

# Robust Face Detection Using Illumination-Compensation and Morphological Processing

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## Abstract

This paper presents a simple and robust face detection algorithm that can be utilized to video summary. We firstly apply the Illumination-Compensation process for reducing the effect of brightness on the image. And then, we analyze the face region based on color in the  $YCbCr$  space to obtain the skin color. Also, we try the morphological image processing called closing algorithm to improve the detection. Experimental results demonstrate the effectiveness of our face detection algorithm that leads to 96.7 % precision ratio on average.

## I. Introduction

Now a days, video contents are easy to access due to the availability of high-speed wireless communication networks and high computing ability of the systems. Among the methods, video summary is necessary for convenient retrieval process and face detection is a crucial step in these video summary applications [2]. The purpose of face detection is to look for and locate face in given images, and its performance has great effect on face tracking, face recognition and actor-based video

summary [3].

In this paper, we present a robust face detection method. The Figure 1 shows the our face detection system.

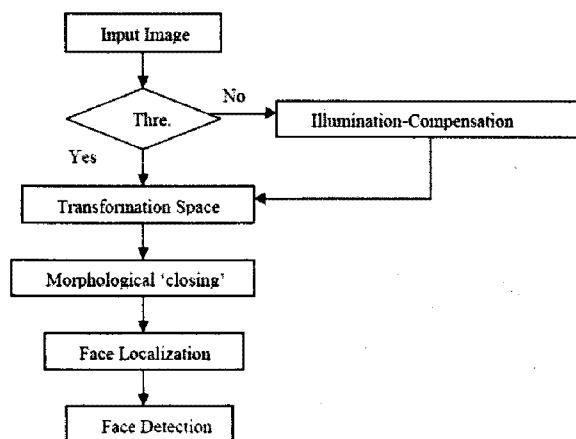


Figure 1. Face detection flow diagram.

## II. Illumination-Compensation

The skin tone color depends on the illumination conditions like an artificially created light inside, strong sunlight as brightness cases and like the shadow, fading effects as dark cases. In this paper, we firstly introduce the compensation method to remove the illumination effects. The Illumination-

Compensation algorithm shown in Fig.2 is consists of 4 steps.

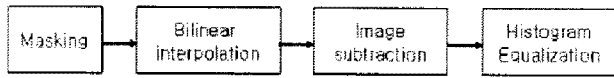


Figure 2. Illumination-Compensation processes.

In Fig. 3(a), original images, the face regions are difficult to understand even eyes. We attempt to find a more efficient way to analysis face detection through the compensating illumination components.



Figure 3. Examples of the Illumination-Compensation. following the 4 steps (b) to (e).

### III. Face Detection

The first step for skin tone detection method is the transformation color space RGB to YCbCr space because RGB is not necessarily the most efficient representation of color due to the HVS (Human Visual System) is less sensitive to color than to luminance. After transformation, we extract skin tone and carry out a one of the famous morphological processes called closing algorithm that consists of dilation and erosion as parts.

$$A \bullet B = (A \oplus B) \ominus B \quad (1)$$

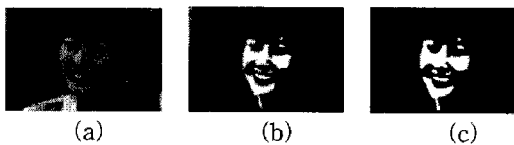


Figure 4. Morphological image processing.

(a) Original images. (b) Skin tone detected images (c) The results of "closing" process.

### IV. Experimental Result

Our approach is applied to detect faces in face images. This approach can be used for video summary. We apply our approach to various genres (news, drama, movie and actor images from web). We test with five databases consisting of total 5661

images and get the precision ratio of 96.7 % on average respectively. Figure 5 marked with red rectangle. Due to the lighting, the face of the Fig. 5(a) images can not detect well. However, these effects are removed from Illumination-Compensation method in Fig 5(b).



Figure 5. Face detection examples (a) without and (b) with Illumination-Compensation method.

### V. Conclusion

In this paper, a color-based face detection algorithm is proposed in YCbCr color space. We use the Illumination-Compensation method and closing algorithm as an important part of the algorithms. Therefore, our algorithm quickly locates a face region compared with other geometric methods such as detect eye or mouth map.

### V. Acknowledgement

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