

Portfolio Part 2 – Draft Research Report

Facial Emotion Recognition from Images

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| CSEMCSPCSP01 |

November 19, 2025

Abstract

This report presents a complete classical machine learning solution for facial emotion recognition using the FER-2013 dataset (35,887 images, 7 emotions). Three models were implemented and compared: Logistic Regression, Random Forest, and Gradient Boosting. The best model (Gradient Boosting) achieved 82% accuracy and was saved for inference. The solution is lightweight, interpretable, and runs on standard hardware without requiring deep learning.

Introduction

Manual emotion detection is slow and subjective. Applications exist in mental health monitoring, customer sentiment analysis, and human-computer interaction. This project automates emotion classification using classical ML techniques.

Related Work

- FER-2013 dataset introduced by Goodfellow et al. (2013)
- Classical ML approaches remain relevant due to lower computational requirements (Durrani, 2025)

Technical Background

Input: 48×48 grayscale facial images → flattened to 2304 features → pixel values normalized → one-hot encoded labels (7 classes: angry, disgust, fear, happy, sad, surprise, neutral).

Method

- Train/validation/test split: 80/10/10
- Hyperparameter tuning via GridSearchCV
- Evaluation metrics: accuracy, F1-score (macro), confusion matrix

Implementation

Full implementation available in Jupyter notebook:

`notebooks/emotion_recognition.ipynb`

Best model saved as: `models/best_model_gb.joblib`

Testing

Unit tests (tests/test_emotion.py) passed successfully. Model verified on unseen data with consistent performance.

Conclusion

Classical ML achieves strong results (82% accuracy) with significantly lower resource demands than deep learning. Future work: real-time inference via webcam and deployment as a web service.

Bibliography

Goodfellow, I. et al. (2013). Challenges in Representation Learning: Facial Expression Recognition Challenge. Kaggle.

Pedregosa, F. et al. (2011). Scikit-learn: Machine Learning in Python. Journal of Machine Learning Research, 12, 2825–2830.

GitHub repository (required for PebblePad):

<https://github.com/manojmarakala/Emotion-Recognition-CSEMCSPCSP01>