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A physiognomy based method for facial feature extraction and recognition

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ABSTRACT

This paper proposes a novel calculation method of personality based on Chinese physiognomy. The proposed solution combines ancient and modern physiognomy to understand the relationship between personality and facial features and to model a baseline to shape facial features. We compute a histogram of image by searching for threshold values to create a binary image in an adaptive way. The two-pass connected component method indicates the feature's region. We encode the binary image to remove the noise point, so that the new connected image can provide a better result. According to our analysis of contours, we can locate facial features and classify them by means of a calculation method. The number of clusters is decided by a model and the facial feature contours are classified by using the k-means method. The validity of our method was tested on a face database and demonstrated by a comparative experiment.

1. Introduction

The physiognomy phenomenon had been a part of Chinese culture since ancient times. To a certain extent, it has had a profound impact on China's political, economic, cultural and daily life [2,3]. In ancient times, this visiting fortune-teller custom was popular with upper officials belonging to the "official school" and it appeared in the neighborhoods of the west and east Han Dynasties, then spread exponentially [13,14,16–18]. Fig. 1 shows the traditional physiognomy. Facial features have been considered in terms of evaluating a person's disposition for thousands of years in both eastern and western cultures. With the development of big data, computer visualization and image processing, more and more statistical data are used to provide facts. Statistical results have verified that there is a strong connection between facial structures and personality traits. For now, various vocational institutes, such as the Merton Institute, which provides services to such companies as AT&T, have used physiognomy as one of their main tools in assessing candidates [1,2,4,6]. A psychological research of Israelis shows that about 75% believe in physiognomy, whereas only 25% think that physiognomy is impossible (the sampling error of the survey is 4%) [3]. Aristotle in his famous work prior analytics asserted, "*It is possible to infer character from features, if it is granted that the body and the soul are changed together by the natural affections*" [39]. It has been verified that people with similar facial features exhibit similar behavioral patterns. A novel practical personality analysis system has been presented by Hsu et al. in 2013 [28] which integrates the professional psychometric personality test with the designed shape-based facial features. In the literature, they construct a personality database by inviting a number of volunteers to fill a questionnaire and they employ a clustering method to classify each facial element from the training set and to verify the connection between facial features and personality. However, the process of extracting and defining facial features and identifying the number of clusters is challenging since it is very difficult to define personality.

In this paper, we propose a new calculation method of personality according to physiognomy. We summarize facial feature classification based on physiognomy. Based on this classification, we design a method to extract facial feature points to help us compute the size of facial features and we employ a number of specific facial features to decide on the number of clusters in particular cases. First of all, we cumulate the histogram of each image and find the better threshold value by using the method of Otsu which is an adaptive method [19]. By using this method we can generate a quality binary image. Then the connected component is used to find the boundary of each facial feature in the face image. We save the contour sequence of the facial feature and locate each facial feature. Third, the classification is decided by two methods.

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Fig. 1. Physiognomy image [13].

The first is the calculation method we have proposed and the other is the clustering method. Comparing the results of the two classification methods, the validity of the calculation method is verified in a very explicit way. This paper is extended from its conference version [29].

2. Related work

Many people in the world history have used the face reading tactics to know others. They all attempt to summarize the experience of facial feature and firmly believe that the face tells a story of one's life. The initial studies were followed by Secord's seminal and comprehensive work before 1970s [30–33] and then research with a focus on baby faces [34]. Psychologists have done much research on face's inner meaning for a long time and showed that different faces reveal different personalities [12,15]. In spite of much research of face reading, it was confusing to researchers that psychological meanings for the same facial feature could be opposite in different papers. So Barbara [2] in clinical medical research (UCSD) proposed to develop an accurate system of psychological meanings which would reflect different levels of all ethnic groups, ages and genders. He studied 6000 faces, proposed accurate and specific psychological meanings for each facial feature which were displayed in many activities. It turns out that people have validated the psychological meaning to be accurate for understanding people.

In China, the ancient people had a great esteem for physiognomy. In the beginning, this kind of fortune-teller custom was popular among the upper officials. For political needs, some dynasties had even created positions for fortune-tellers. The face reading was mainly used to choose officers as well as select concubines because of the feudal rulers deeply convinced by physiognomy. Since Han Dynasty, physiognomy appeared in the folk quietly and then spread like floods. The phase of people asking for was related to every aspect of life, such as health, longevity, love marriage, fortune, career, academic and so on [13,14,16–18]. To some extent, therefore, face reading had an impact on the ancient Chinese political, economy, military, culture, medicine [7–11] and other aspects. Then as the country gradually became open to the rest of the world, a large number of western reading methods were introduced into China and integrated with traditional Chinese physiognomy, which produced the New Face Reading [29]. The purpose of New Face Reading is to determine a person's character suitable for what kind of occupation, rather than his/her fate by observing appearance. However, until now, physiognomy belongs to the non-mainstream borderline culture in today's society. And people who do not have rational knowledge of physiognomy tend to think of it as a kind of superstition and neglect the social cultural function of physiognomy.

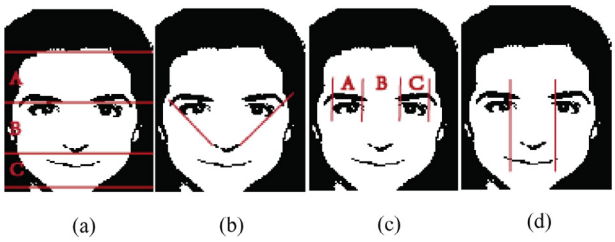

Fig. 2. (a) Face classification standard (b) eyebrow classification standard, (c) eye classification standard, (d) mouth classification standard.

With the increasingly fierce competition in the market today, employment has become a top priority of the contemporary university graduates. In fact, for recruiters, how to choose high-quality staff among candidates is not easy. Before the first meeting between a recruiter and a candidate, the understanding of the candidate is confined to the text on the resume. As a result, the first impression is very important, which is known as "the first effect". As a result, many researchers have built models to select talents by using physiognomy as a main tool. Zebrowitz and Collins [5] reviewed Gibsonian ecological approach and Brunswik's lens model [5] and elaborated a developmental model of relationships between physical and psychological qualities. That model highlights the need of research in identifying configurable physical qualities that may inform accurate perceptions. However, little progress has been made in this regard. Hsu et al. [28] proposed a novel practical personality analysis system based on facial features reading which called "Physiognomy Master". They constructed a new big database of facial features' values and investigated the professional personality of volunteers to find out possible relationships between facial features and personality traits. Based on the perception that people with similar facial features possess similar personality characteristics, they proposed a fusing mechanism that was a powerful tool in social interactions and has achieved positive results.

3. Facial features classification based on physiognomy

The ancient researchers of physiognomy studied countless faces over a long period to determine face reading rules. Physiognomy is one of the most intuitive methods to reflect a person's personality. We have combined ancient and modern physiognomy to understand relationships between personality and facial features.

3.1. Face-shape classification standard

According to the theory of the "San Ting" [13], the person's face is divided into three regions, which are shown in Fig. 2(a).

The face 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 the 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 part of the face, which is associated with the brain. It is related to people's cognitive activities, judgment and intelligence.

B zone is the reaction area of human emotion, which is related to people's feelings and social skills.

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