Chapter 8

Novel Techniques in Skin and Face Detection in Color Images

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ABSTRACT

Human skin detection and face detection are important and challenging problems in computer vision. The use of color information has increased in recent years due to the lower processing time of face detection compared to black and white images. A number of techniques for skin detection are discussed. Experiments have been performed utilizing deep learning with a variety of color spaces, showing that deep learning produces better results compared to methods such as rule-based, Gaussian model, and feed forward neural network on skin detection. A challenging problem in skin detection is that there are numerous objects with colors similar to that of the human skin. A texture segmentation method has been designed to distinguish between the human skin and objects with similar colors to that of human skin. Once the skin is detected, image is divided into several skin components and the process of detecting the face is limited to these components—increasing the speed of the face detection. In addition, a method for eye and lip detection is proposed using information from different color spaces.

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INTRODUCTION

Human skin detection is an active area of research in computer vision. Skin detection has numerous applications, such as face detection (Das et al., 2015; Gondaliya et al., 2015; Hajiarbabi & Agah, 2014; Hajiarbabi & Agah, 2015), identifying and filtering nude pictures on the internet (Fleck et al., 1996), and so on. Skin detection is challenging due to several factors, such as the similarity between human skin color and other entities like color of sand, walls, etc. (Alshehri, 2012), differences of illumination between images, images being taken by different cameras with different lenses, the ranges of human skin colors due to ethnicity, and others. Skin color is an indication of various characteristics such as race, health, age, etc. (Fink et al., 2006). In video images, skin color can be used to show the existence of humans in media (Elgammal et al., 2009). There are several color spaces that can be used for skin detection, and among them RGB, YCbCr, and HSV are more common (Singh et al., 2003). The color spaces can be used individually, or the information of the color spaces can be combined (Hajiarbabi & Agah, 2014).

Face detection is an important step not only in face recognition systems, but also in many other computer vision systems, such as video surveillance (Grace, J., Reshmi, K., 2015), human-computer interaction (HCI) (Khdekar, P. et al., 2016), and face image retrieval systems. Face detection is the initial step in any of such systems. The main challenges in face detection are face pose and scale, face orientation, facial expression, ethnicity and skin color. Other challenges such as occlusion, complex backgrounds, inconsistent illumination conditions, and quality of the image further complicate face detection in images. The problem with most of the popular face detection methods is that they are based on a window that is moved over the image. This process can be time-consuming. In this book chapter, a methodology is described that locates faces based on the human skin color. This process is significantly faster.

Deep learning methods are a type of neural network, which have been designed to work properly when the number of hidden layers in a neural network is increased. In ordinary neural networks when the number of hidden layers increases, the back propagation algorithm often fails to train the network well. Deep learning techniques introduced advanced methods for training a neural network with multiple hidden layers. Because of having several parameters such as the number of nodes in the hidden layer, the random initial weights, etc., the neural network is very flexible, unlike other methods used for skin detection. To the authors knowledge deep learning has not been used for skin detection.

One of the issues in skin detection is that the color of several objects like the color of sand, soil, etc. are quite similar to human skin color, which can cause even a well-designed classifier not to be able to distinguish between such similar pixels.
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