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Design and Development of an Automated System for Early Detection of Diabetic Retinopathy using Image Processing

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Abstract: ***Diabetic retinopathy is a disorder that accounting as a basic origin of uncorrectable vision loss for diabetic patients. The difference in blood vessels of retina leads to a most general disease called diabetic retinopathy. However, earlier identification and remedy through regular screening, blindness can be avoided. Exudates are prime sign of diabetic retinopathy that can feasibly be measured automatically. The focus is to evolve an automated algorithm to analyse the fundus images, perform image processing to extract hard exudates which are fundamental indications of diabetic retinopathy. Hard exudates are small, yellow in color waxy patches of white color. This project implements a method or algorithm which is fast and efficient to detect the exudates. Identify the feature of exudates from the image techniques using CBIR database and to prescribe proper medication.***

Keywords: CBIR-Content based image retrieval; DR-diabetic retinopathy; Hard exudates

I. INTRODUCTION

Diabetes is the metabolic disease where a person will have high sugar level in blood either because of the consistency which does not produce adequate insulin or because of the cells which do not react to the insulin in the body that is made. Diabetic retinopathy is a chief complication that is caused due to long-term effect of the diabetes on retinal eye. This Diabetic retinopathy causes a severe injury to the human eyes like blindness due to the rupture of retinal vessels in eye. Diabetes also weakens the body's blood vessels if not treated. The other complications of this disease, will also affect various human body parts. When there is well measured blood vessels contains a high level of glucose content in a retina, then the eye sight will be shrouded which may spend to eye blindness eventually which is called as Diabetic Retinopathy.

Diabetic Retinopathy is foremost among the diabetic disease in eye, which happens when the blood vessels available in the retina of eye alters. The blood vessels are highly influenceble to diminishing and can undergo a sequence of modifications. When these blood vessels in the retina gets ruptured, then the vessels will swell and leak like a fluid. These changes may advance to closures, from the small blood vessels called as capillaries or the week growth of fresh capillaries which bleed very well. In other instances, fresh blood vessels that are abnormal one will be grown on top of the retina. Diabetic retinopathy is one of the major causes of eye blindness majorly in America and all over 99% countries. It is measured to account for about 12% of all the new instance of blindness per year in the country United States. In Singapore, retinal disease due to diabetes cause for greater than bisection of freshly registered blindness having the disease diabetic retinopathy as utmost among the initial contributors. It is measured that slightly 10% of world population at the age of 40's are affected with these diabetes disease and nearly 20% of this age people will get some kind of diabetic complications in human eye.

The indication of the Diabetic Retinopathy incorporates vision blurness, immediate vision loss in singe eye, Non-proliferative Diabetic Retinopathy (NPDR), which is called background retinopathy and the Proliferative Diabetic Retinopathy (PDR), which is most advanced form of diabetes. NPDR is the preliminary phase of the Diabetic Retinopathy disease. Having ruptured conditions in eye blood vessels, the retina initiates to leak extra fluid content and less content of blood enter the human eye. In NPDR injury the retina contains micro aneurysms called small red dots, the retinal hemorrhages which are minute flecks of blood which leak into retina, then the hard exudates that are accumulation of cholesterol or other fatty cells from the heap that have leaked IRMA which are shunt vessels. The bearing of this type of cuts in several degrees finds whether NPDR is severe NPDR, mild NPDR or moderate NPDR. PDR mainly happens when most of blood vessels near the retina ends, intercepting enough flow of blood. In an attempt to supply blood to the places where the real vessels remain shutting, the retina reacts by creating novel blood vessels known as neovascularization. PDR cause awful eye sight loss compared to that of NPDR since it contains both peripheral vision and the central vision. PDR outcomes vitreous hemorrhages problem, then neovascularization of retina and the pre-retinal hemorrhages.

II. LITERATURE SURVEY

The point of this thesis is to outline a computationally canny strategy to decide exudates, the Non-Proliferative DR manifestation which is viewed to be the unexpresssed phase of retinopathy malady. On the off chance that NPDR is not recognized at it's before stage, it might prompt Proliferative DR, the confounded phase of retinal side effect that may prompts visual deficiency. It is proposed to erect a programmed PC helped location framework that screen countless to recognize the DR in its prior stage for appropriate medicines. In this work, pictures are taken from freely accessible e-optha database. Examination chiefly considers three phases which incorporate expulsion of optic plate and standardization done by histogram preparing; surface data extricated utilizing Dark Level Co-Event Lattice (GLCM) and order is finished with the assistance of Bolster Vector Machines [1].

In this review, a mechanized calculation to identify and grade the seriousness that a hard exudates have is proposed. The discovery procedure depends on top-down picture division and nearby thresholding by a blend of edge identification and locale developing. Utilizing elements of the eye fovea and their geometric relations with other retinal structures, a strategy for the fovea limitation is proposed. Hard exudates evaluation was performed utilizing a polar organize framework focused at the fovea. The aftereffects of hard exudate identification process were approved in view of clinician hand-marked information (ground truth) with a general affectability of 93.2%. The unrivaled execution of this method recommends that it could be utilized for a PC helped mass screening of retinal maladies. The proposed technique is intended to identify and grade HEs from the retinal fundus picture naturally [2].

This paper instigates a computerized technique for location of brilliant injuries (exudates) in retinal pictures. New strategies are created to limit and disengage the optic plate and recognize the exudates. A novel calculation is introduced to restrict the optic plate and treat the disarray because of comparability amongst exudates and optic circle. The calculation utilizes particular shading channels and few picture components to separate exudates from physiological elements in advanced fundus pictures. The portrayal of a picture in RGB shading space permits to considering independently the distinctive channels of the unearthly reaction. The three channels are (red, green and blue) each of which has force esteem extending in the vicinity of 0 and 255. The calculation is tried on many pictures from distributed database and gives incredible and guarantee outcomes [3].

The job is expected to raise a computerized framework to break down the retinal pictures for removing exudates which is essential indications of disease diabetic retinopathy. The procedure principally comprehends of two stages. At the underlying stage, exudates are recognized utilizing morphological picture handling procedures, which incorporates end of optic circle then the identified exudates are arranged utilizing fluffy rationale calculation. The fluffy rational idea utilizes values in RGB shading space of retinal pictures, for the fluffy set. The exudates identified are named ordinary, feeble, hard exudates. The venture proposes to locate the hard exudates inside fundus retinal pictures utilizing morphological picture preparing and fluffy rationale calculation are connected for characterization of identified exudates. The proposed strategy is formed using the morphological picture handling. At the underlying stage, exudates are distinguished utilizing scientific morphology that incorporates disposal of optic plate. [4].

The proposed framework includes handling of fundus pictures for extraction of irregular signs, for example, hard exudates, cotton fleece spots, and expansive plaque of hard exudates. An administer based classifier is utilized for arranging the DR into two classes, specifically, ordinary and unusual. The strange NPDR is additionally characterized into three levels, in particular, gentle, direct, and extreme. To gauge the execution of the recommend choice bolster system, the calculations have been tried on the pictures of Gaze database. The review additionally indicates promising outcomes in arranging the splendid injuries effectively as indicated by NPDR seriousness levels. In this paper, an additional choice bolster method has been created for programmed screening of fundus pictures. The proposed strategy is equipped for identifying the limits of splendid protests forcefully with a normal exactness of 97% [5].

III. APPROACH

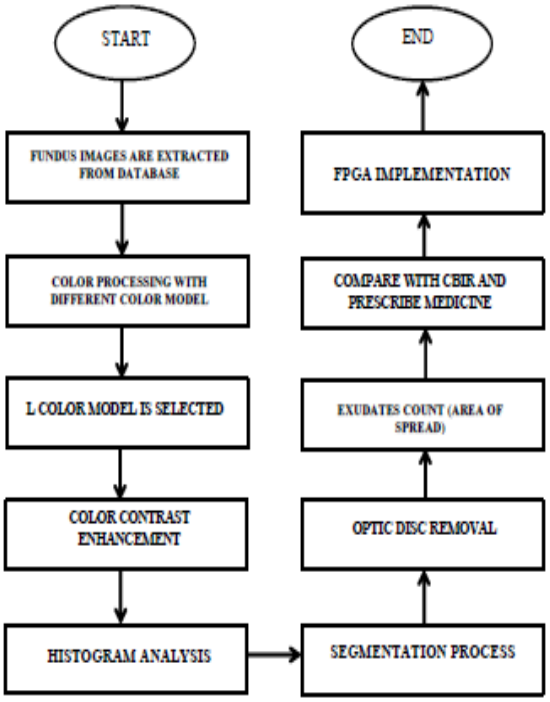

Fig 1. Flow chart of the automated system

Figure 1 shows the flowchart of the algorithm proposed which automatically detects the exudates present in the fundus image of retina, to find the exudate

count so that area of spread can be found, and to perform CBIR and to prescribe medicine based on CBIR.

IV. RESULTS AND DISCUSSION

The algorithm is developed on the hinge of image processing; initially the fundus image is extracted from the file which is obtained through means of the STARE database. The fundus images of eye in STARE database are taken from fundus camera which is distinct microscope which consumes low power fixed with a camera. An indirect ophthalmoscope is the basis for optic design. The acceptance of lens resides on optical angle which are represented by angle of view of fundus camera. The document of fundus photography contains retina and the tissues called neurosensory tissues in a human eye which finds the electrical pulses which our brain make outs from converted optical image. These retinal images or photographs are used to discover the disease and to provide the treatment for fundus eye.

Fig 2. Fundus image from STARE database

The symptoms which are found in retinal fundus image due to diabetic retinopathy are hard exudates. The extracted fundus images containing exudates of DR are color processed in different color models so that a particular color model is selected in which the exudate contents are correctly visible for further processing and the L i.e. luminance color model is selected in which the exudates are brightly found than that of background. This L color model of fundus image is selected for contrast enhancement. This contrast adjustment upgrades the accessibility of exudates in the image by improving the brightness dissimilarity between exudates and their backgrounds i.e. it makes the brighter part to look brighter than compared to that of background.

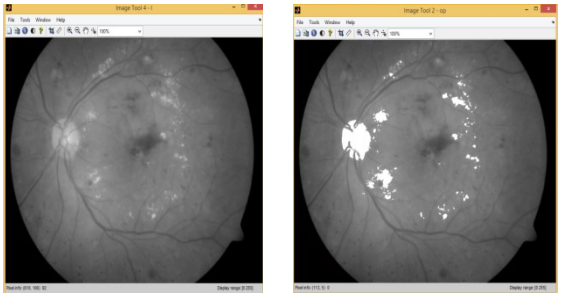

Fig 3. Extracted L color model and contrasted image

To detect the threshold intensity value for segmentation process histogram analysis is done. Image histogram is kind of analysis in which fundus image of eye is represented in a graphical form of tonal dissemination of digital fundus image in x-y axis. The final peak intensity is selected as threshold for segmentation process. The segmentation process is the method in which the contents of fundus image are segregated into many segments like set of pixels which are also called as super-pixels with intensity values. The segmentation also called levelization aim is to analyze and/or alter the depiction of an fundus image into different thing which is more understandable and effortless to examine.

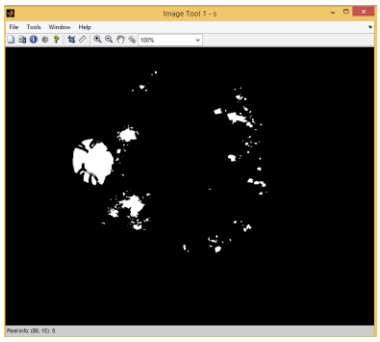

Fig 4. Resulting image after two level thresholding

The result of segmentation contains both optic disk and exudates. Only exudates are extracted by neglecting higher area blobs. The entire process in tested on FPGA as well, along with MATLAB. This method takes approximately 3.683 seconds for processing compared to that of existing watershed algorithm which takes 1500 seconds which is less than with an accurate exudate counts.

V. CONCLUSION

A proposed automated technique for detecting hard exudates which is a symptom of DR was successfully developed by employing image processing, segmentation through histogram analysis. The proposed approach was validated by using fundus images taken from STARE dataset. This proposed algorithm has a capacity to be developed as a block of DR grading system to help the DR suffering patients due to hard exudates mainly in rural areas who have lack of ophthalmologist in analysing fundus images. In future we can perform this algorithm on other fundus image datasets and also can extend this proposed algorithm to detect cotton wool spots in retina which are also symptoms of DR and an integrated system for DR diagnosis can be built.

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