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A Review Paper on Facial Expression Recognition

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Abstract: Facial recognition and interpretation of human expression are becoming an integral part of Mobile apps, intelligent products and services. Facial expression which can describe the state and behaviour of human and can be used in security domain. Facial expression can be used in domains such as healthcare, marketing, environment, security and social media. In this facial expression recognition method we are extracting features using histogram oriented gradient (HOG), LBP, LTBP, which will extract features from static images and for classification Support vector machine (SVM), KNN is used. We are recognizing six basic expression which are happy, sad , surprise , anger, disgust ,fear and we will try to add more expressions.
Keywords: FERS, HOG, LBP, LTBP, KNN, GRNN, SVM, AAM, ANN

I. INTRODUCTION

Facial expression recognition by computer plays a key role in human computer interaction. Facial expressions, voice, hand gestures, body movement, heartbeat and blood pressure are the psychological characteristics used to identify the emotional state of a person. Compared to all these characteristics facial expressions and speech are the more expressive. According to Mehrabian, a psychologist, verbal language convey 7% of the message in face to face communication, speech convey 38% and facial expressions provide 55 % of the message. Ekman and Friesen research indicates facial expressions are universal and innate. Facial expressions convey the person's thought process and form a very powerful method of nonverbal communication. Facial expressions allows for rapid communication. There are six basic facial expressions Happy, Surprise, Disgust, Unhappy, Fear and Angry [2].

The next generation computing like pervasive computing, human computing and ambient intelligence will have to develop user interfaces that readily respond to naturally happening, multimodal, human communication. The principal functionality of this interface will be the capacity to perceive and understand human intentions and emotions as communicated through facial expressions [5]. The most significant issue in this challenging field of human – robot interaction is the capability to automatically recognize emotional state of a human being. FER related problems can be directly mapped to facial deformation. Different persons with varying degree of ethnicity, age and gender could express the same emotion, but with nimble differences and even then majority of the involved muscles work in such a way so as to give a coherent characterization of those emotions.

II. SHORT RESEARCH PAPER OUTLINE

A. Facial Expression Recognition Using General Regression Neural Network

Archana Shirsat, Tejal Uplenchwar, Kushal Tuckley, Kiran Talelev. The commonly used face detectors are the Viola-Jones face detector and Kanade-Lucas-Tomasitracker. Ada Boost Technique is used in the Viola-Jones face detection algorithm. Efficient Local Binary Pattern (LBP) technique is used obtain a feature vector which reduces the entire image data to a single feature vector ready for classification. There are two types of feature descriptors: Global Feature Descriptors and Local Feature Descriptors. Global descriptors are based on Geometry of pattern whereas Local descriptors are based on appearance of face pattern. The final step in the FER system is the classification of the extracted facial features into the six already defined classes namely: Happy, Unhappy, Surprise, Disgust, Fear and Angry. We use machine learning approach to classify the expressions. General Regression Neural Network (GRNN) is used for comparative analysis of different window sizes. GRNN belongs to a class of The emotion classification is a two class classification task. There are two emotional state of the person. First, positive emotions exhibiting Happy and Surprise expressions. Second negative emotions exhibiting Unhappy, Disgust, Fear and Angry expressions. Observation of face can help to decide if the person is serious, thinking, happy, sad or feeling pain , sad, disgust and so on. Many application areas such as crime investigation, medical sciences, market research, E-learning, Security, authenticate user etc. can benefit. classification task[3]. There are two emotional state of the person. First, positive emotions exhibiting Happy and Surprise expressions. Second negative emotions exhibiting Unhappy, Disgust, Fear and Angry expressions. Observation of face can help to decide if the person is serious, thinking, happy, sad or feeling pain, sad, disgust and so on. Many application areas such as crime investigation, medical sciences, market research, E-learning, Security, authenticate user etc. can benefit.

Unsupervised learning approach. It estimates the output directly from training data using any arbitrary function. A overall of 94.54% of accuracy is obtained but this method is only good for low resolution image.

B. Human Facial Expression Recognition from Static Images using Shape and Appearance Feature

Naveen Kumar H N, Jagadeesha S. The proposed work is implemented on Cohn-kanade data set for six basic expressions (happy, sad, surprise, anger, fear and disgust). The existing systems on FER can be categorized into two types; systems which rely on image sequences and systems which rely on static images so as to identify the inferred emotion. The fundamental block of FER system consists of face detection, HOG feature Extraction and SVM classification. Use of integral image representation in viola jones face detector makes the detection faster. Pre-processing stage is optional and operations such as geometric correction, histogram equalization and contrast enhancement, resizing and low used to classify the expression posed by a test image to a particular class of six basic expression

Pass filtering may be employed for the acquired image prior to feature extraction so as to improve the detection rate. Feature extraction block computes shape and appearance features from the face detected image using HOG feature. In the training phase of a classifier the extracted features from train image dataset are used to generate a model for training model FER system. In test phase, the same feature extracted from the test image is the average performance of the proposed work for Cohnkanade dataset is shown in above table. The overall accuracy is found to be 92.56%.

LBP	Geometric Features	HOG
91.7%	85%	92.56%

C. Facial Expression Recognition Based On Texture and Shape

Wenchao Zheng, Cuicui Liu. In this paper author uses facial expression recognition through the shape of facial feature points and texture information of specific areas based on Active Appearance Model (AAM). Model-based method: Edwards G and Cootes T: - the facial feature points through point distribution model and grey model, and used the position change of specific points as motion parameters to recognize facial expression.

1) *Techniques*: Active appearance model statistical model to detect facial feature point's key point is to find the right model parameters to ensure synthetic face close enough to the original expression composed of shape model and texture mode. The purposed approach can achieve accurate classification up to 89.23% and is also robust, reduction of feature dimension have retained the identification rate. Future work can focus on the process of AAM fitting, and the part reflecting expression difference need to have more weight, which will further improve expression identification rate.

D. Facial Recognition using Histogram of Gradients and Support Vector Machines

Face recognition is widely used where security is a major concern. The most common problem in face reorganization is arises due to pose variations, different illumination conditions. Face recognition is done using Histogram of Oriented Gradients (HOG) technique in AT & T database with an inclusion of a real time subject to evaluate the performance of the algorithm. The feature vectors generated by HOG descriptor are used to train Support Vector Machines (SVM) and results are verified against a given test input. SVM can be used most frequently as a binary classifier. However, it can be used to classify multi-class data.

The method checks whether a test image in different pose and lighting conditions is matched correctly with trained images of the facial database.

The method checks whether a test image in different pose and lighting conditions is matched correctly with trained images of the facial database. The results show minimal false positives and improved detection accuracy. The accuracy can be calculated by adding the true positive values and true negative values and dividing by total samples that we are taken. This shows an overall accuracy of 90.2439% computed. The future work involves the face recognition in 3D images using the deep learning where convolution neural network is used to train dataset because it captures high-level features providing good representation.

E. 3D Facial Expression Recognition Algorithm using

1) *Local Threshold Binary Pattern and Histogram of Oriented Gradient:* Facial expression which carries rich information of body behaviour is the leading carrier of human affective and the symbol of intelligence. Facial expression plays an important in communication is transmit more than half of information. Facial recognition is done using histogram of oriented gradients and LTBP for multi-feature fusion. Local Threshold Binary Pattern (LTBP) features which based on Local Binary Pattern (LBP).

Then it is used to combine with Histogram of Oriented Gradient (HOG) features to get multi-feature fusion for 3D facial expression recognition. We propose a method in which a new #d facial expression method named LTBP which has more local texture feature information based on LBP and second is fusion algorithm to fuse the LTBP and HOG. The dataset used in this are of Binghamton university called as BU-3dFE. The dataset contains 100 subjects of 56% female and 44% and this subject ranges from 18 to 70 years. This fusion of LTBP and HOG algorithm gives accuracy of 90.1%.

Table I: Summary of Different Extraction Segmentation Techniques

Feature Extraction Method	Description	Merits	Demerits
HOG feature Extraction	Feature extraction block computes shape and appearance features from the face detected image using HOG feature	1. Characteristics of local shape or gradient structure are better projected. 2.Shape and appearance of the face which are better characterized by intensity gradients or edge directions.	1.It is difficult to decide Cell size in HOG feature extraction
Local Binary Pattern	In which centre pixel and its corresponding neighbour pixels, calculate thresholding value for neighbour based on centre pixel.	a) It's robustness to monotonic grey-scale changes caused such as illumination variations. b) Its computational simplicity.	a) Binary data is sensitive to noise.
Active Appearance Model	For each image to be classified, calculate its initial appearance parameters c, and then gradually reduce the gap between the synthetic expression and the original Expression by an iterative approach.	1)Not robust to shape changes 2)Not robust to changes in pose and expression	a) All the information in the image region covered by the target object, rather than just that near modelled edges.

Table II: Summary of Different Classification Segmentation Techniques

Classifier	Description	Merits	Demerits
Support vector machine	a) It is also used for decision making. It works on two stages: 1) Off-line Process 2) Online Process b) Multi-class support vector machine as a set of binary SVM for training and classification	a) SVM is well suited to work with high dimensional data. b) Classification accuracy is more as compared to other conventional classification techniques. c) SVM is robust enough, even when training samples have some distortion.	a) Section of kernel function and kernel parameters for mapping original data into higher dimensional data is difficult. b) Learning process can be time consuming. c) It works only with two classes appropriately
Artificial Neural Network	a) Artificial Neural Networks are successful for classification in the area of pattern recognition and object detection. ANN is among the most powerful tools available for detecting subtle relationships in massive amounts of seemingly unrelated data	a) Relatively easy to use. b)Great for complex/abstract problems like image recognition.	a)Often abused in cases where simpler solutions like linear regression would be best. b) Increasing accuracy by a few percent can bump up the scale by several magnitudes
General regression neural network	a) GRNN can be used for regression, prediction, and classification. b) GRNN can be a good solution for online dynamical systems.	a) Single-pass learning so no backpropagation is required. b)High accuracy in the estimation since it uses Gaussian functions. c)it can handle noises in the inputs	a)Its size can grow to huge size which computationally expensive. b)There is no optimal method to improve it
K- nearest neighbour	a) In ***k***-nearest neighbours algorithm (*k*-NN) is a non-parametric method and used for classification and regression	a) It can be used for both classification as well as regression predictive problems. b)It is robust to noisy training data.	a) In the KNN distance based learning is not clear. b)We need to determine value of parameter K.

III. CONCLUSION

In this paper we conclude that different techniques are used for facial expression recognition (FER) system. Every technique has some merits and negative marks. For feature extraction we can use histogram of oriented gradient, local binary pattern and active appearance model methods. For classification we can use support vector machine, artificial neural network [1]. Additionally see different classification techniques with its benefits and negative marks. For more accuracy we can use histogram of oriented gradient for feature extraction and support vector machine for classification.

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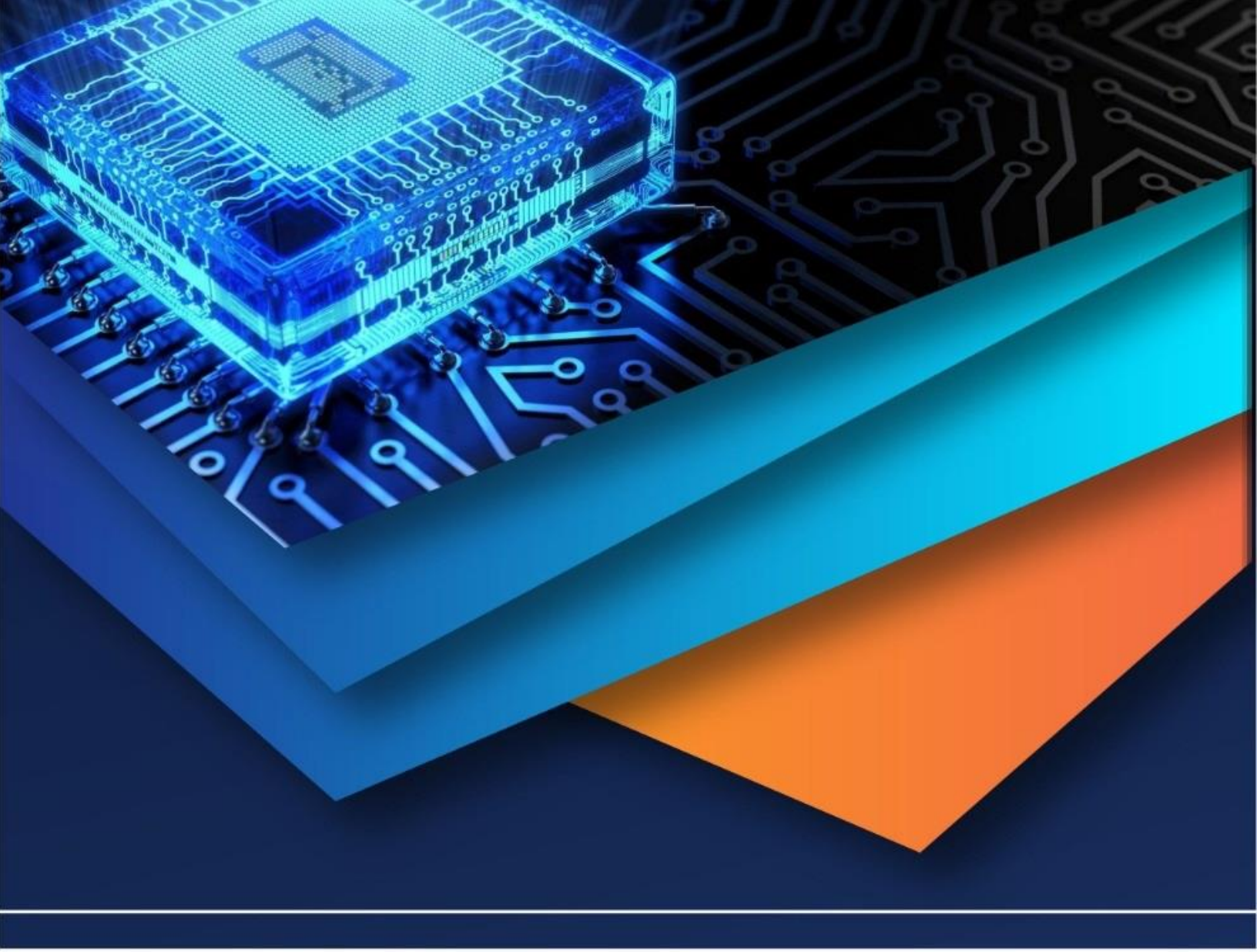

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