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Statistical Analysis of 3D Images of Alzheimer's disease

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Alzheimer's disease is the most common type of dementia which it has no cure nor imaging test for it. Diagnosis of the Alzheimer's disease (AD) still a challenge and difficult. An early diagnosis for Alzheimer's disease is very important to delay the progression of it. This paper extract and analyze various important features of 3D-MRI brain medical images to provide better analysis and diagnosis of AD. These extracted features had been used for detection of the abnormalities among different demented and non-demented MRI AD images. This paper deals with the statistical analysis to discriminate among the different types of tissue. Also, it investigates and building up an efficient Computer Aided Diagnosis (CAD) system for AD to assist the medical doctors to easily diagnose the disease. Statistical, structural, and textural features had been extracted for different images. These extracted features had been used as an input to the SVM classifier. In addition, all these features had been applied to the proposed algorithm and then had been classified using SVM classifier. The performance of the CAD system based on statistical analysis and the proposed algorithm had been measured using different metric parameters. Also, the proposed algorithm had been applied to the images with intensity level. The obtained results indicate that the metric parameters increase from 60% without using the proposed algorithm to 100% using the proposed algorithm.

Alzheimer's disease is a degenerative brain disease and the most common cause of dementia. The most common initial symptom is a gradually worsening ability to remember new information, planning or solving problems, completing familiar tasks at home or work, Confusion with time or place, and problems with words in speaking or writing. Alzheimer's disease is a progressive disease, which means that it gets worse over time. There is no cure, specific blood or imaging test for Alzheimer's disease. However, some drugs are available which may help slow the progression of Alzheimer's symptoms for a limited time. Diagnosis of the Alzheimer's disease (AD) still a challenge and difficult, especially in the early stages. The early detection will be key to prevent, slow and stop Alzheimer's disease. The last 10 years have seen a tremendous growth in research on early detection. Statistical analysis method is one of the important methods for feature extraction in digital images. There are different previous approaches that depends on extracting statistical, textural, and structural features from digital images in different application.

The statistical analysis of 3D and 2D images of AD had been presented in this paper. Different important statistical, structural and textural features that had been extracted from different AD MRI images (normal, very mild AD and mild AD). The 3D images had been analyzed in three plans and the features had been extracted from each plane. Studying and analyzing these extracted features may help the medical doctors to diagnose the Alzheimer's disease.

This paper presents the proposed algorithm which consists of six stages. These stages are:

1. Preprocessing and Normalization for the input images.
2. 3D or 2D image to 1D signal conversion.
3. Proposed feature selection method.
4. Proposed feature extraction method.
5. Cross-validation
6. Feature matching or Classification process using SVM.

The obtained results represent different extracted features from normal, very mild and mild 3D MRI images. The features had been extracted from the images planes (X-Y, X-Z, and Y-Z). The number of pixels used for calculation was very large this leads to high values for each feature. By studying the three difference types of extracted statistical, structural and textural features it is noted that, the values of these different extracted features for normal, very mild and mild stages may help the medical doctors to diagnose the Alzheimer's disease. The results concluded as follows:

1. The SVM classifier had been used to classify the statistical features of the images into two classes (normal and patient). The obtained values of the metric parameters were about 60%.