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A Novel Approach for Detection of Anomalies in Images related to Diabetic Myonecrosis

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Abstract*:* Diabetes mellitus (DM) and its complications is a comprehensive challenge to health care systems. Diabetic Myonecrosis or diabetic muscle infarct (DMI) is a rare complication of diabetes or possibly under diagnosed. Image processing methods have become crucial in solving various medical Imaging problems. The proposed work is mainly dealt with processing of medical images related to Diabetic Myonecrosis. A novel approach is designed in this paper by having Hybrid Morphological Reconstruction (HMR) Technique as Pre-Processing With Watershed Segmentation Method as Post-Processing.

Keywords: Image, segmentation, necrosis, morphological, watershed.

I. INTRODUCTION

Diabetic mellitus (DM) is a metabolic disorder that characterized by inability of the pancreas to control blood glucose concentration. This predicament results may make out blood glucose levels out of range [2]. It is described in longstanding diabetes. Although it was first reported in 1965, only case reports and a systemic review of these cases have been published [3, 4]. Clinical presentation is with acute onset of muscle pain, commonly the thigh. Diabetes Myonecrosis can be misdiagnosed as cellulitis, deep vein thrombosis or facsiatis. Magnetic resonance imaging (MRI) is sufficient, in the appropriate clinical context, to enable the diagnosis, hence avoiding inappropriate treatment [11].

On a Technical note Image Processing is utilised to extract important features from the images, through which better perception of the scene can be obtained for human viewers [1]. The biological vision system is one of the most important means of exploration of the world to humans, making complex task easier for betterment of understanding [7].

There are numerous algorithms that can be utilised for different applications but enhancement and segmentation are considered as most sort out methods for improving the details in an image. It is not possible to judge that any one method is best in Image processing applications but one can use trial and error method as a practical approach for obtaining the perfect results. Image Enhancement is a fundamental task in digital image processing and analysis, aiming to improve the appearance of image in terms of human brightness perception [8]. Whereas the Segmentation is mainly useful in classification of objects and labelling of the features extracted from image for easy analysis. One should look into that processing of images is done without blemishing the integrity of original image.

II. HYBRID MORPHOLOGICAL RECONSTRUCTION

Due to the imperfection and variations, the appearance of microscopic images is generally not homogeneous. In order to reduce the influence from undesirable variations within, the Hybrid Morphological Reconstruction (HMR) [12] is used to enhance the image

III. WATERSHED SEGMENTATION

Watershed segmentation falls under Morphological image processing methods and is a distinguished image segmentation technique because of its significance related to mathematical morphology. Morphological operators have been applied for vasculature segmentation [9] because the fundamental morphology of the vasculature is known a priori to be comprised of linked linear segments and because of speed and noise resistance. The concept of watersheds is based on visualizing an image in 3 dimensions given by two spatial co-ordinates versus intensity. Here one can consider only three points for clear explanation of the topic and they are (a) points belonging to regional minimum (b) points at which a drop of water, if placed at the location of any of those points, would fall with indeed to a single minimum; and (c) points at which water would be equally likely to fall to more than one such minimum. The points fulfilling condition (c) form crest lines on the topographic surface and are termed *divide lines* or *watershed lines* [6].

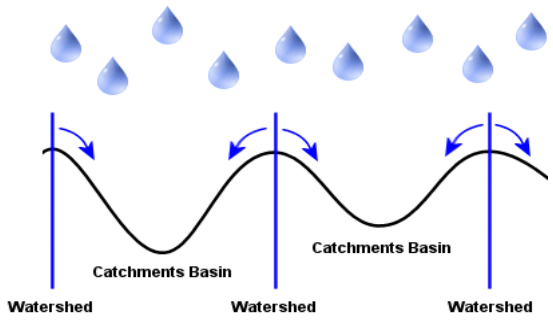

Fig 1. Watershed representation

The standard objective of this method is based on the concept to find watershed lines. The basic idea is simple,

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suppose that a hole is punched in each regional minimum and that the entire geography is flooded from below by allowing water rise through the holes at uniform rate [5]. The entire process is described by a concept that a dam like thing is constructed to avoid merging and flooding may take place when water reaches the top level of dam. Consequently, watershed algorithm extracts the boundaries. In [10] watershed algorithm was used for segmentation of splats, a collection of pixels with similar color and spatial location.

IV. EXISTING WORK

In literature [11, 12] the above said algorithms have been used as pre-processing or post-processing methods with other algorithms. But in this work these two algorithms are combined to form a hybrid model to attain effective results for easy classification and analysis of the inner lying cause of the anomalies present in the images related to Diabetes.

V. PROPOSED WORK

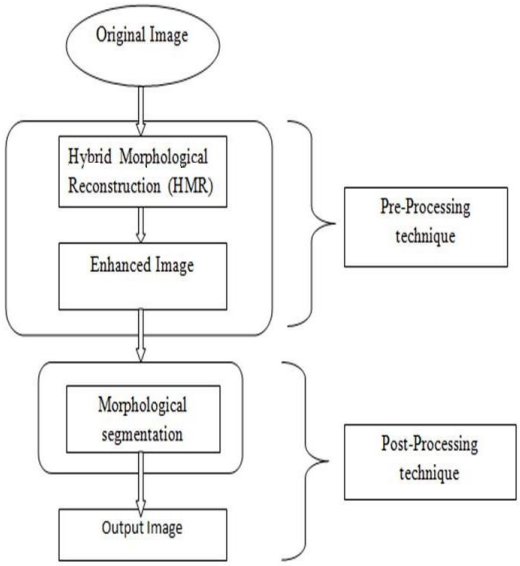

Fig 2. Block Diagram of Implemented Model

The implemented method is used to enhance and segment the medical image. Here Hybrid Morphological Reconstruction (HMR) technique is used to enhance the medical images, and Morphological segmentation is the enhanced medical image.

Model description:

The images that are obtained from public database Image Courtesy*:* Radiology and Molecular Imaging; Sultan Qaboos University Hospital, Al Khod, Oman. Hence the image is processed using the MATLAB software and the image undergoes several algorithms to get a better output. Initially the RGB image is converted into grey scale to avoid complex calculations. Next step is to perform the Gradient Magnitude segmentation function. After the above two steps are finished then the main step, watershed transform segmentation is performed. Watershed transform is the region base segmentation method. In this step it fills the gaps present in the images and finally the analyzing the result.

VI. RESULT AND ANALYSIS

The original image (Figure 3) considered in this work is an axial fat-suppressed T2-weighted image which shows enlargement and increased signal intensity of the vastus lateralis muscle (*) and rectus femoris (open white arrow). There is fluid in subcutaneous tissue and intermuscular fascia (black arrow).

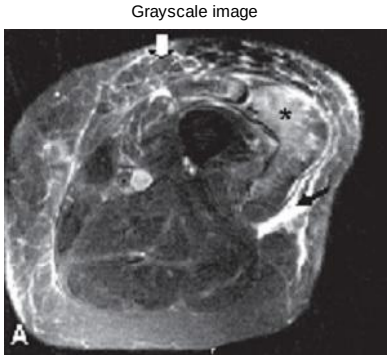

Fig 3. Axial fat-suppressed T2-weighted image (Image Courtesy: *Radiology and Molecular Imaging ;Sultan Qaboos University Hospital, Al Khod, Oman.*)

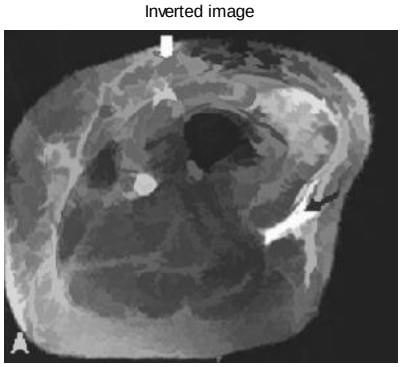

Fig 4.Inverted Image

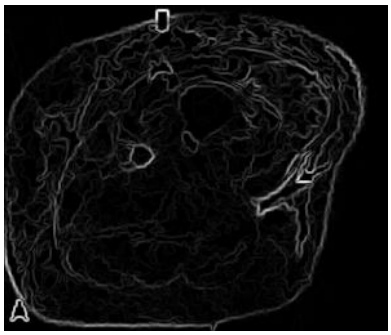

Fig 5.Gradient Magnitude Image

The result obtained in figure 4. shows the enhancement of vastus lateralis muscle and intermuscular fascia areas of original image. And after application of Gradient magnitude method of post-processing results in clear threshold image (Figure 5) of intermuscular fascia part of the original image. Whereas in reconstruction process from figure 6 it is evident how intermuscular fascia part enlarges and may further result in necrosis of the muscle leading to permanent damage of the muscle shown with Gray shaded area which is represented by black arrow.

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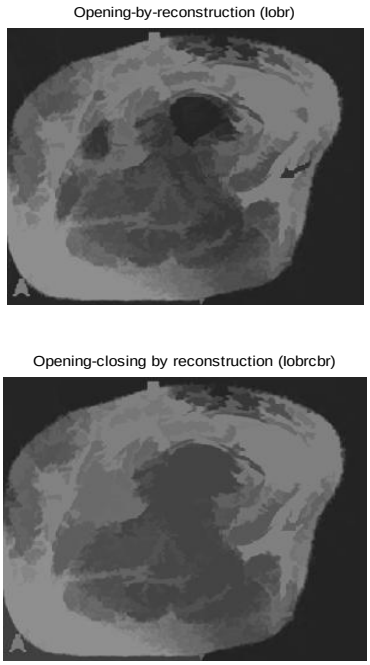

Fig 6. Reconstruction process

Another image(Figure 7) is an axial fat-suppressed gadolinium-enhanced T1-wieghted considered in this work shows areas of diffuse enhancement of the vastus lateralis and rectus femoris. There is focal rim enhancement with a low–signal-intensity center within the vastus lateralis (white arrow) suggestive of muscle necrosis.

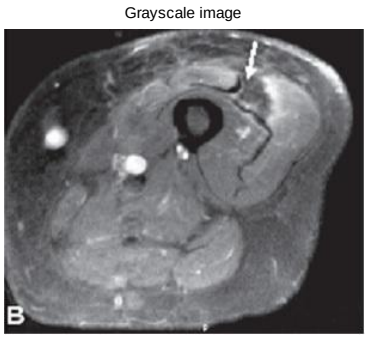

Fig 7**.** Axial fat-suppressed gadolinium-enhanced T1-wieghted image

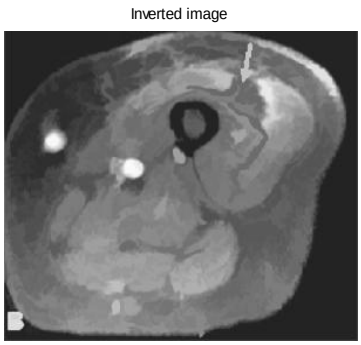

Fig 8 Inverted Image

The result obtained in figure 8 which is an inverted image of original image shows vastus lateralis (white arrow) suggestive of muscle necrosis with different gay shades (indicating muscle can be cut down into fibrous parts).

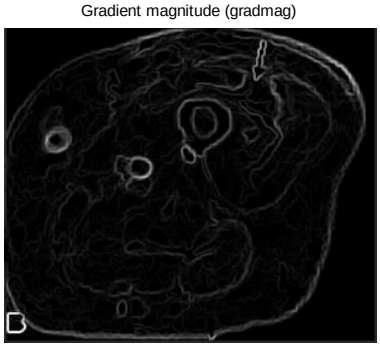

Fig 9 Gradient Magnitude

And after application of Gradient magnitude method of post-processing results in clear empty area formed in vastus lateralis (Figure 9) due to lack of healthcare towards Diabetes Mellitus.

VII. CONCLUSION

The experimental results of Hybrid Morphological Reconstruction Technique as Pre-Processing with Watershed Segmentation Method as Post-Processing are quite suitable for educating the common man related to Diabetic Myonecrosis. In future development other pre-processing algorithms combined with the implemented post processing method can give perspective results so that the Medical Professionals may make use of this algorithm for earlier detection of the abnormality and this framework in form of a group wise images may be used to educate a common about seriousness of the problem.

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