Face Liveness Detection and Recognition Using Shearlet Based Feature Descriptors

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ABSTRASCT

Face recognition is a widely used biometric technology due to its convenience but it is vulnerable to spoofing attacks made by non-real faces of valid user. The aim of this paper is to develop a multifunctional feature descriptor and an efficient framework which can be used to deal with both face liveness detection and recognition. In this framework, new feature descriptors are defined using a multiscale and multidirectional transform (shearlet transform). Then, stacked auto-encoders and softmax classifier are concatenated to detect face liveness and identify person.

1. INTRODUCTION

The framework of the proposed approach is summarized in Fig. 1. An image or a video entering the framework is first subjected to a face detector. Then, shearlet based feature descriptors are extracted from these face images. The extracted descriptors are applied to detect the liveness of the face. If it is a real face, these descriptors can be directly used for face recognition. The calculation process of Shearlet Based Feature Descriptors (SBFD) in a gray scale image is summarized in Fig. 2. The extracted SBFD can be feed into stacked auto-encoders and the final face liveness and face type are predicted by a softmax classifier. The detailed architecture of this framework is shown in Fig. 3.

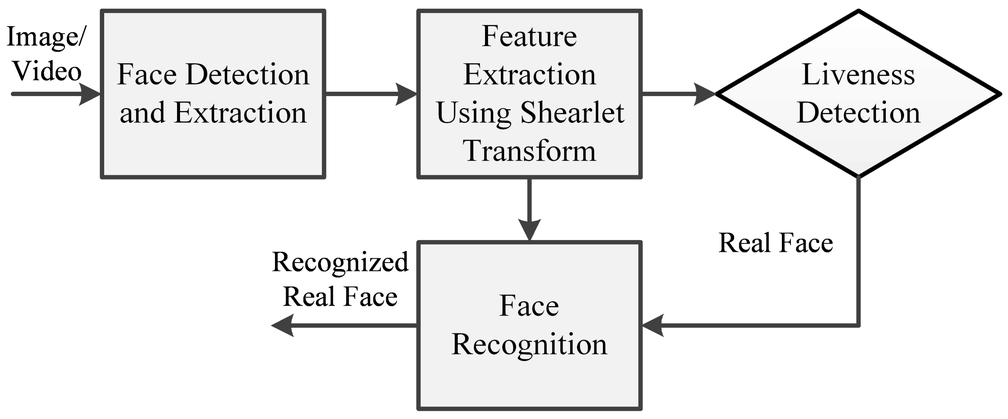

Fig. 1. High-level overview of the proposed framework.

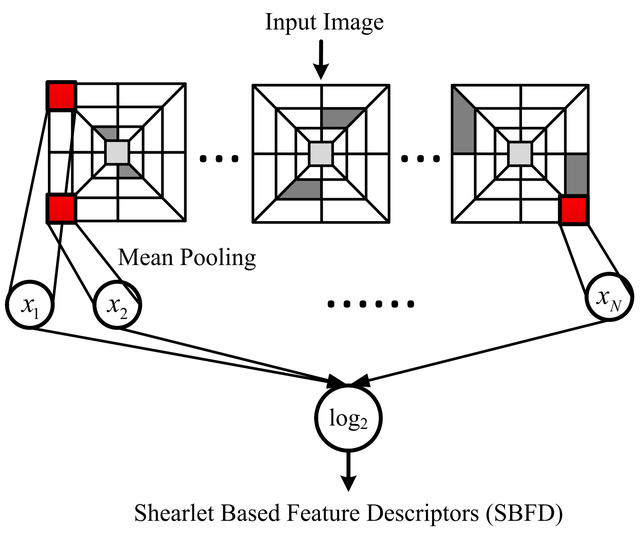

Fig. 2. The calculation process of SBFD.

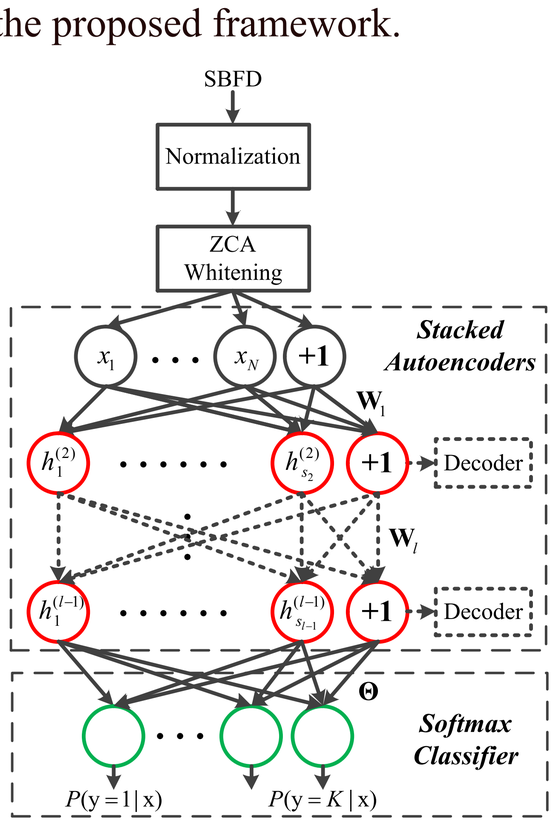

Fig. 3. The architecture of stacked auto-encoders and softmax classifier.

2. EXPERIMENTAL RESULTS

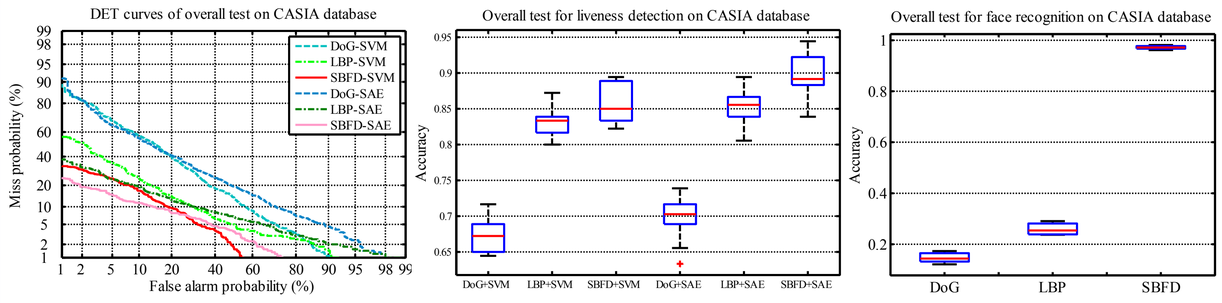

Fig. 3. From left to right. DET curves of six methods for overall test after 100 iterations. Box plot of liveness detection accuracy of six methods over 100 trials for overall test. Box plot of face recognition accuracy of three methods over 100 trials for overall test.

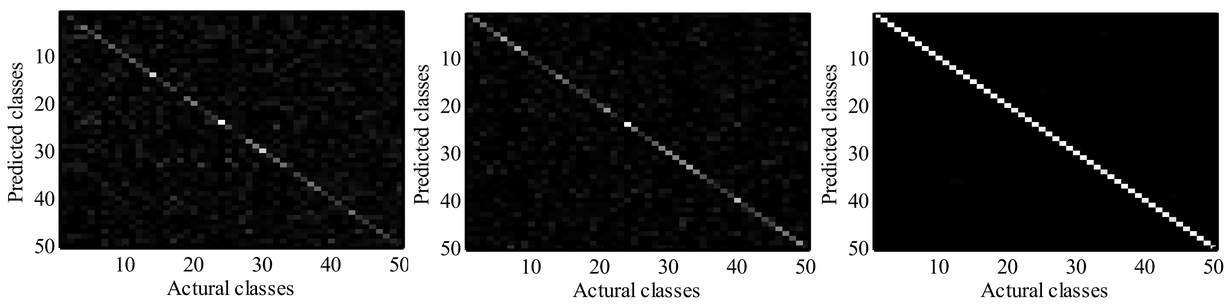

Fig. 4. Mean confusion matrix for face recognition across 100 trails for overall test. From left to right. Mean confusion matrix of DoG. Mean confusion matrix of LBP. Mean confusion matrix of SBFD.

Table 1. Median classification accuracy for 100 iterations of liveness detection test on the CASIA database.

		Low	Normal	High
Quality Test	DoG+SVM	0.6833	0.7167	0.6833
	LBP+SVM	0.7667	0.8500	***0.9000***
	SBFD+SVM	***0.9333***	0.9000	0.8167
	DoG+SAE	0.6333	0.7500	0.7500
	LBP+SAE	0.7500	0.8167	***0.9000***
	SBFD+SAE	***0.9333***	***0.9167***	0.8667
		Warped	**Cut**	**Video**
Fake Face Test	DoG+SVM	0.6278	0.6444	0.7056
	LBP+SVM	0.8278	0.7944	0.8167
	SBFD+SVM	0.8333	***0.9389***	***0.9278***
	DoG+SAE	0.6389	0.6889	0.7111
	LBP+SAE	***0.8500***	0.8389	0.8889
	SBFD+SAE	***0.8500***	0.9333	0.9167
Overall Test	DoG+SVM	0.6611		
	LBP+SVM	0.8333		
	SBFD+SVM	0.8444		
	DoG+SAE	0.7167		
	LBP+SAE	0.8556		
	SBFD+SAE	***0.8889***		

Table 2. Median classification accuracy for 100 iterations of face recognition test on the CASIA database.

	Low	Normal	High	Overall
DoG	0.2320	0.2680	0.1640	0.1480
LBP	0.4040	0.3560	0.3320	0.2320
SBFD	***0.9840***	***0.9960***	***0.9880***	***0.9720***

3. CONCLUSIONS

In this paper, we have proposed a multifunctional feature descriptor and an efficient framework which can be used to deal with face liveness detection and face recognition. This unified framework is based on shearlet transform, stacked auto-encoders and softmax classifier. We evaluated this approach using CASIA Face Anti-Spoofing database. The results show that our approach is suitable for both of the two tasks.