

Facial Emotion Recognition using Convolutional Neural Network

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Abstract: Human Facial Emotions fetch much of information visually rather than articulately. Facial Emotion Recognition plays a significant role in human-machine interaction. Automatic facial emotion recognition system has multiple applications, but not limited to human behavior understanding, synthetic human expressions and detection of mental disorder. Recognizing emotions high recognition rate by computer is a very challenging task to perform. The two very popular methods proposed to use mostly in automatic FER systems are based on the geometry and appearance of the structure. Facial Emotion Recognition is mainly performed in 4 stages, which are pre-processing, phase detection, feature extraction and expression classification.

Keywords: Autistic, Convolutional Neural Network (CNN), Django, Keras, Machine Learning (ML).

1. Introduction

Recognizing the Facial Emotion Expression has been a very easy task for humans, but achieving the same with computer algorithm a very difficult task to perform. Few times it is difficult for a person to recognize the emotions of another person. With the wide advancement in computer technology and machine learning, we are now able to detect emotions from images and recognize them. In the interpersonal relationship Human emotion recognition plays a very important role. Emotions are reflected from hand and gestures of the body, speech and through facial expressions. The emotions are automatically recognized by human brain and to do the same, software has been developed.

The automatic recognition of emotions has been a conversational and interesting subject from the early eras; there is little advancement that is made in the field. Extracting and understanding of emotions has preferential interplay between human-machine communications. The main motto of this paper was to introduce a method based on facial emotion recognition which identifies student's understanding over distant learning process.

The proposed facial emotion recognition model, mainly includes three stages, they are feature extraction, secondly, the subset features and finally, emotion classifiers. Haar Cascades method is applied to find the input images i.e., the face, for

extraction of eyes and mouth, and then through the Sobel edge detection to gain the characteristic value. With the help of Neural Network classifiers, six types of emotions are recognized and classified.

2. Literature Review

Akriti Jaiswal et al. [1] paper displays the design of artificial intelligence system which is skilled to detect emotions using facial expressions. The paper debates about the emotion detection procedure.

Ashwin T S, et al. [2] paper predicts about the multiuser face detection-based eLearning system which uses SVM which is based on supervised machine learning technique. Experimental results show that this system has an accuracy of about 89% to 100% with different datasets. They have used GPU along with CPU which improves the speed of the emotional feature processing and the system achieves a speedup factor of 2.

Pyae Phyoo Thu et al. [3] paper has discovered the performance of emotion-based satire detection model using machine learning algorithms such as Regression, Naïve Bayes, SVM and ensemble classifiers. Experiments made on shifting base classifiers used to ensemble classifiers prove that the model is unclear and implicit in nature of satirical emotions which can lead to misclassification of accuracy.

Pooja Rani et al. [4] paper has been successful to work on detecting the emotions of autistic children from their facial expressions. They have worked on four emotions like sad, happy, neutral and angry. Detection of facial emotions of the autistic children is performed using algorithms such as image processing and machine learning. Local Binary pattern is used to extract features from the faces of the autistic children.

Dario Bertero et al. [5] paper dealt with a real-time Convolutional Neural Network model for detecting speech emotions. The model was trained using raw audio from some small datasets such as TEDx talks speech data which is automatically interpret into three emotion classes like angry, happy and sad. It has achieved an accuracy which is 5% higher than a feature-based SVM baseline with an accuracy of 66:1% with evaluation time of some hundred milliseconds.

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Binh T. Nguyen *et al.* [6] paper grants a possible method to detect human emotions. Facial landmarks are extracted for the faces which are detected in camera. Different kinds of features are then examined for predicting the emotions. The system detects emotions with an accuracy of 70.65%.

Prashanth Kannadaguli *et al.* [7] paper has created an emotion detection system based on Bayesian multivariate modeling. It compares the same with Hidden Markov Modeling (HMM) scheme. Both the systems are built using probabilistic pattern recognition and acoustic phonetic recognition. As kannada is a South Indian language and the author is a native kannada speaker, he used four emotions in Kannada to analyze the schemes.

Mandar Deshpande *et al.* [8] paper targets to natural language processing on Twitter feeds which conducts emotion analysis mainly on depression. Some Individual tweets are distinguished into two: neutral and negative. The tweets are classified based on curated word-list to spot the depression tendencies. SVM and Naïve-Bayes classifier are used for class prediction. The results prove that system provides an accuracy of 83% for Naïve-Bayes classifier and is 79% for SVM.

Alexandra Cernian *et al.* [9] paper depicts a Mood Detector application. This application is developed to recognize the mood and emotional state of the user. It is done by examining 3 physical parameters such as pulse, skin electro conductivity and temperature using ML algorithm. The algorithm is trained with the data which is acquired from the users. This application is been tested many numbers of time till the results generated by the learning algorithm are confirmed.

3. Methodology

In our project we have trained the model with grey-scaled images. Fig. 1 shows block diagram.

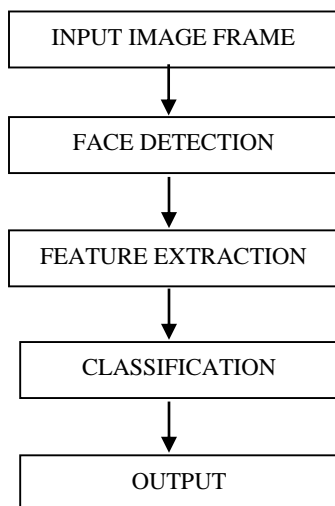


Fig. 1. Block diagram

In this project we have trained the model with the dataset collected from Kaggle which consists of nearly 34000+ images. Fig. 1 shows the system architecture of facial expression recognition project, where the video frame is given as input to the system. The system detects the face, processes and provides the output according to the facial expressions.

A. Input Image Frames

A video with different emotions is given as input, from which different face images are taken as input image frames.

B. Face Detection

The purpose of face detection is to identify facial image from the images provided in the dataset. Here a single image is taken from the dataset, and scanned. Further it is verified whether the image consists face or just any background image. The face determination phrase identifies if the input data (image) is a face. After face detection step the result is sent for pre-processing so that extraction of the facial features can be done.

C. Feature Extraction

The step feature extraction is most important since it extracts the characteristics by applying feature extraction algorithm. The steps compress the obtained information, reduction inappropriate features and removal of unwanted data. Then, the facial region is transformed into a vector within a given dimension where the characteristics of the face correspond to the locations. After this step, analysis of the features occurs and the identification part is used to learn each person's face and store it in the database. Once the system is trained, the system is tested against a given input images. All above steps are performed again.

D. Classification

It is the final step for all image processing system. Many methods and techniques are available for classification of images. Neural network is a best technique for classification. It suits for both linear as well as nonlinear dataset. It works for images which are not in the dataset since it is a self-learning model which consists of many hidden layers. In the recent years, many systems of artificial neural networks have been used widely. Other classification techniques are clustering, decision tree, support vector machines etc., which are used for classification.

E. Training

The model is trained with total of nearly 28710 grey-scaled images. The model is trained separately. The images are randomly split into 21% of total images as testing images and remaining as training images.

F. Testing

The trained model is now saved and connected to web interface. Web interface is created for user friendly interactions. The web page accepts the grey-scaled images as input. It is then pre-processed. The model then displays the result as to what the emotion is.

G. Web Application

The web interface is created for user friendly interactions with the model. Webpage is created using the Keras ML Framework, Django and is written in python language. First the user needs to register themselves into the system and then login to the system. The user can now select the image to recognize the emotion. After a few seconds the webpage displays the

result as to which emotion the image consists of.

4. Result

We have proposed a Machine Learning model for Facial Emotion Recognition using the Convolutional Neural Networks (CNN). This model is trained with CNN architecture. The web-based interface is created which connects the model for user friendly interactions. Grey-scaled images are taken as input. The input image is preprocessed. The model then predicts the result as to which emotion the image consists of. The model predicts of 82% accuracy.

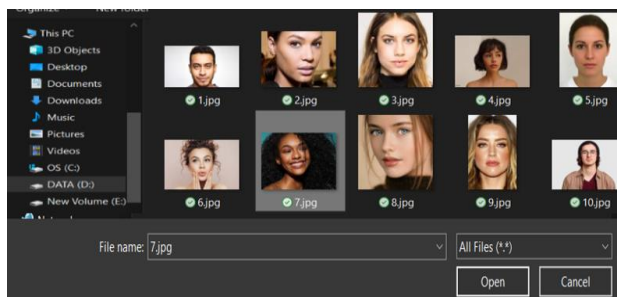


Fig. 2. Input Image

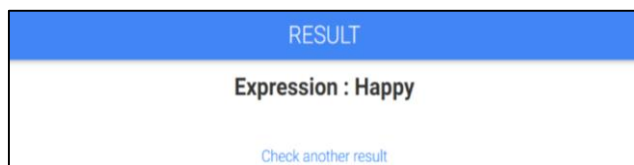


Fig. 3. Result

5. Conclusion

Facial emotion recognition using CNN paper provides model which resolve the difficulties of emotion recognition on facial expression. Dataset consists of pixel values of images in csv format. Images are generated from those pixel values and

system is trained using a CNN approach. By the Neural Network classifier training, six different types of emotions are gained. The facial emotion recognition is very helpful in distant education; it permits the identification of a student's learning and progress status in real time. So, the teacher can make note in the changes in student's behavior and update teaching strategies. In future, we can develop a mobile or hybrid mobile application to determine the emotions of students or people. Also, System can be added with a greater number of emotions to determine varieties of emotions.

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