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An Improved Model for Analysis of Diabetic Retinopathy Related Imagery

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Abstract

Currently, Image processing techniques are captivating a noteworthy part in order to get to the bottom of a range of medical Imaging problems. Retinal problems have become very common ailments in Diabetic patients and are the cause for visual morbidity. The methodology used here involves the application Hybrid Morphological Reconstruction procedure With Watershed Segmentation method to yield outputs. The outcomes from the proposed method are the processed images related to Diabetic Retinopathy, interpreted to give an analysis based on the clinical concepts. The main significance and improvement with the proposed method is the examining the image processing techniques (enhancement and segmentation) on Diabetic Retinopathy images that can improve the quality of life.

Keywords: Analysis, Diabetic Retinopathy, Exudates, Improved, Image

1. Introduction

In view of the fact that existence is importance, a great deal of endeavor has been conceded out these days to make a diagnosis of health issue and its related issues of concern. Diabetes Mellitus (DM) is metabolic disarray that renowned by incapacity of the organ pancreas to administer blood glucose absorption. Thus as a consequence it leads blood glucose intensities out of range[1,2]. The topic of research considered here is about the images related to Diabetic Retinopathy. Diabetic Retinopathy is one of the disorders that may occur in Diabetic patients if proper care and medication is not followed. This may also lead to loss of vision in most of the neglected cases. The images of the Diabetic Retinopathy (DR) come with the problems such as hard exudates, soft exudates, micronaneuyrysms, hemorrhages and neovascularization[3]. In this work three images (Courtesy to the Public data base from which images were acquired are given below the original images) have been considered with combination of above said problems to analyze the detected results obtained. The output images from the proposed method are not useful for analysis and thus only the images which show up the above said problems after processing are considered. Systematic screening programs for diabetic eye disease have been developed in many countries[4]. Even though there is a lack of awareness, sometimes it is due to innocence or ignorance of the patients related to Diabetes. A periodical clinical test and computational interpretation are required to overcome this disorder. Thus this has led many researchers around the world to focus on imaging technologies to create awareness among the people who

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are more prone to this disorder. On a methodological basis Digital Image Processing techniques on application formulate the majority of fundamental features from the images[5], as a result of which superior perspicacity of the view can be achieved for human perception and viewing ability[6]. The imaging methods with appropriate technical computing tools will be more useful in an assortment of medical applications. There is no certain rule in literature of Image Processing methods that any particular method can be useful for all the applications, it's a mere trial and error logic is used most of the times. The proposed work uses MATLAB tool to produce results and carry out the analysis as it contains a high-quality number of toolboxes.

2. Hybrid Morphological Reconstruction (HMR)

The microscopic images acquired from various modalities are not homogeneous because of the underlying causes of imaging modalities uses, limitations and discrepancies. Thus here it is proposed to use Hybrid Morphological Reconstruction (HMR) technique an enhancement method to reduce the influence from detrimental discrepancies (irregularities) within. Once the irregularities are removed, the resultant images are further investigated with segmentation procedures to attain the expected outcome.

3. Morphological Watershed Segmentation

Morphological Watershed segmentation belongs to the branch of Morphology and is a notable image segmentation technique for the reason that of its implication interrelated to mathematical concepts of morphology. The Morphological operators are functional here for vasculature segmentation[5] since the primary morphology of the vasculature is known a priori to be encompassed of concurrent linear segments and as of speed and noise resistance. Fundamentally there exists 4 morphological image processing techniques, but here they are used in combination to solve the concerned problem. The theory of watersheds is the foundation concept on envision of an image in three dimensions specified by two spatial co-ordinates versus intensity. The salient features of concern here are regional minima, single minimum and crest lines on topographic planes in addition are referred as divide *lines* or *watershed lines*[7]. The distinctive rationale of this system locates on the conception to get watershed lines[8]. In straightforward expressions this supposition seems like; suppose that a hole is thumped in each regional minimum and that the entire geography is swamped from underneath by making water to rise in the course of the holes at regular rate[9]. In[10] the researches utilised watershed methods for segmentation of splats which is a assortment of pixels with similar color and spatial location. After extraction of the contours, the image was segmented with respect to the rectangles extracted[11]. The features extracted afterwards are to be analyzed for a momentous coverage of the proposed algorithm on the considered application.

4. Proposed Model

The proposed and implemented model shown in Figure 1 is used to process the medical input images related to application concerned here. The process flow mentioned in figure 1 comprises of both enhancement and segmentation methods belonging to the family of Morphology. In this work the enhancement of images is done by Hybrid Morphological Reconstruction (HMR) whereas image segmentation is carried out by Morphological watershed method. The above said techniques work as pre-processing and post-processing procedures respectively in this algorithm implementation.

Diabetic Retinopathy images available in Public database are used as inputs for the proposed work (Courtesy of the images is mentioned at the images). The acquired image will be in its default mode i.e. RGB image, is experimented by means of the technical language tool MATLAB and the image go through appropriate and earlier mentioned procedures to yield results. Even though there a numerous number of toolboxes and block sets available as library in MATLAB, only a few of them come into use depending upon type of application and requirement of the user. Generally the toolboxes which may come into take part here are Image processing Toolbox and Image acquisition Toolbox. In order to make the proposed methods work smoothly the RGB image at initial stage is converted into grey scale to avoid complex calculations. And then Gradient Magnitude operator is used to perform derivative process on images. The resultant image appears to be like an X-ray image from Gradient operation. Following the above two procedures, the main procedure morphological watershed transform segmen-

tation is performed. The gaps present in the concerned images are filled here (it is identical to watersheds happening around us, which envisions the filling up of the bores and wells with rain water for preservation purpose) and then analysis of the outcomes is carried at final stage.

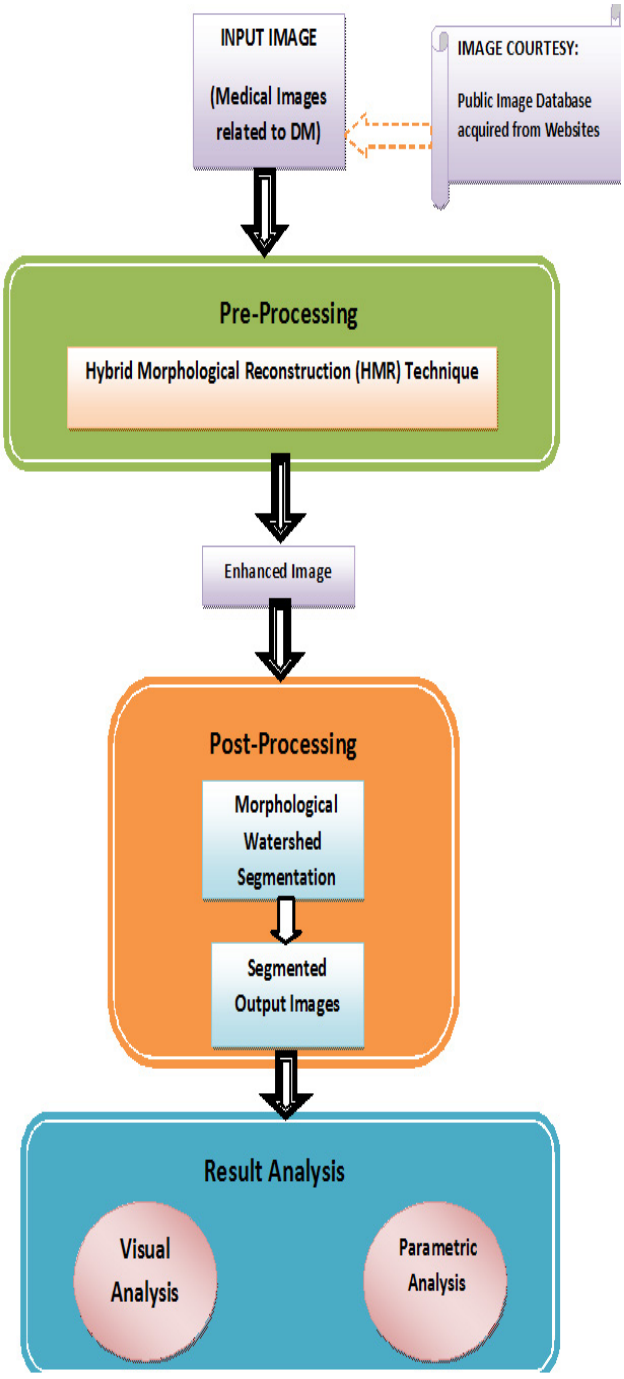

Figure 1. Block Diagram of Implemented Model.

5. Results and Analysis

The results obtained after application of retinal images associated with Diabetes to the proposed model are promising to carry out a perfect analysis with respect to human perception.

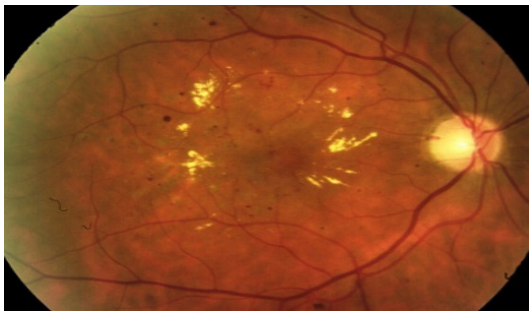

Figure 2. Retinopathy image showing Hard Exudates and hemorrhage *(Image Courtesy: Illinois Retina & Eye Associates).*

Figure 2 corresponds to Diabetic Retinopathy image showing hard exudates and hemorrhages. This is considered as the input image to the proposed model. In initial stage the input image is change to simple inverted image sometimes referred as Gray Scale image, revealed in figure 3 acquiesces principally the hard exudates highlighted due to variation in value of Intensity level.

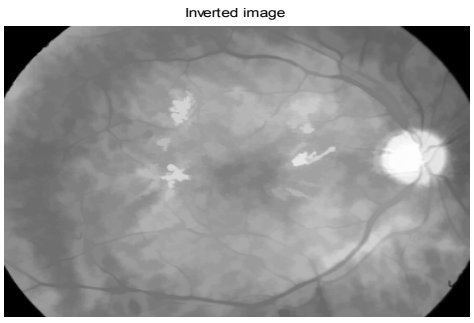

Figure 3. Inverted Image.

Figure 4 is a resultant gradient magnitude output image which give you an idea about the clear disjointing of hard exudates from the background signified with an arrow mark symbol.

The output images of the proposed system numbered from Figure 3 to 6 are used to envisage the existence of hemorrhage in the retinal image and analysis is carried out based on the visualization of the outcomes. Region of

Interest (ROI) can be seen in the resultant output images indicated by varied intensity levels.

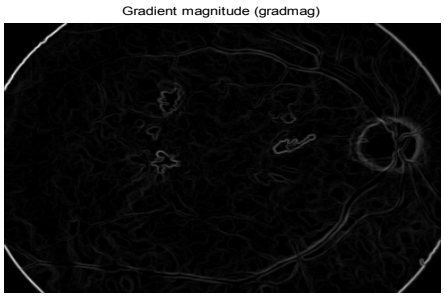

Figure 4. Gradient Magnitude.

Figure 5. Image reconstruction by regional Maxima.

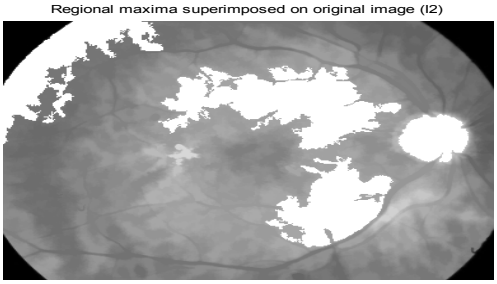

Figure 6. Superimposed image.

Figure 7. Retinal image showing hemorrhage and soft exudates.
(Image Courtesy: Research Library, Graduate School of Medical Sciences, Kunamoto University, Japan).

The input concerned here is figure 7, a retinal image showing hemorrhages and soft exudates. This is considered as the input image to the proposed Hybrid model. In initial stage the input image is change to simple inverted image sometimes referred as Gray Scale image, revealed in figure 8 acquiesces principally the soft exudates as well as hemorrhage (visible in black shaded region) with a variation in the intensity level values.

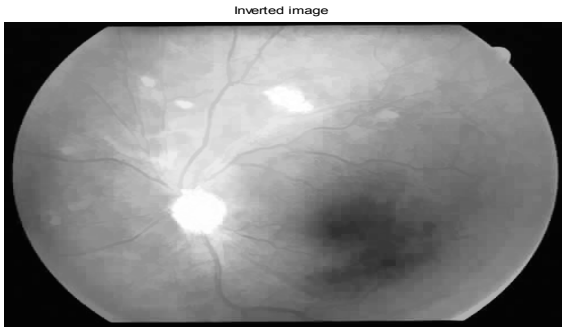

Figure 8. Inverted imag

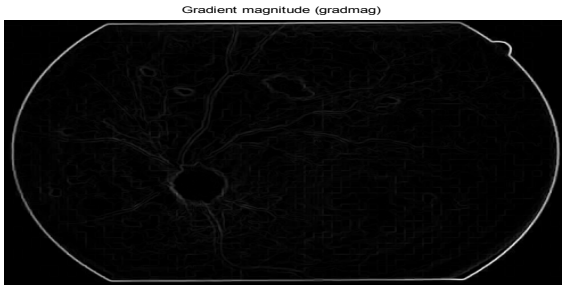

Figure 9. Gradient Image.

Whereas figure 9 is a resultant gradient magnitude image, representing the comprehensible disjointing of soft exudates (wool spots) from the background indicated by arrow mark for the convenience of researcher.

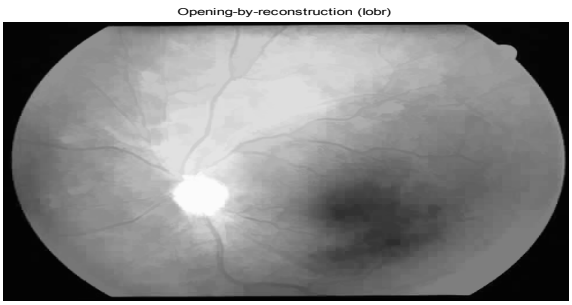

Figure 10. Opening by Closing.

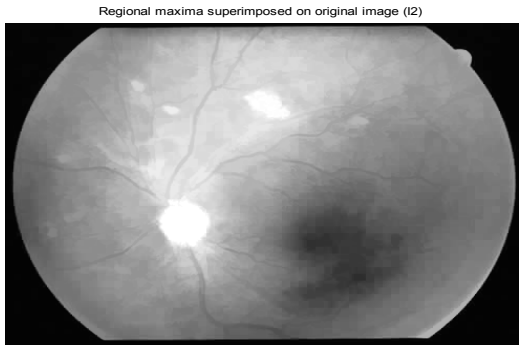

Figure 11. Superimposed image showing soft exudates (wool spots).

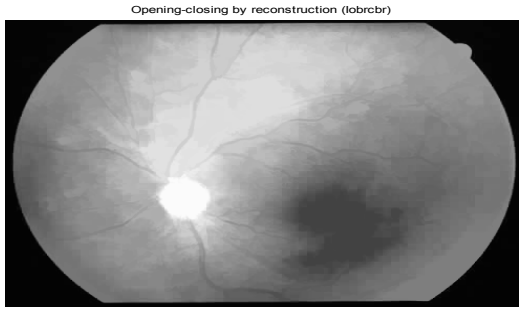

Figure 12. Reconstruction using Opening by Closing.

The output images of the proposed system numbered from Figure 3 to 6 are used to envisage the existence of soft exudates (in appearance of wool spots from figure 10,11,12) and hemorrhage in the DR image and analysis is carried out based on the visualization of the outcomes. Region of Interest (ROI) can be seen in the resultant output images indicated by varied intensity levels.

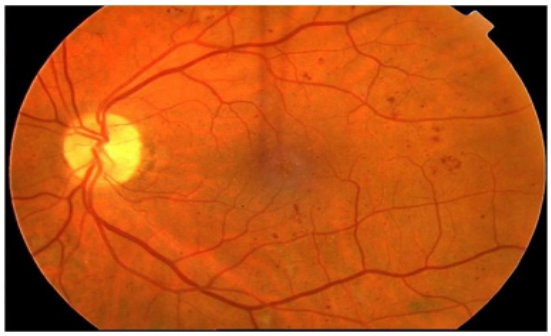

Figure 13. Microaneurysm and hemorrhages *(Courtesy: Retina Consultants, NSW).*

Figure 13. represents an image with Micronaneuyrysms and hemorrhages and is fed to the proposed hybrid model. A retinal microaneurysm is a small area of blood protruding from an artery or vein in the back of the eye. The protrusions present may unlock and disclose blood into the retinal tissue nearby.

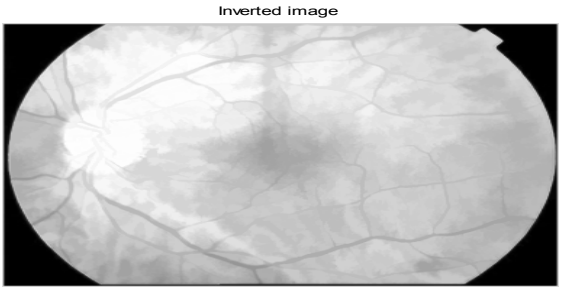

Figure 14. Inverted image.

In initial stage the input image is change to simple inverted image sometimes referred as Gray Scale image, revealed in figure 14 acquiesces principally hemorrhage (visible in black shaded region) indicated by varied intensity levels.

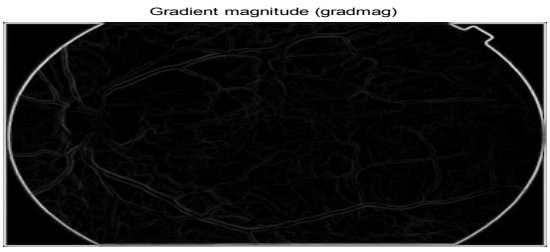

Figure 15. Gradient Magnitude image.

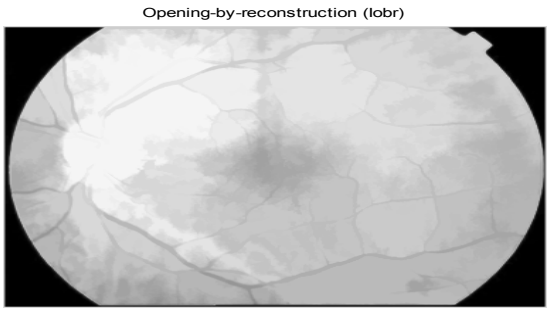

Figure 16. Reconstruction by opening.

figure 15 is a gradient magnitude image which shows Micronaneuyrysms which are visible as tiny spots which are scattered though out the eye.

The final work here, image reconstruction process by opening envisages the centre part of figure 16. enclose hemorrhage in the retinal image which can be effortlessly apparent from manifestation of the resultant images.

6. Conclusion

The simulation results of proposed hybrid model in this research work are to a certain extent appropriate for detection of presence of anomalies in Diabetic Retinopathy Images. In this work problem such as hard exudates, soft exudates, micronaneuyrysms and hemorrhages of Retinal images were clearly explained with the help of obtained results. The analysis carried out in the paper 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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