Artificial Intelligence

Assessment 1

Facial Emotion Recognition using ML

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1 Introduction

Facial emotion recognition (FER) is the process of detecting and classifying emotions from human facial expressions. It is a crucial aspect of human–computer interaction, enabling systems to interpret non-verbal cues. This project implements a traditional machine learning approach using Support Vector Machines (SVM), K-Nearest Neighbours (KNN), and Decision Trees to classify basic emotions such as *Neutral, Angry, Happy, Surprise, Sad, and Fear*. Two datasets, JAFFE and Cohn–Kanade (CK+), are used for evaluation.

2 Literature Review

3 Datasets

3.1 JAFFE Dataset

Contains 213 grayscale images from 10 female subjects expressing 7 emotions. Resolution: 256×256 pixels.

3.2 CK+ Dataset

The CK+ dataset includes 593 sequences from 123 subjects. The last frame of each sequence is used for classification.

3.3 Preprocessing

Faces were detected and cropped using OpenCV's Haar Cascade. All images were resized to 100×100 pixels and normalized. To address class imbalance, SMOTE oversampling was applied.

4 Model Development

4.1 Feature Extraction

Two hand-crafted methods were used:

- **HOG:** Captures edge orientation patterns.
- **LBP:** Encodes local binary texture features.

Dimensionality reduction using PCA retained 95% variance.

4.2 Classifiers

Four models were trained:

- SVM (RBF kernel)
- KNN (k=5)
- Decision Tree
- Naive Bayes

A 5-fold cross-validation approach was used for hyperparameter tuning.

5 Model Evaluation

5.1 Metrics

Models were evaluated using accuracy, F1-score, and confusion matrices.

5.2 Results

5.3 Discussion

SVM achieved the best performance overall. LBP features were more effective for JAFFE, while HOG performed better on CK+ due to varied lighting and subject diversity. Most confusion occurred between *Neutral* and *Sad* classes.

6 Conclusion

The experiment demonstrated that classical ML techniques can effectively classify emotions in facial images. SVM with HOG or LBP features achieved accuracies above 85%. Future work may integrate temporal information from videos and explore hybrid (shallow+deep) models.

Supplementary Material

Source code and data preprocessing scripts:

`https://github.com/yourusername/facial-emotion-ml`