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Applying Image Processing Technology to Face Recognition

Tung-Ming Liang

Department of Electrical Engineering
National Changhua University of Education No.2, Shi-Da Road
Changhua City, 500, Taiwan

Ming-Sung Chiu

Department of Electrical Engineering
National Changhua University of Education No.2, Shi-Da Road
Changhua City, 500, Taiwan

Yun-Cheng Wu

Department of Electrical Engineering
National Changhua University of Education No.2, Shi-Da Road
Changhua City, 500, Taiwan

Ming-Tsung Yeh

Department of Electrical Engineering
National Changhua University of Education No.2, Shi-Da Road
Changhua City, 500, Taiwan

Chao-Hsing Hsu

College of Engineering
Department of Information and Network Communications,
Chienkuo Technology University No. 1, Chiehshou North Road,
Changhua 500, Taiwan
hsu@cc.ctu.edu.tw

*Yi-Nung Chung

Department of Electrical Engineering
National Changhua University of Education No.2, Shi-Da Road
Changhua City, 500, Taiwan
ynchung@cc.ncue.edu.tw

Correspond Author: ynchung@cc.ncue.edu.tw

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Abstract. *An Algorithm of image processing technology which applies the multiple-feature comparison for face recognition is proposed in this paper. Two color spaces are applied in this technology to obtain a better skin color feature. In the process, the labeling connected components are used to detect the possible human face. The region of interest (ROI) of human face is marked by the connected area. In human face image, eyes and nostril are more obvious by using the S-component of the HSV color space and histogram equalization algorithm. However, the lips will be easier to find out by using the YCbCr color space. After discovering all the face features, some parameters should be calculated, such as the distance of the eyes, the distance of the nostrils, and the distance between left or right eyes with the lips. These values of the related parameters are used to compare with the trained data in the database. Moreover, the weighted factors will be added to the comparison algorithm to improve the recognition accuracy. The proposed algorithm is quite easy. Based on the comparison result with other algorithm, the proposed approach is easy and has high accuracy also.*

Keywords: Multiple-feature comparison, face recognition, region of interest

1. **Introduction.** The biometric identification technology is the most accurate method for identifying a person. There are many human face recognition algorithms [1-3] investigated by researchers. It is one of important methods for a security control system. There are many kinds of biometric methods presented in research articles which indicate the face recognition is the most efficient method [4-6]. An approach of the multiple face feature comparison method is proposed in this paper. In this study, an image processing technology is applied to obtain the human face features [7-8].

After the human image captured by the camera, the image pre-processing is applied to deal with the captured image. The image pre-processing process can simplify the image and can reduce the processing time for image recognition procedure. These images may be corrupted by random variations which include the intensity of the light, poor contrast, shadow, and noise. In the process, the noise should be removed and needs to enhance the image to improve the recognition results. The unnecessary area of pattern in the image needs to be removed, which can save the processing time. Therefore, the region of interest (ROI) must be set to save the computation time. In this paper, the YCbCr color space and HSV color space are applied [9-11]. The YCbCr color space offers a threshold to determine the skin color area and find the face area. After finding the face area, the system starts to capture the features from the face area. At first, the characteristics of the image Saturation (S) in the HSV color space is applied to make the face features more obvious and reduce the impact of shadow effect. And then, the binarization image process is applied to capture the features of the eyes and nose. The features of the mouth can be captured easier by adjusting the Cr threshold. Finally, the morphological processing is applied to deal with the three features. The related parameters can be found, which are used to compare with the trained data in the database.

In order to save the computation time, the grayscale image is applied in the process. The grayscale image converted by original image contains background noise. It needs to filter out the noise before applying the edge detection processing. The edgy positions are usually on the object and the background of border, so it can use this principle to detect the edge of the object. Common edge detection methods include Sobel edge detection, Prewitt edge detection, and Canny edge detection method. In this paper, the Canny edge detection method is proposed to detect the edge of the object [9-10]. The Canny

edge detection method has done the filter out noise in pre-processing. The dual hysteresis thresholds are applied in this algorithm. This process let Canny edge detection have advantages of filtering and enhancing edges.

The proposed identification method applied in this study is using the distance of multiple features for comparison. Applying this method can save more time than that of applying the general principal components analysis (PCA) algorithm. Because the general PCA identification method is to extract the main components of the entire picture for comparison. Because it takes the main components of the entire picture for identification, so the feature values of the main components are too many and the identification time is much. The identification method applied in this study can save a lot of time. Based on the experimental results, the proposed algorithm has high accuracy for face recognition also.

The rest of this paper is arranged as following. The proposed architecture is presented in the second section. The proposed algorithm includes the technology of image processing and pattern recognition process. The third section is the experimental results. In this section, a test algorithm is applied. Several sets of data are tried in the experiment which can find the recognized results. The conclusion is presented in the last section.

2. System architecture.

At first, the image processing for face recognition is presented. The general color space of the image is using RGB. However, the images using RGB color system is easy influenced by shadow or ambient illumination changes. In this paper, the system will transfer the RGB system to HSV color system which can reduce the influence. HSV color space contains three components, in which H represents the hue, S represents the saturation, and V represents the brightness. The hue element usually thinks of the colors which like red, green or others. The saturation is the ratio of colorfulness to brightness which is grayscale. The value (V) is the color lightness such as the light green or dark green. After the color space conversion, the system obtains a relative image with reference background. However, the image contains three components in color space, which will increase the computation burden. Therefore, it needs to apply the binarization process and let the picture become a gray image.

After the image is become grayscale, the environmental factors may lead to different image quality, especially for the outdoor image. The image enhancement algorithm is applied to solve this problem, which involves histogram equalization and edge sharpening process. The results obtained by equalizing the histogram. The histogram distribution is more evenly distributed between 0 and 255 grayscale intensity. The image is more obvious than the original grayscale image after applying the image enhancement algorithm and the contrast and brightness are significantly improved. This image features will be more suitable for the following process. After the histogram is equalized, the contrast of the image is obviously increased and the features are also obvious. The results of the following edge detection need more accurate, so the image needs further edge enhancement program. The concept is to subtract a fuzzy image from the original image to adjust the numerical scale so that the output image is more clear.

The purpose of edge detection is to detect the point where the brightness change in the image. It is usually in the boundary between the object and background. The grayscale image converted by the original image contains much background noise. It need to filter out the noise and then to detect the location of the block. The principle of the image edge detection is to calculate the grayscale difference and gradient change to determine the greater gap. Try to find the boundary of more obvious bright and dark changes. These positions are usually on the object and the background of border, so it can use

this principle to detect the edge of the object. In this paper, the Canny edge detection method is used to detect the edge of human face.

Morphology processing is often used in target detection, noise removal, block segmentation and skeleton boundary capture. The principle is based on the mathematical theory of the collection. The operation is to use mask in the image of the pixels as a shift operation. This mask also known as structural elements, the user can set the size and shape of the structural elements. According to different morphological algorithms do different treatments to achieve image segmentation and recognition purposes. Many of the applications of morphology can be deduced based on these basic operations to perform advanced image processing. In addition, applying morphology to image processing simplifies image data and maintains the basic outline of the graph. After morphology process, the face image is shown in Figure 1.

FIGURE 1. The face image after morphology process

The system flow diagram proposed in this study is shown in Figure 2. The process is divided into several execution parts which are input image, capture face, feature extraction, and recognition comparison. Usually the image is needed to filter out the background and noise to obtain the target. In this paper, the YCbCr color space method is applied, which gives a threshold to determine the skin color area and judges whether it is face area or not. After finding the face area, the system starts to capture the features from the face area. At first, it uses the characteristics of the image Saturation (S) in the HSV color space to make the face features more obvious and reduce the impact of shadow effect also. And then, it uses the binarization image to capture the features of the eyes and nose. The features of the mouth are captured by adjusting the Cr threshold in the YCbCr color space. After morphological processing of the three features, the relative distances are calculated, and each distance has its weighting ratio to increase the recognition rate.

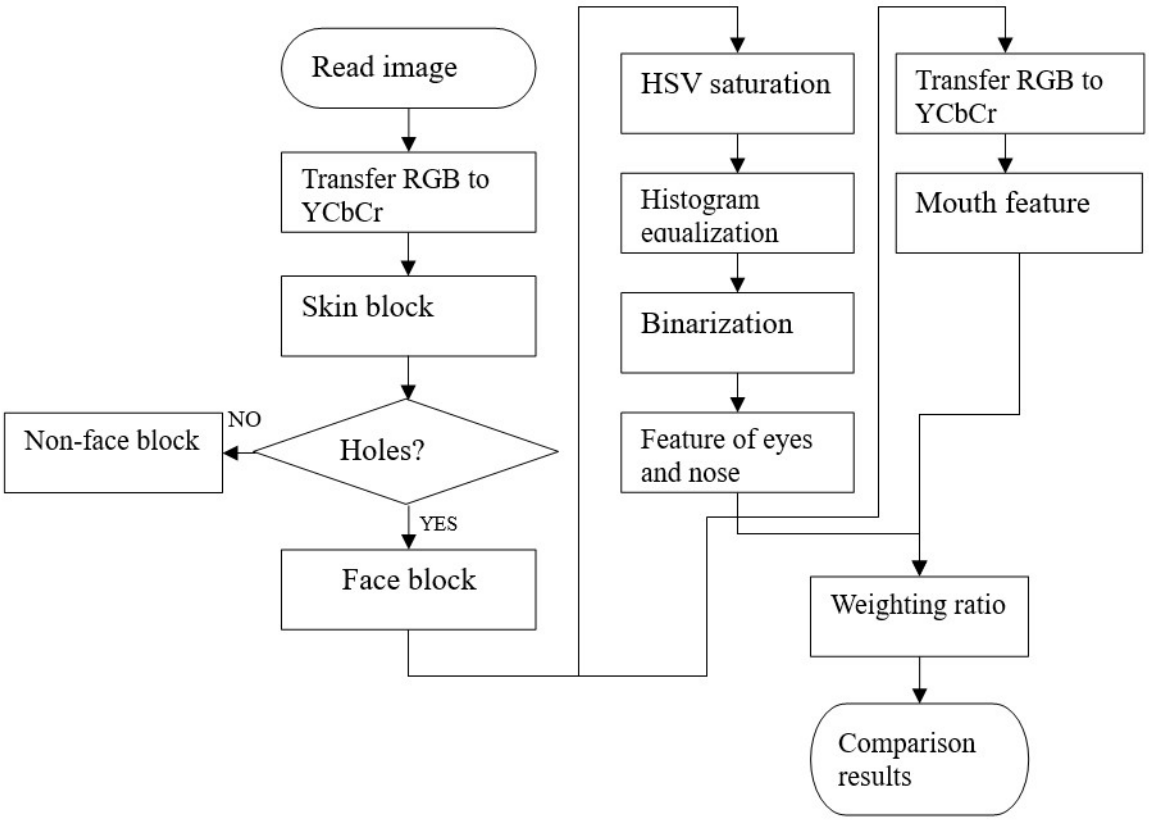

FIGURE 2. System flow diagram

3. **Experimental results.** In this section, the proposed image processing technique is applied to conduct the experiments. The identification method applied in this study is using the distance of multiple features for comparison. Applying this method can save a lot of time. We chose several facial features which are eyes, nostrils, and mouth. Because the distance between the eyes, and the distance between eyes and mouth are different for each person. The area of this triangle is different also, so we take these features to recognize the face. In addition, we also find the nostril features. Multiple feature values make the recognition accuracy much better.

The experimental sequence of image includes original image, color space conversion, skin color block, face block, region of interest, color saturation, histogram equalization, and binarization. Finally, the feature map of eyes and nostrils, and feature map of eyes and mouth are obtained. The size of the gallery picture will adjust to be the same size of the experimental face also. The sequence of images after conducting the proposed algorithm is shown in Figure 3.

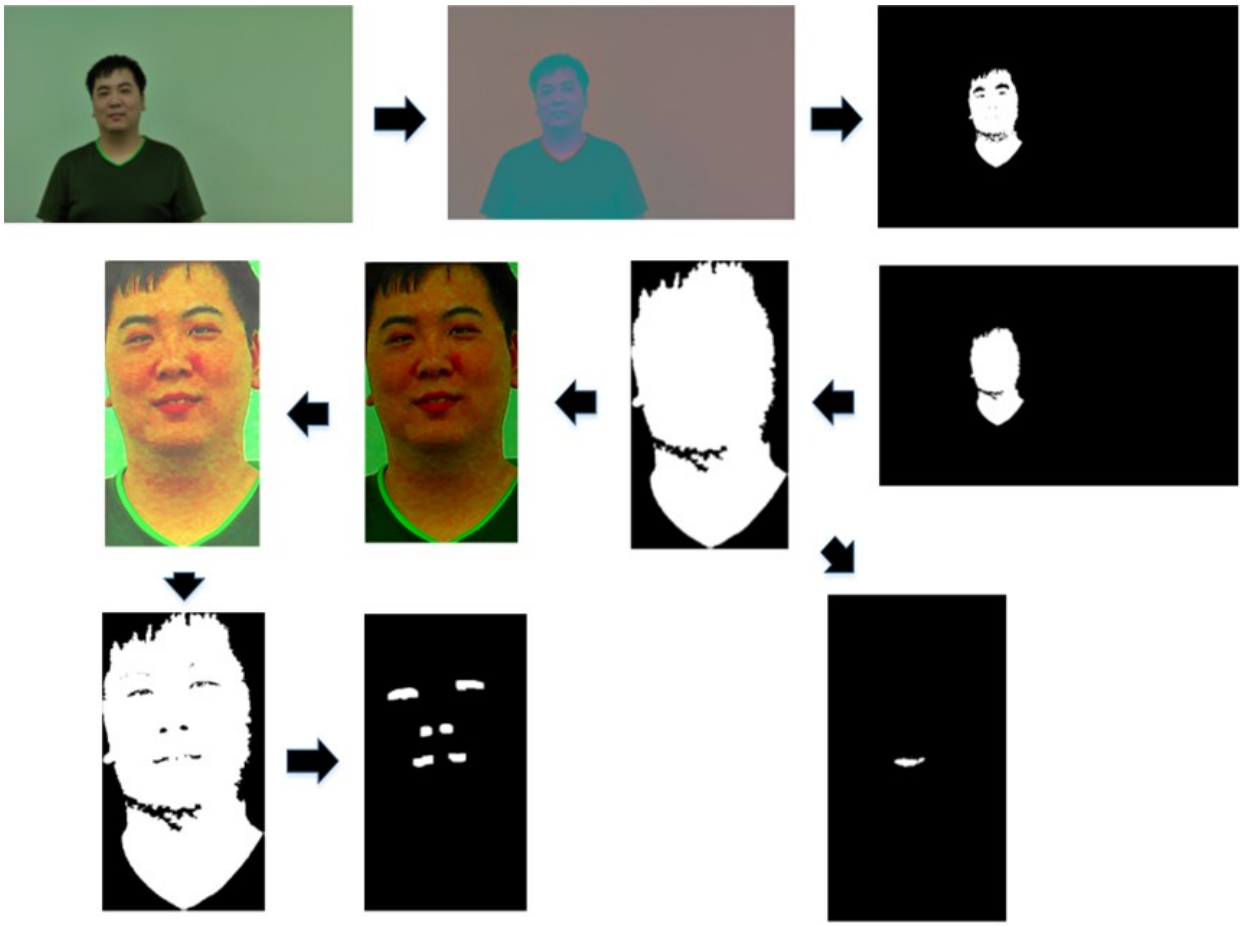

FIGURE 3. The sequence of images

In this paper, the comparison result with other method is shown in Table 1. It can be found that the method used in this study is better than the traditional PCA algorithm in both the identification time and the identification accuracy rate. It also can prove the feasibility of this method.

TABLE 1. The test accuracy

Identification method	Identification time (seconds)	Identification accuracy
The proposed method	4.179	98.75%
The PCA method	30	89.75%

4. **Conclusion.** One face recognition algorithm by using image processing is proposed in this paper. The recognition process includes skin color extraction, face extraction, automatic region of interest extraction, enhanced image and feature comparison. In this paper, we strengthen the color saturation and histogram equalization methods which can make the features easier to be captured. Moreover, the background feature extraction

failure due to light and shadow problems are solved also. Finally, a weight ratio is added to the extracted feature data to increase the recognition rate. Based on the experimental results, the recognition accuracy is 98.75%.

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