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SIGNIFICANCE OF IMAGES AND ALGORITHMS OF IMAGE PROCESSING FOR DETECTION AND DETERMINATION OF DIABETES AT EARLY STAGE

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ABSTRACT

Now-a-days diabetes is the main problem, it is showing impact on human being's organs like eyes, due to this Diabetic retinopathy causes one type of blindness which occurs in the human being at the age of 35 years on wards, Diabetic foot Ulcers is another problem, even it will show the effect on spinal chord also., Now a days, lot of techniques and methods are there to identify this Diabetic disease at early stages by using Fundus and OCT(Opical Coherence Tomography) , wherein images helps to identify Diabetic Retinopathy, the Infrared Red Thermal Images to identify the Diabetic Mellitus. These images will be used with different algorithms, techniques. In this paper, we have approached a method we had discussed to detect automatically and analyze these exudates and hemorrhages, by using the Fundus and OCT images in Diabetic Retinopathy and Thermal IR Images in the Case of Foot Ulcers, which are pre-processed via local, contrast enhancement by using the adaptive method

KEYWORDS*:* Diabetic Retinopathy, Fundus Images, OCT Images, Thermal IR Images, Foot Ulcers, Chanvase Algorithm

INTRODUCTION

Diabetic retinopathy is now -a -days a major cause of blindness in people at the early age. There are two types of Diabetic Retinopathy, which can be seen in human beings, namely type1 and type2. The type1 DR is in the early age of around 21years to 22 years. This may lead complete blindness in coming future. This can be identified in early stages of humans [2].

Segmentation, based on edge base, involves with the identification of borders of infected areas in the fundus images, here the image noise may not make the perfect detection, and each pixel has to be considered as region, which can be further identified by region growing. After this, the histogram technique is applied to classify the pattern images. In this process the optic disc area or surface can be identified.

In most of the cases, the increment of diabetic ulcers in the foot can be avoided or gradually make delay with the proper treatments that are given at an early stage. It describes the importance of an early detection, and diagnosis, of diabetic foot treated by specialized medical doctors in the health care centers or hospitals. In diabetic foot, the treatments are related to education of diabetic foot and regular care. However, in the present, serious complications such as an occurrence of an ulcer, could be reduced only by diabetes experts, as there can be several shapes that could be observed. In both the cases, the possible amount of variations in a plantar foot temperature is usually less than 4°C.

The foot areas as right and left with temperatures in a diabetic patient should not differ more than one degree centigrade. Therefore the difference in temperature, which is greater than 2.2°C can be treated as an abnormal condition. So with the detection this increased temperature between the two feet, and providing proper treatment, can decrease the occurrence of foot ulcers on the bottom of the diabetic.

Most of the research is concerned about diabetes and the temperature difference between the feet should not be more than 1°C. This research work concentrates on the two factors, primarily to improve the early detection, diagnosis of DF in hospitals, and another one is to reduction of the chances of ulcers and related amputations [4] in the diabetic foot. Among all those possible factors that can help in such tasks, temperature is a most important characteristic of a DF. The Ulcer foot is important with a serious complication of diabetes mellitus [4] (DM). The aim of this work, is for prevention of Ulcers by close monitoring on a regular basis, which reduces the surgical operation compel frequencies 50 to 90%.

The OCT images

OCT imaging technology is used in obtaining high resolution images of the Retina and internal segmentation of the eye. And glaucoma can be increased due to pressure, and it may cause damage the optic nerve.

The OCT images are the 3D objects. These are important, because these provide the non-invasive diagnostic images; this is the difference between the X-ray images and MRI images

Whenever the trabecular meshwork of the eye becomes inefficient eye becomes dry, eye pressure will raise and it is called as IOP (intraocular pressure). By this raised pressure, the optic nerve will be damaged. But it is not an early symptom at early ages, the eye pressure will be expressed in millimeter Of Mercury (mmHg). So, in this paper, we had adopted the methodology by which we can determine the Diabetic Retinopathy at early stages [23].

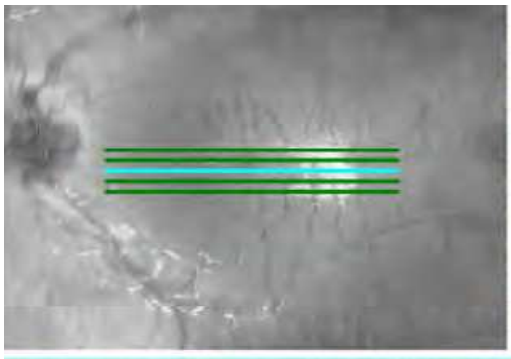

Figure 1: The Normal OCT Image

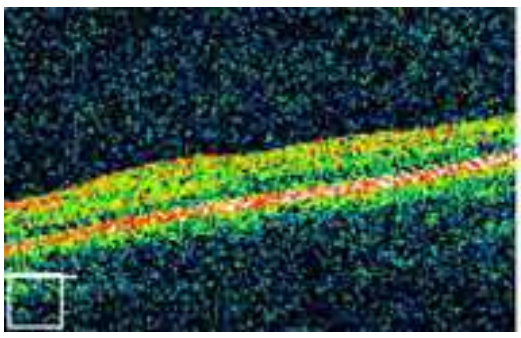

Figure 2: The OCT Image

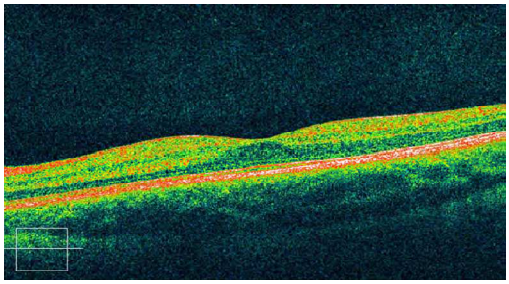

Figure 3: The Infected OCT Image

PROPOSED WORK

The general objective of this paper lies in the domain of diabetic foot and it follows the two already mentioned research directions: i.e., to improve the early findings and diagnosis of diabetic foot and reduce the ulcer occurrence in a diabetic foot. It will be on the basis of analysis of infrared image of thermal of sole of foot [16].

The two possible directions are:

Find the new strategies to improve the early stage diagnosis with detection of diabetic foot at hospitals from the analysis of infrared thermal images [22].

Design and test a home based system to monitor foot temperature using an IR camera.

Here the second objective will require the development of a dedicated system, using an IR camera to measure the temperature of the plantar foot at home. Developing and testing such a device in a small time is a difficult issue

The Fundus image quality depends on procedure of acquisition and under which operators using, and the quality again depends upon the exclusion criteria which applied on the images [8].

The conversion of colour image into black and white image then moat operator is applied.

Finding Contrast

It is a measurement of intensity contrast between a pixel and its neighbourhood pixels in the whole image:

$$\text{Contrast} = \sum_{i,j} |i-j|^2 p(i,j)$$

In this paper, we used the method of standardization of colours based on the contrast. Because to eliminate the confusion between the pathology colours in the Fundus images, here we have to use a set of 40 Fundus images of different age group people [28].

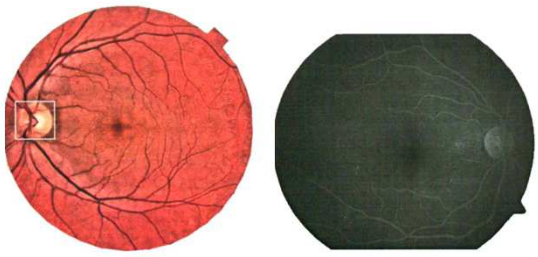

Figure 4: Pre Processing of Images

Diabetic Foot

General Information

The Ulcer in the foot is important with a serious complication of diabetes mellitus (DM). Our aim is for prevention of Ulcers, with treatment of multi disciplinary of ulcers, and near monitoring on a regular basis, which reduces the surgical operation that compel frequencies from 50 to 90%. By this several organizations in countries, such as the W.H.O. and the International Diabetes Federation, set goals to reduce the rate of surgical operations as maximum as possible and diabetic patients has up to 22 times greater risk of amputation of lower limbs compared with normal person [15].

However, the patients with both weak nerves and proper blood flow the foot ulcer, symptoms not present. Below Figure explains the visualization of the ulceration mechanism, and Figure below shows an illustration of foot ulcers [17].

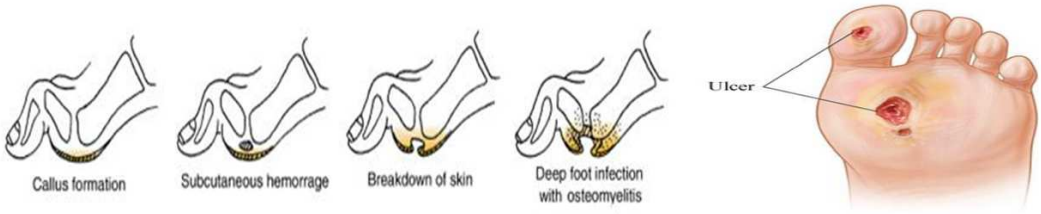

Figure 5*:* An Illustration of Foot Ulcers

The above figure shows the areas where foot ulcer is very likely to occur. These can be named areas at high risk as illustrates in the picture. So detecting these problems in these zones is of a great interest. Here we may consider the tiny areas at less risk are circle with 2cm of radius. This characteristic is an important for systems build to detect these problems in a diabetic foot. [18]

Diagnosis of Diabetic Foot

From this analysis, a risk based classification is given by the medical doctor. The risk here means that the risk of developing a foot ulcer. This classification is may not same in every country.

In India, for example, the classification used in most hospitals is as follows:

- **Grade 0:** No neuropathy, no ischemia, possible foot deformations is independent of the diabetes.
- **Grade 1:** Small neuropathy defined as the absence of sensation at least one point of the points is at risk on the feet.
- **Grade 2:** Neuropathy with foot deformation and ischemia.
- **Grade 3:** Previous amputations, and ulcers that has been more than for 3 months. [21]

A zero grade means that the patient has no diabetic foot. Any other numbers of grade mean patient has diabetic foot. And the risk based classification is Low risk, Medium risk and High risk, and MRI images also used to determine the earliest stage diabetic [11]. In Diabetic Retinopathy, we use the MOAT Operator for image sharpening, which can be done within the frequency domain using a high - pass filter, the transitions of edges, and sharpness in the gray levels of the images represent the high-frequency components. The attenuation of low-frequency components will be done in the Fourier Transform, without disturbing the high-frequency information [12].

This can be done by multiplying the filter spectrum

$$\mathcal{G}(u,v) = \mathcal{H}(u,v)\mathcal{F}(u,v)$$

H (u, v) is the image spectrum

F **((u, *v*))** in Fourier space,

Where $\mathcal{F}(u,v)$ is the Fourier Transform of Image $f(x,y)$

The Histogram technique is applied to the images,

p' (a) is the probability of finding a pixel with the value *a* in the image. $Area_1$ is the area or the number of pixels in the image and *H1 (a)* is the histogram of the image

$$p_1(a) = \frac{1}{Area_1} H_1(a)$$

$$f(a) = D_m \frac{1}{Area_1} \sum_{i=0}^{a} H_c(i)$$

Here Edge based segmentation is widely used, it is difficult that if there is no border and at the border, due to damage of image noise. It is used to identify various regions of the image in segmentation which further involves the region growing. By the fundus photography, the retinal image quality can be obtained, the colour image is colour normalization is required to analyse the image. The histogram specification approach is used in it to normalize the colour of retinal images. By this we can make equalize the intensity of original image changing intensities. After generating the histogram, then the optic disc is inside of the nasal, and it is insensitive to light so it can be called as the blind spot. So, this portion can be known as image noise during analysis, and if we have gone through the Foot Ulcers images.

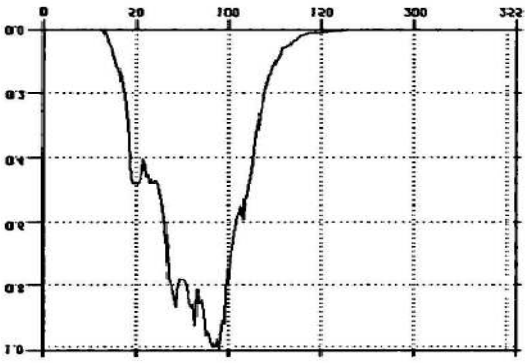

Figure 6: Histogram for Eye

The normalized temperature is calculated by using the formula

TN = |ΔT°| / TR

Where,

TN = Temperature normalization and

|ΔT°| = |TR – TMF| the difference in temperature °C

TR = corresponding forehead temperature in °C and

TMF = foot temperature mean value (°C).

Segmentation

There are many common methods for segmentation, such as edge detection, region growing, and most recently active contours. Active contours are the methods which iteratively modify an initial contour to fit the desired contour. Here we choose to implement the globalization based Chan and Vese segmentation method. It is particularly adapted when the contours are not sharp as it is the case of this thesis.

The results which are shown in Figure below is with 300 iterations. The initial contour is a circle in the middle of the image and having a diameter of 150 pixels.

RESULTS

The reliable determination, the relationship between the average retinal vessel diameter and the distance from the optic disc and the width of blood vessel shows monotonic decrease by taking the distance into account of the optic disc to the centre.

Distance with Optic Disc to Width of Vessel

The Vessel pixels near the centre of optic disc and the width of blood vessel shows the Monotonic decrease with the centre. If the blood vessel volume isn't changed, then no need of branching.

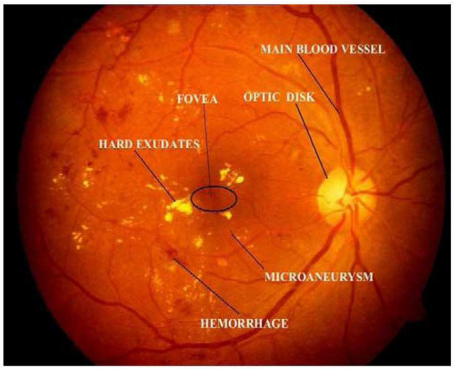

Figure 7: After the Distance Evaluation

After analysing the images, in this paper the Histogram process used for funds images for colour normalization, here it is required that the uniform intensity should spread along with the image, and remaining the optic disc area can be generally not classified and it is called as noise [29]. The optic disc can be removed by edge base detection.

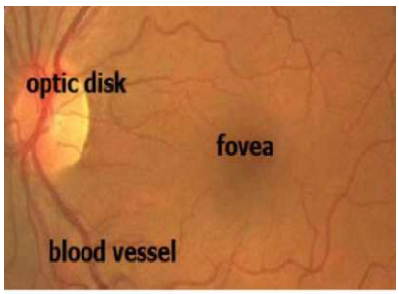

Figure 8: Optic Disk, Blood Vessel of Eye

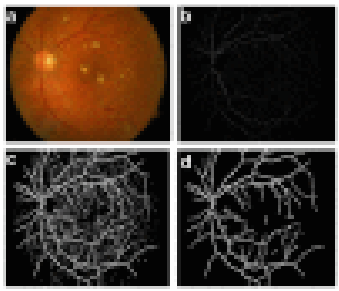

Figure 9: The Identification of Blood Vessel

After detection of blood vessels by edge detection, further the morphological filter algorithm operation is used for segmentation.

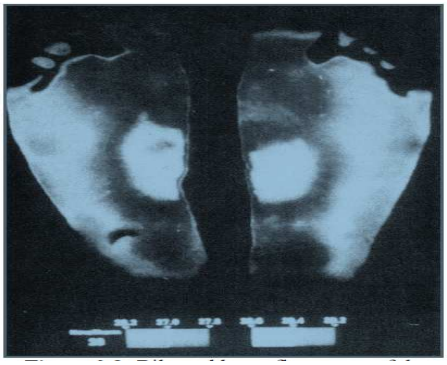

Figure 10: Thermal Image Processing in a Normal Person

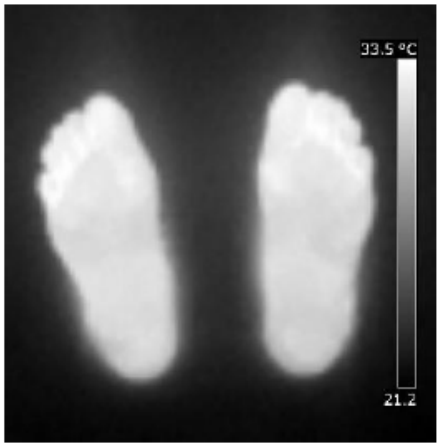

Figure 11: Mirror Image of the Foot

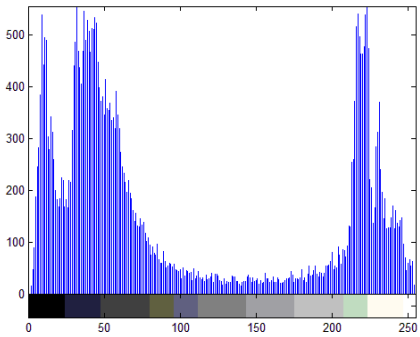

Figure 12: Histogram Representation

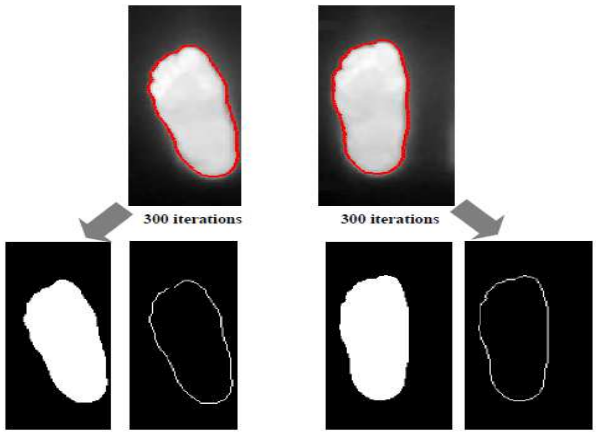

Figure 13: After Segmentation of the Image

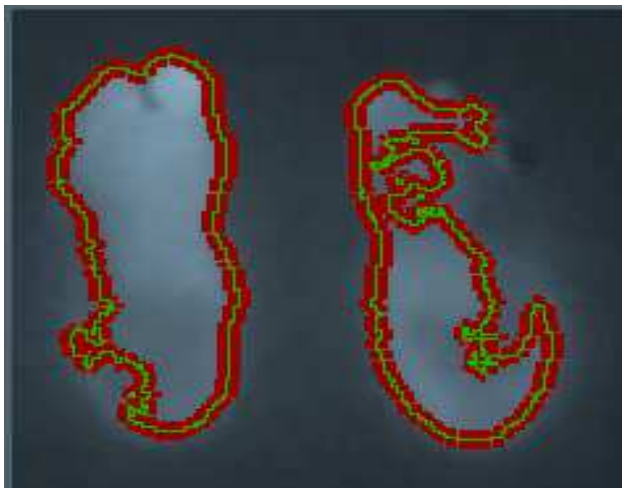

Figure 14: After Complete Iterations, the Segmented Image

CONCLUSIONS

In this paper, we had discussed the different methods to detect the Diabetic Retinopathy by using the methods. And further these can be carried out by using other techniques and algorithms like SVM classifier etc.. And for Diabetic foot ulcers, Diabetic foot is a major public health concern. Therefore, the main objective of this paper is to estimate the of thermal potential image processing in the early detection and diagnosis of type-2 diabetic foot in the health care centers. The main advantages of thermal image processing are that it is very simple to use, contactless, non-invasive, non-radiant, and also very fast working.

Some images show hyperthermia in the heeling region. And some Images reveal toes hyperthermia. The remaining images show another kind of hyperthermia on the plantar foot surface.

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