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Facial Expression Recognition: A Review

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***Abstract*- Facial expressions are the fastest means of communication while conveying any type of information. These are not only exposing the sensitivity or feelings of any person but can also be used to judge his/her mental views. This paper includes the introduction of the face recognition and facial expression recognition and an investigation on the recent previous researches for extracting the effective and efficient method for facial expression recognition.**

***Keywords*- Facial Expression Recognition, Face Detection, Face Extraction and Expression Classification.**

I. INTRODUCTION

As we are stepping forward from one generation to another, innumerous technologies are abiding us according to our necessities. Thus, we are thoroughly depending on these technologies as a part of human-computer interaction. And one of them is facial expression recognition.

Face plays an important role in social communication; equally facial expressions are vital. Facial expressions not only expose the sensitivity or feelings of any person but can also be used to judge his/her mental views. Facial expression recognition is a method to recognize expressions on one's face. A wide range of techniques have been proposed to detect expressions like happy, sad, fear, disgust, angry, neutral, surprise but others are difficult to be implemented.

Facial expression recognition is composed of three major steps:

- Face detection and preprocessing of image,
- Feature extraction and
- Expression classification.

The objective of this paper is to understand the basic difference between the face recognition and facial expression recognition and to investigate the effective facial expression recognition rates by acknowledging the existing proposed models. This paper is organized in six sections and the second section includes the basic terminologies which are essential to understand for both face recognition and facial expression recognition.

The third section of this paper includes the difference between the face recognition and facial expression recognition. The fourth section explains about the procedure being followed for the recognition of facial expressions. The fifth section includes a review of ten previous researches in the expression recognition using various techniques. The sixth section is conclusion and it is about acknowledging the facial expression rate above 90%, calculated from the collected review. The final and seventh section discusses about the future scope.

II. BASIC TERMINOLOGIES

1. Face Detection:
Face detection is to determine that a certain picture contains a face we need to be able to define the general structure of face. Luckily human faces do not greatly differ from each other; we all have noses, eyes, foreheads, chins and mouths; and all of these compose the general structure of a face.

It is a concept of two-class classification: face versus nonface. Face detection can be regarded as a specific case of objectclass detection. In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. It can be understood as:

Fig 1. Face Detection.

2. Face Identification:
In this the system compares the given individual to all the other individuals in the database and gives a ranked list of matches.

3. Face Verification: - In this the system compares the given individual with who that individual says they are and gives a yes or no decision.

4. Facial Expressions:

Facial expression is one or more motions or positions of the muscles beneath the skin of the face. These movements express the emotional state of the person to observers. It is a form of non-verbal communication. It plays a communicative role in interpersonal relations. The common ones are:

Fig 2. Types of Facial Expression.

III. DIFFERENCE: FACE RECOGNITION AND FACIAL EXPRESSION RECOGNITION

Table 1. Difference: Face Recognition and Facial Expression Recognition

Face Recognition	Facial Expression Recognition
It is a computer application for automatically identifying or verifying a person from a digital image or a video frame.	It is a computer application for identifying the facial expressions of any person either using an image or a video clip or the person itself.
Procedurals steps: Data acquisition, input processing, face image classification and decision making.	Procedurals steps: Face detection, feature extraction and expression classification.
Applications: Voter verification, banking using ATM, mobile password	Applications: Health care, games, elearning.

IV. FACIAL EXPRESSION RECOGNITION

Generally, face is a union of bones, facial muscles and skin tissues. When these muscles contract, warped facial features are produced. Facial expressions are the fastest means of communication while conveying any type of information. An implementation of facial expression recognition may lead to a natural human-machine interface.

In 1978, Ekman and Frisen reported that facial expression acts as a rapid signal that varies with contraction of facial features like eyebrows, lips, eyes, cheeks etc., thereby affecting the recognition accuracy, also happy, sad, fear, disgust, anger and surprise are six basic expressions which are readily recognized across very different cultures. Facial expression recognition involves three steps face detection, feature extraction and classification of expression.

Fig 3. Facial Expression Recognition.

The pre-processing step for recognizing facial expressions is face detection. The steps involved in converting a image to a normalized pure facial image for feature extraction is detecting feature points, rotating to line up, locating and cropping the face region using a rectangle, according to the face model. The face detection involves methods for detecting faces in a single image.

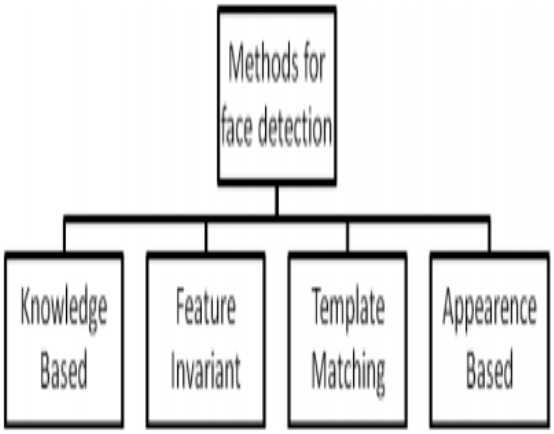

Fig 4. Methods for face detection.

V. FEATURE EXTRACTION

Feature extraction converts pixel data into a higherlevel representation of shape, motion, color, texture, and spatial configuration of the face or its components. Feature extraction generally reduces the dimensionality of the input space.

The reduction procedure should retain. essential information as it is an important task in pattern recognition system. Feature extraction can be done using various techniques.

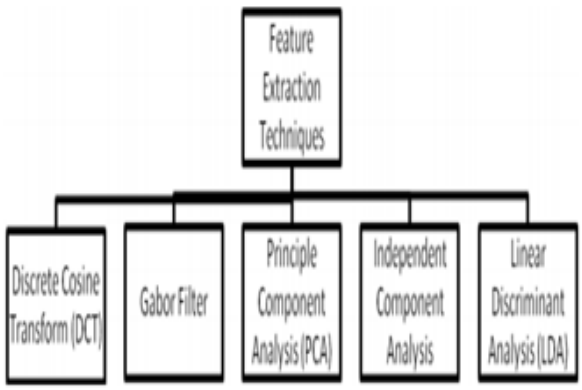

Fig 5. Feature extraction.

VI. A REVIEW OF PREVIOUS RESEARCH PAPERS ON FACIAL EXPRESSION RECOGNITION

Table 2. Review of Previous Research Papers on Facial Expression Recognition.

Author	Title	Expressions	Face Detection	Feature Extraction	Expression Classification	Accuracy (%)
Banu, Danciu, Boboc, Moga, Balan[1]	A novel approach for face expression recognition	Angry, disgust, fear, happy, neutral, sad	Appearance based	Bezier-curve, k-mean	Feed-forward neural network	85
Wang Zhen, Ying Zilu[2]	Facial expression recognition based on adaptive local binary pattern and sparse representation	Angry, disgust, fear, happy, neutral, sadness, surprise	JAFFE database (fusion approach: GRAY+SRC and ALBP+SRC)	Gabor filter	SRC	70
Jizheng, Xia, Lijang, Yuli, Angelo[4]	Facial expression recognition considering differences in facial structure and texture	Joy, sadness, surprise, angry, disgust, fear	(1) Cohn-kanade database (2) BHU facial expression database	FPDRC+CARC +SDEP	RBF	(1)88.7 (2)87.8
Deepti, Archana, Dr. Jagathy[3]	Facial expression recognition using ANN	Happy, sad, normal	Appearance based	DCT	NN	-
Jiawei, Congting, Hongyun, Zilu[5]	Facial expression recognition based on completed local binary pattern and sparse representation	Angry, disgust, fear, happy, neutral, sadness, surprise	JAFFE database (Fusion approach: GARY+SRC and CLBP+SRC)	Gabor filter	SRC	69.52
Jizheng, Xia, Yuli, Angolo[6]	Facial expression recognition based on tSNE and adaboost M2	Angry, disgust, fear, happy, neutral, sadness, surprise	JAFFE database	t-SNE	(1) SVM (2) Ada boost M2	(1) 90.3 (2) 94.5
J.J. Lee, Md. Zia Uddin, T.S. Kim[7]	Spatiotemporal human facial expression recognition using fisher independent component	Anger, joy, sad, surprise, fear, disgust	Cohn-kanade database	FICA	HMM	92.85

Weifeng, Caifeng, Yanjiang[8]	facial expression recognition based on discriminative distance learning	Angry, disgust, fear, happy, neutral, sadness, surprise	JAFFE database (1)Gray (2)LBP (3)Gabor	Gabor filter	SRC (D-KSVD)	(1)85.7 (2)78.6 (3)94.3
Ying, Zhang[9]	facial expression recognition based on NMF and SVM	Angry, disgust, fear, happy, neutral, sadness, surprise	JAFFE database	NMF	SVM	66.2
Anagha, Dr. Kulkarnki[10]	Facial detection and facial expression recognition system	Angry, fear, disgust, surprise, sad	Feature invarian	AAM	(1)Euclidean distance method (2)ANFIS	(1)90-95 (2)close to 100

VII. CONCLUSION

After investigating various face detection, feature extraction and expression classification methods and techniques we conclude that the effective facial expression recognition can be achieved by ANFIS tool, which is close to 100%. And the algorithms with 90 and above facial expression recognition rate tested by the [6], [7], [8], and [10] are also efficient.

VIII. FUTURE SCOPE

The facial expression recognition can be tested using physiological signals, as the physiological signals are strongly co-related to human emotions. These signals are not controllable by humans. The main signals on which facial expressions are responsible are temperature, respiration, skin conductance, and cardiac function. The efficient output can be produced using physiological signals.

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