IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Facial Expression Recognition Based on Deep Learning Algorithm

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Abstract:

Facial expressions play an important role in conveying the emotional states of human beings. Classification of human emotions remains an important and challenging task for many computer vision algorithms. Recently, deep learning approaches have been applied to emotion recognition field due to the discriminative power of Convolutional Neural Network (CNN). In this project, to predict the patient facial expressions automatically using HAAR Cascade and CNN Algorithm. If it is negative emotion, gives an alert message to the doctor. HAAR Cascade algorithm used to extract the facial points of humans. And Convolutional Neural Network (CNN) Algorithm used to predict the human emotions in which matching the feature vectors of trained model then label the emotions. After, classify the emotions if it is positive or negative emotions with improved accuracy.

Keywords: Facial expressions, human emotions, deep learning approaches, facial points, HAAR Cascade, Convolutional Neural Network (CNN).

I.Introduction:

Facial emotion recognition is the process of detecting human emotions from facial expressions. The human brain recognizes emotions automatically, and software has now been developed that can recognize emotions as well. This technology is becoming more accurate all the time, and will eventually be able to read emotions as well as our brains do. AI can detect emotions by learning what each facial expression means and applying that knowledge to the new information presented to it. Facial expressions play an important role in conveying the emotional states of human beings. Classification of human emotions remains an important and challenging task for many computer vision algorithms. Recently, deep learning approaches have been applied to emotion recognition field due to the discriminative power of Convolutional Neural Network (CNN). In this project, to predict the patient facial emotions automatically using HAAR Cascade and CNN Algorithm. If it is negative emotion, gives an alert message to the doctor. This project contains two phases. They are Training phase and Testing phase. In Training phase, We trained seven basic emotions are angry, disgusted, fearful, happy, neutral, sad, surprised. First, Admin or Doctor upload the datasets. The uploaded datasets contain 2D face images. Next, Admin trains the feature vector points for each emotion using HAAR Cascade algorithm by extract the facial points of humans like Nose, lip and eye features and these are stored in emotional database. And in Testing phase, Real time face capturing by web camera that also 2D images. Then, only detects the foreground face of the image. After construct the feature vector points of the face by using HAAR Cascade Algorithm. And it goes to emotional database. In this database, Convolutional Neural

Network (CNN) is in built it predicts the human emotions in which matching the feature vectors of trained model then label the emotions. After, classify the emotions if it is positive or negative emotions with improved accuracy. If the emotion can be negative means, automatically send the alert message to the doctor.

II.Literature Survey:

Aishwarya Kulkarni [1] proposed one such intelligent system to recognize human facial expressions automatically. The system has been segmented into four phases. The first phase involves pre-processing and face detection. The second phase involves segmentation and feature point extraction. The third phase involves data reduction method which reduces the dimension of feature points of the facial components obtained by feature point extraction. The fourth phase involves the emotion classification wherein the face is classified based on the emotions it exhibit.

Ashutosh Vaish [2] proposed emotion detection is exploited by taking the Accelerated Kaze (A-Kaze) features for emotion recognition. The Kaze Features work in a way such that object boundaries can be preserved by making blurring locally adaptive to the image data without severely affecting the noise-reducing capability of the Gaussian blurring, thereby increasing the accuracy of the system. After extracting the Kaze features, GMM is constructed and thus a Fisher Vector representation is made. The extracted features are passed through an SVM detector. An efficiency of 87.5% has been shown thus proving that Kaze can also be used effectively in the field of facial image processing.

Biao Yang [3] proposed Facial expression recognition (FER) is a significant task for machines to understand the emotional changes in human beings. However, accurate hand-crafted features that are highly related to changes in expression are difficult to extract because of the influences of individual difference and variations in emotional intensity. Therefore, features that can accurately describe the changes in facial expressions are urgently required. Method: A weighted mixture deep neural network (WMDNN) is proposed to automatically extract features that are effective for FER tasks. Several pre-processing approaches, such as face detection, rotation rectification, and data augmentation, are implemented to restrict regions for FER. Two channels of facial images, including facial grayscale images and their corresponding local binary pattern (LBP) facial images, are processed by WMDNN. Expression-related features of facial grayscale images are extracted by fine-tuning a partial VGG16 network, the parameters of which are initialized using VGG16 model trained on ImageNet database. Features of LBP facial images are extracted by a shallow convolutional neural network (CNN) built based on DeepID. The outputs of both channels are fused in a weighted manner. The result of final recognition is calculated using softmax classification. Results: Experimental results indicate that the proposed algorithm can recognize six basic facial expressions (happiness, sadness, anger, disgust, fear, and surprise) with high accuracy. The average recognition accuracies for benchmarking datasets "CK+," "JAFFE," and "Oulu-CASIA" are 0.970, 0.922, and 0.923, respectively.

Byoung Chul Ko [4] proposed FER can be conducted using multiple sensors, this review focuses on studies that exclusively use facial images, because visual expressions are one of the main information channels in interpersonal communication. This paper provides a brief review of researches in the field of FER conducted over the past decades. First, conventional FER approaches are described along with a summary of the representative categories of FER systems and their main algorithms. Deep-learning-based FER approaches using deep networks enabling "end-to-end" learning are then presented. This review also focuses on an up-to-date hybrid deep-learning approach combining a convolutional neural network (CNN) for the spatial features of an individual frame and long short-term memory (LSTM) for temporal features of consecutive frames.

Dhwani Mehta [5] proposed Extensive possibilities of applications have made emotion recognition ineluctable and challenging in the field of computer science. The use of non-verbal cues such as gestures, body movement, and facial expressions convey the feeling and the feedback to the user. This discipline of Human–Computer Interaction places reliance on the algorithmic robustness and the sensitivity of the sensor to ameliorate the recognition. Sensors play a significant role in accurate detection by providing

a very high-quality input, hence increasing the efficiency and the reliability of the system. Automatic recognition of human emotions would help in teaching social intelligence in the machines. This paper presents a brief study of the various approaches and the techniques of emotion recognition. The survey covers a succinct review of the databases that are considered as data sets for algorithms detecting the emotions by facial expressions. Later, mixed reality device Microsoft HoloLens (MHL) is introduced for observing emotion recognition in Augmented Reality (AR). A brief introduction of its sensors, their application in emotion recognition and some preliminary results of emotion recognition using MHL are presented. The paper then concludes by comparing results of emotion recognition by the MHL and a regular webcam.

Feng-Ju Chang [6] proposed a deep learning based method for estimating 3D facial expression coefficients. Unlike previous work, our process does not relay on facial landmark detection methods as a proxy step. Recent methods have shown that a CNN can be trained to regress accurate and discriminative 3D morphable model (3DMM) representations, directly from image intensities. By foregoing facial landmark detection, these methods were able to estimate shapes for occluded faces appearing in unprecedented in-the-wild viewing conditions. We build on those methods by showing that facial expressions can also be estimated by a robust, deep, landmark-free approach. Our ExpNet CNN is applied directly to the intensities of a face image and regresses a 29D vector of 3D expression coefficients. We propose a unique method for collecting data to train this network, leveraging on the robustness of deep networks to training label noise. We further offer a novel means of evaluating the accuracy of estimated expression coefficients: by measuring how well they capture facial emotions on the CK+ and EmotiW-17 emotion recognition benchmarks. We show that our ExpNet produces expression coefficients which better discriminate between facial emotions than those obtained using state of the art, facial landmark detection techniques. Moreover, this advantage grows as image scales drop, demonstrating that our ExpNet is more robust to scale changes than landmark detection methods. Finally, at the same level of accuracy, our ExpNet is orders of magnitude faster than its alternatives.

Ivona Tautkute [7] proposed Classification of human emotions remains an important and challenging task for many computer vision algorithms, especially in the era of humanoid robots which coexist with humans in their everyday life. Currently proposed methods for emotion recognition solve this task using multi-layered convolutional networks that do not explicitly infer any facial features in the classification phase. In this work, we postulate a fundamentally different approach to solve emotion recognition task that relies on incorporating facial landmarks as a part of the classification loss function. To that end, we extend a recently proposed Deep Alignment Network (DAN), that achieves state-of-the-art results in the recent facial landmark recognition challenge, with a term related to facial features. Thanks to this simple modification, our model called EmotionalDAN is able to outperform state-of-the-art emotion classification methods on two challenging benchmark dataset by up to 5%.

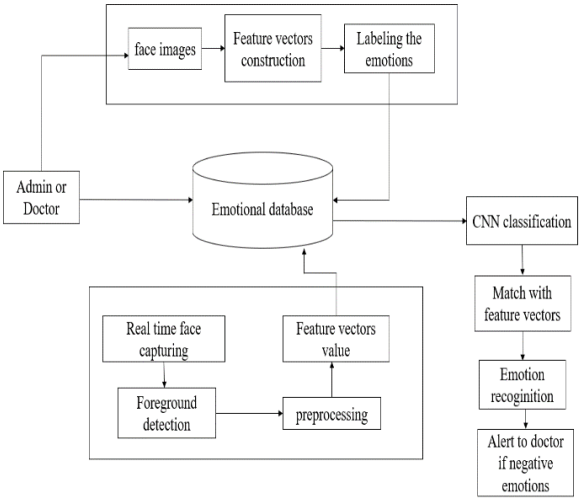
Pratik Gala [8] proposed the most essential component of an individual's body is the human face and it acts as the main indicator for the behavioral and the emotional state of the individual. Information can be extracted from the human face in the form of facial features which can then be processed and trained to identify the mood of the individual. For recognition of an individual's mood, the system uses Facial Expression Recognition (FER) concept and depending on the recognized mood, song is played. This system eliminates the time-consuming and the tedious work of manually playing the songs from any playlist available on the Web or in any other Application. For face detection, the system utilizes the Viola-Jones (VJ) Algorithm along with Bounding Box technique while for the purpose of feature extraction Principal Component Analysis (PCA) is used along with the concept of finding the minimum Euclidean distance which classifies the mood of the individual.

Yingruo Fan [9] proposed a novel Multi-Region Ensemble CNN (MRE-CNN) framework for facial expression recognition, which aims to enhance the learning power of CNN models by capturing both the global and the local features from multiple human face sub-regions. Second, the weighted prediction scores from each sub-network are aggregated to produce the final prediction of high accuracy. Third, we investigate

the effects of different sub-regions of the whole face on facial expression recognition. Our proposed method is evaluated based on two well-known publicly available facial expression databases: AFEW 7.0 and RAF-DB, and has been shown to achieve the state-of-the-art recognition accuracy.

Zhanpeng Zhang [10] proposed Interpersonal relation defines the association, e.g., warm, friendliness, and dominance, between two or more people. We investigate if such fine-grained and high-level relation traits can be characterized and quantified from face images in the wild. We address this challenging problem by first studying a deep network architecture for robust recognition of facial expressions. Unlike existing models that typically learn from facial expression labels alone, we devise an effective multitask network that is capable of learning from rich auxiliary attributes such as gender, age, and head pose, beyond just facial expression data. While conventional supervised training requires datasets with complete labels (e.g., all samples must be labeled with gender, age, and expression), we show that this requirement can be relaxed via a novel attribute propagation method. The approach further allows us to leverage the inherent correspondences between heterogeneous attribute sources despite the disparate distributions of different datasets. With the network we demonstrate state-of-the-art results on existing facial expression recognition benchmarks. To predict interpersonal relation, we use the expression recognition network as branches for a Siamese model. Extensive experiments show that our model is capable of mining mutual context of faces for accurate fine-grained interpersonal prediction.

III.Proposed Architecture with Module Explanations:



- **Facial image Acquisition:**

  capture the face image or upload the datasets. The uploaded datasets contains 2D face images. In face recoginition, identify the faces which are captured by web camera. The web camera images also 2D images.

- **Preprocessing and Facial features extraction:**

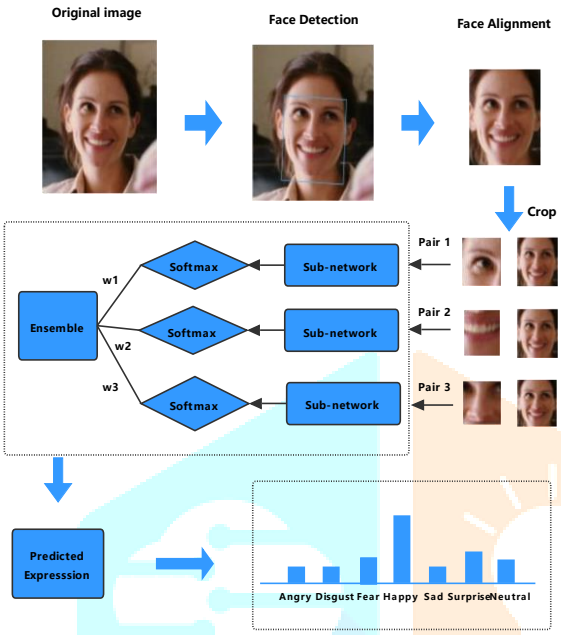
  Admin can train the feature vector points for each emotions. And enable the camera to identify background and foreground pixels. Finally detect the facial points for future verification. Extract the facial features using iterative closest points. Nose tip detection perform, after that lip and eye features are extracted. Extract features using HAAR cascade algorithm.

- **Emotion classification algorithm and Notification:**

  Implement Convolutional Neural Network (CNN) deep learning algorithm to match with facial features. Categorize the emotions such as positive and negative emotions. Can capture image in real time and match the test features with emotion databases. If the emotion can be negative means, automatically send alert to doctor.

IV. Methodologies:

In this project, to predict the patient facial emotions automatically using HAAR Cascade and CNN Algorithm. If it is negative emotion, gives an alert message to the doctor.



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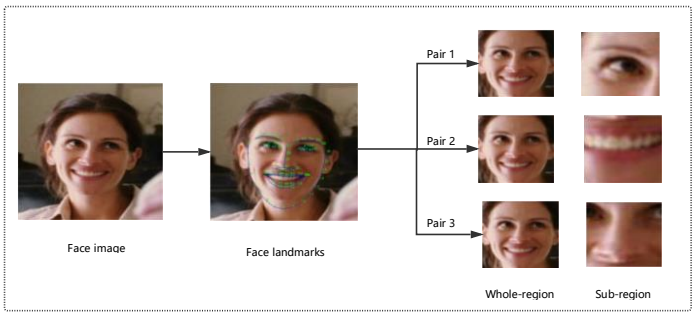
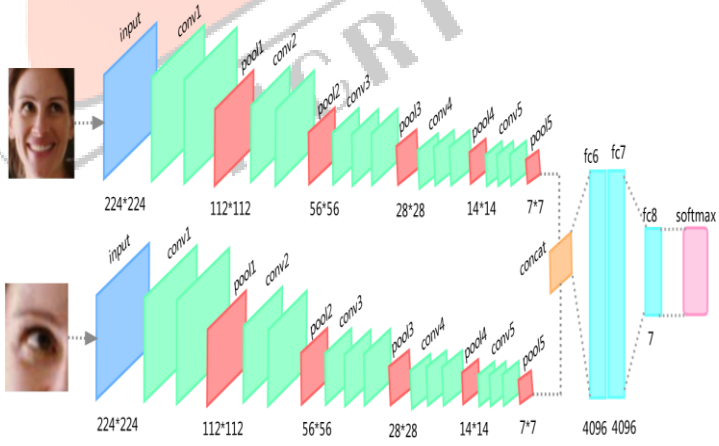
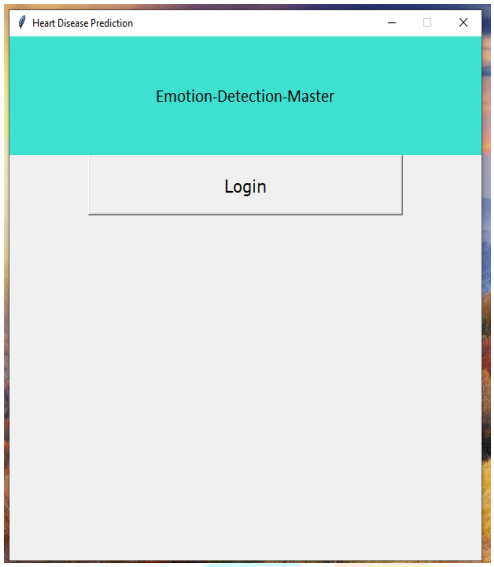


And in Testing phase, Real time face capturing by web camera that also 2D images. Then, it only detects the foreground face of the image. After construct the feature vector points of the face by using HAAR Cascade Algorithm. And it goes to emotional database. In this database, Convolutional Neural Network (CNN) is in built it predicts the human emotions in which matching the feature vectors of trained model then label the emotions. After, classify the emotions if it is positive or negative emotions with improved accuracy. If the emotion can be negative means, automatically send the alert message to the doctor.

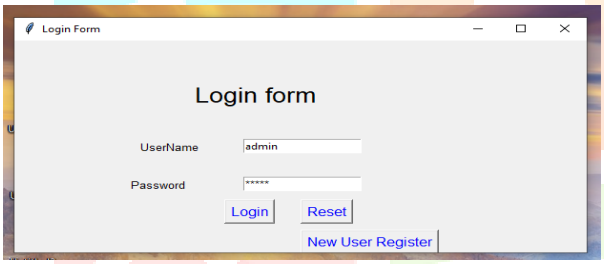


V.Experimental Results:

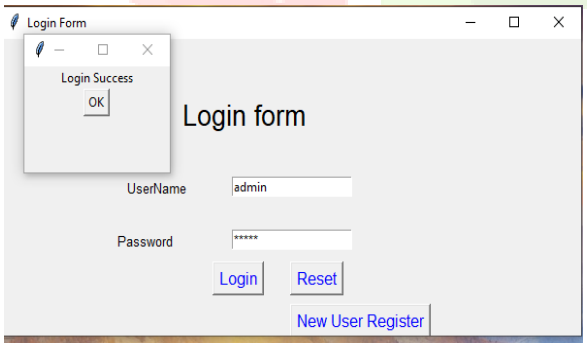
Home Page:



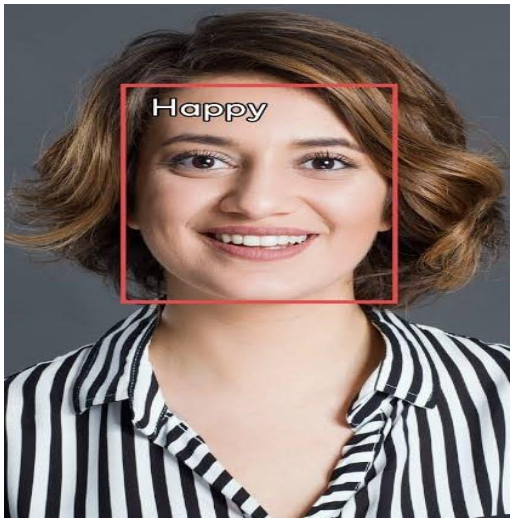
Login Page:



Login Success message:



Face Emotion Detection:



Alert Message:

VI.Conclusion:

The face detection and emotion recognition are very challenging tasks. They require a heavy effort for enhancing the performance measures of face detection and emotion recognition. This area of emotion recognition is gaining attention owing to its applications in various domains such as gaming, software engineering, and education. This paper presented a detailed survey of the various approaches and techniques implemented for those

approaches to detect human facial expressions for identification of emotions using HAAR Cascade and Convolutional Neural Network (CNN) Algorithms. Also it classify the positive and negative emotions. If it is negative emotion, it sends alert message to the doctor. In future, we enhance the text message alert to voice message alert and we predict more than seven facial expressions and then, we predict the emotions more than one patients at a time.

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