ICASSP 2019 Paper Number: 4158

Fine-tuning approach to NIR face recognition

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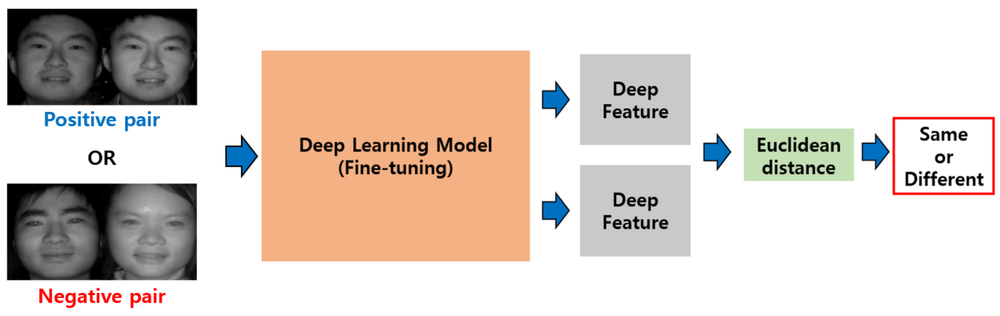
Introduction

Motivation

- Due to the active NIR lights, the intensity of the NIR face image changes very slightly in the poor light conditions
- In addition, face recognition (FR) using NIR images is robust to spoofing attack[1]
- Despite these advantages of NIR FR, the performance of NIR FR is not high enough because the number of training data is relatively limited compared to that of RGB data.
- Our goal is to overcome this problem by adapting the fine-tuning approach to NIR FR

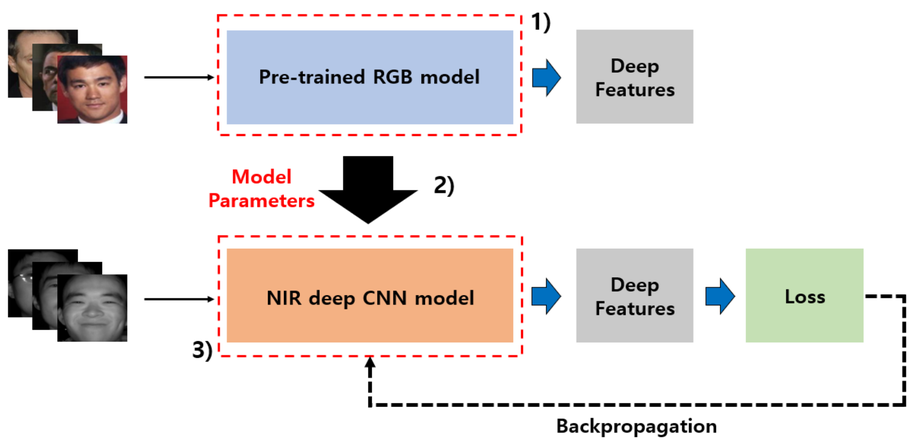
Overall Process of NIR FR



- The pair of two face images is inputted into the deep CNN model for NIR FR
  - ✓ Positive pair: same person / Negative pair: different person
- The model recognizes whether two face images in the input pair are the same person

Proposed Fine-tuning Approach

Training Deep CNN Model for NIR FR



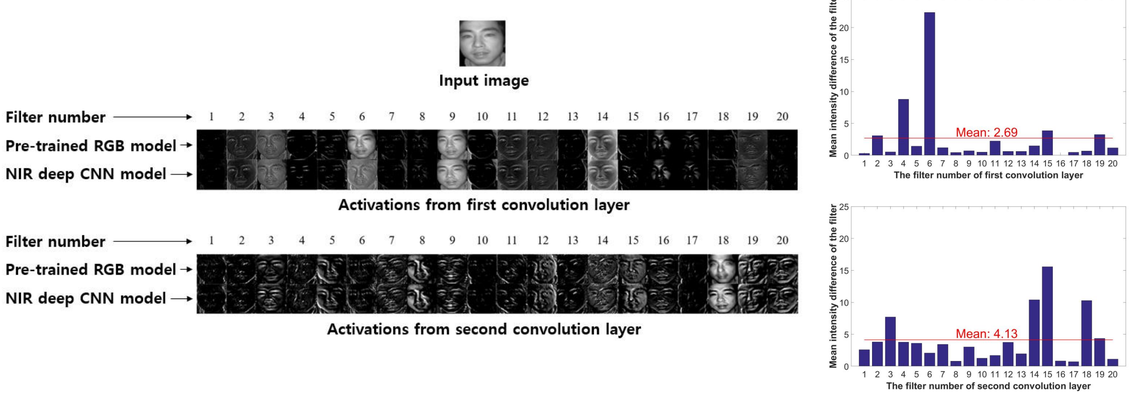
1) The pre-trained RGB model is trained by hundreds of thousands RGB face images, and the parameters of the model are acquired

2) The parameters are set as the initial parameters of the NIR deep CNN model

3) Training of the deep CNN model is conducted by finely updating the parameters of the model

Validity of Pre-trained RGB Model

- From the similarity of the activations, we can expect that the parameters of both models are highly similar
- Therefore, the NIR deep CNN model can be trained effectively by utilizing the parameters of the pre-trained model



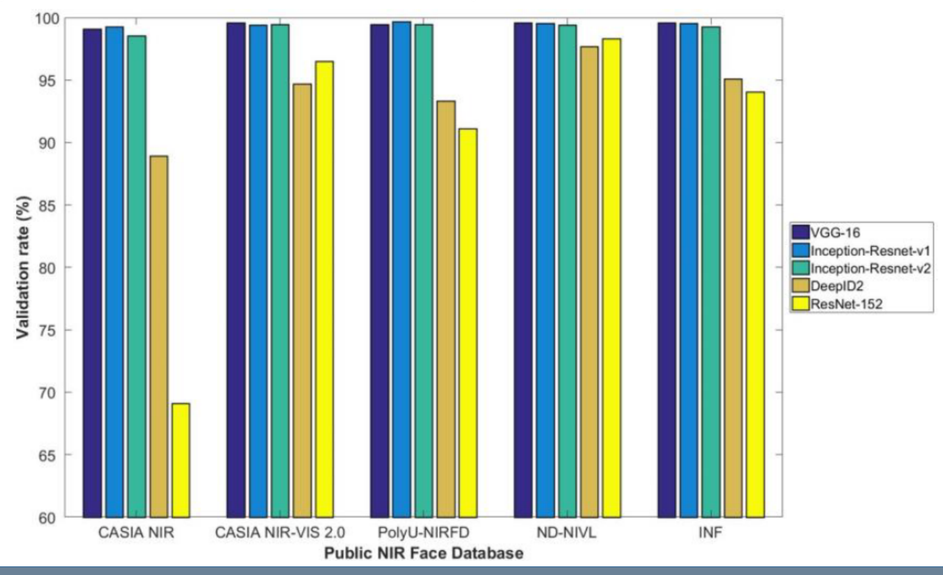
Construction of Private Face database

- We constructed the private NIR and RGB face database to compare the performance of NIR and RGB FR in poor lighting conditions

Experimental Results

Performance on Public NIR Face Database

- Inception-Resnet-v1 and VGGNet-16 achieved more than 99% performance on the most public NIR face databases



Comparison with Existing Methods

NIR FR methods	Identification rate(%)
Zhang *et al.* [14]	90.89
Peng *et al.* [15]	88.65
Fine-tuning (VGG-16)	98.15
Fine-tuning (Inception-Resnet-v1)	97.22
Fine-tuning (Inception-Resnet-v2)	**99.67**

Comparison with RGB FR

- The performances of the proposed fine-tuning approach and RGB FR in the real-world FR scenario

Method	Accuracy(%)	Validation rate(%)	FAR(%)
NIR FR[a]	**96.88**	**94.47**	**0.7**
RGB FR	71.35	100.00	57.30

[a] NIR FR indicates the proposed fine-tuning approach.

- The performances of the proposed fine-tuning approach and RGB FR in the poor lighting conditions

Method	Accuracy(%)	Validation rate(%)	FAR(%)
NIR FR[a]	**96.65**	**84.90**	**0.1%**
RGB FR	86.50	44.03	0.1%

Conclusion

- We showed the validity of the proposed fine-tuning approach from the similarity between the pre-trained RGB model and the NIR deep CNN model
- High performance of the proposed approach was achieved
- In the future, we will focus on alleviating the sensor dependency of NIR FR

[1] Yi, D., Lei, Z., Zhang, Z., & Li, S. Z. (2014). Face anti-spoofing: Multi-spectral approach. In *Handbook of Biometric Anti-Spoofing*(pp. 83-102). Springer, London.