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Efficient Face Expression Recognition Methods (FER): A Literature Review

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ABSTRACT

Recognition of artificial faces is an intriguing and testing problem and affects important applications in various regions, such as cooperation between human computers and data-oriented activity. Facial expression is the fastest correspondence methods for transmitting data.

It is straightforward the outward appearance of an individual by looking at his / her face yet somehow or other with regard to machines it ends up difficult to pass judgment on the outward appearance while using PC devices yet it is not incomprehensible in any way. This not only revealed any individual's affectability or sentiments, but it can also be used to make a judgement on the psychological views, yet again it could not fully understand the perception of human behaviour, the discovery of mental problems and fabricated human expressions. Expressions such as SAD, HAPPY, DISGUST, FEAR, ANGER, NEUTRAL and SURPRISE have been suggested in a broad range of processes

This paper includes implementing face recognition along with facial expression recognition, analyzing recent and past research to extract effective and efficient methods for recognition of facial expression.

KEYWORDS: *Face Expression Recognition, Gabor Filter, Active Appearance Model (AAM), Hidden Markov Model (HMM)*

1. INTRODUCTION

Face denotes a significant role in interaction, and it is also imperative to appear and perceive how an individual feels at a particular minute. Recognition of appearance externally is a strategy for perceiving expression.

The face of a person has so many emotions that are recognized and understood by looking at the face. Happy, Fear, Sad, Disgust, Angry, Neutral, and Surprise might be these emotions and expressions. People have misconstrued once in a while that there is a stark difference between face recognition and facial expression. The important thing is as follows:

Face Recognition: This application identifies or verifies an individual from a digital image or video. It includes information acquisition; processing of inputs, classification of face images and decision making. It is commonly used in voting verification, ATM banking, mobile password, and so on.

Facial Expression Recognition:
This recognizes any person's facial expressions using either an image or a video clip or the person himself. It includes face detection, extraction of features, and clincludes classification of speech. It is commonly used in the healthcare, games and e-learning sectors.

Woody Bledsoe[1], Helen Chan Wolf and Charles Bission[2] mainly used facial expression recognition technology. Together with Helen Chan and Charles Bission, Bledsoe chipped away during 1964 and 1965 using the PC to perceive human faces.

Applications based on "Biometric Artificial Intelligence" can particularly differentiate a person by dissecting instances depending on the face surface and shape of the individual[3][4].

Facial recognition can be delegated recognition or holistic recognition where, together with a mixing unit, Principal Recognition involves outfit of highlight extractors or classifiers.

Principal recognition or holistic recognition can be delegated where Principal Recognition involves a collection of highlighted extractors or classifiers together with a mixing unit.

Holistic Recognition-This provides the whole face a solo contribution to the structure of recognition.

Recognition of facial expression is comprised as follows in a few significant steps:-

1. Face detection and processing of image also known as Image Acquisition
2. Pre-Processing
3. Feature Extraction
4. Expression Classification

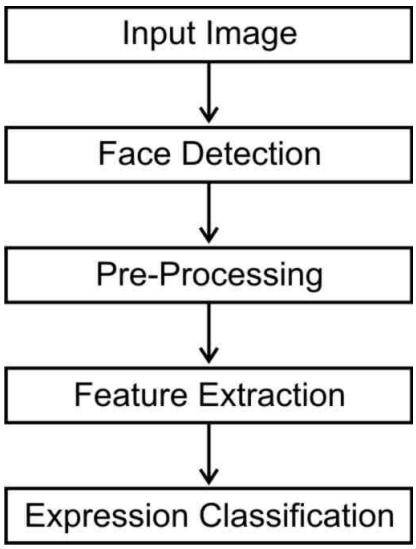

Figure1. FER System Flow Chart

Below is a brief introduction of the following steps involved in Facial Expression Recognition:

(1) Image Acquisition or Face Detection: The image can be static image above all else, or successions of images must contain more information than a still static image.

For Artificial Expression Recognition, 2D monochrome (dark scale) facial image successions are the most common type of images used. There are four methods that can efficiently distinguish a face, such as Learning Based, Feature Invariant, Template Matching, and Appearance Based.

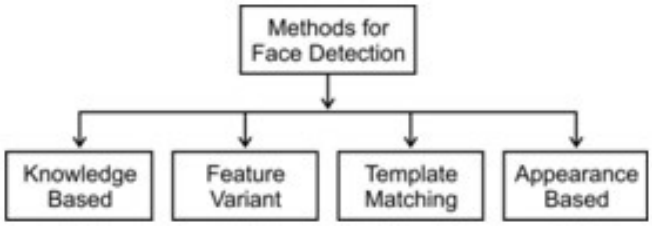

Figure2. Methods of face detection

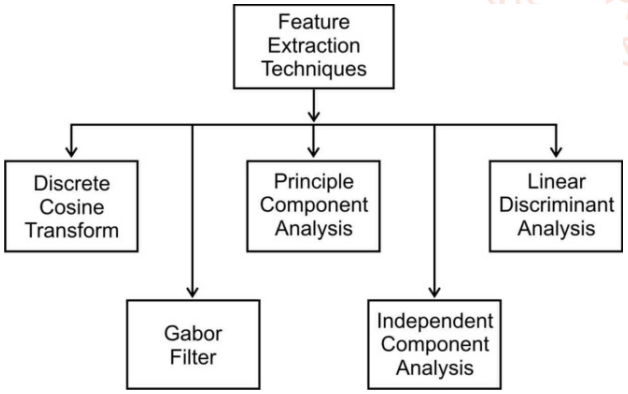

Figure3. Various Feature Extraction Techniques

(2) Pre-Processing: It includes Signal Conditioning{ such as elimination of noise, standardization against the variety of pixel position or splendor, etc.} The standardization of the image depends on eye or nostril references.

(3) Feature Extraction: It shifts to a higher-level depiction over Pixel Data. It decreases the input space dimensionality. Using the feature extraction techniques, it tends to be completed. This includes a Discrete Cosine Transform[DCT] Gabor Filter, Main Component Analysis[PCA], Independent Component Analysis[LDA].

(4) Expression Classification: As examined before an person has so many expressions at certain time frames and a broad range of methods has been suggested to define those expressions. Recognizing expressions such as happy, sad, fear, disgust, angry, neutral, surprise. Facial expression recognition systems do not recognize either six expressions or the AUs more frequently than anything it requires. Wide-ranging study on facial expression analyses has been conducted over the past decades. The most commonly used facial expression analysis is performed as far as the action units suggested in the Facial Action Coding System are concerned and as far as all inclusive emotions are concerned: joy, sadness, anger, surprise, disgust and fear. The two main categories used in facial expression recognition are activity units (AUs)[10] and Ekman's prototypical facial expressions[11].

2. FACIAL EXPRESSION RECOGNITION APPROACHES

Facial Action Coding System (FACS)

In 1978, the framework for estimating facial expressions was provided by Ekman et al.[12] called the FACS–Facial Action Coding System. FACS was developed by investigating the relationships between contraction of muscle(s) and changes in their face appearance. The Face can be divided into Upper Face and Lower Face Action units[13] and the resulting appearances are recognized as well. The figures show a part of the activity units that are joined. Muscle constraints responsible for a comparable activity are distinguished as an Action Unit (AU). The undertaking of expression examination using FACS is dependent on disintegrating observed expression into the action unit structure. There are 46 AUs that talk to outward appearance modifications and 12 AUs connected with the direction and direction of the eye stare. Activity units are deeply engaging as far as facial developments are concerned; in any event, they do not provide any information on the message to which they are speaking.

Prototypical Facial Expression

A usually small subset of seven important categories of expressions, observed through FER frameworks to be noticeable cross-sectionally over culture for use. As stated by the hypothesis of the Ekman[14], there are six vital expressions of emotions that are all inclusive to people from various nations and societies. They are anger, neutral, disgust, fear, happy, sad and surprise..

Rather than depicting the detailed facial features most facial expression recognition system attempts to perceive a small arrangement of prototypical passionate expressions. Some facial expressions are a mixture of more than one expression as for example of fear, sorrow and disgust, they state a combination that occurs. A few methodologies were used to overcome the above problem. There are two main classes of feature classification strategy: for instance, statistical non-AI approach, Euclidean and direct segregation research[15]. Machine learning approaches, for instance, Feed Forward Neural Network [16], Hidden Markov Model[17], Multilayer Perception, Support Vector Machine[18], and so on.

There are two categories that can be divided into current methods: image-based strategies and model-based strategies.

Picture-based methodologies that focus on perceiving facial operations by observing changes in the facial appearance of

the officer more frequently than doing whatever it takes not to autonomously and statically organize behavior or AUs More often than not, this kind of approach includes two main phases. To begin with, different facial highlights, e.g., optical stream [20][21], unambiguous element estimation (e.g., wrinkle length and educational level)[22], Haar highlights[23], Local Binary Patterns (LBP) highlights[24][25] autonomous part investigation (ICA)[26], include focuses[27], Gabor wavelets[28] and so on. The expressions/ AUs are acknowledged by recognition systems, such as Neural Networks, Support Vector Machines (SVM), rule-based methodology, AdaBoost classifiers, Sparse Representation (SR) classifiers, and so on, given the separate facial highlights. The ordinary shortcoming of picture-based approaches for AU recognition is that they will generally legitimately view each AU or certain AU mix individually and statically from the image data, regardless of the semantic and dynamic links between AUs, although some of them explore the transient characteristics of facial highlights.

By using the links between AUs, model-based approaches overcome this deficiency and perceive the AUs at the same moment. Lien et al.[29] used many Hidden Markov Models (HMMs) to talk in time about the growth of facial operations. Classification is accomplished by selecting the AU or AU blend that amplifies the likelihood of the separate facial features generated by the HMM. Valstar et al.[30] used a mixture of SVMs and HMMs and flanked the SVM method for almost every AU by showing the temporary progress of facial activity. The two techniques misuse AU's worldly circumstances. As it may be, they suffer failure to exploit AU's spatial circumstances. The solution for this problem is: Tong and Ji used a Dynamic Bayesian scheme to show the spatiotemporal associations between AUs effectively and to achieve remarkable improvements over the picture-based method. In this paper, apart from showing the spatial and worldly connections between AUs, we also use the attitude and facial element focus information and, more critically, the coupling and associations between them. Expression Classification by classifiers should be feasible. It includes hidden Markov Model [HMM], Neural Network [NN], Support Vector Machine SVM, AdaBoost, Spare Representation [SRC].

3. COMPARATIVE ANALYSIS

Similar investigation of the above mentioned facial expression recognition methodologies is shown in the table in this section. These methodologies are evaluated for standard facial expression databases such as Japanese woman outward appearance (JAFFE), FERET as far as the particular system's recognition rate, advantages and faults are concerned.

Table1. Facial Expression Recognition approaches Comparison

Recognition Approach	Database	Recognition Rate
LBP	JAFFE	80%
ICA	FERET	89%
PCA	AR-Faces	70%
PCA+ Gabor	JAFFE	85%
PCA	JAFFE	70%
LDP	JAFFE	89%
LTP	JAFFE	89%

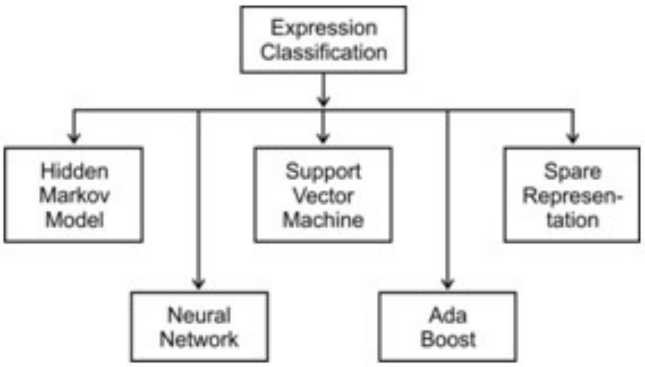

Figure4. Graphical comparison of various facial expression techniques applied on standard face databases such as JAFFE, FERET etc.

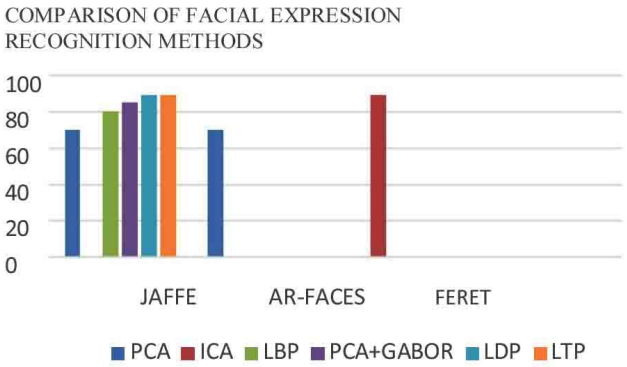

Figure5. Comparison of facial expression recognition methods

4. FUTURE DIRECTIONS

Facial expression recognition these days achieves a important place in various areas as it operates effectively under the circumstances that are required. A great deal of studies has been achieved and is going on in facial expression recognition, yet there is a need for progress, enhancement and development at the same moment. Considering the above examined outward appearance recognition techniques, which show better results in static conditions but failures under shifting conditions, e.g. change in modernity, variety present, maturing element and expressions. These are major causes that affect the display of almost all usual facial expression recognition techniques.. In this manner, future work should be feasible to overcome these problems and interpret the emotions of the individual "Environment in real-time under minimum constraints." For instance, enhancement and high objectives, there are two promising points for expression identification in the future. Both should be able to construct the recognition rate in recognition of facial expression.

5. CONCLUSION

Recognition of facial expression is an exceedingly best assignment in the field of PC vision, which has achieved significance as a result of its various applications in the last few years. Many specialists have worked thoroughly to demonstrate that accurate recognition system for facial expression is mandatory. This paper offers guidance for different applications. For the growth and advancement of the new methodology, numerous experts have worked carefully to demonstrate accurate facial expression identification analysis. Key focuses, demerits and applications of the few techniques have been substantially evaluated in this paper. In addition, a close investigation was carried out to delineate the exhibition and accuracy of

various methodologies. This paper finally concludes by recommending to the scientist the possible instructions for enhancing the facial expression identification system exhibition.

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