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Analysis on techniques used to recognize and identifying the Human emotions

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Article Info	ABSTRACT
	Facial expression is a major area for non-verbal language in day to day life communication. As the statistical analysis shows only 7 percent of the message in communication was covered in verbal communication while 55 percent transmitted by facial expression. Emotional expression has been a research subject of physiology since Darwin's work on emotional expression in the 19th century. According to Psychological theory the classification of human emotion is classified majorly into six emotions: happiness, fear, anger, surprise, disgust, and sadness. Facial expressions which involve the emotions and the nature of speech play a foremost role in expressing these emotions. Thereafter, researchers developed a system based on Anatomic of face named Facial Action Coding System (FACS) in 1970. Ever since the development of FACS there is a rapid progress in the domain of emotion recognition. This work is intended to give a thorough comparative analysis of the various techniques and methods that were applied to recognize and identify human emotions. This analysis results will help to identify proper and suitable techniques, algorithms and the methodologies for future research directions. In this paper extensive analysis on various recognition techniques used to identify the complexity in recognizing the facial expression is presented.

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1. INTRODUCTION

Emotions play a very important function in many fields likes forensic crime detection, psychologically affected patients, students mentoring in academics and victim observation in court, etc. However, so much of the growth happened in this technological domain, still, we can find lots of drawbacks and loopholes in terms of accuracy in various results we found in our survey work. There are a number of jobs performed by individuals and groups. The goal of facial expression is to identify oneself by observing a single image or multiple images, which is the emotion that the image shows. The human face has several components such as eye, nose, mouth, Brow and a few others. Based on the movement of those components and change of shape and sizes emotions may be extracted in various ways. Reorganization of emotion in human has become a greatest challenge faced in the interaction of computer and humans. Most of the effort on emotion recognition focuses on information extracted from visual or audio separately. Numerous surveys have been published in different areas, analyzing and recognizing the gestures and movements of human face and tracking of eye is still an unsolved problem with respect to accuracy rate. Many researchers in this area are been set as a benchmark and basement for many of the current research topics. Researcher in his work [1]

has dedicated his career to the pursuit of emotions, focusing mainly on six different emotions surprise, sadness, fear, anger, disgust, happiness. However, in the year 1990s, he dilated his list of basic emotions, together with a variety of positive and negative emotions including amusement, Dislike, awkwardness, relief, pleasure, satisfaction, guilt and pride

Understanding facial expression can be seen as a common phenomenon but has become the most essential indication in the history of emotional psychology. More recently, research on facial expressions has led to the emergence of new concepts, new techniques, and innovative results. In this case, scientists are formulating alternative accounts, while previous versions are acquiring new interests. Darwin's arguments suggest that emotions have evolved to the point of acting as an instrument of communication between individuals. In the year 2003 author Gao et L used dLHD and ID3 decision tree classification method (Noh et al in 2007). Zhao and Pietikainen in 2009 used SVM and Song et al in 2010 used SVM for the classification method. The researcher in his work specified that SVM classifier gives higest accuracy for several facial expressions [2]. The unsupervised learning algorithm called LVQ-Learning Vector Quantization (Bashyal in 2008) and MLP is also used for classification [3]. KNN algorithm (Poursaberi in 2012) is a method of classification through which relationship among the assessment models are estimated during training. HMM classifier be the one of the statistical representation for categorize expression into various types in face detection (Taylor in 2014). Classification and regression tree is machine learning algorithm (Salman in 2016) used for classification using distance vectors. CNN (2016). MFFNN, DNN (2015), MDC (Islam in 2018) are some of the classifiers used recently. With respect to many classifiers SVM gives improved reorganization accurateness and also better classification. Compared to the past algorithm used for classification presently the SVM classifier is greatly use classifier. Other classifiers like CART, pair wise, Neural Network based are used in modern years compared to past decades

Emotion recognition systems realize applications in several fascinating areas. With the recent advances in artificial intelligence, significantly automaton robots, the requirement for a strong expression recognition system is obvious. The recognition of emotions plays a very important role within the recognition of one's own fondness and in turn, helps to form a sensitive and sensitive human-machine interface (HCI). Additionally, the 2 main applications, particularly Artificial Intelligence and sensitive human machine interface, Emotion recognition systems area unit utilized in an outsized variety of alternative domains like telecommunications field, video gaming, video animation, psychiatry, in automotive security, educational computer system and many others. Many algorithms have been suggested to develop systems/applications that can detect emotions very well. Computer applications could communicate better by changing responses based on the emotional state of human users in various interactions

Emotion detection using the facial components suggested before is still being used. It was mainly observed that for emotion detection we need to do it by stage by stage. Preprocessing is the first stage, and then comes the feature extraction and then the classification. As the year passed there has been lot of growth and advancement in these three stages with different variety of algorithms. In the present observations more number of features are extracted from the faces to verify the emotions.Facial emotion recognition field is gaining a ton of attention and in past two decades with applications and modernization not solely within the sensory activity and psychological feature sciences, however additionally in emotional computing and computer animations. A much more modern study suggests that there are far more basic emotions than antecedently believed. Within the study revealed in Proceedings of National Academy of Sciences, researchers known 27 totally different classes of emotion. Instead of being entirely distinct, however, the researchers found that individual's expertise these emotions on a gradient. Recognition in the form of facial emotion and expression has additionally been increased. Recently because of fast development of machine learning and artificial intelligent (AI) techniques, as well as the human computer interaction, a computer game (VR), augment reality (AR). Detection of facial expression in advanced driver assistant systems and recreation is also found.

Although the technology for recognizing emotions is important and has evolved in different fields, it is still the unanswered problem. Detecting the feeling of being human can be achieved through the use of facial images, voice, and body shape. With this detection, the image of the face is the most frequent source and to detect emotions above the entire frontal facial image are commonly used to detect emotions. The procedure for recognizing emotions is not simple but complex because it extracts the appropriate characteristics and Detecting emotions requires complex steps.The Facial Expression Recognition (FER) consists of five phases as shown in Figure 1. Noise elimination/improvement is performed in the pre-processing phase take an image or a sequence of images (a time series of images from neutral to an expression) as an input face for further processing. Detection of facial components detects return on investment in eyes, nose, cheeks, mouth, eyes, forehead, ear, front head, etc. The characteristic extraction phase concerns the extraction of the characteristics from the ROI. Here, we discuss the work not included in previous surveys, which has changed in the last two decades in the detection of emotions. The topics discussed in the following sections are on the comparison between previously done work and the present research being carried out.
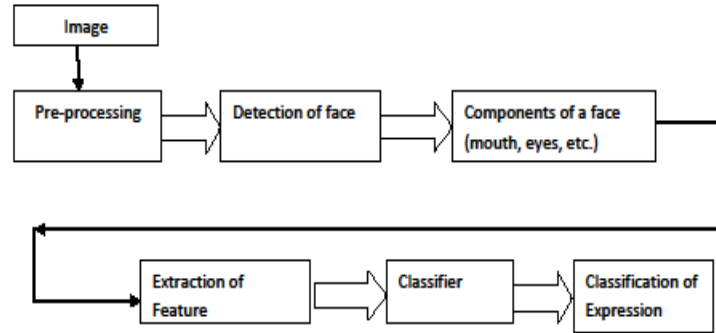
Figure 1. Phases of facial expression recognition

2.   RESEARCH METHOD

Pre-treatment will be the first step in detecting a face. To get purely facial images with good Intensity, proper size, and identical normalized shape we have to conduct pre-processing. To convert image into a clean image of the normalize face for taking out the characteristic is the detection of characteristic points, which rotate to get in line, identify and cut the facial region by means of a four-sided figure, according to the copy of the face. A single image in the Detector faces can be categorized into four methods based on Feature-based, Appearance-based, Knowledge-based and template based as shown in Figure 2.
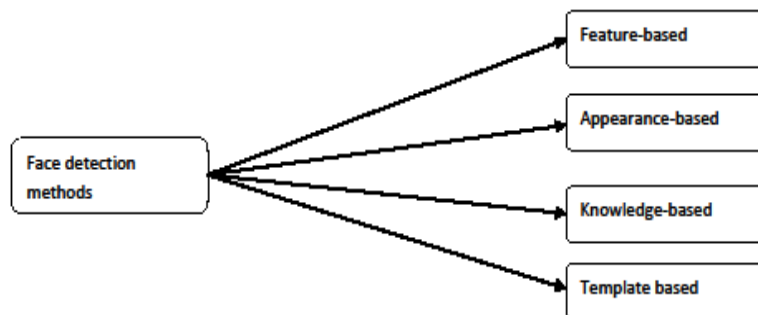

Figure 2. Face detection methods

2.1. Feature based

Feature based: This technique is used to find faces by extracting structural options within the face. Initially it will be trained as classifier and so to differentiate between which is facial and non-facial region. Concept is our self-generated information of faces is to beat the bonds. This approach divided into many steps and even photos with several faces they report a success rate of 94%.

2.2. Texture-based

Texture-Based: The recognition of the emotion is done on the plot characteristic extract from the gray-level coexistence matrix, GLCM characteristics are extracted and Format with the support machine carriers by diverse cores. Statistical and features that are taken from GLPM are given as the input for classification to SVM. The detection rate is identified as 90% [4]. The algorithm detects the characteristic points of a victimization abstraction filter technique by the data given by author [5]. The group indicates the victimization of the facial candidate. Initially it should be trained such that the classifier can identify the facial region and non-facial region. This technique is based on an 85% detection rate with one hundred images with different scales and direction of purpose.

2.3. Skin color based

Skin color Based: As expressed by author in [6], algorithms are compared using 3 colors. This mixture of color leads to face detection algorithm with color replacement. Once the skin region is obtained, the expression of the eyes is eliminated by obscuring the background colors and the image is reshaped in grayscale and the binary image as an acceptable limit. The rate of detection is accurate to 95.18.

2.4. Multiple feature

Multiple Feature: Adaboost has selected the multiple features of the face region algorithm [7]. The face is divided into different regions by different orthogonal regions. Components like nose, eyes, mouth are identified for the purpose of analysis. Area where the combination was used and given as input for the classifier. In this phase it will choose one of the best arrangements and then modify the weight in the coming process. Detection routine in many characters is great than the main component of the common orthogonal part analysis method.

2.5. Template matching methods

Template matching methods: when the image is given as an input this method will match it with the defined template and identify the face. For example, we can divide the face into many parts, like eyes, nose, mouth. Also, we can design a model in which can be helpful for the edge detection. This approach is easy to implement, however, it is not sufficient for detecting of face. However, shape of templates is planned and managed in these issues.

2.6. Appearance-based methods

Appearance-based methods: Designed mainly for face detection. The appearance-based technique depends on the number of people authorized coaching face pictures to search out face models. This type of approach is best compared to alternative when we think of performance. Generally, the appearance-based technique has faith in techniques from applied mathematics analysis and machine learning to search out the relevant characteristics of face pictures. This technique conjointly employed in feature extraction for face recognition.

3.   RESULTS AND DISCUSSIONS

Effect of light should be eliminated to scale for a fixed size image [8]. To identifies the face on the image automatically facial points should be detected. Algorithmic scheme proposed [9] with the technique [10] is commonly used for face detection. Algorithmic rule has been tested within the Cohn-Kanade info, also as in technology & Mathematical Modeling [11] info. Detection of fourteen points of facial expression with a median exactness of 86% in Cohn- Kanade info and 83% within the info of mathematical modeling.In Eigen face based algorithm of Yogesh Tayal et.al [12] applies to a mixture of images taken with special illuminations and background, the size of the image and the time needed for the algorithm is 4.5456 seconds. Here we can take Euclidean weight & distance of the input image. With the help of data base comparing, characteristics and calculation of recognizing of face is done. Knowledge based methods-this method mainly depends on rules that are set and it support human information in discovering the face. For example, face has a nose and mouth at a bound distance and same with the nose with one another. As the large drawback with this strategy is that the problem in constructing associate degree acceptable set of rule. Several false positive foundations were very general and careful. This type of approach alone is short andnot capable to search out several faces in numerous pictures. The face, color and shape of the skin adapt to the size of the window and to the color signature to calculate the color distance [13]. A face normally comprises nose, eyes & mouth with exact distance and their position with each other. The major problem in the method comes when rules have to be defined. Tactics reached 93.4% detection with false positives up to 7.1%.

3.1. Template matching

Template Matching: Author in his paper [14] says it is based on local, statistical and local characteristics Binary models (LBP) for the recognition of the independent expression of the person. The detection with help of MMI is equivalent to 86.97% and it is 85.6% in the JAFFE database.

3.2. Active shape model

Active Shape Model: Author in his paper [15], says the sequence of images is performed frankly Model of wire structure and algorithm for support of vector and tack of active appearance. The machine (SVM) is used for classification. The model deforms the shape for the final frame when the expression changed.

3.3. Distribution features

Distribution Features: Author in his paper [16] paper, the images were taken and five significant parts were cut out the image that is made for extraction and, therefore, stores the specific eigenvectors for expressions. The eigenvectors are calculated and input facial image is accepted. SVM is used for classification.

3.4. Feature extraction

Feature Extraction: It is a way of recognizing face. Several steps are involved such as Reduction, extraction of facial appearance and collection of characteristics. Dimensional decrease is a significant task in the form of recognition system. Figure 3 shows the different feature extraction with their recognition rate. Discrete Cosine Transform - Way in of image DCT is applied and features such as mouth, eyes are extracted from image [17] and classifier used is Ada boost with the recognition rate of 75.93%.
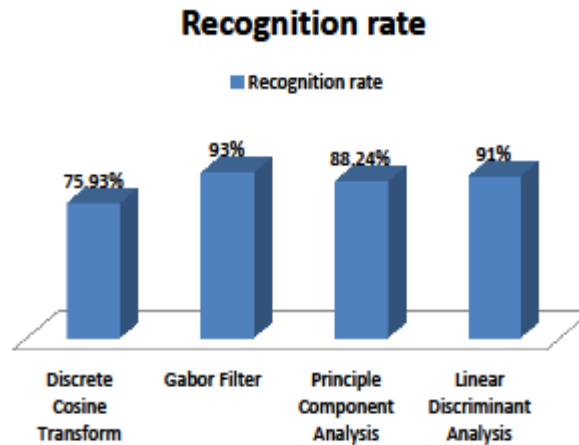
Recognition rate

■ Recognition rate

Figure 3. Feature extraction and recognition rate

3.5. Gabor filter

Gabor Filter: To separate different expression Gabor filters are used. The database of expressions used to recognize the recognition system was JAFFE and recognition rate is above 93%.

3.6. PCA

PCA: Extraction of facial features by analyzing the main components according to the author [18] Analysis of the main weighted components (WPCA) the method is used in merging multiple functions for the classification. The Euclidean distance is calculated to obtain the resemblance involving the models and therefore the recognition of the facial expression is done with the nearest algorithm. The recognition rate is 88.25% LDA: Linear discriminant method: was proposed for calculating discriminating vectors with two stage procedure [19]. Vectors are combined together using the K-means grouping method with each one change sample and 91% recognition was proposed in this classifications:

3.6.1. Hidden markov model

Hidden Markov Model: Hidden Markov model was developed, categorizing the higher emotional states as involved, insecure, disagreeing, hopeful and discouraging, starting from the lowest level. Author view is Emotional categorization is well formed to know the state of emotions, so it works as information, so a corresponding assignment is assigned between facial features. Expert Rule is used for segmenting & for recognizing the emotion state of number of video sequences. In this the probabilistic frame of modeling variable time sequence and the union of detection calculation is performed in actual time. Unsafe emotion reorganization is 87 %.

3.6.2. Neural networks

Neural Networks: There is an arrangement of 2 Methods, the extraction of features and the neural network. There are two phases in face detection & cataloging. Preprocessing of image is done to reduce the time taken and increase the time Image quality. Here neural network trains with face and not the face pictures as of the Yale Face information. Pictures within the knowledge set area unit 27x18 eighteen pixels the pictures area unit in Grayscale in wrangle forma and its speed of come is 84.4 percent.

3.6.3. Support vector machine

Support Vector Machine: Scanning of each video frames in real time for the first time will detect the front face, so the faces are resized in patches of images of the same size together by means of a bench Gabor energy filters. Finally, author developed a system that gives the style of completely different

countenance codes at twenty-four frames per second and animates the facial look generated by the computer; it's additionally the secret writing of absolutely computerized facial action. Therefore, the recognition rate is 93%.

3.6.4. AdaBoost

AdaBoost: The front face may be a sequence of pictures classified in seven categories as surprise, anger, fear, disgust neutral, joy, sadness. Here the popular technique is dead while not feature block. The color of the skin is detected during this document. The facial expression area unit extracted and at last the facial expressions area unit distinct from the shifting the characteristics of the world mark on the face from the formula projected by the author victimization Classifier supported AdaBoost. Therefore, the rate of accuracy is 90%. As shown in Figure 4 authors have different opinion for classifications and accuracy rate [20]. Table 1 shows the analysis of different methods and technique used for emotion detection with their accuracy.
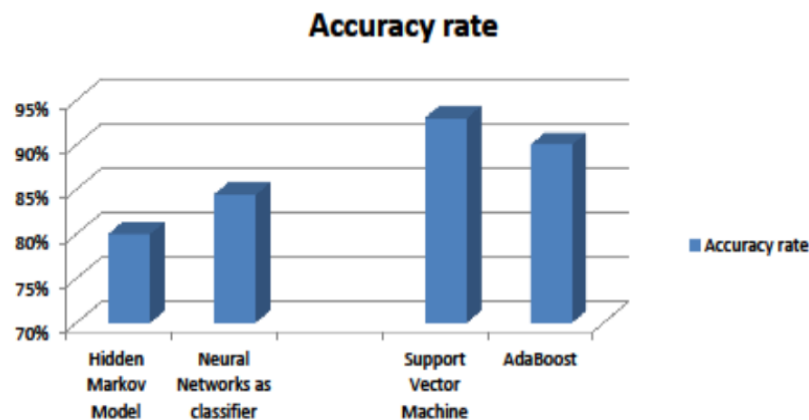

Figure 4. Classification and accuracy rate

Table 1. Analysis of different methods and its accuracy

Methods	Recognition Accuracy(%)	No. Of Expressions Recognized	Advantages And Major Contribution	Ref. and Year
CNN	Not reported	Not reported	-Multiscale feature extractor - In plane pose variation	[21] 2002
dLHD and LEM	86.6	3	Oriented structural features	[22] 2003
RVM-relevance vector machine	90.84	-	Recognition in Static images	[23] 2005
Multi stream HMMs	-	-	Recognition error reduced to 44 % compared to Single stream	[24]2006
ID3 decision tree	75	6	-Cost effective with respect to accuracy and with speed	[25] 2007
LVQ and GF	88.86	Not reported	Efficient emotion detection	[26]2008
SVM and GASM	6 93.85	Learning using Adaboost	-Selection was flexible	[27]2009
5 parallel bayesian classifiers	-	-	-Multi classification is achieved -Static and real time video	[28] 2010
SVM	82.5	6	-Based on distance features -Effective recognition highest CRR	[29]2011
LBP,SVM	95.84	6	-Image based recognition -Spatial temporal feature	[30]2012
Lines of connectivity	93.8	3	Triangular face using LC and geometric approach	[31]2013
GF,MFFNN	94.16	7	Computational cost is very less	[32]2014
SVM and DCT	98.63	6	Fast and high accuracy	[33]2015
OSELM-SC	95.17	6	-Online sequential extreme learning machine -Good recognition accuracy and robustness	[34]2017
DCT,GF,SVM	More than 90 percent	8	Good Detection rate in various light source	[35]2018
CNN,SVM	-	-	Better classification compared to state of art CNN -Deep learning Features	[36]2019

4. CONCLUSION

The purpose of this paper is to identify face detection problems and challenges and compare numerous ways for face detection. There's a major advancement in this area because it is helpful in real-world application product. Various face detection techniques are summarized, and eventually methods are mentioned for face detection, their options, advantages and accuracy. This paper compares algorithms which are helpful for emotion detection based on their accuracy and recent development. There is still an honest scope for work to urge economical results by combining or raising the choice of options for detection of face pictures in spite of intensity of background color or any occlusion.The important feature enhancements which are discussed from recent papers are emotion detection from the side views and different parameters for real time applications such as medical, robotics, forensic section and many more.

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