Emotion Detection: A Feature Analysis

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Abstract- **Emotion detection is receiving lots of attention from researchers from last decade for improving the interaction between human and machine. We proposed system to define different types of features to automatically detect emotion from facial image using action units (AUs). Proposed system automatically detects faces from the captured image and codes them with respect to seven dimensions like Happy, Sad, surprise, Fear, disgust, Anger and Neutral. This paper focuses on automatic extraction of feature points and emotion detection from the two-dimensional digital face photo. Some improvements and simplifications are made on the basis of the previous research.**

This approach is validated on a posed visual database and a natural interactive database to test the robustness of proposed algorithm.

Keywords—*emotion detection;facial feature extraction; facial expression;facial Action Units (AUs);*

I. INTRODUCTION

Human facial feature extraction is the key of facial image analysis, which has been widely used to face recognition and emotion detection.

A basic automatic emotion detection system from facial features generally consists of following three steps: 1) face acquisition, 2) facial feature extraction and representation, and 3) facial expression classification.
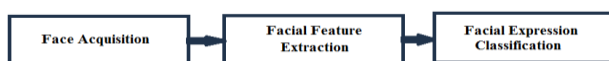

Fig. 1: Steps of Automatic Emotion Detection System

A preprocessing stage is Face acquisition which detects or locates the face region in input images or sequences. After detecting or locating the face from given input, the next step is to extract facial features from original face images to represent emotions. The last step of an automatic Emotion detection system is to classify different emotions based on the extracted facial features.

The rest of paper is organized as follows. In Section II the literature survey on the current algorithms and methods for emotion detection. In Section III the proposed system architecture and steps are presented. Section IV will give brief explanation about system analysis and design. Conclusions are presented in Section VI.

II. LITERATURE SURVEY

Based on the existing surveys conducted so far, five categories have been identified for face and facial feature detection. Geometry- based methods, Colour- based approaches, Appearance- based methods, Motion- based methods, Edge-based methods.

Presently, Particle Swarm Optimization (PSO) algorithm is applying for the emotion detection purpose, another Guided Particle Swarm Optimization (GPSO) algorithm apply on the movements of specific facial points called Action Units (AUs) but the limitations of this system was the AUs should be physically specified on the given subject before the image taken for test. Locus- Kanade (LK) algorithm is implemented to resolve this limitation and it allows Run time AUs detection and keeps track of their positions.
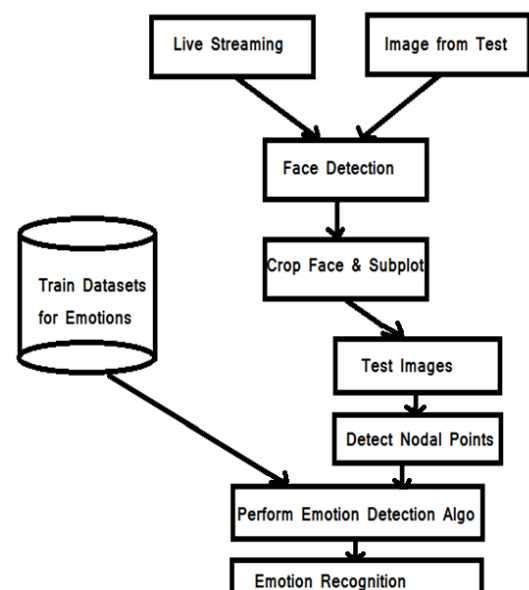
III. PROPOSED SYSTEM

Fig. 2: System Architecture

1. Train Datasets for Emotions:

Database contains existing values that can be later used in comparisons to find out the closest matching emotion to be displayed as output. The different datasets are trained for the different emotions.

2. Live Streaming

Live streaming is the fundamental step of image acquisition in real time, where image frame is received using streaming media. In this stage, the application receives image from built-in webcam or external video camera device. The streaming continues until input image frame is acquired.

3. Image from Test

Image acquisition from the given set of test images, where image frame is received from set of images in device. In this stage, the application receives image which is already present in the device.

4. Face Detection

Skin color segmentation, discriminates between skin and non-skin pixels. Skin segmentation permits face detection to focus on reduced skin areas in preference to the entire image frame. Face detection can be considered as a specific case of Object-class detection that discovers size and location of objects, listed in class, within an input image. In this step, face is detected by identifying facial features while ignoring all non-face elements. To perform face detection image is first converted into a binary form and scan the image for forehead. We then search for maximum width of continuous white pixels till we reach eye brows. We now cut the face in such a way that its height is 1.5 times that of its width.

5. Crop Face and subplot:

After detecting all the faces from given image the next step is to crop the each and every face and subplot them. For every detected face in subplot create new face image and send it for emotion testing.

6. Test Images

The numbers of faces detected from image are sending one by one for the nodal detection and detect emotion for every test image.

7 Detect Nodal Points (Feature Detection)

Information about the current face state is required to figure out the emotions. The first step should be to find exact positions of some feature points. Therefore certain feature points that are detectable and also useful for emotion interpretation have to be selected. In coherency to the emotion interpretation, 10 significant features points have been defined: two points for each the pupils, the eyebrows, the two mouth corners as well as the upper and the lower

lip. Figure 3 shows the location of each these points as red crosses.

In Figure 3 the search regions are drafted. To find the feature points in this region two different techniques are employed. An adaptive contrast filter which uses the min and max gray values in the eyebrow region is used to extract the eyebrows to detect their borders. Thus an exact representation of the eyebrow is obtained as a polygon. These polygons are used to localize two points on the eyebrows at a certain distance from the pupils. Figure shows a sketch of the eyebrow search regions.
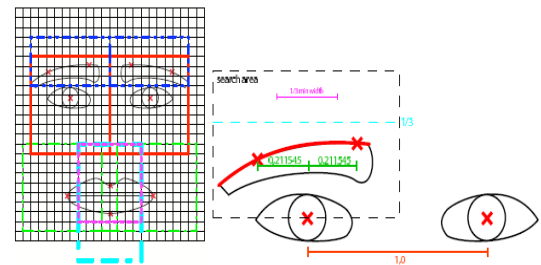

Fig.3: Feature points and their position regions.

7.1 Eye Detection

For eyes detection too, we convert RGB image to binary image and then scan image from W/4 (where W is width) to remaining width in order to find the middle position of the eyes. Next, we determine upper position of the two eyebrows. For left eye search ranges from W/8 to mid (middle position between eyes) of the image and for right eye from mid of the image to W-W/8 of the total width. We then place continuous black pixels vertically in order to get eyes and eyebrows connected. To achieve this for left eye, pixel lines are placed vertically between mid/2 to mid/4 and in case of right eye vertical black pixel lines are placed between {mid + (W-mid)/4 } to {mid + 3*(W − mid)/4}. We further search black pixel lines, horizontally, from the mid position to the starting position so as to locate the right side of left eye. To detect left side of right eye we scan the starting to mid position of black pixels within the upper and lower position of right eye. The left side of left eye is simply the starting width of image and right eye's right side is the ending width. Using this we cut the left side, the right side and the upper and lower positions of each eye from the previous RGB image.

7.2. Lip Detection

Another important feature to be detected to analyze emotions is Lip. It helps us to know whether shape of lips is : plain, slightly curved, broadly curved , pout , parted lips. This module outputs a lip box having dimensions that can contain entire lip in the box and some part of nose.

8. Emotion Detection Algorithm

Next step after detecting features is to recognize the emotions. For this we check out for the combination of Action Units given in Table 3 on the basis of distance between the nodal points. This static Action Units and their distance are then compared with the values already present in database. Then the nearest matching pattern is picked and related emotion is given as output. If the input doesn't match the ones in database, then average height for each emotion in database is computed & on basis of this a decision is made.

The Algorithm for Proposed system:-

Step 1: T=CreateDatabase(TrainDatabasePath) to train the database for different emotions.

Step 2: Create and initialize the set of N number of Action Units (AUs) tracked for M number of emotions.

Step 3: add particle, P, representing the positions of AUs for each emotions.

Step 4: Take Input image from Test images.

Step 5: detect the T number of faces accurately from given test image.

Step 6:

For(i=1;i<=T;i++) // for all the detected faces

{

    For(j=1; j<=M; j++) //for all emotions

    {

        For(k=1; k<=Q; k++) // Number of particles in M

        {

         1. Calculate the distance between nodal points of face according to particle present in the Emotion set.

         2. Compare all particles of Action Units for each Emotion.

         3. Calculate the % of Result for each emotion M.

        }

    Return the best Emotion match found;

    }

Return emotion for all detected faces from test image

}

9. Emotion Recognition

Once the comparison is done for all Action Units, the output will display the detected emotion of the portrayed input.

IV. SYSTEM ANALYSIS AND DESIGN

The entire sequence of training and testing is sequential and can be broadly classified as consisting of following three steps:

1. Database Preparation

The following pictures are some examples for the different classes of expression

HAPPY

SAD

SURPRISE

ANGRY

DISGUST

FEAR

2. Training

Train database for different emotion is carried out by following steps:

1. Select (.JPG) files using open file dialog box to train database for different emotions.

2. By using those read all the facial features of each person for different emotions and store it into the database in train folder.

3. Calculate values for different Action Units.

4. Find the range of distance between face center and all 10 nodal points in the group of Action Units for the neutral emotion.

5. For each person calculate the Euclidian distance between nodal points and compare with all his images for different basic emotions and store data in database for each emotion separately.

3. Testing

Testing is carried out by following steps:

1. Select an image which is to be tested using open file dialog box.

2. Image is Read and normalize.

3. Detect the Faces from image and subplot them.

4. For every face detect the facial features and Nodal point's position.

5. Find the distance from face center to all nodal points and compare them with the database for different set of Action Units.

6. If this distance is match with any set of Action Units from the present in database return the detected Emotion or If the input doesn't match the ones in database, then average height for each emotion in database is computed & on basis of this a decision is made.

V. EXPERIMENTAL RESULTS

Select Image from Test database and detect nodal points:

Fig. 4: Select image from test database

Detects Nodal Points and Display Emotion:

Fig. 5: detect feature points and return emotion

CONCLUSION

In this paper, it is mainly discussed about the extraction method of the feature area and feature points from the two dimensional face positive and side photos. Some improvements and simplifications are made on the basis of the previous research. The feature regions are calibrated through the edge detection, clustering and gray integral projection. Different algorithms are adopted for the feature points in different situations. Proposed system automatically detects human emotions on the basis of facial expressions. Moreover, it further takes a step to improvise the emotion detection technique using distance between nodal points and Action Units Implementation which is more adaptive and resurface as the ones with utmost importance in various other fields like that of robotics, computer graphics, automation and animation, automatic pain detection system. The system works well for faces with different shapes, complexions as well as skin tones and senses basic six emotional expressions.

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