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Active Contours Techniques for Automatic Detection of Glaucoma

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Abstract: ***The inadequate fluid flow between the iris and cornea of eye leads to glaucoma. The important technique to asses patients effected with glaucoma is analyzed by ultra sound images of the eye, For the detection of the structural changes an algorithm is proposed to focus on automatic detection and determining the exact location of the apex point of the anterior chamber region for efficient angle calculation from the various live ultra sound images. It is very important to detect glaucoma in its early stages for diagnosis and hence this algorithm addresses the importance of precise results with effective immunity towards speckle noise.***

Index Terms: Active contours, Angle calculation, AOD-500 (Angle open distance), Apex point determination, masking, UBM (Ultrasound bio-microscopy)

I. INTRODUCTION

Development of MATLAB tools results in the effective analysis and simulation of various biomedical images, specifically eye images i.e., Ultra sound images (UBM). UBM images are the basic source of analysis of glaucoma where the disease symptoms and Ancient techniques ESO [1] to cure glaucoma can be known by glaucoma research foundation [2]. Glaucoma can be analyzed by physical analysis of patient by the medical experts but in this algorithm, we can analyze the same glaucoma by the UBM images of an eye. Where their, characteristics and clarity discussed by R.Youmaran etal [3]. By having the clear information of the disease and UBM images we can detect the Glaucoma by using the MATLAB in personal computer. The Xiaoyang song, etal [4], gives the various levels of computer based diagnosis system MATLAB operation with information of image processing required to analysis the UBM images. Image processing techniques with MATLAB by Rafel Gonzalez, etal [5]. These UBM images of eye are usually associated with poor resolution, poor contrast, and noise and divaricated anterior chamber edges. An Algorithm is proposed to meet the above challenges and effective angle calculations.

II. MATERIALS AND METHODS

Types of Glaucoma detecting analysis

Ophthalmoscopy:

It is an Instrument examines the optic nerve. Doctor analyze the shape and color of optic nerve, if nerve looks unusual then two special glaucoma tests will be done the two tests are perimetry and Gonioscopy.

Perimetry:

It is a visual field test, which helps to draw a map of patient's vision.

Gonioscopy:

It is painless eye test and pudding manual analysis of eye images checking for the condition of iris meets the cornea. Which is fairly time consuming and accuracy of parameter measurements varies between experts. For this reason an algorithm is developed to analyze eye ultra sound images automatically to reduce processing time taken by existing techniques of manual/computer based algorithm without compromising on the speed, accuracy, sensitivity, cost and compatibility of the product. As well it addresses with the importance of precise results with effective speckle noise.

III. ALGORITHM

In order to calculate the clinical parameters of interest, new region classification and segmentation techniques based on Active contours are developed. The ultra sound images of eye are very noisy, with poor resolution and weak edge delineation, which required the development of effective segmentation to overcome these challenges. The complete algorithm is shown in fig.1.

Segmentation:

Image segmentation is one of the most important steps leading to the analysis of processed image data the main goal is to divide an image in to parts that have a strong correlation with objects or areas of the real world contained in the image .We may aim for the complete

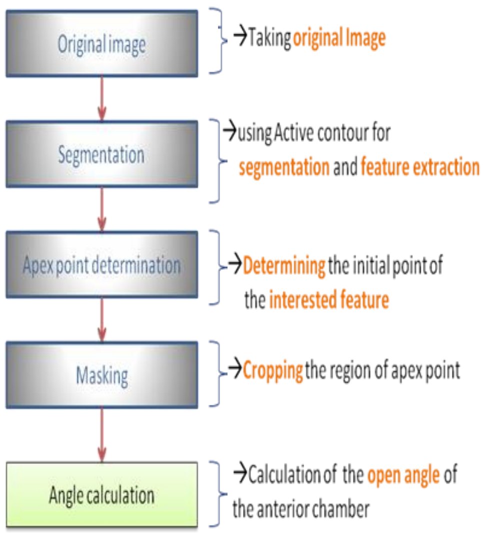

Fig.1. Glaucoma Detection Algorithm

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segmentation, which results in a set of disjoint regions corresponding uniquely with objects in the input image, or for partial segmentation, in which regions do not corresponds directly with image objects. The image analysis models became popular since their publishing in work since the publishing work on "Snakes: Active contour models" *Michael Kass* etal [6] since then they have become active and successful research branch of image segmentation.

Apex point:

The field of mathematical morphology contributes a wide range of operators to image processing, all based around a few simple mathematical concepts from set theory. The operators are particularly useful for the analysis of binary images and common usages include edge detection, noise removal, image enhancement and image segmentation. The two most basic operations in mathematical morphology are erosion and dilation. Both of these operators take two pieces of data as input: an image to be eroded or dilated, and a structuring element (also known as a kernel). The two pieces of input data are each treated as representing sets of coordinates in a way that is slightly different for in binary and grayscale images. In this project, image erosion is of interest.

Masking:

Using (X_{ref}, Y_{ref}) as the reference point in the original image, a 50x50 square mask is to be created around the image. This is primarily done because; the region of interest is the anterior chamber just to its apex point, to avoid spurious layers interfering with the AOD 500 determination.

Once the masking square is set, the image is to be processed again in order to obtain the approximate angle of the anterior chamber apex.

Angle calculation:

The Ultrasound Bio-microscopy (UBM) images resolution reveal that distance between 2 pixels is approximately equal to 19.52 µm. Hence in order to calculate the Angle Open Distance 500 µm, it is necessary to move a distance of approximately 500 µm (approx 25 pixels) from the apex of the masked anterior chamber along its edges. From here, a perpendicular line to the virtual reference line is to be projected to calculate AOD using analytical geometry concepts. From the point of intersection of the perpendicular to the virtual line, another perpendicular to the other saddle edge is to be drawn (see Figure 6). Let the two angles be θ_1 and θ_2. So the effective angle in radians will be $\theta = \theta_1+\theta_2$ or $\theta = \theta_1-\theta_2$ depending upon the position of θ_2, whether it is above or below the line L3.

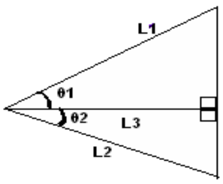

Fig.2. Example for angle calculation

After finding θ, the diagnosis of the eye can be determined by comparing it with a threshold angle (θ_C). If the θ is found to be greater than θ_C, the eye is diagnosed as normal eye; otherwise, it is diagnosed to be diseased eye.

IV. RESULTS

UBM Glaucoma images are presented in the fig.3 gives an effective angle calculation. Software in MATLAB was developed to extract angle from glaucoma UBM images. Various samples of glaucoma affected and unaffected images are tested to analyze the Glaucoma. The results have proven good comparatively than earlier techniques.

V. CONCLUSIONS

Images with both diseases effected and unaffected eye samples of various patients have overcome the problem of Speckle Noise with Effective segmentation that have given promising results in the most of the cases comparatively in detecting the glaucoma.

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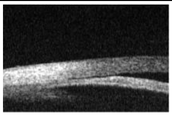
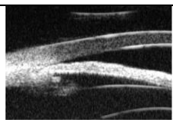
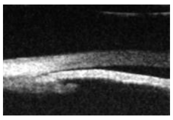
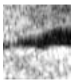
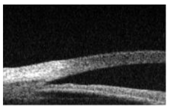
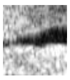
SNo	UBM EYE SAMPLES	ANGLE OBTAINED	GLUCOMA ANALYSIS
1		 Angle = 24.7151	NO GLUCOMA
2		 Angle = 14.7151	GLUCOMA DETECTED
3		 Angle = 17.3121	GLUCOMA DETECTED
4		 Angle = 27.7151	NO GLUCOMA
5		 Angle = 14.3823	GLUCOMA DETECTED
6		 Angle= 23.6273	NO GLUCOMA
7		 Angle = 15.7151	GLUCOMA DETECTED

Fig.3.Angle calculations for various Glaucoma Samples

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