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FACIAL EMOTION RECOGNITION USING MACHINE LEARNING

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Abstract

Face detection has been around for ages. Taking a step forward, human emotion displayed by face and felt by brain, captured in either video, electric signal (EEG) or image form can be approximated. Human emotion detection is the need of the hour so that modern artificial intelligent systems can emulate and gauge reactions from face. This can be helpful to make informed decisions be it regarding identification of intent, promotion of offers or security related trends. Recognising emotions from images- or video is a trivial task for human eye, but proves to be very challenging for machines and requires many image processing techniques for feature extraction. Several machine learning algorithms are suitable for this job. Any detection or recognition by machine learning requires training algorithm and then testing them on a suitable dataset. This project explores a couple machine learning algorithms as well as feature extraction techniques which would help us in accurate identification of the human emotion.

Keywords Facial emotion recognition, face detection, feature extraction, classification

Introduction

Facial expressions play a very important role in human communication. The human face is the richest source of emotions. As society continues to make more use of human-machine interactions, it is important for machines to be able to interpret facial expressions in order to improve their authenticity or to make them less machine and more human. Our brains make vision seem easy. It does not take any effort for humans to tell apart a lion and a tiger, read an article, or recognizing a human's face. But these are actually hard problems to solve with a computer: they only seem easy because our brains are incredibly good at understanding images.

Emotion can be recognised through a variety of means such as voice intonation, body language, and more complex methods such electroencephalography (EEG). However, the simpler, more practical method is to examine facial expressions. There are seven types of human emotions shown to be universally recognizable across different cultures: anger, disgust, fear, happiness, sadness, surprise, contempt. Interestingly, even for complex expressions where a mixture of emotions could be used as descriptors, cross cultural agreement is still observed. Therefore, a utility that detects emotion from facial expressions would be widely applicable. Such advancement could bring applications in medicines, marketing and entertainment. The task of emotion

recognition is particularly difficult for two reasons: (1) There does not exist a large database of training images and (2) classifying emotions can be difficult depending on whether the input image is static or in a transition frame into a facial expression. The latter issue is particularly difficult for real time detection where facial expressions vary dynamically.

Literature review

Giorgana and Ploeger (2012) [1] exhibited a completely programmed FERS to perceive the feeling of sadness, joy and surprise. For feature extraction they used Gabor filters and utilized AdaBoost for feature selection. A recognition rate of 87.14% has been accounted for utilizing the one-versus-one support vector machine (SVM) and Error-Correcting Output Codes (ECOC) with standardized face pictures that are 96x96 in size.

Wang and Xiao (2013) [2] proposed a new technique of facial expression classification based on neural network ensembles. To extract features from face images they used Principal Component Analysis and Gabor filters. MD-Adaboost is used to combine the results of neural network classifiers. Classifiers are trained using different feature sets to improve the classification and stability of the classifiers. The approach was evaluated in JAFFE image database. The experiments demonstrates the positive effect of the neural network ensemble based classifier, and show that the MD-Adaboost based classifier was more efficient and firm than other algorithms.

Ghimire and Lee (2013) [3] introduced two methods for recognizing dynamic facial expressions, either directly by using multiclass Adaboost, or by using Support Vector Machine on the boosted geometric features. The geometric features are extracted from the sequences of facial expression images. The landmark initialization and tracking is based on the Elastic Bunch Graph Multi-resolution method. Multi class Adaboost with dynamic time warping similarity distance between the feature vector of input facial expression and prototypical facial expression, is used as a weak classifier to select the subset of discriminative feature vectors. The recognition rate of 95.17% using feature selective multiclass Adaboost, and 97.35% using SVM on boosted features, is achieved on the Extended Cohn-Kanade (CK+) facial expression database.

Abidin and Harjoko (2012) [4] focused on static images of single person for facial expression recognition. They used integral projection method for localization and segmentation of face portion from the images. The features have been extracted by using fisherface method. To recognise the facial expression the neural network was used as a classifier.

Proposed model

Facial expression recognition process organize in five basic phases which is shown in figure. In first phase take the images as input. Input may be static

images or sequences of images (video frames) in expression recognition. The second phase performs various pre processing techniques such as noise reduction, image enhancement on the input image. Noise can be random or white noise with no coherence, or coherent noise introduced by the devices mechanism or processing algorithm. Normalization is one of the pre-processing technique to remove illumination problem. Normalization is the process that changes the range of pixel intensity values. Normalization against variation of pixel position or brightness is done.

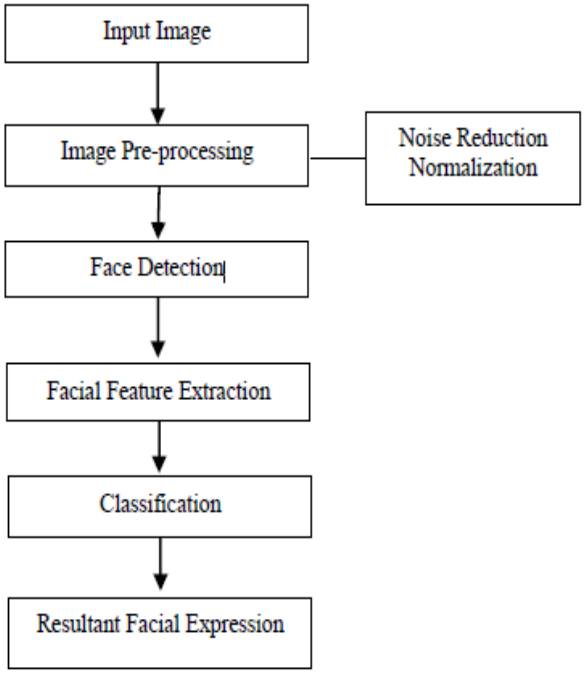

Fig: Facial emotion recognition block diagram

Face detection:

Face detection [5] is essential phase of emotion recognition of facial expression. The objective of face detection is utilized to recognize and find any face present in the image, in straightforward words we say that it is process identifying the face from input image. For identification and understanding the mood of people, it is very important that computer recognize face very effectively.

Fig: Original image from the database and detected face from the image

There are four diverse methodologies of face detection:

1. Knowledge based approach
2. Template based approach
3. Feature invariant approach
4. Appearance based approach

Facial feature extraction:

Feature extraction transform the pixel image data into higher level representation of motion, appearance of inner structures. Feature extraction methods extract holistic features from the initial representation features of face. The main goal is reducing the dimensionality of the input space and

to minimise the variance in the data caused by sudden conditions such as lighting, alignment errors or (motion) blur, and to reduce the sensitivity to contextual effects such as identity and head pose.

Fig: Detected landmarks from the face

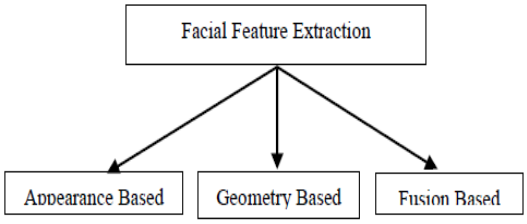

Fig: Categorization of feature extraction methods

Facial expression classification

This is the last and resultant step of facial expression recognition which uses the features extracted from the previous step and tries to classify the features set based on the similarities between the feature data. According to past researches, there are a lot of approaches discovered for the facial expressions classification. In them we are using Support vector macine (SVM) [6].

Support vector machine (SVM)

The idea of support vector machine is creating a hyper plane in dimensional feature space and separate two classes of data with a maximum margin of hyper planes. The separating hyper plane maximizes the distance between two parallel hyper planes. This optimum hyper plane is produced by maximizing minimum margin between two sets. Therefore, the resulting hyper plane will only depended on border training patterns called support vectors.. A classification approach separating input data into training and testing sets. Each instance in the training set has one ”target value” and more than one “attributes”. The aim of SVM is to design a model (based on the training data) which predicts the target values of the test data given only the test data attributes [7].

Recently several studies have reported that support vector machine delivers higher accuracy in terms of data classification compared with other classifiers. As the SVM classify data with the set of support vectors by minimizing the structural risk, the average error between input and their target vectors is reduced. SVM is used in various recognition, pattern recognition, and emotion recognition and in many more applications.

Result

After the training process, we provide the retrained model with the image we wish to classify. Note that the retrained model can classify images only with the classes we provided initially in the retraining inception part, so if the image is for example, an image of a tall building the result would be the best possible match among the classes. The system can identify only the images it is trained for just like humans, seeing something we have never seen before we shall not be able to identify it.

Conclusion

Facial expressions are very effective way to convey human emotions. It plays a very vital role in human communication irrespective of languages. It is observed that development of an automated system that accomplishes facial expression recognition with good classification accuracy but for limited types of datasets under uncontrolled conditions. However advance approaches (higher level feature extraction) which involved machine learning statistical techniques improve the performance and accuracy of recognition system.

Future enhancements

The future enhancement can be an action that is done upon recognition of the emotions. If we get a sad emotion, we can have the system play a song or tell a joke or send his/her best friend a message. This can be the next step of AI where the system can understand, comprehend the user's feelings and emotions and react accordingly. This bridges the gap between machines and humans. We also have an interactive keyboard where the users can just use the app and the app will then identify the emotion and convert that emotion to the emoticon of choice.

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