A Face Detection Using Multiple Detectors for External Environment

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Abstract. We propose a method of multiple context fusion based robust face detection scheme, multiple cascade and finally decision using correlation table. It takes advantage of multiple cascade face detector fusion by context. We propose the filtering classifier method for illumination face image. And then we constructed cascade classifier from applied different filtering method. The multiple cascade detectors made from six single context detectors. Six contexts are divided k-means algorithm, and classify illuminant. In this paper, we proposed the classifier fusion method by using correlation between face images. The proposed face detection achieves the capacity of the high level attentive process by taking advantage of the context-awareness using the information from illumination. We achieved very encouraging experimental results having varying illuminant.

1 Introduction

The face detection technology involves automatically detecting the position and the area of face from a random scanned picture or digital video data. The algorithm of this technology searches for a limited set of facial features, but the features appear to be different from a case to case due to various conditions of the real world [1, 2, 3, 4]. Context, in this paper, is modeled as the effect of the change of application working environment. The context information used here is illumination. As environment context changes, it is identified by the multiple context fusion, and the detection scheme is restructured [5, 6, 7, 8]. The goal of this paper is to explore the possibility of environment-insensitive face detection by adopting the concept of multiple context fusion. According to the environmental change, the face image is variously expressed [3, 5]. Therefore, in this paper, we propose the face detecting method using several contexts for robust face detection in the various environmental changes. And, we proposed the multiple face detectors to fuse each the context face recognition result. The multiple face detectors are comprised of several detectors. And the single face detector has the cascade face detection structure. The cascade face detector is comprised of two face detection units. We employ K-means for the context modeling and awareness. It provides the capacity of the high level attentive process by the environment context-awareness in face detection. We achieve very encouraging results from extensive experiments.

L. Wang et al. (Eds.): FSKD 2006, LNAI 4223, pp. 1299 – 1302, 2006.

2 Face Detection Architecture Using Multi-context

2.1 Learning

In this session, we make the correlation table and cascade classifier from training face images. The correlation tables decide final detection result from cascade face detector. Clustering method is used K-means algorithm, we divided six class. And we make the classifier for context. First classifier practice histogram equalization and second classifier practice the contrast stretching. Because we divided the face for illumination, we applied different preprocessing filter.

2.2 Testing

Fig. 1 shows our face detection flowchart. In testing step, we apply cascade classifier and correlation table. Therefore, we improve the reliability by using correlation table between contexts. Environment context is analyzed and identified using the K-means. Input pattern is vectorized for image size of 20x20 sizes; input node had size of 10x10 pixels. That image is converted 1x100 dimension vectors. Context shows images of three clusters various illuminant face dataset, we define 3 step illuminant environment EQ(1). We use probability of face is true and probability of face is false.

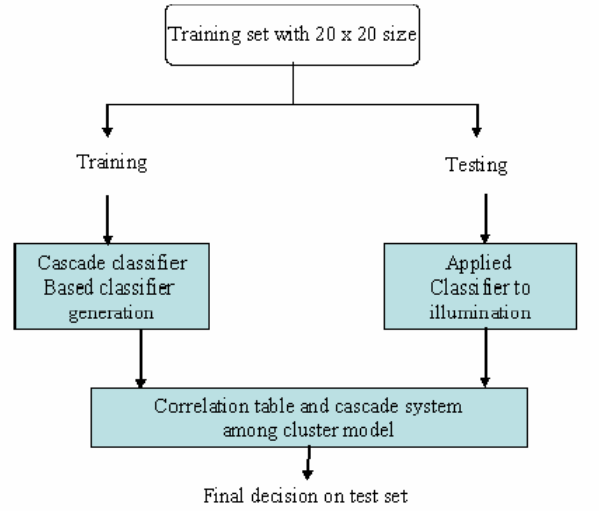

Fig. 1. The proposed face detection architecture

$$P(X \mid True) = \exp(-0.5 * ((x - \mu \mathbf{T})/\delta \mathbf{T})^2) / (\sqrt{2\pi} * \delta \mathbf{T}) \quad (1)$$

3 Experiment

The experiment of the proposed method has been performed with images captured in various environments 100 images are captured and used in the experiment. Inha data

set include 100 of person. In CMU database, total image number is 130 images including 507 faces. Tables compare the detection rates (AR) for the context-based color system and the umbers of context-based Bayesian classifiers for the three boosting-based systems, given the number of false alarms (FA). And Table 1 shows that the result of face detection between multiple context based Detector and context based multiple cascade detector fusion in CMU testset1. Table 2 shows that the result of face detection between multiple context based Detector and context based multiple cascade detector fusion in CMU testset2. We know that propose method is good face detection performance other method. Also, number of context very closes, and different face detection ratio. We could improve illuminant face detection performance by using cascade detector combination.

Table 1. Face detection result of proposed face detector in CMU testset1

Face detection according from face context number					
Nine face context		Five face context		Proposed architecture	
AR	FAR	AR	FAR	AR	FAR
88.75	59	90.0	62	92.80	24
91.70	68	92.3	70	94.08	35

Table 2. Face detection result of proposed face detector in CMU testset2

Face detection according from face context number					
Nine face context		Five face context		Proposed architecture	
AR	FAR	AR	FAR	AR	FAR
84.6	3	90.3	7	94.9	2
86	14	91.2	15	96.1	10

The combined cascade face detector is also investigated. In this experiment, the factor illumination was considered and experimental images were classified by the actor of illumination. We classified bad illumination images into the image including a partially lighted face, good images into that including a nearly uniformly lighted face.

4 Conclusion

The context information used here is illumination. We generated cascade face detector for each context. And then we combine face detection result from each face

detector. We could improve the face detection by using cascade face detector combination. As environment context changes, it is reliability. The detection scheme aims at robustness as well as fast execution way under dynamically changing context. In this paper, we has been resolved by employing K-means for divided context illuminant group. The proposed face detection achieves the capacity of the high level attentive process by taking advantage of the illumination context-awareness. Experimental result has shown that the proposed system has detected the face successfully 96.1% of CMU testset2.

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