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A PROPOSAL ON IMAGE PROCESSING METHODS FOR THE SYSTEMATIC ANALYSIS OF DIABETIC RELATED IMAGES

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Abstract:
Today there is almost no area of technical endeavor that is not impacted in some way or the other by Digital Image Processing. The ultimate aim in a large number of image processing applications is to extract important features of the image data. Where an image description, interpretation, or understanding of the scene can be obtained for human viewers**,** or to provide 'better' input for other automated image processing techniques when an image is processed for visual interpretation, the viewer is the ultimate judge of how well a particular method works. Diabetes Mellitus (DM) is a metabolic disorder that characterized by inability of pancreas to control blood glucose concentration, this problem results in blood glucose levels out of normal range. Whenever DM is associated with other diseases may become more harmful than earlier. The Objective of this research work to give easy analysis of the anomalies underlying due to DM using various Imaging technologies. In this process the new hybrid approach is established by combining pre-processing method Hybrid Morphological Reconstruction Technique followed by post-processing method Watershed Segmentation to obtain good results to analyze and forecast the abnormalities in the considered problem for accurate diagnosis. And also to make the products of this research freely available to the academic and medical community as open standard system. In this work the exploration and investigation of the significance of less commonly used estimate parameters in process of medical image analysis is done.

Keywords: Image, segmentation, Diabetic, morphological, watershed

1. INTRODUCTION

Because Human Life is worthier than all things, much effort have been carried out today to diagnose a disease and its disorders Diabetic mellitus is a metabolic disorder that characterized by inability of the pancreas to control blood glucose concentration. This problem results in blood glucose levels out of normal range [2]. Cardiovascular disease is responsible for 80%of deaths among diabetic patients much of which has been attributed to CAD (coronary artery disease). However, there is an increasing recognition that diabetic patients suffer from an additional cardiac insult termed Diabetic Cardiomyopathy [3]. The underlying problem in most of the diabetic patients with CVD is Atherosclerosis leading to narrowing of blood vessels supplying the heart; there by causing heart failure. Atherosclerosis (also known as arteriosclerotic vascular disease or ASVD) is a condition in which an artery wall thickens as the result of a build-up of fatty materials such as cholesterol. Epidemiological and Clinical trial data have confirmed the greater incidence and prevalence of heart failure in diabetes [4]. Whereas Diabetic retinopathy (DR) is one of the major causes of visual morbidity. DR is usually asymptomatic until the disease is at a late stage, making early detection and treatment essential.

The ultimate aim in a large number of image processing applications is to extract important features from the image data, from which a description, interpretation, or understanding of the scene can be obtained for human viewers, or to provide `better' input for other automated image processing techniques[1]. The biological vision system is one of the most important means of exploration of the world to humans, performing complex tasks with great ease such as analysis, interpretation, recognition and pattern classification [7].

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 of atherosclerosis images (Electron micrograph Images) and retinal images

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subdivides into its constituent regions or objects. The level of detail to which the sub division is carried depends on the problem being solved. Considerable care should be taken to improve the probability of accurate segmentation.

2. Motivation (Need and Importance of Research Problem)

The most burning problem in India is **'Metabolic Syndrome'**. One of these is the DM, calling India the diabetes **Capital** of the world as there is an alarming rise in prevalence of diabetes, which has gone beyond epidemic to the pandemic one. For every 10 seconds a person dies from diabetic related causes in the world. Now there is an urgent need to break the link between diabetes and its related complications. For this purpose image processing based analysis can potentially be helpful for earlier detection, education and treatment. Medical image analysis of Diabetic patients with its related complications such as DR & CVD (i.e. on Retinal Images, Coronary angiographs, Electron micrographs etc) is to be the aprioristic because of its more prevalence.

There are limitations to clinical assessment and investigation in medical images obtained by different diagnostic methods that are available at present. The survey carried out on the work has provided that most of the work is done on separately about DR and DM with CVD which is not in a way that it can be understand by a common man. The easiest of analysis should be carried in this process. But unfortunately the limited work has been done internationally in the area. The quality of the images such as retinal images related to DR and electron micrographs, coronary angiographs of diabetic patient with CVD can be improved by image enhancement techniques. Further detection and extraction of important features that are needed for accurate diagnosis can be obtained by image segmentation techniques.

3. Diabetic Related Causes

Diabetic Cardiomyopathy: An Overview

The microscopic images Arteries are considered for three conditions such as Normal, Severe and moderate. These images represents the cross sectional view of a blood capillary of a right coronary artery.Arteries have three layers inter most layer tunica intima, middle layer tunica media and outermost layer tunica adventitia. Atherosclerosis leading to narrowing of blood vessel which carries blood to the heart, thereby causing heart failure.

Diabetic Retinopathy: An Overview

The images of the diabetic retinopathy (DR) come with the problems such as hard exudates, soft exudates, micronaneuyrysms, hemorrhages and neovascularization. In this work three images (Courtesy to the Public data base from which images were acquired) have been considered.

Diabetic Myonecrosis: An Overview

Diabetic Myonecrosis or diabetic muscle infarct (DMI) is a rare complication of diabetes or possibly under diagnosed. 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 [12,13]. 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 [14].

4. Objectives and Scope:

The Objectives of this research work are given below in a simple and obvious way that on attaining these goals will lead to the betterment of mankind both physically and scientifically.

- To study recent algorithms related to Image Enhancement (Homomorphic filtering, Histograms, CLAHE etc) and Segmentation (K-Means, Fuzzy C-Means and Watershed) to solve the problem and attempt to modify the algorithm for specific application.
- To establish the **Hybrid model** as said in title of the topic by combining the image processing (Enhancement and segmentation) techniques as per requirements and also to tabulate statistical comparison of image attributes.
- To explore and investigate the significance of less commonly used estimate parameters in process of medical image analysis.
- To develop a frame work for qualitative automatic medical imaging to detect and forecast the abnormalities in the considered problem for accurate diagnosis.
- To make the products of this research freely available to the academic and medical community as open standard system.

5. Plan of work and Methodology:

The Methodology is given below as a step by step procedure to solve the considered application.

a. Medical visual data base collection:

To collect the image data base (Retinal images, Electron micrographs and Coronary Angiogram images) from Online (Public Database) and also from Diabetic research institutes (**Already taking help from *Diabetic Care Centre*, Nandalur, A.P., *RSSDI (Research Society For The Study Of Diabetes In India), Delhi* & *BMESI (Biomedical Engineering society of India)*, Manipal, Karnataka**). The visual data consists of varied databases with documents of differing modalities and varying characteristics.

b. Implementation of algorithms:

The image enhancement and segmentation algorithms for which implementations are available will be considered for the purpose. The algorithms for which no implementation is available will be adopted as part of the project.

The preferred programming platform is **MATLAB** technical computing language ***(R2010a and above)*** using toolboxes image acquisition, image processing, fixed point and neural networks. Algorithms implemented on other platform such as medical imaging software **MIPAV** can be utilized provided their results are useful for solving the problem.

c. Testing:

The algorithms will be tested on the collected medical visual data base. Some algorithms may extract important features from extensive testing.

d. Analysis:

Using the results of the tests, an assessment of the algorithm will be made. Therefore a statistical comparison and graphical representation between a normal group (DM) and abnormal group (DM with DR & CVD) will be tabulated for each algorithm.The results will be compared with the clinical characteristics for a certain period of time taking the help of medical community. Any relative strengths or weaknesses of algorithms should be found. The concepts in the algorithms will be assessed for relevance based on the quality of the algorithms with reference to considered problem/ application.

e. Modified algorithm:

Based on the analysis, one or more improvements to existing recent Image enhancement and segmentation techniques may become apparent. If this occurs, a new algorithm will be devised which demonstrates the improvements.

f. Test modified algorithm:

The improved algorithm will then be evaluated on the basis of the requirements.

g. Expected outcome:

- Survey and analysis of existing methods.
- Strengths and weaknesses of algorithm in comparison with each other.
- Finally the research project might result in the creation of a new algorithm that combines ideas from the existing image processing techniques.

6. Proposed method and Model

The implemented method shown in Figure 7 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.

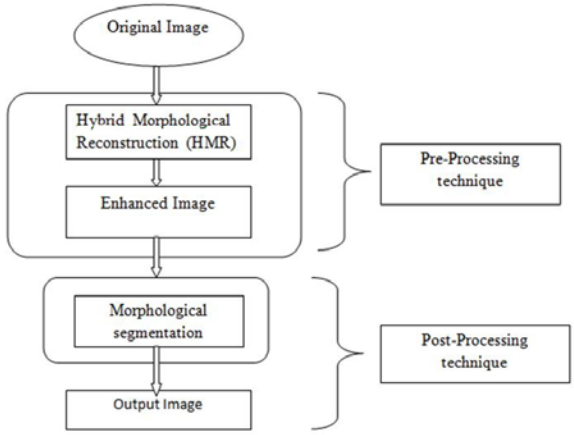

Figure 1: Block Diagram of Implemented Model

Model description:

The images that are obtained from the Public database are used for giving as inputs for the proposed work .Generally the images are RGB images. So the RGB 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.

Hybrid Morphological Reconstruction (HMR)

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) is used to enhance the image.

Morphological 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.

There are three points to be taken into account out of which first point is about regional minima and second point is about single minimum and final point at which water would be equally likely to fall to more than one such minimum form crest lines on the topographic surface and are referred as *divide lines* or *watershed lines* [6]. The standard objective of this method is based on the concept to find watershed lines. In simple words this concept is just like 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]. In [10] watershed algorithm was used for segmentation of splats, a collection of pixels with similar color and spatial location.

Conclusion

The simulation results of Hybrid Morphological Reconstruction Technique as Pre-Processing with Watershed Segmentation Method as Post-Processing are quite suitable for detection of anomalies in Diabetic related images as discussed in above sections. The analysis to be carried out on the simulation results will be useful even to educate common man and easy perception of about what might be the consequences one has to face if Diabetes Mellitus is not considered as a problem to be taken care off within right time.

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