EXTRACTION APPLICATION OF FACE FEATURE/ COMPONENT

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ABSTRACT

Face recognition system has come to a wide area drawing attention for researchers since a long period. In this time face recognition system has a number of areas, like forensic, psychology, and security. Algorithm which used in face recognition is quite a lot and varies, but altogether have three elementary phases, that are face detection, face features extraction, and face recognition. Face detection phase determines and dissociates the part of an image (still image) which defined as a face. Face feature extraction phase can detect face features as information. Face recognition phase identifies human face based on information got from the face feature extraction phase. Face feature extraction phase can detect face features as information. Face recognition phase identifies human face based on information got from the face feature extraction phase. Face feature extraction phase can detect face features as information. Face recognition phase identifies human face based on information got from the face feature extraction phase. Face feature extraction phase can detect face features as information. Face recognition phase identifies human face based on information got from the face feature extraction phase. Face feature extraction phase can detect face features as information. From 70 samples face image, the level efficacy of feature face equals to 88.6 %.

Keywords: face detection, color space, face feature/component

1. INTRODUCTION

For a number of years lately, face recognition have drawn attention to researchers from different backgrounds. Face recognition has become as one of the successful applications in the field of analysis and understanding of image. The reasons are the broadness usage of face recognition technology in the field of law and commercial, besides the available technology made support it during 30 years research. In this time, recognition of face has applied to a number of areas, like forensic, psychology, and security. This research discusses about the step of feature/component extraction in face recognition system. The application determines the location of some feature faces, like mouth, nose and eye conducted the calculation to color space from a face image assumed that has passed from face detection phase. Face feature extraction experiment used

Table 1. Application of Face Recognition

<table>
<thead>
<tr>
<th>Area</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entertainment</td>
<td>Video game, amusement programs, human-robotic interaction, human-computer interaction.</td>
</tr>
<tr>
<td>Identity Card</td>
<td>Badge card, driving license, and passport.</td>
</tr>
<tr>
<td>Information security</td>
<td>Display TV controller, application security, database security, encrypted file, network security, internet access, medical record.</td>
</tr>
<tr>
<td>Observation and law enforcement</td>
<td>Camera surveillance, observation and investigation.</td>
</tr>
</tbody>
</table>

Face recognition as a whole can be divided into 3 phase based on specific problems [3] as figure 1. First is face detection phase which determines and dissociates the part of an image (still image). Second is face component extraction phase. At this phase, detected face from first phase extracts the face to its components (mouth, nose and eye) as information. Last phase is face recognition which identifies/matches the face based on information from face component extraction phase.
MATLAB image processing Toolkit 7.0, Pentium IV processor 3.0 GHz, RAM 512 MB.

2. FACE FEATURE/ COMPONENT LOCALIZATION

We can not deny the important of feature/component in face recognition system because of the number of face recognition methods using features in addition for face as a whole. There are three methods in this phase [3]:
1. Edge, line, and curve methods
2. Feature template-based method
3. Structure matching method, which calculate geometry constrain of feature.

Most approaches to features localization [1] are template-based. However, this approach is able to directly locate eye, mouth based on the calculation of color space component from an image. This approach also uses the algorithm adapted from [2] to localize the nose area. The color space to be used in this research is color space of YCbCr which is often used in the field of video digital. At this format, there are some informations concerning component of luminance (light effect) and chrominance (natural color) of image. Luminance information is kept as single component (Y), and information of chrominance is kept as two different color components which are Cb and Cr. Cb represents the difference of blue intensity with reference value while Cr represents the red intensity as well. The experiment will start with the division of face image area. The division of the area aim to narrow the detection scope so that the expected result of extraction can more accurate, that are : face area, eye area, mouth area and nose area.

2.1 Division of Face Area

The division is meant to detach the detection area among eye and mouth features. The area division is based on assumption as follows [4]:
1. Both eyes are always reside in upper half of face area
2. While, mouth is always reside in undercarriage half of face area.

This division is conducted while a face image is assumed as the result from face detection phase.

The eye area resulted from face area division will be divided again as figure 3. The aim of this division is to narrow the possibility area of right eye and left eye location reside and then separate them, based on assumption:
1. Half of upper eye area is eyebrow/ forehead
2. Half of lower eye area is the location/ position of the right and the left eye
3. The position of eyes is assumed symmetrically, right eye reside in half of right shares and left eye reside in half of left shares of face.

![Figure 3. Division of Eye Area](image)

We determine the location of the eye after the possibility of location from both eye completed. First of all two map of eye will be formed where one map will be formed of chroma component and the other one is formed by using component of luma (luminance). Forming of chroma component of the eye map is based on the perception value of the highness Cb and the lowness Cr that found around eye.

$$\text{EyeMapC} = \frac{1}{3} \{(\text{Cb}^2) + (\text{Cr}^2) + \text{Cb/Cr}\}$$

Where the value of Cr is negativity of Cr value (255 - Cr) and the result of EyeMapC is normalized into [0..255] range.

The eye usually composed of the combination of dark and light pixel in luma component. Hence, the formation of luma component eye map requires morphology operator of grayscale (dilation and erosion) designed to contrast dark and light pixel component of luma around eye area. The operation of dilation and erosion at Y value is using element of hemispheric at selected scale to form eye map of luma, with formula as follows [1]:

$$\text{EyeMapL} = \frac{\text{Y}(x, y) + g_e(x, y)}{\text{Y}(x, y) - g_e(x, y) + 1}$$

Where (+) and (-) symbols are the operation of dilation and erosion. The result of EyeMapL is normalized into [0..255] range. Both map of the eye will be joined to become one map of eye by using AND operator and return into [0..255] range.

Forming step of eye map can be seen at figure 4. The pixels of eye map will be selected to determine which pixels are the part of eye so that forms a binary image, by using threshold. The binary image is then operated by dilation, to be more clarify eye area. The result operation of binary image will be operated
using AND operator to an edge image that is the result of edge detection of Y component by using Canny operator to get a binary image which is the eye map location.

**2.3 Division of Mouth Area**

Similar to the eye map, this division is also meant to narrow the possibility area of mouth location, which based on assumption:

1. The mouth is imprecise reside in the centre, but rather a few/ little lower
2. The width of the mouth is more or less almost equal to distance among both eye.

The mouth component extraction only requires component of chrominance Cr and of Cb as the form map of mouth after we got a possibility area of mouth location (figure 5). Forming of mouth map is based on the perception that mouth area contains more red component and smaller blue component than other facial area. Consequently, the chrominance component Cr is greater than Cb near the mouth areas. Therefore the formula can be as follows [1]:

$$
\text{MouthMap} = Cr^2 \cdot (Cr^2 - \eta \cdot Cr/Cb)^2 \left(1/n \cdot \sum Cr(x, y)^2 \right)^{\frac{1}{n}} \left(1/n \cdot \sum Cr(x, y) / Cb(x, y) \right)
$$

Where n is the amount of image pixels, \( \eta \) parameter is the mean ratio of \( Cr^2 \) and \( Cr/Cb \). The result of MouthMap is normalized again. Figure 6 shows forming step of mouth map [1].

**2.4 Division of Nose Area**

The extraction of primary face features such as eyes, nose and mouth relies on fact that the distance between the eyes is proportional to the distances between the face features [2]. Consequently, if one of the features is detected then the approximate position of the other features will be known and appropriate masks could be created to extract the features from the face image. The geometric face model and the relationships between these measures are defined as follows [2]:

1. Let the distance between two eyes is D;
2. The vertical distance between two eyes and the center of nostrils is 0.6 D;
3. The face width could be calculated as 1.8;
4. The width of nose is about 0.6.

**2.5 Facial Component Extraction**

The extraction process then conducted after we got the map from each face component. This experiment is limited by marking area of face component at one particular face image. We exploit facility of Imfeature provided by MATLAB. This function determines initial coordinate from a constrain which is the form of box bounding along with its measure. The constrain is designated to the area of a binary image having pixel with value equals to 1 (white).

**3. EXPERIMENT RESULT**

The examination process used 70 face images as input to the program taking by digital camera. The image assumed have passed early stage of face recognition system that is face detection phase so that yield a face image to the face feature extraction program. The level efficacy of the face feature extraction program can be achieved.
4. CONCLUSION AND PERSPECTIVES

Face feature phase is one step in a face recognition system. We can detect a face and locate its features/components. The extraction here aims to get information from a face image. From 70 face images (35 men face and 35 women faces) used as samples image gives the level efficacy equal to 97.1%, 98.6% and 82.9% for eye, mouth and nose extraction success. As a whole the level efficacy of this application program in extracting the face features (eye, mouth and nose) is equal to 88.6% from totalizing 70 face images. Some factors causing the happening of failure are the existence of hair closing over some of object faces because of hair has ability to reflect light, in-accurately in forming of mouth binary map. This program can be used to extract the feature face accurately figured at one particular digital image with skin color vary and at unstable illumination condition. In future we plan to refine the program and to have the measure of each the feature and between the features as informations so that we can use these informations for face recognition phase.

REFERENCE


As from table 2, the number of person who their eyes can be extracted is totally 68 people, 69 people for their nose and 64 people for their mouth as well. It is around 80% the experiment can extract the women image and 97.1% can extract the men image. The experiment shows that the phase of face component extraction of a face image can know enough the location of the eye, mouth and nose component. Some failure images occur because of the existence of less condition of the image. Existence of hair closing over some of object faces (WOMAN 23), the head position/pose (WOMAN 11). This matter result the detecting of hair mentioned as the part of a feature because of hair has ability to reflect light. Some other factors are the pose, luminance (MAN 26), presence/absence of structural component, facial expression, occlusion, image orientation and imaging conditions so that cause less area of features detected [5]. Inaccurately in forming of binary mouth map also cause less area of feature detected. The result can be developed again to look for measure of the features and apart between features as information to be used next in face recognition system, such face identification as a whole. It can also add up with other face feature component, so that the data will be more accurate in the case of recognize a face image.

Table 2. Number of Extracted Features

<table>
<thead>
<tr>
<th># of samples</th>
<th># of Extracted Eye (E)</th>
<th># of Extracted Nose (N)</th>
<th># of Extracted Mouth (M)</th>
<th># of E+N+M</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 Women</td>
<td>33</td>
<td>34</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>35 Men</td>
<td>35</td>
<td>35</td>
<td>34</td>
<td>34</td>
</tr>
</tbody>
</table>

Figure 8. Some of the extracted file images.