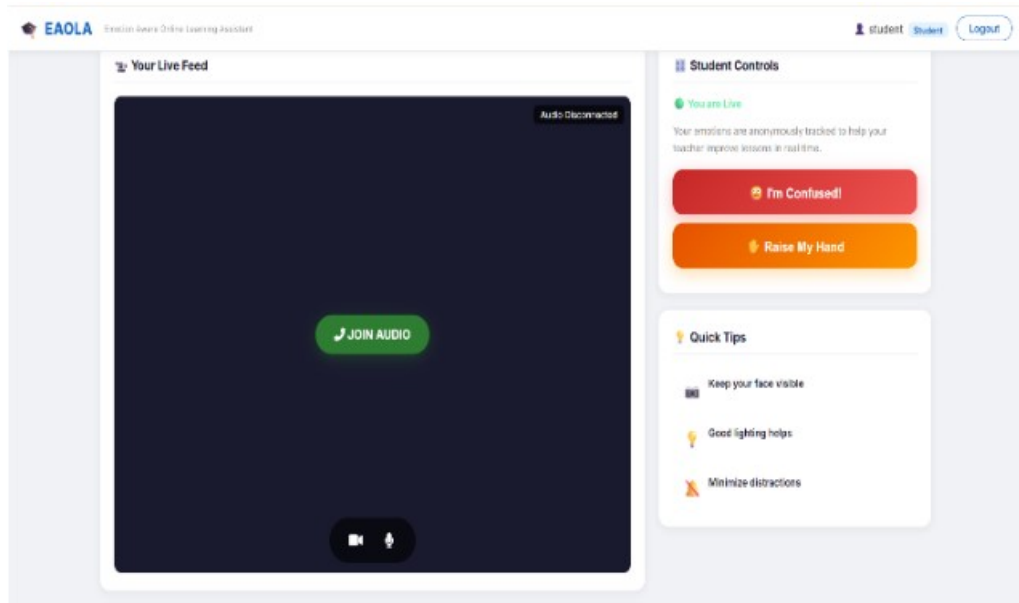


Figure 3: Student Dashboard.

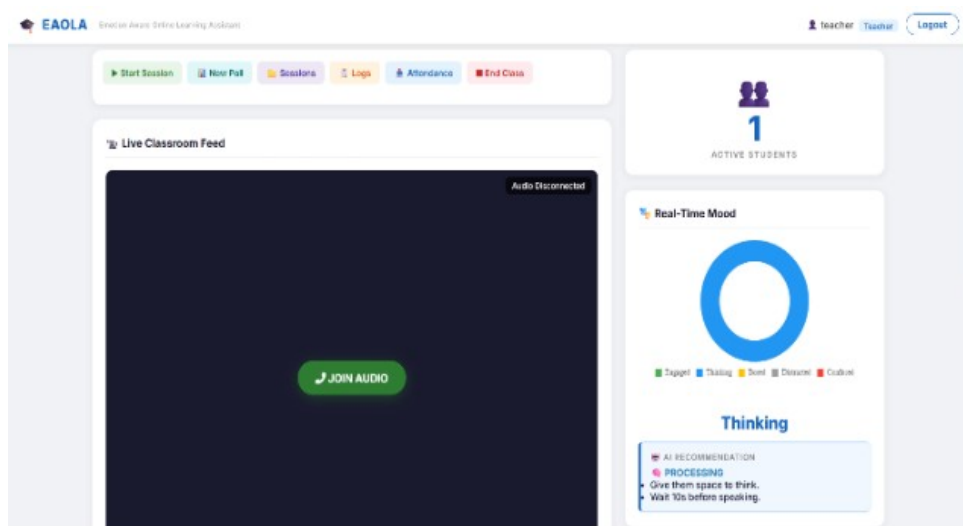


Figure 4: Teacher's Dashboard.

Data Gathering and Webstreaming

During the live virtual classes, students join the online sessions through webcam enabled devices like phone, laptops. Instead of the continuous video capturing the system captures the video frames in the fixed time intervals to reduce the computational load of the system. After that these frames are transmitted securely and carefully to the server for processing [15]. Because of this frame sampling approach, the system can maintain its performance even when there are large number of students present. With respect to the second objective of our research, the interpretation of the sentimental state also takes into consideration the conditions in which learning takes place.

Learning atmosphere includes all the important and relevant information of a student or group participating in the educational activity [19].

Facial Expression Recognition (FER)

Facial emotion detection is the core component of the system. Every detected face is then analysed through a trained machine learning model which classifies the faces further into the predefined emotional categories. Feature extraction mainly focuses on the facial landmarks such as eyes, eyebrows, mouth shape and facial muscle movement [16]. The trained model processes these features and then generate the emotion predictions in real time.

Emotion awareness plays a very important role during the online learning sessions as sentiments affect student's intellectual functioning, cooperation and comprehensive results that makes the emotion cognizant systems important for engaging virtual sessions [10].

Sentiment Accumulation and Classroom Evaluation

Only single student emotions separately are not enough to lead educational commitment. So, system combines the emotional data of all the students so that it can generate the student learning perception.

Teacher Dashboard and Depiction

A dedicated teacher's dashboard is developed which shows the emotional insights of the student faces clearly and efficiently. The teacher's dashboard updates in real time and also shows the visual indicators such as emotion counter, engagement graphs etc. It shows the count of student per emotion. The emotion chart is shown along with the time stamp. This dashboard helps the teacher to understand the emotional state of the class without disturbing the lecture.

CONCLUSIONS

This study shows that detecting emotions in virtual learning environments, by using tools like Microsoft Teams along with voice and facial expressions analysis, can be a very effective and scalable way to improve student interaction and participation.

The system uses CNNs for facial analysis and RNNs (with LSTM) for voice analysis. Because of this, it achieves good accuracy and fast response time. It also overcomes some limitations of earlier systems like Affective and Emotient.

According to the study, Online learning can sometimes lead to better academic performance than traditional classroom learning, and students who complete task regularly tend to perform better. However, many students still prefer classroom-based learning. Both intrinsic (internal) and extrinsic (external) motivation were observed in this study, but intrinsic motivation was found to be stronger.

Traditional classroom learning is still a well-established method. Some students are not comfortable with change and may see online learning negatively. They feel more comfortable sitting in a classroom, taking notes, rather than studying on a computer. On the other hand, some students value face-to-face interaction, class discussions, community learning, and building a connection with teachers.

This paper combines ideas from learning science, affective computing, instructional psychology, and GenAI to propose a dual-adaptive system, this system can adjust learning content and tone based on the learner's needs. The project successfully designed and implemented an Emotion-Aware Online Learning Assistant, which solves a major problem in online education-the lack of real-time emotional feedback.

By combining facial emotion recognition with classroom-level emotion analysis, the system improves interaction between teachers and students. It can detect student's emotion in real time, helping teachers monitor engagement and improve the learning environment.

In conclusion, this system supports the development of adaptive and learner-focused education. It also shows how artificial intelligence can improve the quality and effectiveness of virtual classrooms. Because it can predict students' performance, provide useful insights, and adjust teaching methods, this system has a strong potential to transform the future of education.

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