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Analysis & Detection of Primary & Secondary Glaucoma – A Brief Survey

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***Abstract*—** This paper gives a brief review about the glaucoma eye disease detection so that any person who is working on the similar disease would get a small idea so that he / she can get some idea about the disease in the human eye. In fact to say, the paper can be thought of as an introductory paper about the Glaucoma. A number of researchers have worked on the static & dynamic mobile WSNs till date (both at the simulation level & at the hardware implementation levels). To start with, 100's of research papers were collected from various sources, studied @ length & breadth and a brief review of the eye disease issues was being made & presented here in a nutshell. In the sense, the recent works done by various authors across the globe is being presented here in this context so that this review article serves as the base for any researcher who is working in the field of ophthalmology.

Keywords-*Glaucoma, Eye, Disease, Normal, Affected, Blocks, Pressure.*

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I. INTRODUCTION

Glaucoma causes permanent blindness due to the damage of optic nerves. It is an incurable disease so the diagnosis of the disease is very imperative. The data shows that it is one of the leading cause for blindness in the world, and also the second most eye disease in numbers. So, the diagnosis of this disease in the early stage, and patient monitoring for long time and arriving with an applicable remedy in an appropriate time window by an ophthalmologist is a imperative [1]-[20].

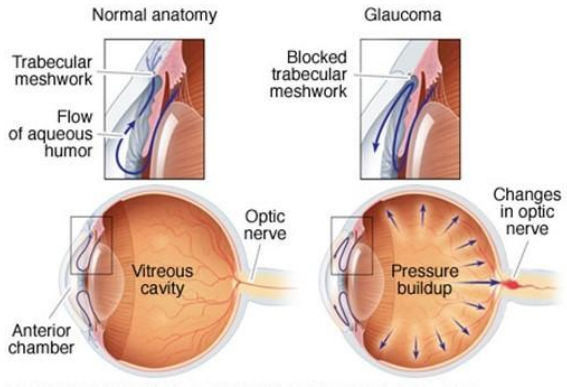

Fig. 1.1 : Anatomy of normal and glaucoma eye

When circulation of liquid called aqueous humor, in the front part of the eyes is not proper it results in a high fluid pressure inside the eyes. This is the cause for glaucoma. Tis is illustrated in the Fig. 1. The aqueous humor in normal eyes, discharges out of the eye the channel resembling mesh. When this channel for whatever reason gets blocked, the liquid density increases, and thus causes in the high pressure. This causes Glaucoma. In the Fig. 1 shown, there is a lot of difference which is shown between the anatomy of the normal eye & the glaucomatic eye, i.e., the eye which is affected with the glaucoma disease [21]-[40].

Fig. 2 : Vision of normal and glaucoma eyes

II. REVIEW OF LITERATURE / SURVEY

A large number of researchers have worked on the topic, "Development of novel algorithms for detection of glaucoma in human beings". In this section, a brief review of the work done by various authors is being presented with their advantages & drawbacks. A brief review of the various types of glaucoma was discussed in the previous sections. In this context, we are going to find out the CDR for healthy & unhealthy images along with the establishment of some relationships between various parameters. In the following sections, we give a brief review about the detection of glaucoma is dealt with along with hardware implementation of the same.

Sameer Ruparelia, shows a method to implement image segmentation algorithm in a FPGA which requires minimum hardware resources, low execution time and is suitable for use in real time applications. A pipelined architecture of algorithm was designed, implemented in VHDL and synthesized for Xilinx Virtex-4 FPGA. In the implementation, image was loaded to external memory and algorithm is repeatedly applied to the image. To overcome the problem of over-segmentation, pre-processing step was used before the segmentation and implemented in the pipelined architecture.

The pipelined architecture of pre-processing stage can be operated at up to 228 MHz. The computation time for a 512 x 512 image was about 35 to 45 ms using one pipelined segmentation unit. A proposal of parallel architecture was discussed which uses multiple segmentation units and was fast

enough for the real time applications. The implemented and proposed architectures were excellent candidates to use for different applications where high speed performance was needed.

Mohammad I. describes an efficient FPGA based hardware design for different image processing, enhancement, and filtering algorithm. Here the spatial and temporal parallelism from the structure of FPGA was exploited. The approach used was a windowing operator technique to traverse the pixels of an image and apply the filters to them. The results are obtained for image size of 585 x 450, but the approach discussed can be used for images of any size, as long as the FPGA memory will hold it. The implementation was created with the Xilinx Spartan-6 FPGA on a Nexys3 board in mind.

The design was limited to a 5 x 5 window, but the modular approach to this paper's implementation allows for greater window sizes to be implemented more easily. One major issue is the combinational sorting algorithm will have to be changed due to calculations becoming increasingly complicated when the number of pixels approaches higher values. A large part of the improvement is possible in the algorithms themselves. Better results can be obtained by using different operators and calculation methods and convolution kernels.

Chetan Tulasigeri - In this model, advance thresholding algorithm was used for cup and disc segmentation. This algorithm is based on spatial variations in the illumination. This system is modelled to segment the complete brighter area by using Otsu's method. This method was used to segment both disc and cup area which will help to find out the mean and class occurrence of original image. The parameters were used to calculate the threshold value of the disc and cup of the fundus image. The system model segmentation is highly perfect and more efficient for the computation. This proposed algorithm was designed and implemented with efficient architecture and hardware implementation for the purpose of real time operation was carried out. The HDL coding is done by using Xilinx and validation is performed on Spartan6, FPGA.

S.Aruchamy presented a strategy for identification of glaucoma screening in retinal fundus pictures utilizing DSP board. The technique happens in two phases: (1) Identification of optic nerve head in image processing utilizing circular Hough method. (2) Secondly the optic disc width is recognized and cup is sectioned. The proposal amongst disc and cup is computed for unusual image testing.

The developed method is tried on an openly accessible retinal image informational set and the standard exactness accomplished was 97.5%. Hardware implementation of enhancement of retinal fundus image using Simulink was carried out by V. Krishna Sree & P. Sudhakar Rao in their IEEE paper. Image enhancement is basically improving the interpretability or perception of information in images for human viewers and providing 'better' input for other automated image processing techniques. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer. The work done by them addressed the implementation of image enhancement algorithms like brightness control, contrast adjustment and histogram equalization on FPGA that have become a competitive alternative for high-performance digital signal processing applications.

With the advent of mobile embedded multimedia devices that are required to perform a range of multimedia tasks, especially image processing tasks, the need to design efficient and high-performance image processing systems in a short time-to-market schedule needs to be addressed. Hence, the Image enhancement algorithms implemented in hardware have emerged as the most viable solution for improving the performance of image processing systems. Their proposed work gave the implementation of efficient image enhancement algorithms on Field programmable gate array (FPGA) using Matlab & Simulink.

Pranjal Das *et.al.* - In this paper, a computer-assisted method for the detection of glaucoma based on the ISNT rule was presented. The Optic Disk(OD), Optic Cup(OC) and Neuroretinal Rim (NRR) are among the important features of a retinal image that can be used in the detection of glaucoma The OD and OC are segmented using watershed transformation. The NRR area in the ISNT quadrants is obtained from the segmented OD and OC. The method is applied on the publicly available databases HRF, Messidor, DRIONS-DB, RIM-ONE and a local hospital database consisting of both normal and glaucomatous image.

S.R. Patil, Nilam M. Gawade - Retinal image analysis is a nonintrusive diagnosis method in modern ophthalmology. In this paper, a method to segment blood vessels in the retinal images is discussed. The morphology of the blood vessels is an important indicator for diseases like diabetic retinopathy, glaucoma etc. The segmentation of the retinal images allows ophthalmologist to perform mass vision screening examinations for early detection of Diabetic Retinopathy and its treatment planning. The images from the public dataset DRIVE are used. For better segmentation performance Spartan 3 FPGA hardware is used. The pre-processing is done in MATLAB and further processing is carried out using FPGA. For the software implementation Xilinx Platform Studio 10.1 is used.

G.C. Sekhar *et.al.* expressed that optical disc (OD) size in Ocular Hypertension(OHT) patients is smaller compared to Primary Open angle Glaucoma (POAG) patients and normals. The horizontal and the vertical diameters were measured. An advanced thresholding algorithm for diagnosis of glaucoma in fundus images by Chetan Tulasigeri & Irulappan - In this model, Advance thresholding algorithm is used for cup and disc segmentation. This algorithm is based on spatial variations in the illumination. This system is modelled to segment the complete brighter area by using Otsu's method These parameter are used to calculate the threshold value of the disc and cup of the fundus image. HDL coding is done by using Xilinx and validation is performed on Spartan6, FPGA.

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In majority of the work done by the various authors presented in the previous paragraphs, there were certain drawbacks / disadvantages / lacunas such as consideration of only one or two parameters, etc. Many of them have not considered unhealthy images, noise effects were not considered, usage of fractional CDR was considered, SNR was not considered, etc….. Couple of these drawbacks are going to be considered in our research work with multiple parameters & new algorithms are going to be developed which will be verified through effective simulation results through Matlab/LabVIEW & practically implemented using hardware kits (DSP/FPGA/Micro-controller).

Similar to the works presented by a large no. of researchers in the preceding paragraphs, there were still quite a number of works done by many researchers across the world till date in the field of glaucoma eye detection in humans. But, here, we have considered only the important ones [1]– [250], which are being referred by us in the context of the providing remedial measures for the glaucoma eye detection & its permanent cure. In majority of the work done by the various authors presented in the previous paragraphs, there were certain drawbacks / disadvantages / lacunas, which was presented at the end of the work done by each author. Some of the above mentioned drawbacks which were existing in the works done by the earlier researchers can be considered by the future researchers, their own problem can be defined & new algorithms can be developed in order to overcome some of the deficiencies of the existing algos. The research work could be verified through effective simulation results done in the Matlab / LabVIEW, thus substantiating the research problem undertaken along with some hardware implementation of the same, validating the sim results.

III. Conclusions

A brief review of the work done by various authors is being presented with their advantages & drawbacks in this review / survey paper. The information presented in this paper is just the work done by various authors till date in a nutshell so that the researchers can know about the recent advances in the work done on glaucoma & its related items and can further refine their work with some additional informations, define their own research problem looking into the drawbacks of the works of the existing works.

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