ABSTRACT

Medical image plays an important role in monitoring patient's health condition and giving an effective diagnostic. Mostly medical images suffer from different problems such as poor contrast and noise. Poor contrast medical images with noise may deliver inadequate data for the visual interpretation of affected portions. Hence it is necessary to enhance contrast and remove noise in order to improve the quality of a various medical images to provide appropriate diagnosis. An automatic brain tissue segmentation on clinically acquired magnetic resonance image is a very challenging task due to the presence of intensity inhomogeneity, noise and the complex anatomical structure of interest. Due to the existence of noise in clinical magnetic resonance brain images, various segmentation techniques suffer from low segmentation accuracy.

This thesis focuses to solve the above mentioned problems and proposes two contrast enhancement algorithms for medical image enhancement and a novel segmentation algorithm for magnetic resonance brain tissue segmentation. The proposed methods are based on histogram equalization and fuzzy logic. Histogram equalization is one of the most popular techniques used for image contrast enhancement, since histogram equalization is computationally fast and simple to implement. Even though, it tends to introduce some annoying artifacts and unnatural enhancement, including intensity saturation effect. To overcome this drawback, several histogram equalization methods for contrast enhancement have been proposed. Although these methods produce an output image with a significant

contrast enhancement, they may fail to strengthen the fine details in the medical image which may leads to improper diagnosis.

In order to overcome this drawback, exposure based contrast limited bi-histogram equalization method is proposed to improve the visual quality of medical images. The proposed method has three stages: At first, input histogram is sub-divided into two histograms based on the exposure threshold to preserve mean brightness and strengthen the fine details. Then, the two sub histograms are clipped to limit the contrast amplification and a new dynamic range is assigned to each clipped sub-histogram by its exposure threshold value. At last, a contrast-enhanced image is gained by equalizing each clipped sub-histogram individually. Experiments were conducted on a wide variety of medical images to evaluate the performance of proposed method both qualitatively and quantitatively. Extensive quantitative measures show that the proposed technique achieves better performance in terms of peak signal to noise ratio, entropy, contrast ratio, enhancement measures and computational complexity when compared to state of art enhancement methods. The proposed algorithm improves contrast while preserving brightness and visual quality. The proposed method provides a better quality for disease examination and diagnosis.

To overcome the insignificant contrast and unnatural enhancement, the fuzzy contextual dissimilarity adaptive histogram equalization is employed. The proposed method consists of two modules. In the first module, fuzzy dissimilarity histogram is formulated by finding fuzzy neighbourhood dissimilarity for every pixel using fuzzy rules. Then, the fuzzy dissimilarity clip limit is computed based on a fuzzy inference system. Contrast and discrete entropy are the two parameters used by the fuzzy inference system to achieve fuzzy dissimilarity clip limit. Then, the enhanced output is obtained by equalizing the fuzzy dissimilarity adaptive histogram. In the second module, contextual intensity transformation is applied to fuzzy dissimilarity adaptive histogram equalized output to get final enhanced images. Experiments were conducted and tested on a wide variety of magnetic resonance images to evaluate the performance of the proposed method both qualitatively and quantitatively. Extensive quantitative measures show that the proposed technique yields better performance in terms of PSNR, entropy, contrast ratio and enhancement measure when compared to state of art enhancement methods. The proposed algorithm not only improves contrast but also preserves natural characteristics. The proposed method offers a better scope for disease analysis and diagnosis.

Tissue segmentation and classification becomes fundamental steps in clinical diagnosis. Classification or segmentation of brain tissue is used to detect and diagnose normal and pathological tissues such as multiple sclerosis tissue defects and tumor. Due to existence of noise in clinical magnetic resonance brain images, various segmentation techniques suffer from low segmentation accuracy. Thus, to overcome the ambiguity, an enhanced fuzzy relaxation approach called fuzzy relaxation based modified fuzzy c-means clustering algorithm is presented. The proposed method has two stages: At first, exposure based sub-image fuzzy brightness adaptation algorithm is implemented for the enhancement of brain tissues and it is followed by a modified fuzzy c-means clustering algorithm to segment the enhanced brain magnetic resonance image into white matter, gray matter and cerebrospinal fluid tissues. The experimental results are shown and compared with existing techniques in terms of quantitative measures such as sensitivity, specificity, accuracy, jaccard similarity and dice similarity coefficient. The proposed method produced highly satisfactory values of sensitivity, specificity and segmentation accuracy. The proposed method achieves a good trade-off between intensity inhomogeneity and noise. The proposed method conforms its success on brain tissue segmentation and provides extensive support to radiologists and clinical centres.