

Intelligent Engagement Detection in E-Learning Through Facial Emotion Analysis Using CNN-IDBN Hybrid Model

Rama Bhadra Rao Maddu

Research Scholar

Department of Computer and Information Science
Faculty of Science, Annamalai University
Annamalainagar, Chennai, Tamil Nadu 608002, India
Email - maddu.ramabhadrarao@gmail.com

S. Murugappan

Research Supervisor

Department of Computer and Information Science
Faculty of Science, Annamalai University
Annamalainagar, Chennai, Tamil Nadu 608002, India

Abstract: Internet-based educational activities including viewing lectures, taking examinations, and participating in virtual meetings require students to engage with digital content. During these activities, learners express varying emotional states such as boredom, frustration, happiness, indifference, and confusion. Effective online education requires instructors to monitor student engagement levels accurately to provide targeted pedagogical support. This paper introduces a novel engagement prediction framework for online learners based on facial emotion analysis through four key phases: preprocessing, feature extraction, emotion recognition, and engagement assessment. We implement face detection preprocessing followed by extraction of Improved Active Appearance Model (IAM), Shape Local Binary Texture (SLBT), Global Binary Pattern (GBP), and ResNet features. These extracted features are processed through our proposed Hybrid Classification model combining Improved Deep Belief Network (IDBN) and Convolutional Neural Network (CNN) approaches. The system determines student engagement through enhanced entropy-based processing of recognized emotions. Experimental evaluation against existing methods (DBN, SVM, CNN, LSTM-CNN, LSTM, and RF) across multiple metrics demonstrates superior performance, with our hybrid model achieving 95% accuracy at 80% learning for the CK+ dataset and significantly higher sensitivity (60%) for FER-2013 datasets.

Keywords: Student engagement detection, online learning environment, improved feature extraction, emotion recognition, hybrid neural network model.