# Multispectral Images Applied to Face Recognition


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## Introduction

Nowadays it is possible to see a growth of applications that use facial recognition systems, whether for collective use, as in companies, or for personal use, as in smartphones

The infrared spectrum, namely the Near Infrared (NIR), Short Wave Infrared (SWIR), and Long Wavelength Infrared (LWIR) spectral bands, has been used successfully in facial recognition systems, as a complement of the visible spectrum. These systems, which use more than one spectral band, are called multispectral.

Figure 1: Illustrative images of the VIS, NIR and LWIR spectral bands.

## Methods

The method used to extract the face embeddings to perform facial recognition is based on the concept of Domain Specific Units. Where is showed that low level features in deep convolutional neural networks (DCNN) can be adapted to a specific spectral band, removing the need to adapt all the DCNN.

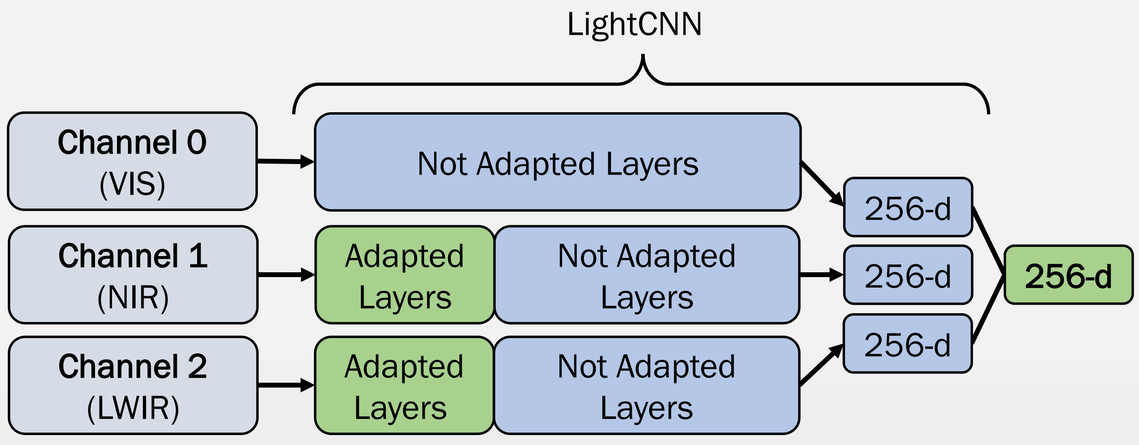


Figure 2: Overview of the proposed architecture: adapted layers (green) and not adapted layers (blue).

For this work it is used the LightCNN model, chosen because of the low number of parameters. The LightCNN takes as input 128x128 pixel images and produces a 256-dimensional embedding. Each 256-d embedding represents the identity of the person through the spectral band of the channel used. Then all embeddings produced are concatenated.

The last fully connected layer is added to produce the final 256-d embeddings, which can be used as a face representation by all the channels.

With the final 256-d embeddings, it is used a classifier to identify the identity of the person.

## Experiments and Results

The first studied carried out allowed to choose the appropriate classifier. Three classifiers were implemented: SVM (with linear and rbf kernel) and kNN (with Euclidian distance). After the best hyperparameter were found, the test set was used to choose the best classifier.

A rank-1 score of 99,7%, 99,2% and 99,2% was achieved for the SVM-Linear, SVM-rbf and kNN, respectively. Figure 3 presents the cumulative matching curve (CMC) for each classifier up to rank-10.

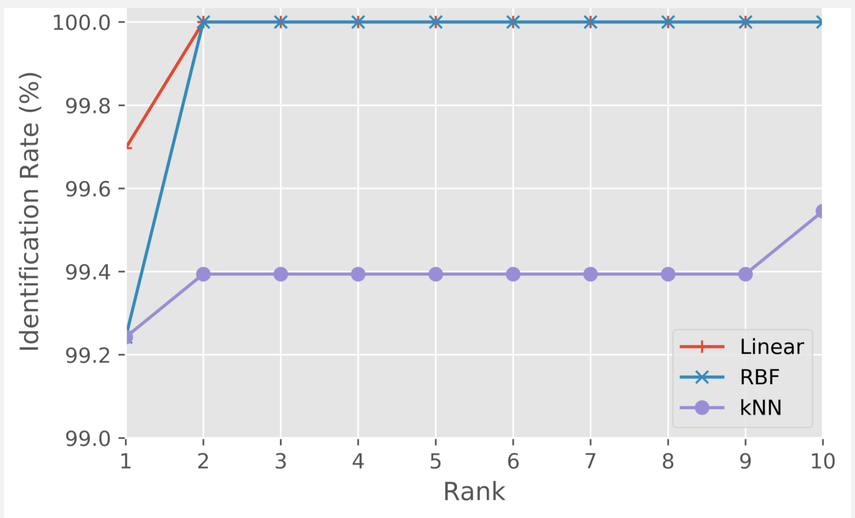


Figure 3: Cumulative matching curves for each classifier up to rank-10.

When compared with other methods the proposed architecture proves to be a viable choice for multispectral face recognition, obtaining higher results.

Table 1: Comparison with state-of-the-art face recognition methods for the Tufts dataset.

| Method | Rank-1 |
|---|---|
| Circular HOG | 94,5 % |
| TR-GAN | 88,7 % |
| **Proposed Methodology** | **99,5 %** |

## Conclusions

In this work, it is proposed a new architecture for facial recognition using multispectral images. The architecture produces 256-d embeddings that represent the identity of a person through multispectral images. To test and compare this architecture it is used the Tufts face dataset. To classify the 256-d embeddings an SVM-rbf classifier proved to be the best classifier, obtaining the higher rank-1 score.

Experimental results verify the effectiveness of the proposed architecture in multispectral face recognition when comparing with other state-of-the-art methods.

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