National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Development of Feature Extraction and Classification models for Skin Lesion Analysis
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Abstract	: Skin lesion analysis is one of the important task for identifying and detecting skin cancer at early stages to improve the survival rate of patients. Depending on the severity of infection, skin lesions are categorized as benign or malignant. Melanoma, a malignant form of skin lesion, is responsible for the majority of skin cancer-related deaths. Early detection of melanoma is essential for timely treatment. Designing an intelligent model for skin lesion classification (SLC) task is challenging due to the presence of high degree of similar morphological appearance between malignant and benign skin lesions, intra-class variation, low contrast between normal skin and lesion region, and the presence of artifacts in lesion images, imbalanced sample distribution across different classes. This study leverages various machine learning and deep learning techniques along with multiresolution analysis for binary and multiclass classification of skin lesion. Attempt has been made to solve various issues in SLC and to improve diagnostic performance. In this regard, four models are proposed using dermoscopic images. The first three contributions address two class SLC problems, while the fourth contribution focuses on multiclass SLC tasks. The first contribution proposed a derived feature set that incorporates both color and texture features for classifying skin lesions into benign and malignant categories. An entropy-based graph fuzzy SVM (EGFSVM) classifier is designed to address the imbalance issue in the skin lesion dataset. It provides higher priority to malignant (minority) lesions compared to benign (majority) lesions. It improves the performance of the model by enhancing the performance of minority sample class. In the second contribution a customized deep convolutional neural network architecture is designed to distinguish between malignant and benign lesions. This model is specifically designed with fewer convolutional layers, reduced filters, and fewer parameters, which leads to improved performance in SLC. Compared to pre-trained models such as VGG16, ResNet50, and InceptionV3, it outperforms them while achieving state-of-the-art results. The third contribution proposed an approach that combines deep and wavelet features for SLC. In this method, the standard pre-trained ResNet50 model is used to extract deep features from the dermoscopy images. These lesion images are then transformed into the wavelet domain using the lifting wavelet transform (LWT), with the level-2 approximation component serving as the wavelet feature. The deep and wavelet features are concatenated to represent the lesion image. To further enhance the feature set, the Neighborhood Component Analysis (NCA) algorithm is applied to select a smaller, dimensionally-reduced subset of these concatenated features. The resulting reduced feature set is classified using a multilayer perceptron. This approach demonstrates that integrating wavelet features with deep features enhances the discriminative power of the classification model. These two class SLC models are validated using ISIC 2016 and PH2 dataset. In forth contribution, a hybrid model is designed to address the multiclass SLC task. This methodology integrates the pre-trained ResNet50, pre-trained VGG16, and Vision Transformer (ViT) models. The pre-trained ResNet50 and pre-trained VGG16 models are employed to extract patches from the input lesion images, whereas the ViT model is trained on these extracted patches to classify lesions. This hybrid technique improves classification performance by exploiting both local and global aspects of lesion images, facilitating more precise discrimination among seven distinct classes of lesions. This model is validated using HAM 10000 and PH2 datasets.