Project Title: Facial expression analysis

Team: S.T.A.R.T.

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1.What is the problem exactly and what are you going to achieve?

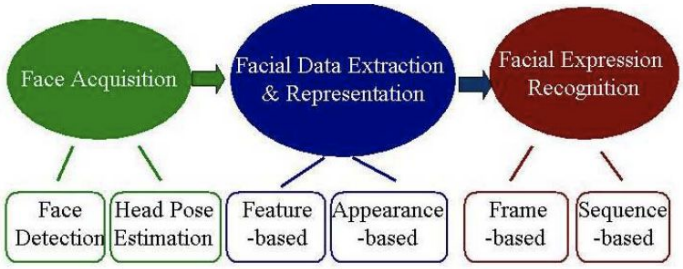
The problem we are trying to solve is mainly regarding analyzing people's facial expressions in pictures. To be exact, firstly, our algorithm will recognize human faces in a picture. Then, based on the current state of the face, we can analyze the organs such as the nose, mouth, eyebrows, and other muscles to determine if this face reveals any anxiety, anger, happiness, sadness, and other emotions.

When the details of the face are gathered, we need to find the emoji that best matches the face shown in the picture.

2.How is this problem relevant to this course?

In order to analyze facial expression, we need to fully understand the key features in the raw image. We divide it into three stages, face acquisition based on face detection and head position estimation, facial data extraction and representation based on features and appearance, and facial expression recognition based on frames and sequences. The complex features, like the intensity, in the image are hard to capture and analyze, which is also one of the hardest points in our project. In our project, we first need to make the energy of the input more uniform (2d filter), like decreasing the noise in the image. For facial detection and head position estimation, we need to use edge detection to train a complex convolution neural network and rotation and scale invariance to achieve a high accuracy task.

3.What others have tried to solve this problem?



The facial expression has been widely and actively studied by researchers from 1999 to now. The main approach for this problem is divided into three stages, face acquisition based on face detection and head position estimation, facial data extraction and representation based on features and appearance, and facial expression recognition based on frames and sequences. Deep learning and convolutional neural networks are also complemented with the main approach due to the fact that we need a highly reliable system to recognize facial expression.

4.What approaches are you going to try and why do you think these approaches might work?

We need to automatically locate human faces using a process called acquisition and therefore find the region of human faces for our system inputs.

Then our system will analyze facial changes caused by facial expressions. There are two main methods. Geometric feature-based methods and appearance-based methods. The shapes and locations of facial organs are represented by geometric facial features. We then use appearance-based methods, such as Gabor wavelets to calculate a feature vector. We can use face normalization to get rid of head rotation and resize the head.

The last step is facial expression recognition. Once, we recognize the facial expression, we find the emoji whose description best matches the facial expression.

5.What steps are you going to take to achieve your goals in this project?

- Read different papers that are related to facial expression analysis
- Set up a github repo and gather some libraries, source code, dataset etc
- Classifies the dataset and label the input images
- Perform some 2D filter on the dataset and apply edge-detection to detect the head position
- Adjust the image with scale or rotation so that it can fit into our algorithm
- Use regression to complete the facial data extraction and compute the probability distribution
- Train the neural network models to get a higher accuracy
- Research on solutions for the current limitations and improve the algorithm
- Complete the final report and get prepared for the presentation

References:

Tian, Ying-Li, Takeo Kanade, and Jeffrey F. Cohn. "Facial expression analysis." In *Handbook of face recognition*, pp. 247-275. Springer, New York, NY, 2005.

Tian, Y-I., Takeo Kanade, and Jeffrey F. Cohn. "Recognizing action units for facial expression analysis." *IEEE Transactions on pattern analysis and machine intelligence* 23, no. 2 (2001): 97-115.