Facial Expression Recognition

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***Abstract*—Facial expression analysis is rapidly becoming an area of intense interest in computer science and human-computer interaction design communities. The most expressive way humans display emotions is through facial expressions.Solving this problem can also help many of the Psychologists.It can also help the systems like Safe Home System for detecting the house owners mood and output accordingly.Also this can be used for lie detecting system,interviews for detecting what is going on in persons mind etc.Automatic Facial Expression Analysis (AFEA) consists of three steps : face acquisition , facial data extraction and representation and facial expression recognition.Properly labelled training data set is needed here.**

Keywords : Gabor Wavelet,Ficudial Points,Geometric Feature,Appearence based Feature,Radial Symetry Transform,FACS EFACS,Gabor Wavelets

I. Introduction

Artificial intelligence systems to recognize human emotion have attracted much research interest.Applications in domains like domains such as customer-attentive marketing, health monitoring,and emotionally intelligent robotic interfaces. In light of the important role that facial expression plays in communicating emotion in humans **Facial action coding system FACS**: is a human-observer-based system designed to detect subtle changes in facial features.Some facial expressions have the same meaning across all cultures.These expressions can be used to detect the emotions of the people .This **project is aimed to recognize the face expression captured from the front camera**. It uses a set of single static images with different expression labels as the training database, projectes the expression to different spaces, and calculates out the similar face expression in the training database, thus gives out the label of that face as the recognition result of the captured face. The changes in the facial expressions denoted as facial action units .Here,in this paper we basically extract the features that we need to consider for detecting facial expressions using Viola Jones algorithm.

II. Literature Review

So,after reading papers papers mentioned in references,we found out the following.

Geometric facial feature extraction method uses Baud Method i.e. Shape ,texture and/or location information of prominent component such as mouth,eyes,nose , eyebrow and chin for feature extraction. Appearance based feature extraction use Image filters like Gabor wavelets that generate facial feature for either whole face or specific regions in a face image.

44 action units are related to the contraction in the specific set of facial muscles.

Various combination of **FACS(Facial Acion Coding)** action units can help us determine various other facial expression. The ones other than the specific combination of FACS are coded in separate systems called the **Emotional Facial Action System (EMFACS)** in which emotion specific expression as well as more positive and negative emotion can be obtained.**Problems** Action units vary with the eye opening and contrast between the iris and sclera for different people belonging to different region. Such individual differences may have important consequences for face analysis also there are individual difference in the expressiveness which differ from people to people.

To develop algorithms that are **robust** to individual differences in features and behavior, it is important to include a large sample of varying ethnic background,age and sex which includes people with facial hair and wear jewelry or eyeglasses etc.**Radical symmetry transform** Creates dynamic spatio-temporal representation of a face which helps in classification into a expression classes.

III. Face detection method

So,our problem which needed to be solved is detection of faces in images. A human can do this easily, but a computer needs precise instructions and constraints.**Viola–Jones** algorithm is used to detect the face from the given image.But,Viola–Jones requires full view frontal upright faces. Thus in order to be detected, the entire face must point towards the camera and should not be tilted to either side. It's one of the constraint of Viola-Jones algorithm.

Characteristics of Viola–Jones algorithm which make it a good detection algorithm are:

- Robust – very high detection rate (true-positive rate) very low false-positive rate always.(strong)
- Real time – For practical applications at least 2 frames per second must be processed.
- Face detection only (not recognition) - The goal is to distinguish faces from non-faces (detection is the first step in the recognition process).

Viola-Jones algorithm has 4 different stages.

1] Haar Feature Selection
2] Creating an Integral Image
3] Adaboost Training
4] Cascading Classifiers

However, since the features used by Viola and Jones all rely on more than one rectangular area, they are generally more complex.

Haar Feature Selection

So,here our system is designed with the help of giving input by some faces and some non-faces.We will make our system to learn that which is face and which is not.In edge detection we have a pattern where we have some low and high values, where bright area is surrounded by dark area.We will apply the convolution kernel to the all over image.

Fig. 1: Haar Feature that looks similar to the bridge of the nose is applied onto the face

Fig. 2: Haar Feature that looks similar to the eye region which is darker than the upper cheeks is applied onto a face

Here black region is replaced by +1 and white region is replaced by -1.

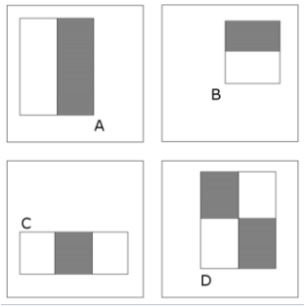

Fig. 3: Feature types used by Viola and Jones

We will add the pixel value under white rectangle and will add the pixel value under black rectangle and then sum of all white region is subtracted from black region and single value which we get is output.When we are detecting a eye in face the surrounded area of eyes are black more compare to the other face parts.So,applying one of the feature we will detect eye.We can change the size of feature.There are more than 1,60,000 types of different features.

Integral Image

Integral Image means get the new pixel value by just adding the pixel values from left and top region.

Adaboost

Adaboost is a machine learning algorithm which helps in finding only the best features among all 160000+ features. Adaboost will eliminate the redundant features. Means which feature is relevant and which is irrelevant is determined by adaboost and it will select few features which are relevant to us.

After identifying the features it will give weight to the features. A good feature or a relevant feature which is extracted by adaboost is known as Weak Classifier and a linear combination of this features is used to decide whether it's a face or not and it will together form a strong classifier.Output of weak classifier is either 1 or 0.

Cascading

After performing adaboost we will have less number of features which we have to check on our image. But it's still not feasible to calculate all the features. So we use cascades. Means out of all features some features are kept in one classifier. So,here from the output of 1st classifier we know that it's a face or not.

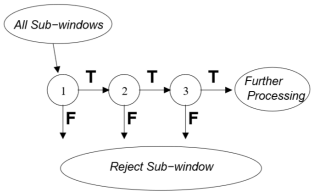

Fig. 4: Schematic depiction of a the detection cascade. A series of classiers are applied to every sub-window

The overall form of the detection process is that of a degenerate decision tree, what we call a "cascade". A positive result from the rst classier triggers the evaluation of a second classier which has also been adjusted to achieve very high detection rates. A positive result from the second classier triggers a third classier, and so on. A negative outcome at any point leads to the immediate rejection of the sub-window.

IV. Main Result

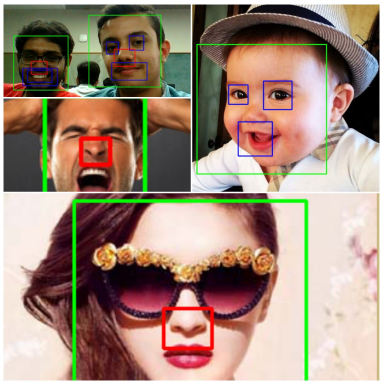

Fig. 5: Feature types used by Viola and Jones

We have done our simulation using python (IDLE).Our code can detect eyes, nose, lips and mouth.But whenever a person wears a goggle, at that time we can't be able to detect the eyes and also whenever a person's eyes are close at that time also we can't be able to detect the eyes.

References

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