Facial Expression Recognition: A Survey

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Facial Expression Recognition has attracted increasing attention in recent years

# Scholarcy Highlights

* Facial expression is a major non-verbal means of expecting intentions in human communication.The work of Mehrabian [1] in 1974 shows that 55% of messages pertaining to feelings and attitudes is in facial expression, 7% of which is in the words that are spoken, the rest of which are paralinguistic
* With the rapid development of artificial intelligence, automatic recognition of facial expressions has been intensively studied in recent years
* The past decade has witnessed the development of many new Facial Expression Recognition (FER) algorithms
* This paper provides a comprehensive review about recent advances in FER technology
* We divide the conventional methods into three major steps, i.e., image preprocessing, feature extraction, and expression classification
* The latest FER approaches, especially the GAN-based aproaches, can achieve about 80% accuracy on the Binghamton University 3D Facial Expression (BU-3DFE) [109] dataset, which has different properties than other datasets
* At the end of the survey, we present some challenges and opportunities of the FER that require future research

# Scholarcy Summary

## Introduction

Facial expression is a major non-verbal means of expecting intentions in human communication.

The work of Mehrabian [1] in 1974 shows that 55% of messages pertaining to feelings and attitudes is in facial expression, 7% of which is in the words that are spoken, the rest of which are paralinguistic.

Facial expression has proven to play a vital role in the entire information exchange process in Mehrabian’s findings.

With the rapid development of artificial intelligence, automatic recognition of facial expressions has been intensively studied in recent years.

The study of Facial Expression Recognition (FER) has received extensive attention in the fields of psychology, computer vision, and pattern recognition.

FER has broad applications in multiple domains, including human–computer interaction [2,3], virtual reality [4], augmented reality [5], advanced driver assistance systems [6,7], education [8], and entertainment [9]

## Methods

Facial expression datasets are usually labelled with the expression categories directly.

Such as JAFFE [14], CK+ [15], and FER2013 [114] are annotated with 7 expression categories.

Datasets of one particular category of expression, e.g., GENKI-4K [121] labelled as “smiling” and “non-smiling”, benefit to better understand the specific kind expression on different dimensions and degrees.

In real-world applications of image recognition, training data is normally very limited, which is generally the main reason for the over-fitting problem and sub-optimal accuracy.

On the contrary, using more training data is the common method to obtain better performance.

It is unrealistic to obtain sufficient training samples in real-world applications

## Results

Database Approaches Accuracy [40] Gabor + SRC [41] Gabor + SVM [44] LBP + LP [46] LBP (LDP).

[62] KNN [63] PCA + FSVM/KNN [66] SVM [69] IDA + SVM [71] Haar + Adaboost [47] LPQ + SRC [77] LBP + SRC [85] CNN (3DCNN-DAP) [86] CNN (DTAJN).

[87] CNN (DeeperCNN) [88] CNN (ACNN).

[78] LBP/Gabor + SRC [81] AAM + PNN FERA [115]

## Discussion

According to the peculiarity of human facial expression, a dataset has four notable elements, namely image dimension, shooting environment, labelling method, and elicitation method.

Human facial expression images can be divided into 2D and 3D according to the dimensionality.

2D-type: The traditional 2D laboratory dataset usually has good separability of different categories, due to its exaggerated expression and limited variables.

The JAFFE dataset [14] specially uses.

CE [21] consists of 22 categories of emotions of 230 subjects with facial occlusion minimised.

This type of dataset is useful for understanding the procedure of expression recognition and comparing the performances of different experimental methods

## Conclusion

Facial Expression Recognition (FER) has attracted increasing attention in recent years.

The past decade has witnessed the development of many new FER algorithms.

This paper provides a comprehensive review about recent advances in FER technology.

We first introduce some related terminology and review the research background of FER.

We classify the existing FER methods into conventional methods and deep learning-based methods.

We divide the conventional methods into three major steps, i.e., image preprocessing, feature extraction, and expression classification.

Various possible methods are introduced and discussed