Chapter 2: Human Face Localizations

2.1 INTRODUCTION

Human face localization is a crucial step for human face recognition. The human face regions have to be detected from the images before the face recognition process. The face recognition algorithms previously reported are classified into two groups: algorithms for detecting faces in intensity images [12-15] and algorithms for detecting faces in color images [16-20].

Color information is useful to detect the human face region. However, we cannot use color information for intensity images. For example, most of surveillance cameras nowadays installed in shops and airports are still intensity cameras. And, the electronic processing of mug-shot or identity card databases requires the detection of faces from intensity pictures printed on paper.

Thus, in this book two algorithms are discussed for face region detection, one of which is used for intensity images and the other is used for color images. These two algorithms will be shown in the succeeding sections.

2.2 HUMAN FACE LOCALIZATION FROM INTENSITY IMAGES

The previously reported algorithms used to detect faces from intensity images were shown in chapter 1. [14] used a region-growing method to extract the face region from an intensity image. Nevertheless, when the intensity difference between background and skin-region of the face is small, it is difficult to correctly extract the face region by the region-growing method.

A neural network-based algorithm [12] requires many sample images for training the neural network. This is especially so, since the number of nonface images needed to train the neural network is huge. In addition, the algorithm can detect only the right front faces. To detect faces with varying poses, we have to train the neural network using sample faces with many different poses. As the number of sample face images increases, the discrimination of face images from nonface images becomes difficult.

The eigenspace method also requires many sample images for the construction of the eigenspace. If the number of sample images is not sufficiently large, the method can detect only faces whose patterns are similar to sample faces. In addition, to detect faces with varying poses, we have to construct many eigenspace, each of which corresponds to one pose. If we construct only one eigenspace for faces with varying poses, the discrimination power of the eigenspace decreases. Thus, the eigenspace method requires so much time to detect faces with varying poses.

The face recognition algorithm that has been used in this book is similar to that of [29]. The algorithm uses horizontal and vertical integral projections of the edge image. The images considered in this chapter are head-shoulder images with plain backgrounds, like the passport pictures. Thus, edges clearly appear near the top, left and right boundaries of the head. Therefore, if we require only rough face detection, the algorithm is sufficient for our purpose. The details of the algorithm is illustrated below:

First, the Sobel edge detector is applied to the original intensity image I(x,y), $0 \le x \le M-1$ and $0 \le y \le N-1$. Let E(x,y) denote the obtained edge image where E(x,y)=1 if (x,y) is an edge pixel and otherwise E(x,y)=0.

Next, for each column x and each row y, V(x) and H(y) are computed by,

$$V(x) = \sum_{y=0}^{N-1} E(x, y) \qquad (2.1)$$

$$H(y) = \sum_{x=0}^{M-1} E(x, y) \qquad (2.2)$$

V(x) and H(y) are called the vertical and horizontal integral projections of the edge image E(x,y). Fig.4 shows an intensity image which is a head-shoulder image of a person. The image was taken from the database of University of Bern. Fig.5 gives the edge image obtained from the image of Fig.4 and the vertical and horizontal integral projections of the edge image.