Improved Osteoporosis Detection Process using Lightweight Deep Features

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ABSTRACT

In response to the prevalence of Osteoporosis, a debilitating bone disease, this paper introduces an efficient detection system utilizing Deep Image Features. The approach involves segmenting Osteoporosis images into blocks and applying PCANet Deep Learning for Feature Extraction. These features are then concatenated and subjected to Feature Selection, followed by SVM classification. The method demonstrates effectiveness and reliability in detecting Osteoporosis, potentially aiding medical experts in assessing patient's risk during examinations.

Keywords: Osteoporosis, PCANet Deep Learning, Feature Selection

1 Introduction

This research focuses on Computer-Aided Medical Diagnosis (CAD), specifically for osteoporosis detection. The method, OS-PCANet, extracts lightweight deep features using Principal Component Analysis Network. It differs from PCANet by using Histogram of Oriented Gradients (HOG) for feature vector creation and feature selection to reduce correlations. Evaluation on a database of 174 osteoporosis images demonstrated OS-PCANet's excellent accuracy (IEEE-ISBI Challenge: Bone Texture Characterization [1])

2 Methodology

The feature vector of the image is extracted by extracting all the feature vectors of the blocks (Figure 1). Prior to this process, the system first forms the Convolution Filters using the PCA technique [2], After having configured the Convolutional Filters, it remains to extract the features of the input image. In the last process the main objective of the Fisher score [3] is to obtain a set of data characterized by the divergence of the features of the different classes and the convergence of these features within the same class.

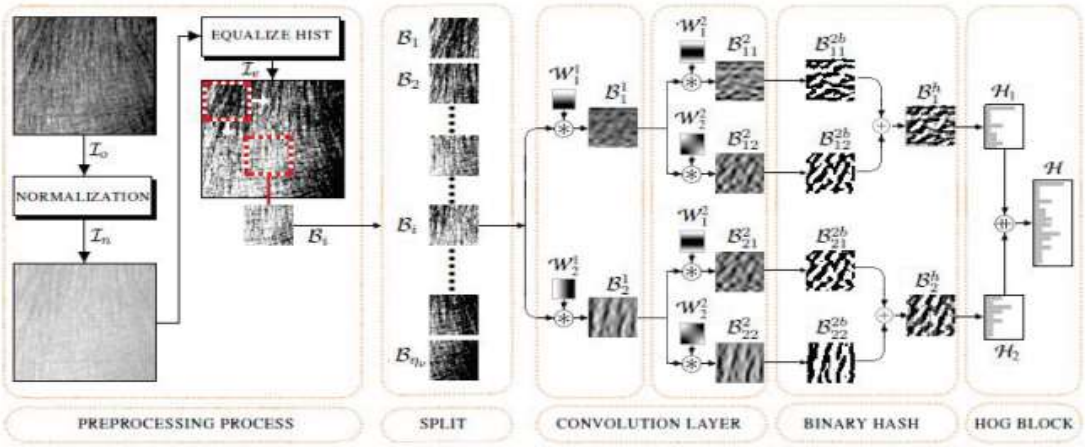

Figure 1: *Proposed osteoporosis feature extraction method using OS-PCANet deep learning. An example of a 2-stages OS-PCANet structure with 2 convolution filters in each stage.*

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3 Results and Discussion

To demonstrate the importance of block-based analysis and the feature selection process, we will choose from 10% to 100% with a step of 5% of the components of each vector then calculate the Accuracy of the system. the feature selection principle was applied in the case of 200×200-sized block using 30% of vector components (Figure 2) and we compare the best results obtained. From this figure, the feasibility of block-based analysis is evident, but what is more striking is the significant impact of the feature selection process, which significantly improved the performance of the CAD system.

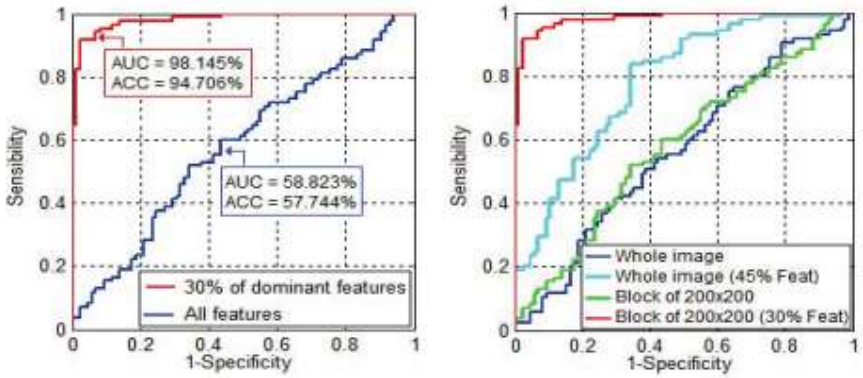

Figure 2: *Impact of the selection of dominant features on system performance (using* (200×200)*-sized block).*

4 Conclusion

Deep learning, an emerging technology, has made a significant impact on various research fields, particularly in computer vision and image processing. In our work, we've proposed an efficient CAD system for osteoporosis detection, achieving excellent results through feature selection. The performance improves with more convolution stages, and future work aims to enhance results through data fusion and explore lightweight deep learning techniques like DCTNet, DSTNet, and ICANet.

5 Declarations

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