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Fusion for Component based Face Recognition

Yanjun Yan
Syracuse University, Department of Electrical Engineering and Computer Science, yayan@syr.edu

Lisa Ann Osadciw
Syracuse University, Department of Electrical Engineering and Computer Science, laosadci@syr.edu

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Yanjun Yan and Lisa Ann Osadciw
EECS, Syracuse University
Syracuse, NY, USA
{yayan, laosadi}@syr.edu

Abstract— **This paper proposes a practical way to realize the diversity in face recognition system for performance improvement by fusing the classification results from the components (characteristic regions such as eyes, nose and mouth) and from the whole face image, instead of concatenating the face feature and the modular features for a single classifier. The extracted sub-images are not totally independent from the face image, but the experiments show that the fused result is improved from the recognition result based on the face or components alone. The fusion is implemented and compared at both score level and decision level. Communication resources are preserved between the sensor and fusion point in decision level fusion at the expense of performance, and the selection of which fusion scheme to use depends on the system resources and performance requirement.**

In the same way that the face images are used to construct the Eigenface [1] or DFLDA [2] feature space for recognition, the componentsare used to construct the feature spaces for each part on their own. Four components are considered in the simulation: eyes, nose, moth and forehead to derive similarity scores for four classifiers.

Score level fusion sums the scores from each classifier to make the final decision as shown in Figure 1. The summation could be weighted according to the relative accuracy and importance of each individual classifier [3], [4]. Score level fusion needs to transmit the real number scores from the classifiers to the fusion center. This takes more transmission recourses than the categorical ranking decisions from the classifiers, but the score provides more information.

Decision level fusion utilizes majority voting to fuse the results from each classifier as shown in Figure 2. Decision level fusion greatly reduces bandwidth needs on transmission. However, once the decision is made at each classifier based on the scores, the information on their relative degrees of similarity is lost preventing its use in the final decision.

As shown in Table I, the classifiers based on the components are weaker than the classifier based on the face. Variations based on different weighting of the five classifiers are tried.

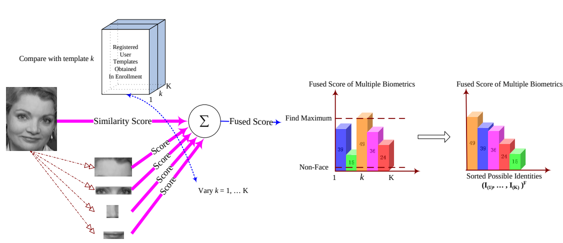

Fig. 1. Score Level Fusion of face and components

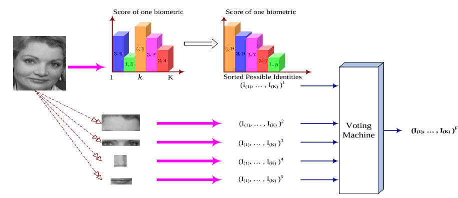

Fig. 2. Decision Level Fusion of face and components

When the five classifiers are weighted equally, the recognition rate improves dramatically by over 10%.

Decision level fusion needs the ranking of the indices of the possible identities from each classifier, but is still capable of improving performance by about 9%.

TABLE I
FACE RECOGNITION RATE WITHOUT AND WITH FUSION

Recognition Rate (%)			
		by PCA	by DFLDA
Without Fusion	Face	79.375	94.286
	Eyes	61.875	70.714
	Nose	58.125	67.123
	Mouth	51.875	64.286
	Forehead	73.75	73.571
With Fusion	Score Fusion	**90.625**	**99.286**
	Decision Fusion	**88.75**	**97.857**

The experiment result by DFLDA method leads to similar conclusion, and DFLDA method is shown to achieve better recognition rate than baseline eigenface method.

The decision level fusion is original in this paper, and more fusion schemes, instead of majority voting, can be experimented to see how much each module contributes to the fused result, and whether a variable fusion scheme, changing according to the performance of each classifier, works better than using a fixed fusion scheme, which incorporates the results from some classifiers but not from others all the time.

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