Analytical study of fuzzy C-means clustering algorithm and LVQ ANN

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ABSTRACT
Image segmentation is a significant process in the visualization of human tissues, particularly during clinical analysis of magnetic resonance (MR) images. The Whole brain consists of several tissues precisely white matter (WM), gray matter (GM) and cerebrospinal fluid (CSF). It is hard to differentiate these tissue regions exclusively because these areas are not properly defined by boundaries. MRI brain images are extensively used in medical field for diagnosis, treatment, surgical planning, and research.
In this paper, we have implemented the different version of fuzzy C-Means clustering algorithm and Learning Vector Quantization (LVQ) ANN on MR brain image to extract WM, GM, and CSF. These algorithms have been commonly used and provide a flexible method to automated image segmentation, particularly in the area of brain segmentation. The performance of FCM and LVQ is appraised on Brain Web Database where T1, T2, and ρ weighted images are chosen, whose thickness is 5mm with different noise and intensity non uniformity (RF). Experimental results show the supremacy of segmentation accuracy even on the noisy MRI brain image. The accuracy, sensitivity, and specificity are improved with better segmentation.

Keywords *- cerebrospinal fluid, Fuzzy C-means, gray matter, LVQ, MRI, segmentation, white matter.*
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I. INTRODUCTION

Several imaging techniques are implemented by the doctors namely magnetic resonance imaging (MRI), computed tomography CT, mammography, X-ray, Single photon emission computed tomography SPECT. Magnetic resonance imaging is a very versatile in case of whole body imaging, like brain, heart, abdomen, knee etc. [1]. Radio waves and strong magnetic field are used in MRI scan to produce pictures of tissues, organs and other structures inside our body which is displayed on a computer. Magnetic resonance imaging (MRI) offers comprehensive images of living tissues. Data acquired from MR images is used for identifying tissue abnormalities such as injuries and cancers; MR is also used comprehensively in studies of brain pathology, where regions of interest (ROI's) are frequently examined in detail, for example in multiple sclerosis (MS) studies [2]. Magnetic resonance images (MRI) is commonly used in the study of brain function, pathology, and anatomy. MRI is a non-invasive technique to present high resolution images which provide high intensity contrast between different soft tissues. It plays a significant role in brain tissue visualization. Tissue segmentation for assessing the brain abnormalities, brain development and evaluation of the progress of treatment can be done by using automatic segmentation, where WM, GM, CSF are main tissues in a normal brain [3].
Dividing an image into a number of non-overlapping meaningful regions is called image segmentation. Segmentation is hard to be performed usually because of region inhomogeneity, blurred region boundaries, and noise [4]. Image segmentation is a key technique to analysis, understand and describe medical images for diagnosing various diseases [5]. It is one of the basic problems in image analysis. In the investigation of medical images for computer-aided diagnosis and therapy, segmentation is often required at an initial stage. It is a challenging and complex task because of the inherent nature of the images. The brain has a very complex structure and its accurate segmentation is vital for detecting necrotic tissues, tumors, and edema for prescribing appropriate therapy. MRI is a vital diagnostic imaging method for the initial finding of abnormal changes in organs and tissues [6].
The processing operation in which an area of the image with specific characteristics is labeled is known as Brain MRI segmentation (BMS). It is the main processing step in many medical researches and clinical applications