A Multi-Level Descriptor Using VGG Model for Osteoporosis Diagnosis

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Abstract. *This work propose a multi-level feature fusion for osteoporosis diagnosis where map features are extracted from X-ray images using VGG model to capture middle-level and high-level information. We achieved 70.58% of accuracy. The proposed methodology provides competitive performance in comparison with related works.*

1. Introduction

This work proposes a new approach for osteoporosis diagnosis from X-ray images using a multi-level feature fusion (MFF) to capture middle and high-level semantic information simultaneously. We combine features from different layers of a pre-trainned VGG network using images pre-processed by Compound Local Binary Patters (CLBP).

2. Related Works

[Palanivel et al. 2019] employed lacunarity to measure texture heterogeneity and used a linear SVM classifier. They obtained an accuracy of 59%. [Zheng et al. 2019] introduced sparse representation and proposed likelihood functions for classification. The results were 70.26% of accuracy. To reduce over-fitting, [Su et al. 2019] enlarged the dataset via data augmentation, 20,800 were generated from the 104 images, with the aim of generate deep features using CNN combined with 560 hand-crafted texture features and SVM classifier, they reached 74.70% of accuracy.

3. Methodology

We used CLBP to preprocess the TCB dataset, half of which from osteoporotic patients and the other half from control subject, in total 174 individuals. Then different features were extracted using VGG16 model at different layers. Finally, the obtained different features were concatenated and classified by logistic regression model.

The VGG was pre-trained with Imagenet dataset. As illustrated by Fig 1, feature maps are extracted from *block5_pool* and *fully-connected predictions* layers. *Block5_pool* is the last max-pooling layer, with size *W*H*F*, where W is width, H is the height and F the filters number. *W*H* are local descriptors of *F* dimensions, that is 7x7x512. Each point of feature map represents a patch. *Fully-connected predictions* layer named FC-1000 was used to represent the high level to capture global information.

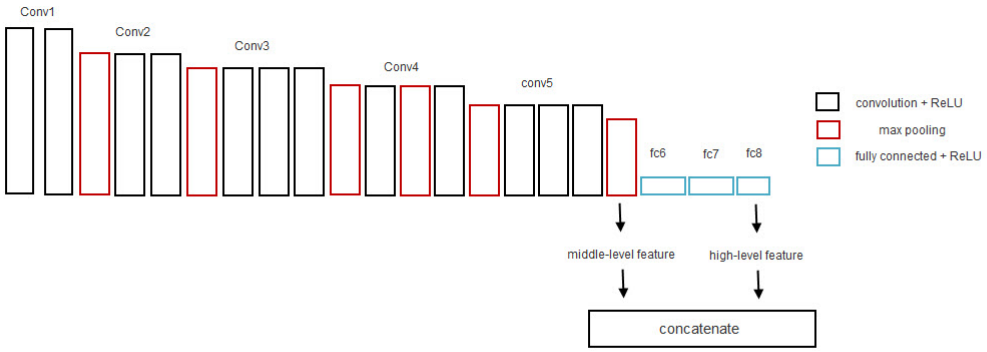

Figure 1. Illustration of the proposed Multi-level Feature Fusion (MFF).

4. Results

Promising results obtained demonstrate good performance. We achieved an accuracy of 70.58%. The recent works proposed by [Palanivel et al. 2019] and by [Zheng et al. 2019] had lower performance with of accuracy with 59% and 70.26%. [Su et al. 2019] used data augmentation, adjust of hyper parameters, combined CNN features with hundreds of hand-crafted features and reaches 74.70% of accuracy. Our proposed methodology does not use any of these. We can conclude that using multi-level features, extracted with pretrained VGG network, could capture features which are determinant to recognize osteoporosis pattern.

5. Conclusion

The present work encompasses a series of contributions. The main contributions can be highlighted: (a) a method to automatically osteoporose diagnosis; (b) evaluate multi-level feature fusion as a feature extraction technique that requires minimum set of parameters; and (c) a descriptor from CNN deep features using transfer learning for a small set of X-ray images. As far as is known our methodology is the first that uses only deep features for diagnosis osteoporosis. For the future works we suggest to explore new ways to use hybrid neural network architectures or even new improvements in VGG architecture.

References

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