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A Survey On Human Facial Expression Recognition Using Machine Learning

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Abstract: *Emotion plays an important role in communication, social interaction, biometric security. It can display personal emotions and indicate an individual's intentions. Not only within people. If Humans want to interact with computers facial expression recognition is essential. Human brain's neural network is very complex to understand Many algorithms are used for recognition but they all lack in one thing that is accuracy. Generally Images and videos are used for recognition. But for effective recognition Head rotations and its positions are to be considered. With that the facial features like eyes, mouth, nose, lips can be extracted from face to identify emotion. Profile salient facial patches (PSFP) Algorithm can be helpful for precision in recognition. By using this algorithm facial landmarks can be detected easily and the slightest detail of the face can be determined. From this study the integration of information from facial expressions and the emotions of a human like netural, happiness, sadness, fear, surprise, disgust, and anger can be recognized by using algorithms like Profile salient facial patches (PSFP), Viola–Jones, Ensemble algorithm (Ada-AdaSVM), robust 3D head-tracking. This analysis can provides insight into artificial intelligence or machine intelligence that uses machine-learning algorithms to simulate the human brain.*

Keywords: Facial expression, Emotion recognition, Head rotation, Image processing, facial dataset

I. INTRODUCTION

Facial expression provides valuable information about human psychology and that information is used to analyze mood of a person. Facial expression recognition is mainly to recognize emotional state of human beings. Emotion plays a key role in social interaction which can be detected by several factors such as facial expressions, body gestures, and speech patterns. This recognition is based on facial muscle movement. Human brain translates the thoughts and feelings of human by facial emotion, speech, body movements which helps in deciding the behavioural patterns of a person and his ability to communicate. Each emotion has a different muscle movement and facial patterns these movements and patterns can be automatically detected using various machine learning techniques such as Profile salient facial patches (PSFP) , Viola–Jones, Ensemble algorithm (Ada-AdaSVM), robust 3D head-tracking. These techniques classify and divided our facial features into different categories such as eyes, noes, eye brows, lips. So, by this facial expression recognition system human emotion can be determined in an easy and effective manner and accurately classify the facial expressions into various categories such as netural, happiness, sadness, fear, surprise, disgust, and anger.

II. LITERATURE SURVEY

[1] Bin Jiang1* ,Qiuwen Zhang1 , Zuhe Li1 Qinggang Wu1 and Huanlong Zhang2 (2021). Non-frontal facial expression recognition based on salient facial patches. jivp-eurasipjournals.springeropen.com, 1-19.

This paper is about a method called salient facial patches (SFPs) which plays a major role in facial expression recognition. This salient facial patches method useonly frontal face images or videos for recognizing the expressions. Under different head rotations ,this method is very effective for decting and recognizing facial expressions.For detecting facial landmarks and estimating head poses from profile face images, a tree-structured part model is used for pose-free landmark localization. To obtain the salient facial patches from profile face images, the facial patches are selected using the detected facial landmarks while avoiding their overlap or exceed of the actual face range. By using this method detection will be easy and can achieve higher accuracies under most head rotations.

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[2] L. B. Krithika 1·G.Lakshmi Priya 1 (2020). Graph based feature extraction and hybrid classification approach for facial expressionrecognition.link.springer.com,1-17.This paper is about a method called Graph based feature extraction and hybrid classification approach (GFE-HCA) for effective and accurate recognition of facial expression.Many algorithms are utilized for recognizing the facial expressions, but they lack in the issues like inaccurate recognition of facial expression. Initially, the face image is identified using the viola jones algorithm. The facial parts such as right eye, left eye, nose and mouth are extracted from the detected facial image.

The graph based feature extraction and hybrid classification approach helps to extract the features from the extracted facial parts. From these extracted features, facial expressions are recognized and classified using a self organizing map based neural network classifer. By using this method results in increase of facial expression recognition rate.

[3] Mukku Nisanth Kartheek1,2 · Munaga V. N. K. Prasad1 Raju Bhukya2 (2021). Modified chess patterns: handcrafted feature descriptors for facial expression recognition. link.springer.com, 1-20.Methods like Radial cross pattern, chess symmetric pattern and radial cross symmetric pattern are used for accurate and efficient facial expression recognition. The main task is to develop feature descriptors that could effectively classify the facial expressions into various categories. These are implemented in a 5 × 5 overlapping neighborhood to overcome some of the limitations of the existing methods such as Chess Pattern (CP), Local Gradient Coding (LGC) and its variants.There are 24 pixles surrounding the center pixal and radial cross pattern extracts two feature values by comparing 16 pixels with the center pixel and chess symmetric pattern extracts one feature value from the remaining 8 pixels.

The experiments are conducted using RCP and CSP independently. This method demonstrates the efficiency to recognize and detected the emotions and personal feelings of an individual.

[4] Ebenezer Owusu , Justice Kwame Appati 1* and Percy Okae 2 (2022). Robust facial expression recognition system in higher poses. link.springer.com,1-15. This paper is about the algorithm called robust 3D head-tracking which is used for the recognition of facial emotion expression recognition.The facial features are tracked from one frame to the next using the ellipsoidal tracking model and the visible expressive facial key points are extracted using Gaborfilters. The ensemble algorithm Ada-AdaSVM is then used for feature selection and classifcation. This algorithm is used to improve the recognition accuracy in severe head poses by proposing a robust 3D head-tracking algorithm based on an ellipsoidal model, advanced ensemble of AdaBoost, and saturated vector machine. This technique is evaluated using the Bosphorus, BU-3DFE, MMI, CK+, and BP4D-Spontaneous facial expression databases.

[5] AndryChowanda (2021). Separable convolutional neural networks for facial expressions recognition. link.springer.com, 1-17.This paper is about the method called Automatic facial expressions recognition to automatically capture, recognize, and understand emotions from the interlocutor. Many techniques proposed to increase the accuracy of emotions recognition from facial cues. This method aims to build compact networks with depth wise separable layers while also maintaining performance. Convolutional neural networks require an enormous computational power to train and process emotional recognition. This techniques enables the researcher to understand and recognize the emotions displayed through our facial expressions. These patterns can be automatically detected, learned through machine learning techniques and mapped to the appropriate emotions.

IIII. METHODOLOGY

3.1 Methodology 1

Profile Salient Facial Patches

Profile salient facial patches is a face detection method which is used for human facial expression recognition.The accurate detection of facial landmarks can improve the accuracy of salient facial patches on the non frontal face images. There are three main steps in the non frontal facial expression recognition system face detection, feature extraction, and feature classification, face detection, feature extraction, feature classification.

The head pose may be a combination of different directions in a three-dimensional space. This approach is highly suitable for non-frontal facial expression recognition. To simultaneously detect the human face and track facial feature points use global mixtures to model topological changes due to viewpoint variations.

For each viewpoint i, i∈ (1, 2, ⋯, m), they define n node tree

$$T_i = (V_i, E_i), V_i \subseteq V.$$

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The connection between the two parts forms an edge in Ei. There are two main steps in their frameworkInitialization. For each viewpoint i, the measuring of landmark configuration s = (s1, s2, ,sN) is defined by scoring function f:

$$f_i(I,s) = \sum_{j \in V_i} q_i(I,s_j) + \sum_{(j,k) \in E_i} g_i(s_j,s_k)$$

$$s* = \arg\max_{i \in (1,2,\cdots,M)} f_i(I,s)$$

Once the initial facial landmarks s have been detected procrustes analysis is employed to project the 3D reference shape model onto a 2D face image.

3.2 Methodology 2

ROBUST 3D HEAD TRACKING:

Robust 3D Head tracking is a method which tracks the facial features from one frame to the next using 3D facial data. With 3D data, information, such as the size and shape of an object, can be correctly estimated in each frame without prior assumptions.The first priority is to detect the focal points in each frame .The next step is to search for matching features or objects across all frames. This method addresses the changing behavior of a moving object and the preceding annotations of the scene. This procedure uploads images and robustly tracks the features across frames using the proposed ellipsoidal model. llipsoidal feature tracking method can Accurate track a human face from the forehead, to the left cheek, to the chin, to the right cheek and back to the same spot on the forehead where the tracking began unmistakably demonstrates that the human face is best shaped like an ellipse. with N feature points tracked across frames, where N represents the most relevant feature points. Finally, this is a multi view system based on the assumption that cameras are positioned around the subject to capture various rotation movements.

IV. RESULTS AND DISCUSSION

4.1 Methodology 1

Profile Salient Facial Patches

Headpose	HOG	LPB	Gabor
90	97.92	96.67	95.83
45	99.17	98.75	98.33
0	100	100	100
-45	100	98.75	99.85
-90	98.33	99.17	96.25

Each facial expression is shown with three different gaze directions: frontal, left, and right. This method can estimate the head poses along pitch, yaw, and roll directions. However the method was only needed to estimate the head poses along the yaw direction. The size of the facial patches was typically set to 16 × 16. HOG, LBP where, P = 8, R = 1 and Gabor filters where, u = 1, v = 1, 2, ⋯, 8 were respectively applied for the feature extraction.

4.2 Methodology 2

Robust 3D Head Tracking

In addition to the 6 basic emotional expressions, various systematic head poses and 13 yaw and pitch rotations were presented. Texture images have a resolution of 1600×1200 pixels whereas the 3D faces comprise approximately 35,000 vertices.

The expressions included anger, disgust, fear, happiness, neutral, sadness, and surprise. The average recognition accuracy is 97.2%.

$$\alpha(t) = \left\{ f_j(t) \middle| 1 \le j \le N \right\}$$

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Pose	Expression	Average recognition(%)	Expression	Average Recognition(%)
10 Yaw	Neutral	100	Happiness	99.2
20 Yaw	Neutral	99.8	Sadness	98.0
30 Yaw	Neutral	99.2	Disgust	98.4
L45 Yaw	Neutral	97.3	Anger	98.4
R45 Yaw	Neutral	97.8	Fear	99.4
L90 Yaw	Neutral	63.2	Surprise	99.6
R90 Yaw	Neutral	78.2	Overall average	98.9
PR	Neutral	89.2		
CR	Neutral	98.2		

V. CONCLUSION

In this paper several machine learning techniques are applied for recognition of human facial emotion. PSFP an algorithm based on salient facial patches was used for emotion recognition. The main advantage of PSFP is its facial landmark detection method to track key points from a pose free human face. And this algorithm determines the facial patches under different head rotations with high accuracy. Robust 3D Head tracking is a method based on 3D facial data. Its main advantage is that it tracks the facial features from one frame to the next using 3D facial data. This algorithm can Accurately track a human face from the forehead ,to the left cheek, to the chin, to the right cheek and back to the same spot on the forehead where the tracking began unmistakably demonstrates that the human face is best shaped like an ellipse. It is concluded from the results that the proposed recognition methods are efficient and reliable for human facial expression recognition.

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