Facial Expression Recognition using Naive Bayes` Model

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1 Introduction and Overview

Facial Expression Recognition is something that humans can vividly do on a daily basis. On a personal level, if you know someone long enough, you know how they are feeling even without uttering a word - a true friend/partner/sibling/family member. There are a number of applications for this technology. Applications of Emotion Recognition are spread across different fields like Medicine, E-learning, monitoring, Marketing, Entertainment and Law. One of the application is "ATM not dispensing money when the user is scared". This is a challenge for a computer to perform with accuracy. There are many AI methods like neural networks, SVMs which can help in solving this problem.

Our motivation comes from the Kaggle fer2013 challenge. We look into a Naive Bayes` approach to solve this problem. Although this doesn't give a high accuracy for commercial use, it gives an idea of how tough it is to build an AI method with great performance standards. We aim to classify an image into any one of the seven expreesions (Anger, Disgust, Fear, Happiness, Sadness, Surprise, Fear).

Related work

Many people/companies have done great work in the field of facial expression recognition. EYERIS Technology's EmoVu software is by far the most accurate and most reliable for commercial applications. Kaggle gives many challenges and its fer2013 challenge is to recognise an expression off a face.

2 Methods

dlib and cv2 are two of the best libraries available for python to work on images. They have methods to find a face and extract features from it. cv2 is used to read the image using the method *cv2.imread()*, dlib is used to find the number of faces in the image using the method *dlib.get_frontal_face_detector()*, dlib is used to predict the 68 landmarks using the method *dlib.shape_predictor()* which has already been trained on the *iBUG 300-W dataset*.

2.1 Naive Bayes` Method

Naive Bayes` classifiers are a family of simple "probabilistic classifiers" based on applying Bayes' theorem with strong (naive) independence assumptions between the features. In our problem we derive the features using the 68 landmarks.

Calculate the mean of the 68 points, this point is similar to centre of mass of a body as all the features are scattered around it. One idea is to find the distance of each point from the mean and use it as a feature, but the problem is that if a particular face is zoomed in or enlarged we get greater distances from the mean, whereas for a face which is not zoomed in enough the distances from the mean can be very small. To overcome this problem we caclulate the angle the point makes with respect to the mean and the axes. These angles have be used as features for this problem.

The probability of an angle given an expression (P(Xi|E)) is increased if any point lies in that angle of view from the mean. Probability of each angle given one the 7 expressions is stored in an output file to be used by the testing code.

Test code finds the maximum of all probalities for each angle (using the angles of the particular 68 landmark points) of the seven expressions using the output file from training. The expression corresponding to the maximum probability is assigned to that particular image.

3 Experimental Analyses

Expression	Actual	Result
anger	30	0
disgust	72	0
fear	2	0
happiness	575	315
sadness	68	3
surprise	30	5
fear	628	310

Accuracy for test dataset1: 45% (633 are predicted correctly out of 1405 images.)

Expression	Actual	Result
anger	26	2
disgust	4	0
fear	3	0
happiness	890	540
sadness	18	2
surprise	52	13
fear	891	462

Accuracy for test dataset2: 53% (1019 are predicted correctly out of 1924 images.)

Datasets

Dataset is obtained from github and here is a link to the dataset. Dataset contains 13791 labelled images of the seven expression (Anger, Disgust, Fear, Happiness, Sadness, Surprise, Fear). A link to the dataset can be found in the references section.

This dataset has been partitioned into two parts (approx 90% for training purpose) to be used for training and testing.

Results

Accuracy is close to 50% which is good considering we have applied the basic naive bayes` classifier method

4 Discussion and Future Directions

Performance can be improved by considering more features (ex : shape of mouth, shape of eyes, etc...). Performance can also be improved by using more training images as is the case with any AI model (AI models are data hungry).

References

[1] Paul Vangent : *http://www.paulvangent.com/2016/08/05/emotion-recognition-using-facial-landmarks/*.

[2] Kaggle: fer2013 challenge for 7 expressions *https://www.kaggle.com/c/challenges-in-representation-learning-facial-expression-recognition-challenge*.

[3] Dataset: *https://github.com/muxspace/facial_expressions*.