Facial Expression Using Real- time System

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Abstract— Humans can use vision to identify objects quickly and accurately. Computer Vision seeks to emulate human vision by analyzing digital image inputs. For humans to detect an emotion will not be a difficult job to perform as humans are linked with emotions themselves but for a computer detecting an emotion will be difficult job to perform. Detecting emotion through voice, for example: detecting 'stress' in a voice by setting parameters in areas like tone, pitch, pace, volume etc can be achieved but in case of digital images detecting emotion just by analyzing images is a novel way.

The algorithm we proposed first detects facial regions in the image using a skin color model using RGB and HSV color space. Then lip region is extracted from the face region using the lip color model YCrCb color space. All the above color space uses a definite threshold value to differentiate between the regions of interest. Finally after the extraction of lip region from the image, it is compared with the series of templates and on the basis of best correlated template emotion is recognized. The proposed method is simple and fast compared to neural analysis of facial region as a whole. A simple pre defined database will be needed to help detecting various emotions that can be recognized using lip region. Size of database will affect the effectiveness of the proposed algorithm

I Introduction

THIS Human vision can experience emotion as associated with mood, temperament, personality and disposition. Computer Vision seeks to emulate the human vision by analyzing digital image as input. The fact that world is three- dimensional while computer vision is two-dimensional is basically one of the main problems that complicate Computer Vision. Trying to interpret a person's emotional state in a nonverbal form, usually requires decoding his/hers facial expression. Many times, body languages and especially facial expressions, tell us more than words about one's state of mind.

For this project I have performed an experiment which serves multiple purposes:

1. Finding out, once and for all, who "reads" facial expressions better- Men or Women, and if so, suggesting an answer for the question- why do those differences exist?
2. Revealing special features for recognizing classically defined facial expressions and answering the question- which facial cues help us the most decipher facial expressions?

Moreover, I will try to justify those features from an evolutionary point of view.

1.1 Overview

The image will be systematically broken down and analyzed by the series of algorithms to determine the pixels that represent facial region. After this a second algorithm is applied to first crop the facial region and then next algorithm will detect lips from facial region. The automatic algorithm must correctly identify all pixels correctly included in lips while not incorrectly classifying the other regions as lips or lip colored coat. Use of emotion recognition from digital images has a large opportunity and upcoming market. This is the primary reason to adopt a general and easy to apply approach towards the entire process. The approach is based on the assumption that there are not multiple faces in the image.

II Emotions used in this project

In this project we are considering five major emotions which are mainly centering toward lips in facial region. These emotions are: A common assumption is that facial expressions initially served a functional role and not a communicative one. I will try to justify each one of the seven classical expressions with its functional initially role:

1. **Anger:** involves three main features- teeth revealing, eyebrows down and inner side tightening, squinting eyes. The function is clear- preparing for attack.

1. **Disgust:** involves wrinkled nose and mouth. Sometimes even involves tongue coming out. This expression mimics a person that tasted bad food and wants to spit it out.

2. **Fear:** involves widened eyes and sometimes open mouth. The function- opening the eyes so wide is suppose to help increasing the visual field and the fast eye movement, which can assist finding threats. Opening the mouth enables to breath quietly and by that not being revealed by the enemy.

3. **Surprise:** very similar to the expression of fear. Maybe because a surprising situation can frighten for a brief moment, and then it depends whether the surprise is a good or a bad one. Therefore the function is similar.

4. **Sadness:** involves a slight pulling down of lip corners, inner side of eyebrows is rising. Darwin explained this expression by suppressing the will to cry. The control over the upper lip is greater than the control over the lower lip, and so the lower lip drops. When a person screams during a cry, the eyes are closed in order to protect them from blood pressure that accumulates in the face. So, when we have the urge to cry and we want to stop it, the eyebrows are rising to prevent the eyes from closing.

5. **Contempt:** involves lip corner to rise only on one side of the face. Sometimes only one eyebrow rises.

6. This expression might look like half surprise, half happiness. This can imply the person who receives this look that we are surprised by what he said or did (not in a good way) and that we are amused by it. This is obviously an offensive expression that leaves the impression that a person is superior to another person.

7. **Happiness:** usually involves a smile- both corner of the mouth rising, the eyes are squinting and wrinkles appear at eyes corners. The initial functional role of the smile, which represents happiness, remains a mystery. Some biologists believe that smile was initially a sign of fear. Monkeys and apes clenched teeth in order to show predators that they are harmless. A smile encourages the brain to release endorphins that assist lessening pain and resemble a feeling of well being.

Those good feeling that one smile can produce can help dealing with the fear. A smile can also produce positive feelings for someone who is witness to the smile, and might even get him to smile too.

Newborn babies have been observed to smile involuntarily, or without any external stimuli while they are sleeping. A baby's smile helps his parents to connect with him and get attached to him. It makes sense that for evolutionary reasons, an involuntary smile of a baby helps creating positive feelings for the parents, so they wouldn't abandon their offspring.

Figure 2: List of emotions used in this project

III Methodology

3.1.1. Data organization

A face consists of some features on it which play an important role in the detection of the emotions on it. The emotion recognition system is divided into 3 stages: face detection, feature extraction, and emotion classification.

We have encoded our eight emotions in the datasets as {0= happy, 1=sadness, 2=fear, 3=anger, 4=surprise, 5=disgust, 6=contempt, 7=neutral}. Initially, the faces are detected in all the sequences of the Cohn-Kanade Database. First, we have organized the dataset by preparing two folders called "emotions source" and "images source" in the directory we are working and put all folders containing the text files with FACS in a folder called "emotions source" and put the folders containing the images in a folder called "images source". We have also created a folder named "sorted images set", to collect our sorted emotion images. Within this folder, we have folders for the emotion labels ("happy", "disgust", etc.). Each image sequence consists of the development of an emotional expression, starting from a neutral face and ending with some particular emotion. So, from each image sequence, our focus is to extract two images that are one neutral (the first image) and one with an emotional expression (the last image) in the sequence.

3.1.2. Extracting Faces

The classifier will work properly if the images contain only the faces so the images were processed accordingly for the detection of the faces and then were converted to grayscale and were cropped and were stored in some specific folder [7]. We have used a HAAR filter from OpenCV for automatic detection of faces. As OpenCV contains 4 pre-trained classifiers, so it is better we detect as many faces as possible. We have Created another folder called "Extracted faces datasets", and subfolders within this folder for each emotion ("sadness", "happy", etc.).

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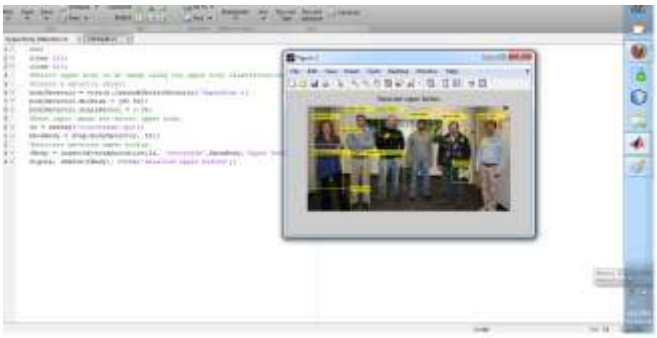
3.2. In Real-Time

In real time the emotions can also be detected but it becomes quite complex when compared to the static images as in the real-time the webcam is recording a video which is a collection of many frames, not just a single frame. In this case, we have used the Facial Landmarks [11] approach to detect emotions, continuously which is more robust and powerful than the fisher face classifier [12] which was used in the sequences of static images but it also required some more features and modules. After installing the Dlib libraries, CMake and boost python build the libraries.

3.2.2. Extracting features from the faces

In the feature extraction stage, the faces detected in the previous stage are further processed for identification of eye, eyebrows, nose, corner of face and mouth regions.

Initially, the likely Y coordinates of the eyes were identified with the use of the horizontal projection. Then the areas around the y coordinates were processed to identify the exact regions of the features. Finally, a corner point detection algorithm was used to obtain the required corner points from the feature regions. derived other measures from this that will inform the classifier more about what is being calculated on the faces detected. We tried to extract more information from what we have. Feature generation is always a better way for classification because it brings you closer to the actual data [16]. The coordinates may change as my face moves to different parts of the frame.



IV Results

The five emotions that we have been working on i.e. happiness, grief, anger, surprise and neutral were successfully identified on the majority of images used. The degree to how well facial region as well as lips detected varied from picture to picture depending on multiple factors. Generally no false emotion were found or wrongly interpreted. The only problem was that database generation was done only on limited faces. Most of the artifacts that were present in the image were rectified separately before applying algorithm.

V Future Work

There are several aspects of this project that have high market potential, so, the concept needs to upgraded for better results. Firstly, this concept needs to be extended from a single face to multiple faces and this concept should be able to adapt itself to non-uniform backgrounds. Secondly, different poses, structural components as well as different imaging conditions should be no hurdle in the process. There should be option of automatic generations of similar dimension templates. More sensitive and adaptive thresholds can be developed for facial and lip detection. Inclusion of more templates in the database so as to make emotion recognition more precise and accurate. Many more emotions can also be introduced. Overall, the aim should be to make this algorithm more flexible and adaptive in real time applications.

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