

Facial Feature Extraction and Recognition for Traditional Chinese Physiognomy

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Abstract—We propose a novel calculation method of personality based on the Chinese physiognomy. The proposed solution combines the ancient and the modern physiognomy to summarize the corresponding relation between the personality and facial feature and model the baseline to shape the face feature. We compute histogram of image by searching for the threshold values to create a binary image in an adaptive way. The two-pass connected component method indicates the feature region. We encode the binary image to remove the noise point, so that the new connected image can provide a better result. The method was tested on ORL face database.

Keywords- face reading, Physiognomy, personality

I. INTRODUCTION

Physiognomy phenomenon had been a part regard as one of the social cultures of China since ancient times. To a certain extent, it has had a profound impact on China's political, economic, culture and people's daily life. [1, 2]. In ancient times, this visiting fortune-teller custom first popular in the upper official which belongs to the "official school" and appeared in the neighborhoods until west and east Han Dynasties, then spread like floods. [26]. Facial features have been considered when evaluating a person's disposition since thousands of years ago in both Eastern and Western cultures [1, 2]. With the development of big data, computer visualization and image processing, more and more statistic data are used to give the facts. Statistic results have verified that there is a strong connection between facial structures and personality traits [1, 2]. For now, various vocational institutes, such as the Merton Institute, which provided services to such companies as AT&T, used physiognomy as one of their main tools in assessing candidates [3, 4]. A psychological research of Israelis shows that about 75% believes in physiognomy, whereas only 25% think that physiognomy is impossible (the sampling error of the survey is 4%) [5].



Figure 1: Physiognomy Image

In this paper, we proposed a new calculation method of personality according to the facial feature of physiognomy from the ancient till now. We summarize the facial feature classification based on the physiognomy. Based on the classification method, we design a method to extract the facial feature points to help us compute the size of facial feature. We cumulate the histogram of each image and find the better threshold value by using the method of Otsu which is a kind of adaptive method. By using this method we can generate a quality binary image. Then the connected component is used to find out the boundary of each facial feature in the face image.

II. FACIAL FEATURES CLASSIFICATION BASED ON PHYSIOGNOMY

The ancient researchers of physiognomy study countless faces over a long period to understand the summed up face reading rules. Physiognomy is one of the most intuitive methods to reflect a person's personality. We combined ancient and the modern physiognomy and summed up the corresponding relation between the personality and facial feature.

A. Face-shape Classification Standard

According to the theory of the “San Ting”, the person’s face is divided into three regions, which are shown in Fig. 2(a).

Face is shown in Fig. 2(a) includes three parts, which are A, B, C. The A part is from the top of the head to the middle of the eyebrows and eyes; The B part is from the middle of eyebrows and eyes to the end of the nose; The C part includes philtrum, mouth and chin areas. We decide the face-shape on the basis of the ratio of these three parts.

A zone is on the top position of the face, which is connected with the brain. It is related to people’s cognitive activities, judgment, and intelligence.

B zone is the reaction area of human emotion, which can show people’s feelings and social skills.

C area has very close relationship with mouth, which can reflect one’s activity and vigor. There is no denying that some singers and athletes may have the developed area of C.

Basically, face-shape can be divided into seven categories according to the different of the three regions which are: the oval face, round face, nabla face, equilateral triangle face, long face, square face and the diamond face.

1) *Oval Face: Oval face:* B is developed and face is narrow. Most of girl whose face shape is oval is beauty and have compliance. This part of professional women can also be able to juggle work and family. This kind of people is full of rational, emotional stability and creativity but lack of stamina and self-esteem is very high.

2) *Round Face:* B is relatively developed and the face is wide. People with this kind of face shape are relatively fat. This part of people is mild, warm, friendly and has a very good coordination, but they are very capricious and individualism. The men with round face don’t understand how to refuse others and duplicity.

3) *Nabla Face:* The area A is wide, B and C is narrow. This kind of face is small and the body of people whose face is nabla type is petite body. Most of these people is cleanliness, meticulous, cold, easy to anxiety. These people are also having the indecisive character. They are focused but too confident.

4) *Equilateral Triangle Face:* The area of C is wide. The overall angular, forehead small and the cheekbones are big. These people are stubborn, indomitable, nervousness, vain, fear of power, and like being touted. These people work actively, and will get along well with like-minded people.

5) *Long Face:* Three areas of face have the same width. This kind of person is careful, enthusiasm for study and good at communication with others. It seems reasonable at a first glance, in fact, it is difficult to show the real one of themselves in front of people. Most male

with this face shape is a playboy, but the female is very shy.

6) *Square Face:* Like the long face, the width of three areas is same, but wide. Such people show a positive attitude to everything. They are willpower strong, handout spirit and have the sense of justice, but lack of accommodation.

7) *Diamond Face:* The parts of A and B are same, but C is relatively narrow. These people are very keen to study, patience, thoughtfulness and have the compassion. The boy of this face-shape is single-mind, but the girl is just the opposite.

B. Eyebrow-shape Classification Standard

The length of the eyebrows is benchmarked against the extended lines, which are from both sides of nose to the canthus. The figure 3 will show the benchmark.

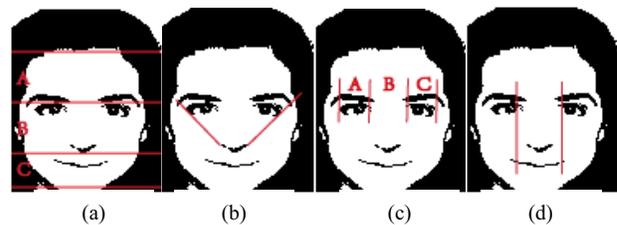


Figure 2. (a) Face classification standard (b) Eyebrow classification standard, (c) Eye classification standard, (d) Mouth classification standard

According to the two baselines, brows can be divided into four categories: eyebrows front on the baseline, eyebrows front beyond the baseline, eyebrows front inside the baseline, eyebrows front-end upward deviating from the baseline.

1) *On the baseline:* This kind of eyebrow is an ideal eyebrow. Most people with inner hot feeling and pay for love at all.

2) *Beyond the baseline:* People with this kind of long eyebrow are gentle, tolerant and slow hot.

3) *Inside the baseline:* This people is always kindhearted, honest, taciturn and work hard.

4) *Upward:* People who have the upward eyebrow straight edge are very good and easy to be a third part.

C. Eye-shape Classification Standard

We define the distance between the eyes as a benchmark. As shown in the figure 4, we divided 3 parts which are part A, part B and C. Part. A and C are eyes of a person, the width of them are almost same. We compare the width between A and B to decide the eye is big or small.

1) *Small eyes:* The size of A area is smaller than B area. People who with the small eyes are usually endurance, dependable and careful. Girls are usually mood fluctuation.

2) *Big eyes*: The size of A area is bigger than B area. The curiosity of these people is strong and they have the rich experience and expression. They may be enthusiasm, pushy, like colorful things and the mental mixture with self-esteem and vanity.

D. Nose-shape Classification Standard

The length of nose is based on the 1/3 of the total length from the hairline to chin. We call the big nose if the length of nose is bigger than benchmark, whereas the nose is small. And the height of the nose is based on the half of the nose length. It is a high nose if size of the height is bigger than the benchmark, whereas the nose is low. According to the width and the height of the nose we divided the nose into seven categories: the Greek nose, short nose, seg nose, bag nose, straight nose, hawk nose and fault nose.

E. Mouth-shape Classification Standard

The mouth has size and the lips have the thickness. Here we just talk about the size of the mouth. As shown in the figure 5, we draw two straight lines from the inside point of iris to consider the size of the mouth. Usually, the length of the girl's mouth is 4cm and the boy's is about 4.6cm.

1) *Big mouth*: The corner of the mouth is outside the line. These ones are energetic and aggressive.

2) *Small mouth*: The corner of the mouth is inside the line. People who with small mouth are wonks, no enthusiasm, implicative and also don't know how to refuse others' opinions and demands.

III. FACIAL FEATURES EXTRACTION

According to the facial feature classification we have introduced, we should extract the key points to divide the facial areas. So we use the flowing steps to find out these key points. First of all, the histogram of each image is computed and an adaptive threshold value method, Otsu method, has been used to get the binary image [20]. Then connected component of the binary image is indicated our respective feature region and also the connected domain will be marked at the same time to help find the feature region easily. A simple research method is applied to extract the key points we need.

A. Image Binarization

The image binarization is the initial stage for facial features extraction. To create the binary images, the following mathematical concepts are applied on original images.

$$Hist(grayL) = \sum_{i=0}^H \sum_{j=0}^W P_{I(i,j)} \quad (1)$$

$$P_{I(i,j)} = \begin{cases} 1 & \text{when } P_{I(i,j)} = grayL \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

$$I_b(x,y) = \begin{cases} 255 & \text{when } Hist(v) \leq Th \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

Where $I(x,y)$ is denoted by original gray scale images, $P_{I(i,j)}$ is the histogram representing time of an occurrence of a pixel of gray level grayL, H is the height of image, W is the width of image, $Hist(grayL)$ is the cumulative histogram function up to the gray level grayL for an image $I(x,y)$ [22,23], where $0 \leq grayL \leq 255$ [. The new binary images, $I_b(x,y)$ is achieved when $Hist(v)$ value is not exceed threshold value Th and the $I_b(x,y)$ image only contains the black pixels of the face feature connected component area.



Figure 2: Binary Image

The threshold Th is fixed by the method of Otsu method is an adaptive method [19]. The work is described in the following equations.

$$g = w0 * (u0 - u)^2 + w1 * (u1 - u)^2 \quad (4)$$

$$u = w0 * u0 + w1 * u1 \quad (5)$$

Where $w0$ is the proportion of the number of foreground pixel points accounts for the total number of the image, $u0$ is the average value of the number of foreground pixel points, $w1$ is the proportion of the number of background pixel points accounts for the total

number, u_1 is the average value of the number of background pixel points, and u is the total average gray level of the image. The final picture of binary image is shown in figure 6. This method is easy to find a relatively threshold to achieve a nice binary image.

B. Connected Component

In the binary images we can see that the black parts are almost the facial feature we need which are connected areas.

In the image processing the connected component analysis is commonly used method of image area (Blob) extraction. Two common connectivity analysis algorithms are two-pass method and seed-filling method. Generally, connected regions refer to the image with the same pixel value and position of the prospect of adjacent pixels image Region. Connected Component Analysis refers to identifying and tagging the each connected areas of the image [25]. In this paper, we use the two-pass method to find out each connected areas of the binary image:

We noted that $b(x,y)$ is the pixel of binary image, foreground pixels value equals 1, background pixels value equal 0, label is accounted from 2 and we use the algorithm of 4 - neighborhood. Two-pass method needs to scan the image two times.

1) *First pass*: reading the current pixel $B(x, y)$, if $B(x, y) = 1$: if all pixels of $b(x,y)$ -neighborhood are 0 then value $b(x,y)$ a new label, $Label = Label + 1$; else $b(x,y) = \min\{Neighbors\}$ and record each label in neighbors.

2) *Second pass*: reading the current pixel $B(x, y)$, if $B(x, y) > 1$, Find the minimum label value among values which are belong to the equal relationship and give it to $b(x,y)$; After the second scanning, the image pixels is formed with the same connected area.

The results of the connected component images will be shown in figure 7. It is clear to find out each facial feature of hairline, eyebrows, eyes, nose and mouth. But there are some interference factors like the hair, discrete points and so on. So before we analyze the connected component, we erode the binary image to remove the noise points. And we achieve better images of connected component.

After the connected component analyzing, locating the facial feature is necessary and a simple linear concept is applied on connected images to detect the feature point locations [21]:

- We denote the hairline is the first line and the chin line is the end line in the new connected images.
- Starting from top-left contour position for left and right points of left eyebrow and eye.
- Starting from top-right contour position for left and right points of right eyebrow and eye.

- Continue scanning after the so called eye area, the left and right corner points of nose will be located.
- Starting from the bottom contour position for mouth corner points.

The located contour corner pixel positions are the corner points we need for classify the facial feature and matching the personality.

IV. CONCLUSION AND FUTUSRE WORK

In this paper, we find out the standard to measure each feature of face based on the previous experience, which let us decide to search the facial feature points. In our work, we extract salient facial features based on histogram method, which is using the adaptive Otsu threshold value to get binary images. Then we achieve the connected component by employing two-pass method and obtain connected images. We optimize for the connected images by eroding the binary images to remove the noise points. The results images are divided into four areas, which are left eye area, right eye area, nose area and the mouth area. The simple line search can segment these areas effectively and help search and locate the key points.

Future work will be focused on building a system to calculate the person's personality by using the standard we have summarized and facial feature extraction method.



Figure 3: Connected Images



Figure 4: New Connected Images

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