

Facial Emotion Recognition System for Enhanced Educational Engagement: Final Report

Student Info

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Abstract

Understanding students' emotional engagement during lectures is critical for educational success. Traditional assessment methods overlook real-time emotional states, limiting instructors' ability to adapt teaching strategies. This project proposes a CNN-based facial emotion recognition system utilizing ResNet-18 with Squeeze-and-Excitation (SE) modules, trained on FER-2013, AffectNet, and RAF-DB datasets. Implemented using TensorFlow and OpenCV, the system delivers real-time emotional feedback to educators. Evaluation metrics such as accuracy, precision, and F1-Score will be used to measure system performance. The expected outcome is a practical and ethical platform enhancing student learning outcomes.

1. Introduction

Emotions influence cognitive processes such as attention, memory, and learning. Traditional evaluation frameworks miss emotional dynamics during lectures. Emotion Recognition Technologies (ERTs) powered by AI offer a pathway to integrate real-time feedback into educational settings. Despite the potential, challenges like cultural sensitivity, ethical concerns, and technical robustness remain. This project aims to develop an effective, real-time facial emotion recognition system addressing these issues.

2. Problem Specification

- Problem Statement: Develop a real-time, robust facial emotion recognition system for educational settings.
- Scope: Focus exclusively on facial expressions without using body gesture data.

- Constraints: Preserve student privacy and ensure real-time processing.
- Type: Classification task (categorizing facial expressions into discrete emotions).

3. Motivations

- Real-world Application: Adaptive teaching based on student emotions.
- Academic Significance: Bridges AI with real-time education feedback.
- Industry Interest: High demand in EdTech solutions.
- Personal Motivation: Passion for enhancing education through innovative technologies.

4. Objectives

- Primary Objective: Develop and evaluate a real-time facial emotion recognition system for classrooms.
- Secondary Objectives:
 - Implement and optimize CNN models with SE modules.
 - Benchmark model performance across datasets.
 - Ensure ethical handling of data and results.
- Long-Term Impact: Enable emotion-aware, personalized learning experiences.

5. Literature Review

- Salloum et al. (2025): Achieved 95% emotion classification accuracy with refined CNN.
- Diwan et al. (2024): Highlighted the need for multimodal emotion recognition.
- Indra Saputra et al. (2024): Emphasized the impact of real-time emotional feedback.
- Katirai (2023): Discussed critical ethical issues related to emotion recognition.

This project differentiates itself by focusing on operational readiness and demographic robustness in educational settings.

6. Proposed Methodology

- Model: CNN based on ResNet-18 with Squeeze-and-Excitation modules.
- Justification: ResNet-18 offers efficient depth; SE modules improve feature recalibration.
- Preprocessing:
 - Face detection and alignment.

- Pixel normalization.
- Data augmentation (flipping, rotation).
- Oversampling to address class imbalance.
- Libraries: TensorFlow, OpenCV, Scikit-learn.

7. Datasets Description

- FER-2013: 35,887 grayscale images across 7 emotions.
- AffectNet: ~1 million images, 450,000 manually annotated.
- RAF-DB: 29,672 real-world annotated facial images.

Challenges: High variance in facial expressions, lighting conditions, and cultural differences in emotional expression.

8. Timeline of Second Semester Project (10 Weeks)

Week 1-2: Finalize literature review, environment setup

Week 3-4: Data preprocessing and exploratory analysis

Week 5-6: Implement baseline CNN model

Week 7-8: Evaluate and refine models

Week 9-10: Draft final project report and submission

9. References

1. Salloum, S. A., et al. (2025). Emotion recognition for enhanced learning.
2. Diwan, A., et al. (2024). Advancements in Emotion Classification.
3. Indra Saputra, K., et al. (2024). AI in Educational Assessment.
4. Katirai, A. (2023). Ethical considerations in emotion recognition technologies.
5. Möller, C., et al. (2022). Cross-cultural study on emotion recognition.