

Title

Facial Emotion Recognition System for Enhanced Educational Engagement:
Project Report

Student Info

Student Name: Muteb Fawaz Almughyiri

Institution: Midocean University

Advisor: Dr. Ashraf Elsayed

Abstract

The growing demand for understanding students' emotional engagement in educational settings has motivated the development of advanced facial emotion recognition systems. Traditional evaluation tools fail to capture real-time emotional states crucial for adapting pedagogical strategies. This project proposes a Convolutional Neural Network (CNN)-based platform utilizing ResNet-18 architecture with Squeeze-and-Excitation (SE) modules, trained on datasets such as FER-2013, AffectNet, and RAF-DB. The aim is to deliver real-time emotion detection for classrooms, providing actionable feedback to instructors. The system's success is measured by performance metrics like accuracy, precision, and F1-Score. Tools including TensorFlow and OpenCV will be employed for implementation. The expected outcome is a robust, ethical, real-time educational emotion analysis system that enhances learning outcomes and personalizes education.

1. Introduction

Emotions significantly influence learning, memory retention, and classroom engagement. Despite this, traditional assessment methods largely ignore emotional feedback. Emotion Recognition Technologies (ERTs), powered by Artificial Intelligence (AI) and computer vision, provide an opportunity to bridge this gap. Implementing real-time facial emotion recognition systems in education could revolutionize teaching by enabling dynamic adaptation based on students' emotional states. However, challenges like cultural sensitivity, data privacy, and real-time processing remain. This report

introduces a project that seeks to address these issues through a novel CNN-based system.

2. Problem Specification

The core problem addressed is the lack of real-time, automated systems for accurately recognizing and analyzing students' emotions during lectures.

- Problem Statement: Develop a robust facial emotion recognition system for educational settings to provide real-time emotional feedback to instructors.
- Scope: Focus on facial-based emotion recognition without incorporating body gesture data in this phase.
- Constraints: Data privacy must be preserved; system must operate in real-time environments.
- Type: Classification (categorizing facial expressions into discrete emotions).

3. Motivations

- Real-world applications: Real-time adjustment of teaching strategies based on student emotions.
- Academic significance: Fills the research gap in integrating AI-based emotional analysis into active educational environments.
- Industry interest: High demand for adaptive learning technologies in EdTech.
- Personal motivation: Commitment to enhancing educational quality through technological innovation.

4. Objectives

- Primary Objective: Build and evaluate a real-time facial emotion recognition system tailored for classroom environments.
- Secondary Objectives:
 - Implement and optimize CNN models with SE modules.
 - Benchmark performance across multiple datasets.
 - Maintain strict ethical standards regarding data handling.
- Long-term Impact: Enable widespread adoption of emotion-sensitive educational technologies.

5. Literature Review

Several studies have influenced this project:

- Salloum et al. (2025): Achieved 95% emotion classification accuracy using a refined CNN with preprocessing and augmentation.
- Diwan et al. (2024): Emphasized holistic emotion recognition combining facial and body gestures, highlighting generalizability issues.
- Indra Saputra et al. (2024): Demonstrated the role of real-time emotion feedback in improving teaching outcomes.
- Katirai (2023): Highlighted critical ethical considerations, stressing privacy and potential algorithmic biases.

In contrast to existing works, our project focuses on robust generalization across demographics and operational readiness for educational settings.

6. Proposed Methodology

- Model: CNN based on ResNet-18 architecture with Squeeze-and-Excitation (SE) modules.
- Justification: ResNet-18 provides efficient depth, while SE modules enhance feature selection, improving emotion classification accuracy.
- Preprocessing Steps:
 - Face detection and alignment.
 - Normalization and augmentation (rotation, flipping).
 - Handling class imbalance with oversampling techniques.
- Tools and Libraries:
 - TensorFlow (for model development).
 - OpenCV (for face detection and video processing).
 - Scikit-learn (for evaluation metrics).

7. Datasets Description

- FER-2013: 35,887 grayscale facial images (48x48 pixels) categorized into seven emotions.
- AffectNet: 1 million facial images, ~450,000 manually annotated across eight emotion classes.
- RAF-DB: 29,672 real-world facial images with basic and compound expression annotations.

Planned Preprocessing:

- Normalize pixel intensities.

- Augment datasets for class balance.
- Remove low-quality images.

Challenges:

- High variance in facial angles and lighting.
- Cultural differences in emotional expression.

8. Timeline of Second Semester Project (10 Weeks)

Week	Planned Activity
1	Finalize literature review, environment setup
2	Data preprocessing and exploratory analysis
3	Implement baseline CNN model
4	Evaluate baseline model and identify weaknesses
5	Implement main model (ResNet-18 + SE modules)
6	Fine-tune hyperparameters
7	Collect evaluation metrics (accuracy, F1-Score)
8	Comparative analysis with baseline
9	Draft final project report and prepare presentation
10	Final review, presentation, and submission

9. References

1. Salloum, S. A., et al. (2025). Emotion recognition for enhanced learning: using AI to detect students' emotions. Smart Learning Environments.
2. Diwan, A., et al. (2024). Advancements in Emotion Classification via Facial and Body Gesture Analysis. Expert Systems.
3. Indra Saputra, K., et al. (2024). The Evolution of Educational Assessment: How Artificial Intelligence is Shaping Learning Evaluation. Indonesian Journal of Computer Science.
4. Katirai, A. (2023). Ethical considerations in emotion recognition technologies: a review. AI and Ethics.
5. Möller, C., et al. (2022). Culture shapes preschoolers' emotion recognition. Journal of Cultural Cognitive Science.