

Portfolio Part 2 – Draft Research Report

Facial Emotion Recognition from Images

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## 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>