A
Synopsis Report On

FACIAL MOOD DETECTION USING IMAGE PROCESSING

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ABSTRACT

This paper presents a facial expression recognition system employing Bezier curves approximation technique. The system is based on facial features extraction using the knowledge of the face geometry and approximated by 3rd order Bezier curves representing the relationship between the motion of features and changes of expressions. For face detection, color segmentation based on the novel idea of fuzzy classification has been employed that manipulates ambiguity in colors. Experimental results demonstrate that this method can recognize the facial expressions with an accuracy of more than 90% in all cases. Finally the system has been implemented using a manipulator robot and issuing facial expression commands.From human face structure, We divide in 3 regions such as right eye, left eye and mouth areas from the face image. Firstly comes the face detection and then detection of the skin region.We crop the facial skin region and connect the largest skin region to detect the skin surface of the human face.

Keywords :Bzier curves, Facial expression, Facial Action Coding System (FACS), Face detection, Fuzzy classification, Skin color, YCbC.

Index

List of Figures

Chapter 1

Introduction

Facial expression analysis has been attracting considerable attention in the advancement of human-machine interface since it provides a natural and efficient way to communicate between humans. Some application areas related to face and its expressions include personal identification and access control, video phone and teleconferencing, forensic applications, human-computer interaction, automated surveillance, cosmetology, and so on. But the performance of the face detection certainly affects the performance of all the applications. Many methods have been proposed to detect human face in images, they can be classified into four categories: knowledge-based methods, feature-based methods, template-based methods and appearance-based methods.When used separately, these methods cannot solve all the problems of face detection like pose, expression, orientation, occlusion. Hence it is better to operate with several successive or parallel methods. Most of the facial expression recognition methods reported to date are focused on recognition of six primary expression categories such as: happiness, sadness, fear,anger, disgust and grief.For a description of detailed facial expressions, the Facial Action Coding System (FACS) was designed by Ekman and Friensen in the mid 70s. In FACS, motions of the muscles of the face are divided into 44 action units and any facial expression are described by their combinations.

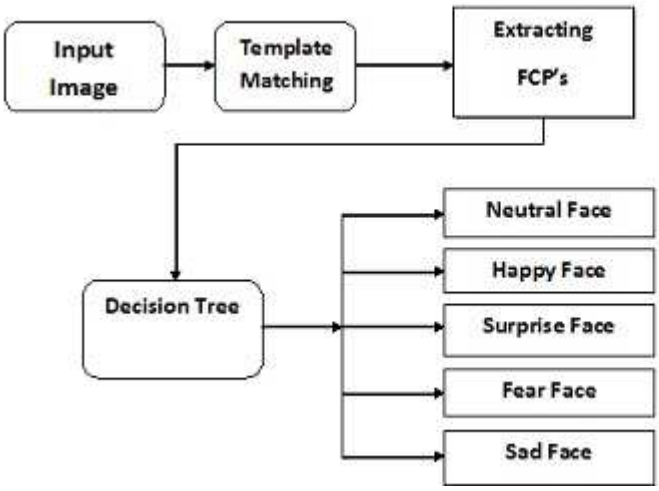

Figure 1.1: Genetic Flow Diagram

Chapter 2

Problem Statement & Objectives

The automatic facial expression recognition system includes:

- Face Detector.
- Facial feature extractor for mouth, left and right eye.
- Facial Characteristic Point - FCP extractor.
- Facial expression recognizer.

2.1 Objectives

The project mainly aims to come up with a solution to the facial expression recognition problem by Sub Problems dividing it into sub-problems of classifications of some specific Action Units. The project's scope includes not only the two class problems which tell about whether an Action Unit is on or off, but also the multi-class problems that will inform the user about multi occurrences of more than one Action Unit at the same time. For this, different methodologies and techniques for feature extraction , normalization, selection and classification.solutions to these problems as well as taking the computational complexity and timing issues into consideration.

The project objective is to implement face recognition in an optimum way in terms of run time onto the embedded system. Various algorithms and methodologies are studied and hardware resources planning will be done to achieve the goal.This kind of face recognition embedded system can be widely used in our daily life in different sectors. We hope that human life can be greatly helped with this technology. Some typical applications are listed as follows:-

- Business Meeting, Gathering.
- Education Teaching assistant.
- Audio-visual speech recognition(visual lip reading to enhance acoustic speech recognition).

Chapter 3

Literature Survey

3.1 Detection and Recognition of Facial Emotion using Bezier Curves

3.1.1 Summary

This presents an approach to recognize human facial expressions for human-robot interaction. For this, the facial features, especially eyes and lip are extracted and approximated using Bzier curves representing the relationship between themotion of features and changes of expressions. For face detection, color segmentation based on the novel idea of fuzzy classification has been employed that manipulates ambiguity in colors. Experimental results demonstrate that this technique can robustly classify skin region and non-skin region. In order to decide whether the skin region is face or not, largest connectivity analysis has been employed. This method can recognize the facial expression category, as well as the degree of facial expression change. Finally, the system has been implemented by issuing facial expression commands to a manipulator robot.

3.2 Approach Based

3.2.1 Advantages

- Lower complexity.
- Less computer demanding.

3.2.2 Disadvantages

- Difficult to extend with more emotions.
- Less precise.
- Difficult to generalize to new data.

3.3 Coding Based

3.3.1 Advantages

- Precise
- Versatile
- Extensible

3.3.2 Disadvantages

- More computer processing required.
- More complexity.

Chapter 4

Theory, Methodology and Algorithm

4.1 Recognition and Analysis of Facial Expression

The human-machine interface (HMI) is definitively evolving to an intelligent multi-model interface, combining various human communication modes. Among others, facial expression is a very efficient mean for human beings to communicate their intention.

Recognition and analysis of human facial expression and emotion have attracted a lot of interest in the past few decades, and they have been researched extensively in neural-science, cognitive sciences,Computer sciences and engineering.

Human interact with each other not only through speech, but also through gestures, to emphasize a certain part of the speech, and to display of emotions. Emotions of the user are displayed by visual, vocal and other physiological means. There are many ways to display human's emotion, and the most natural way to display emotions is using facial expressions, which are mostly based on video sequences.

Mostly based on video sequences.We proposes a scheme to automatically segment an input still image, and to recognize facial emotion using detection of color-based facial feature map and classification of emotion with simple curve and distance measure is proposed and implemented. The motivation is to study the effect official landmark, and to implement an efficient recognition algorithm of facial emotion with still image,while most of researches are using video sequences due to utilize the differences between frames.

4.1.1 Proposed Methods - Normalization

In image processing, normalization is a process that changes the range of pixel intensity values. Applications include photographs with poor contrast due to glare, for example. Normalization is sometimes called histogram stretching. In more general fields of data processing, such as digital signal processing, it is referred to as dynamic range expansion.

How it Works?

Attempts to improve an image by stretching the range of intensity values it contains to make full use of possible values. Unlike histogram equalization, contrast stretching is restricted to a linear mapping of input to output values. The result is less dramatic, but tends to avoid the sometimes artificial appearance of equalized images.

The first step is to determine the limits over which image intensity values will be extended. These lower and upper limits will be called a and b, respectively (for standard 8-bit gray-scale pictures, these limits are usually 0 and 255). Next, the histogram of the original image is examined to determine the value limits (lower = c, upper = d) in the unmodified picture. If the original range covers the full possible

set of values, straightforward contrast stretching will achieve nothing, but even then sometimes most of the image data is contained within a restricted range; this restricted range can be stretched linearly, with original values which lie outside the range being set to the appropriate limit of the extended output range. Then for each pixel, the original value r is mapped to output value s using the function:

$$S = (r - c)\left(\frac{b-a}{d-c}\right) + a \tag{4.1}$$

One problem with this method is that outliers can reduce the effectiveness of the operation. This was already mentioned above when it was suggested that sometimes a restricted range of the input values as determined by inspecting the histogram of the original image might by used. Frequently it is advantageous to select c and d to be at the 5th and 95th percentiles, respectively, of the input values. Alternatively, one can start at the histogram peak and move up and down the value list until only a small (e.g., 1% to 3%) number of values are rejected and left outside the chosen limits for c and d.

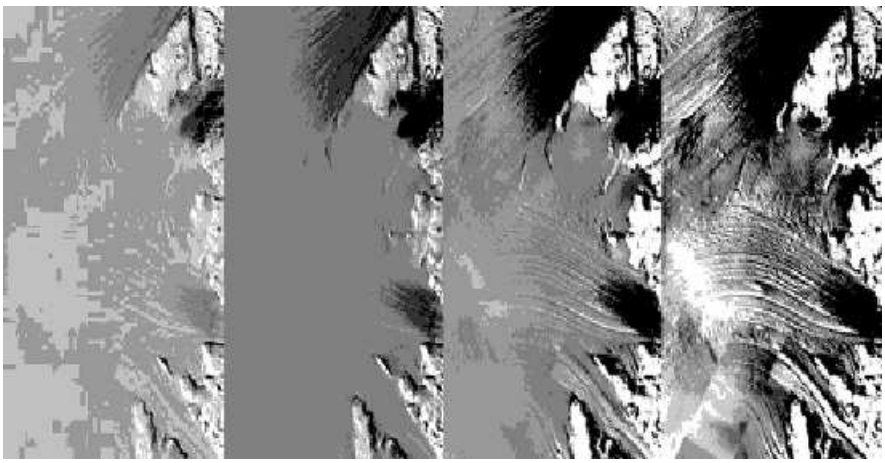

Figure 4.1: Normalization of Image

4.1.2 Detection of Skin Color using YCbCr and connecting Largest region

The first step of our scheme is color space transformation and lighting compensation. Although skin color appears to vary, we assume that there exists underlying similarities in the chromatic properties of all faces and that all major differences lie in intensity rather than in the facial skin color itself. In this case,we have adopted to utilize a skin-color based approach using YCbCr color model. With the color model,luminescence information is represented by a single component, Y, and color information is stored as two color difference component, Cb and Cr.Analysis of YCrCb color space on human skin color .

Any RGB digital image can be converted into YCrCB color space using following equation:

Y=0.299R + 0.587G + 0.114B
Cb = -0.169R - 0.331G + 0.500B
Cr = 0.500R - 0.419G - 0.081B

4.1.3 Conversion according to Threshold

The following steps are needed to convert a RGB image to binary image.Convert the RGB image into grayscale image.Find the threshold value. If the value at the pixel position is greater than the threshold value then the value will be 1(white) else zero (black).

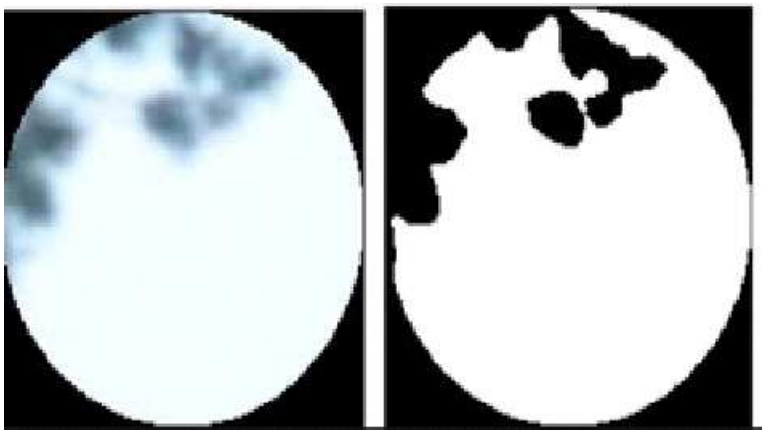

Figure 4.2: RGB to gray-scale

Feature Extraction

Human face is made up of eyes; nose, mouth and chine etc. there are differences in shape, size, and structure of these organs. So the faces are differs in thousands way. One of the common methods for face expression recognition is to extract the shape of eyes and mouth and then distinguish the faces by the distance and scale of these organs.

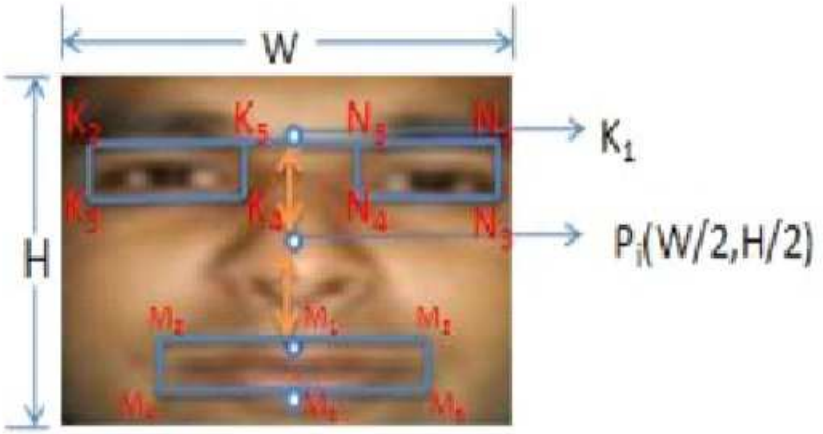

Figure 4.3: Extraction of required region

Let W and H are width and height of an image shown in above figure:

- Mark pixel Pi (W/2, H/2) as centre of image.
- Traverse a distance H/8 from the pixel Pi towards upward and mark a point K1.
- Traverse a distance H/10 towards downward from the point K2 and mark a point K3.
- Traverse a distance W/4 from the point K3 towards right.

- Traverse a distance H/10 from the point K4 toward up and mark the point K5.
- Same steps are repeated for extracting the right eye and mark the point N2, N3, N4, and N5.
- Traverse a distance H/8 from the point Pi towards downward and mark the point M1.
- Traverse a distance W/6 towards left and right from the point M1 and marks the point M2 and M3.
- Start with the point M2 traverse a distance H/10 towards downward and mark the point M4.
- Traverse a distance W/6 from the point M4 towards right ad mark the point M5. Same from point M5 and mark the point M6.
- Traverse the distance H/10 from M6 towards up that meets to the point M3.

Bezier Curves

Left,right eye and lips are:

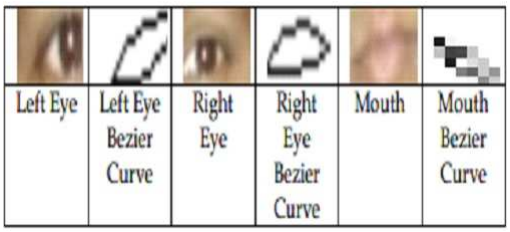

Figure 4.4: Extraction of Bezier Curves

Once the Bezier curve formed features points are located as shown in below image

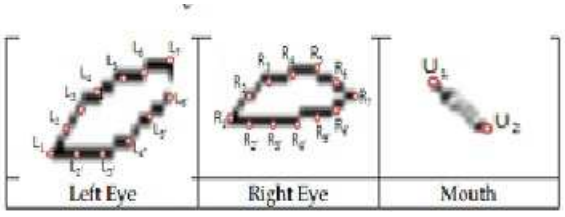

Figure 4.5: Feature Points

4.1.4 Algorithm

Bezier curves are drawn and respected values from the Bezier curves are extracted and compared with values from the database and an appropriate emotion is detected. The algorithm that we have used is as follows -

```
if (Math.Abs(pt - lip_1) + Math.Abs(pt1 - lip_2) + Math.Abs(pt2 - lip_3) +
Math.Abs(pt3 - lip_4) + Math.Abs(pt4 - l_e_1 ) + Math.Abs(pt5 - l_e_2) +
Math.Abs(pt6 - l_e_3) + Math.Abs(pt7 - l_e_4) + Math.Abs(pt8 - r_e_1) +
Math.Abs(pt9 - r_e_2) + Math.Abs(pt10 - r_e_3) + Math.Abs(pt11 - r_e_4)
< min)
{
 emo = 0;
 min = (Math.Abs(pt - lip_1) + Math.Abs(pt1 - lip_2) + Math.Abs(pt2 - lip_
3) + Math.Abs(pt3 - lip_4) + Math.Abs(pt4 - l_e_1 ) + Math.Abs(pt5 - l_e_
2) + Math.Abs(pt6 - l_e_3) + Math.Abs(pt7 - l_e_4) + Math.Abs(pt8 - r_e_
1) + Math.Abs(pt9 - r_e_2) + Math.Abs(pt10 - r_e_3) + Math.Abs(pt11 -
r_e_4) );
}
```

Chapter 5

Plan of Work & Project Status

5.1 Proposed Modules

1. BROWSE AND INPUT IMAGE: Insert image through directory.
2. NORMALIZING: Find the Min & Max values of the image pixels and convert.
3. DETECTION OF SKIN COLOR: Using YCbCr and connecting Largest region Any RGB digital image can be converted into YCrCB color space using following equation:
   Y=0.299R + 0.587G + 0.114B
   Cb = -0.169R - 0.331G + 0.500B
   Cr = 0.500R - 0.419G - 0.081B
4. CONVERTING IMAGE PIXEL TO 1 OR 0: Find the threshold value. If the value at the pixel position is greater than the threshold value then the value will be 1(white) else zero (black).
5. EXTRACTION OF FACIAL FEATURES: Extract Left,Right eyes and lips and implement Bezier curves to detect and compare with values and show appropriate results.
6. FINAL EXPRESSION OF HUMAN FACE: Curves detect the Final Expression of the human face and generates one of 4 Emotions as Output.

5.2 Scheduling

The following table shows the expected flow of work for the accomplishment of the required result.

Table 5.1: Plan of Work

No.	Description	Duration	Complexity	Status
1	Literature Survey:Gathering information for facial expression detection	1 week	1	Done
2	Literature Survey:various methods to detect facial points	1 weeks	2	Done
3	Literature Survey:various methods available for Emotion detection	2 weeks	2	Done
4	Application of techniques to the image	2 weeks	3	Done
5	Use and implementation of Bezier curves	2 week	3	Done
6	Setup and implementation	3 weeks	5	Pending
7	Coding:Environment setup for building UI and backhand	4 weeks	4	Pending
8	Testing of Project	2 weeks	4	Pending
9	Final Testing and application	2 weeks	4	Pending

Chapter 6

Summary

In this paper,we have presented and implemented a simple approach for recognition of the facial expression analysis.The algorithm is performed in two major steps: one is detection of facial region with skin color segmentation and calculation of feature-map for extracting two interest regions focused on eye and mouth.And the other is a verification of the facial emotion of characteristic features with the Bezier curve and the Hausdorff distance. Experimental results shows average successful ratio of 78.8to recognize the facial expression, and this indicates the good performance and enough to applicable to mobile devices.

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Appendix A

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