PERGAMON

Pattern Recognition 36 (2003) 549–562

PATTERN RECOGNITION
THE JOURNAL OF THE PATTERN RECOGNITION SOCIETY

www.elsevier.com/locate/patcog

Iris detection using intensity and edge information

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Received 3 May 2001; accepted 12 March 2002

Abstract

In this paper we propose a new algorithm to detect the irises of both eyes from a face image. The algorithm first detects the face region in the image and then extracts intensity valleys from the face region. Next, the algorithm extracts iris candidates from the valleys using the feature template of Lin and Wu (IEEE Trans. Image Process. 8 (6) (1999) 834) and the separability filter of Fukui and Yamaguchi (Trans. IEICE Japan J80-D-II (8) (1997) 2170). Finally, using the costs for pairs of iris candidates proposed in this paper, the algorithm selects a pair of iris candidates corresponding to the irises. The costs are computed by using Hough transform, separability filter and template matching. As the results of the experiments, the iris detection rate of the proposed algorithm was 95.3% for 150 face images of 15 persons without spectacles in the database of University of Bern and 96.8% for 63 images of 21 persons without spectacles in the AR database. © 2002 Pattern Recognition Society. Published by Elsevier Science Ltd. All rights reserved.

Keywords: Face recognition; Iris detection; Facial features; Template matching; Hough transform

1. Introduction

The face recognition has many applications such as personal identification, criminal investigation, security work and login authentication. Automatic recognition of human faces by computer has been approached in two ways: holistic and analytic. The holistic approach [1–3] treats a face as 2D pattern of intensity variation. The analytic approach [1,4] recognizes a face using the geometrical measurements taken among facial features, such as eyes and mouth.

In the analytic approach, reliable detection of facial features is fundamental to the success of the overall system. In addition, it is also important in the holistic approach for the face normalization [1]. The face in the input image must be normalized to a standard size, location and orientation before it is matched to database faces. And, such normalization can be done using some geometrical measurements among facial features.

The eyes can be considered salient and relatively stable features on the face in comparison with other facial features. Therefore, when we detect facial features, it is advantageous to detect eyes before the detection of other facial features. The positions of other facial features can be estimated using the eye positions [1]. In addition, the size, location and image-plane rotation of the face in the image can be normalized by only the positions of both eyes.

Eye detection is divided into eye position detection [1,2,5–7] and eye contour detection [8–11]. (The second plays an important role in applications such as video conferencing and vision assisted user interfaces [11].) However, most algorithms for eye contour detection, which use the deformable template proposed by Yuille et al. [8], require the detection of eye positions to initialize eye templates. Thus, eye position detection is important not only for face recognition but also for eye contour detection. In this paper eye detection means eye position detection.

Brunelli and Poggio [1] and Beymer [2] located eyes using template matching. In this method, an eye template of a person is moved in the input image and a patch of the image that has the best match to the eye template is selected as the eye region. Pentland et al. [5] used the eigenspace method to locate eyes. In this algorithm, the eigenspaces of the left and right eyes are first constructed using sample images. Next, subimages cut off from the input image are projected

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0031-3203/02/$22.00
PII: S0031-3203(02)00066-3