Chapter five
Discussion, conclusion and recommendation

The main objective of this study was to segment and classify the normal liver in MR image. The results of this study obtained by applying digital image processing technique to an original MR image (Figure 4-1) in order to classify the Axial MRI slice that contain the liver. The researcher adopts classification technique to dissect the MR image into several classes. Classification maps were obtained from original image using pixel intensity and Euclidian distance by assigning a label to every pixel in an image such that pixels with same label shared certain visual characteristic i.e. same run length of grey color (Figure 4-2). According to classification map the liver was delineated in the original image using red line tracing automatically (Figure 4-3), taking advantage of the region label and the delineated function.

The liver was segmented from the classification map use region label algorithm where the liver will be identified as the structure of interest and other tissues will be discarded. Then the segmented liver further more processed by erode and dilate to get rid of the island region and to close gabs in the liver mask.

Then the mask of the segmented liver multiplied by original image to have segmented liver (Figure4-4). The segmented liver was classified into liver tissue, ligament, stone, vessels, hepatic portal and vein. Use first order texture extracted from (3×3 pixels) which include mean, standard deviation, variance and signal to generate a classification map of segmented liver (Figure 4-5).

Linear discrimination analysis was applied to assign the classified region to their respective class, in order to find the accuracy of classification (Figure 4-6). Where the classification accuracy for the whole classes was 94.3%, with 100% classification for liver tissue, IVC, and stone, while ligament, portal and hepatic vein was 85.7% for each (Table4-1).

In summary using Linear discrimination analysis generated a classification function which can be used to classify other image into the mention classes as using the following multi-regression equation; where the vote will be for the class with a higher classification score

$$Liver = (mean \times -1.09) + (variance \times 0.097) + (STD \times -5.42) + (signal \times 9.21) - 67.33$$

$$Ligament = (mean \times -0.62) + (variance \times 0.06) + (STD \times -3.04) + (signal \times 6.73) - 63.41$$

$$Vessels = (mean \times -0.26) + (variance \times 0.007) + (STD \times -0.41) + (signal \times 1.89) - 5.51$$

$$Stone = (mean \times -0.70) + (variance \times 0.132) + (STD \times -7.21) + (signal \times 9.16) - 122.35$$

$$Port\&\ hepatic = (mean \times -0.88) + (variance \times 0.078) + (STD \times -4.23) + (signal \times 8.13) - 64.21$$

The result of the study showed that the textural features mean can differentiate between the classes with minimal interference between ligament and hepatic veins as shown in Figure 4-7

5-2 Conclusion:

This study was carried out in order to characterize and segment the liver in MR Images using texture analysis to objectively segment the liver and classify it into liver tissue, ligament, stone, vessels, hepatic portal and portal vein. Use first order texture extracted from (3×3pixel) which include mean, standard deviation, variance and signal. Diagnostic MRIs have higher contrast resolution and many advantages for image navigation. But partial volume effects and artifacts due to motion and pulsation in MRI and smaller edge magnitudes in MRI cause edge-based segmentation algorithms to be more complicated and lead to confusing diagnosis. Therefore texture analysis can make the MR imaging is best choice for liver diagnosis as a soft tissue.

The classification accuracy for the whole class's were 94.3% and 100 classifications accuracy for liver tissue, IVC, and stone, while ligament, portal and hepatic vein was 85.7% for each.

Recommendations

- Similar approach of liver segmentation can applied to different organs to facilitate accurate measurement and volumetric study.
- Further classification of segmented liver that associated with any hepatic disease.
- Applying segmentation program on liver image acquired by different protocol (T1, T2, proton density…) and orientation (segital and coronal)
- Incorporation of segmentation program in radiotherapy fro accurate localization of tumors and organs at risk.

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