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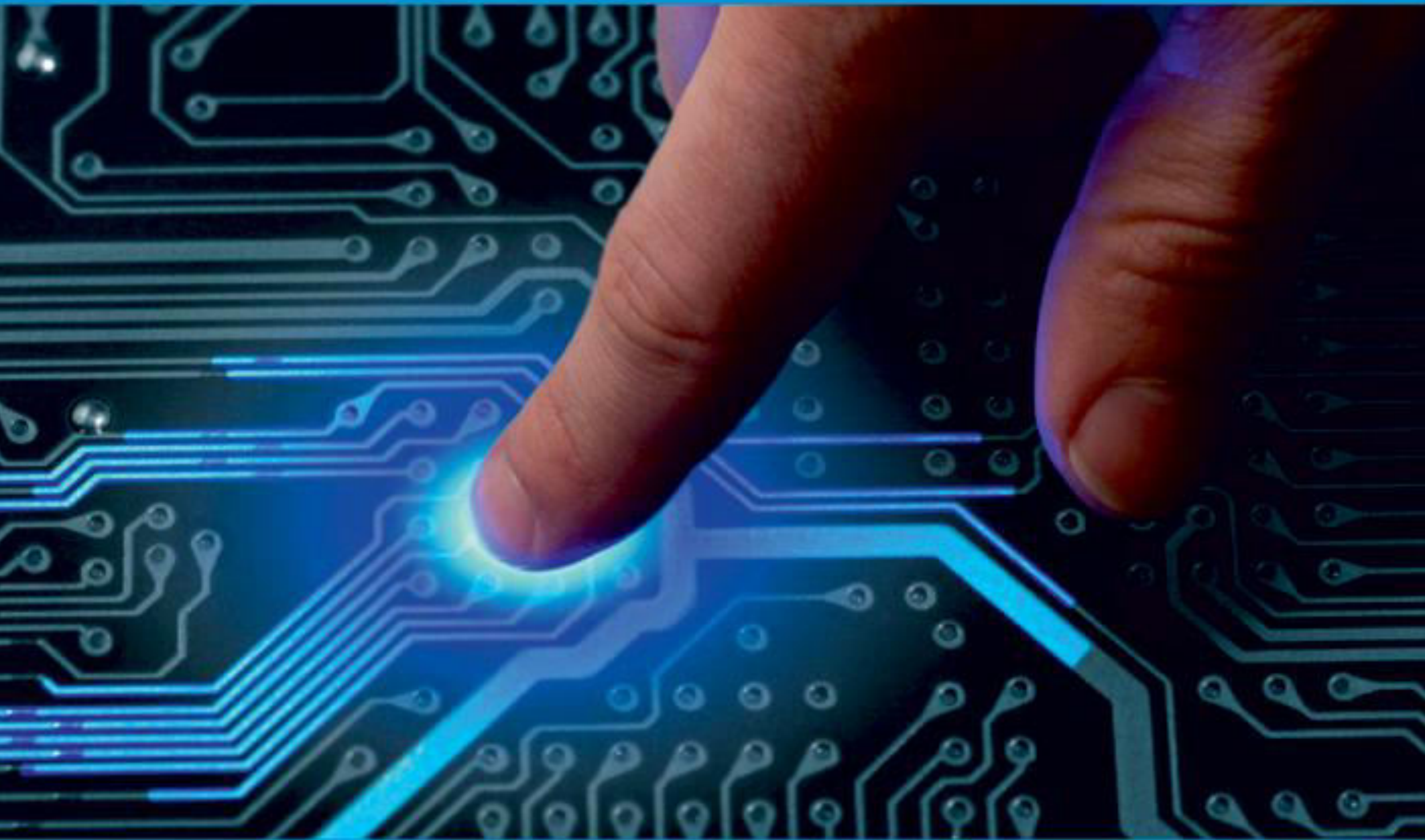

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Enhanced Application in the Early Detection of Glaucoma Using Fundus Images

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ABSTRACT: Glaucoma is a condition in which the pressure inside the eye, known as intraocular pressure, rises (IOP). It's caused by the ciliary body's increased production and lower absorption of aqueous humor, a watery fluid. The optic nerve, which delivers essential information from the retina to the brain and back, is damaged by the rise in pressure. Only a treatment that can lessen or prevent further damage can prevent the damage. Visually, damage to the essential parts of the optic disc and the cup within the disc can be seen. The detection of the optic disc (OD) in retinal images is one of the most important pieces of information in diagnosing retinal illnesses, and it can be done by using an image processing method that concentrates on the traits and characteristics of the optic disc. The optic nerve is the conduit through which information travels from the eye to the brain. The identification of the optic disc aids in determining the source of the pressure that causes the disc to bulge forward within the skull. The reduced blood flow deprives the retina of nutrients, and the increasing pressure within the eye causes nerve cells to die. Glaucoma is the medical term for this condition. As a result, the current study aims to evaluate the glaucoma disease screening performance and to distinguish between normal and glaucomatous eyes using this screening technique. Blood vessel information is important in identifying the optic nerve image, but the computing complexity is significant. The optic disc was identified using a variety of model-based approaches, with methods based on the retinal vascular system playing a key role. However, the success of these methods is dependent on the models, and managing the unexpected image is quite difficult. To solve all of these challenges, a novel technique called GSS is presented for detecting the optic disc and glaucoma illness in retinal fundus pictures. This unique method focuses on seven distinct phases that ultimately determine whether the retinal fundus image is glaucoma-affected or normal.

KEYWORDS: Glaucoma, Optic disc, Retinal images, Optic nerve, GSS, Fundus images.

I. INTRODUCTION

Clinicians use retinal fundus pictures to identify and treat a variety of eye illnesses. It's also one of the most significant places to go for a mass glaucoma screening. Glaucoma is characterized as the "silent thief of sight" since it is the primary cause of vision loss worldwide. Glaucoma affects around 60 million people worldwide, with the number estimated to rise to 79.6 million by 2020. Glaucoma can alter the structure of the retinal layers in the eye [1].Glaucoma is an eye condition that causes blindness. Glaucoma is permanent because it affects the eye's optic nerve [2]. Glaucoma destroys the entire optic nerve. Glaucoma cannot be cured, but it can be treated. Glaucoma can be detected early, which allows for proper monitoring and treatment and reduces the chance of visual loss (Yousif et al., 2008).

The primary strategy for automatic comprehension [3] of fundus images is the extraction of normal and pathological characteristics in color fundus images. Without the need for expert judgement, a fully automated approach involving computer analysis of fundus images could enable an immediate classification of glaucoma. The automatic analysis of digital color fundus images requires the detection of the optic disc [4]. Information about the optic discs is utilized to detect disorders like glaucoma. The retina has anatomic structures such as the vasculature, optic disc, and macula, which will be employed as landmarks for detecting glaucoma indications once the system has detected these regions in the image [5]. The optic disc is the part of the retina where the sclera allows blood vessels and nerve fibers to pass through. It is sensitive to changes in intraocular pressure associated with glaucoma, which can occur asymptomatically and be diagnostic, and must be monitored to track treatment success [6]. Changes in appearance from normal can be used to detect diseases, and the ability to track treatment or disease progression can be used to track changes in successive photos [8].

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II. RELATED WORK

1.2 MEDICAL IMAGE PROCESSING

The input fundus photos are used to identify the optic disc, and the disease affecting the optic disc region is recognized using the fundus images. The detection of otic discs is an important aspect of the eye disease screening method. Fundus imaging can be used to diagnose glaucoma, optic atrophy, and ischemic optic neuropathy, among other eye problems. If left untreated, these disorders can result in blindness. A snapshot of the retina is taken and evaluated to establish if a person has the illness. The manual examination is both expensive and time-consuming, making it impossible to execute screening on a broad scale. The creation of an automatic retinal image screening technology enhances an ophthalmologist's ability to perform mass eye disease screening. A system like this should be able to tell the difference between normal and damaged retinas. As a result, the burden on ophthalmologists will be considerably lessened. When the system has detected these structures in the image, the system will use these places to detect illness indications.

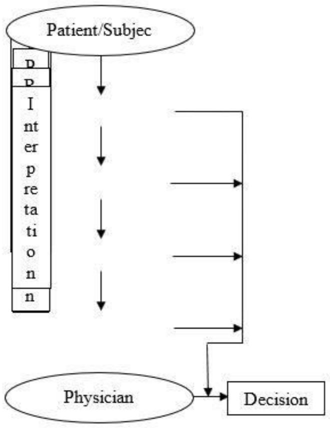

Figure 1. Integrating Image Processing in Medical Science

As a result, an automated screening system will be able to process a huge number of fundus images automatically, allowing ophthalmologists to boost their clinical productivity and efficiency. The combination of medical image processing with the medical profession is depicted in Figure 1.

These fundus pictures are the first step in the screening process and are collected and handled for clinical research. These fundus images are the start of an investigation into the use of computer-assisted screening (CAS) technology to improve the quick screening process, boost efficiency, and improve throughput.

1.3 STATEMENT OF THE PROBLEM

Clinically identifiable glaucomatous changes in the optic disc have been shown to produce visual field abnormalities for several years. This observation is supported by histological evidence of substantial loss of optic nerve fibers prior to noticeable visual field reduction. If glaucoma is detected early in the disease's progression, proper therapy can be instituted to avoid or delay the start of functional loss. As a result, it is critical to diagnose glaucoma as early as possible in order to reduce the risk of patients becoming blind as well as the direct and indirect costs associated with glaucoma. As a result, the glaucoma screening technique serves as an interface tool in diagnosing the disease at an early stage by designing and implementing a new approach for detecting the optic disc in retinal fundus images and identifying the glaucoma condition. The system is suitable for detecting early stages of glaucoma and has essential qualities such as speed, affordability, appropriate sensitivity specificity, and excellent conformity.

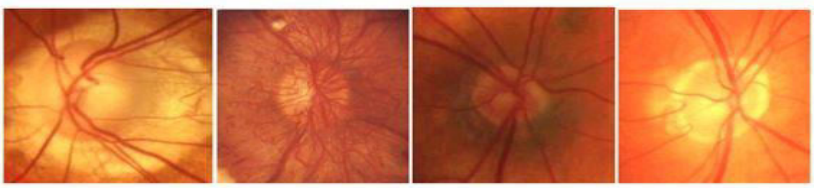

Figure 2. Various Appearance of the Optic Disc

III. PROPOSED ALGORITHM

According to a study of related research, several algorithms were theoretically sound, and many approaches focused solely on the detection of optic discs. It's also discovered that no interface for detecting disease by calculating optic disc abnormalities has been proposed yet. As a result, the goal of this study is to provide an interface for identifying glaucoma disease.

The system is an image processing solution that incorporates a number of different image processing components.

- Intensity enhancement
- Grayscale conversion

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- Fast level multilevel thresholding
- Optic disc identification
- Morphological operations
- Optic disc circle measurement
- Cup to disc ratio

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Glaucoma Screening Architecture (GSA)

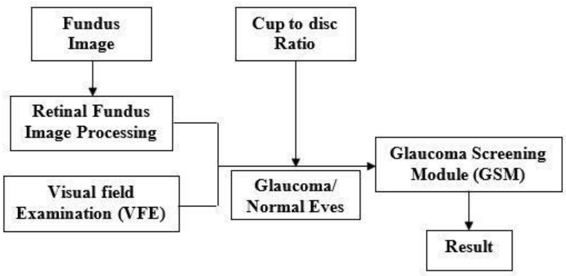


Figure 3. Glaucoma Screening Architecture

Figure 3. shows the glaucoma screening architecture. This architecture focuses on the retinal fundus image processing and the visual field examination. The images were collected from the dataset and they are given for the fundus image processing and the retinal image is examined for the defects and finally, the cup to disc ratio parameter distinguishes the normal image from the glaucomatous retinal images. Thus, the screening system acts as an interface tool in the medical field.

IV. RESULTS AND DISCUSSION

GUIDE (MATLAB Graphical User Interface Development Environment) is a collection of MATLAB-based tools for creating graphical user interfaces (GUIs). These technologies simplify the process of designing and implementing graphical user interfaces.

A. Layoutout the GUI

You can simply lay out a GUI with the GUIDE Layout Editor by dragging and dropping GUI components like panels, buttons, text fields, sliders, menus, and so on into the layout area.

B. Program the GUI

GUIDE creates an M-file that governs how the GUI works automatically. The M-file creates the user interface and offers a framework for all GUI callbacks, or activities that are performed when a user clicks a GUI component. Code can be added to the callbacks using the M-file editor to perform the functions you wish. Figure 4 depicts a sketch that will be utilized as a beginning point for the design.

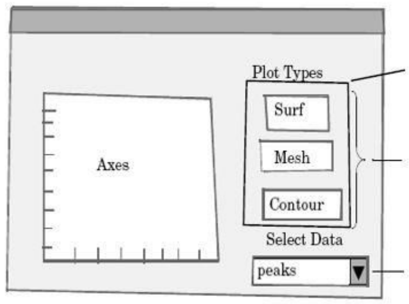
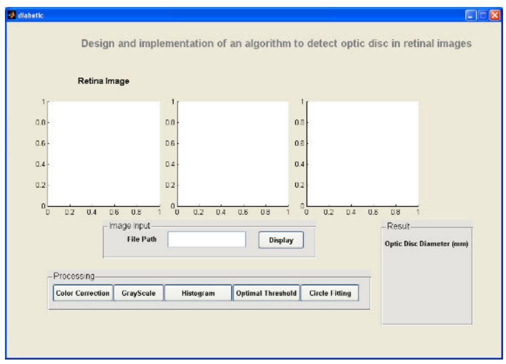


Figure 4. General GUI design

4.1 INITIAL GUI SCREEN

This initial GUI screen contains three axes that display the retinal fundus images, six pushbuttons, and three panels. Each button performs various operations and the output images are displayed according to these operations.



4.2 INPUTTING THE FUNDUS IMAGE:

The input fundus image is displayed in the first axes when the name of the file is given and the display button is pressed. It might be a normal fundus image or a disease-affected image.

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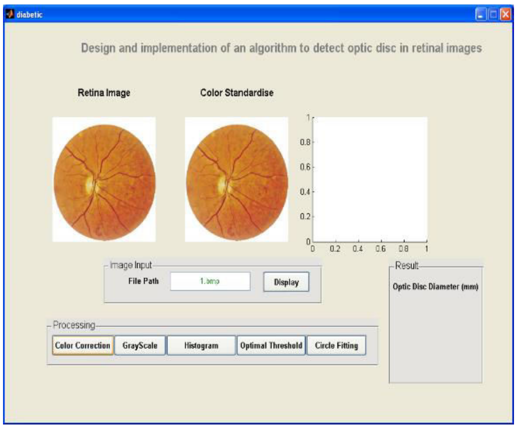
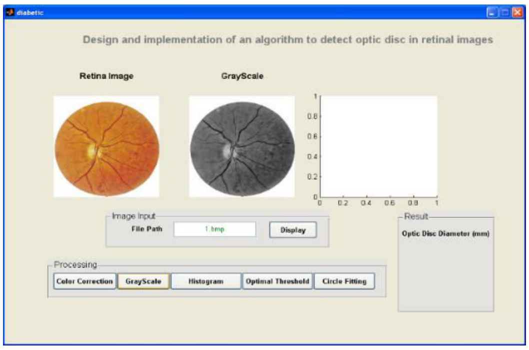
4.3 COLOR CONVERSION PROCESS:

The color conversion process is taken place when the color correction button is pressed on the second axes. The output image will be a color standardized image. The color correction will convert the input image into a normalized image and the variation in the input image can be notified only when the color correction process is carried out.



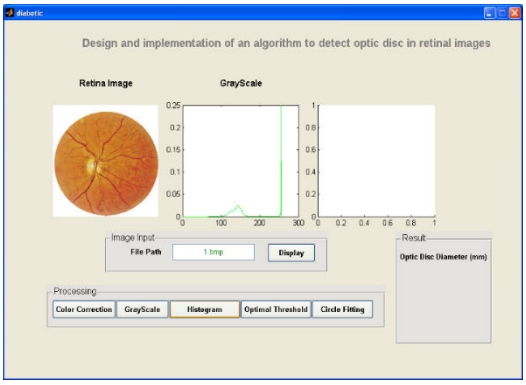
4.4 GRAYSCALE CONVERSION:

The grayscale conversion takes place when the grayscale button is pressed. It is displayed in the second axes. Only when the colored retinal image is converted to the grayscale, the morphological operations can be carried out because this operation can be performed only in the grayscale image rather than in the digital image.



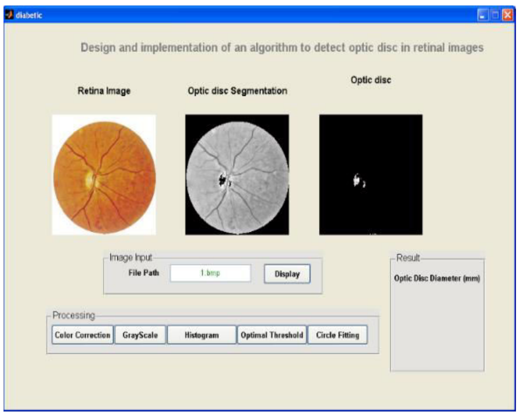
4.5 HISTOGRAM SPECIFICATION:

The widths of the bars in a histogram specification are proportional to the classes into which the variable has been divided, and the heights of the bars are proportionate to the class frequencies in a bar graph of frequency distribution.



4.6 OPTIMAL THRESHOLD:

The optimal threshold is the next process where the optic disc gets segmented. The optic disc segmentation takes place in the second axes and the region of interest i.e. the optic disc alone is extracted in the third axes.



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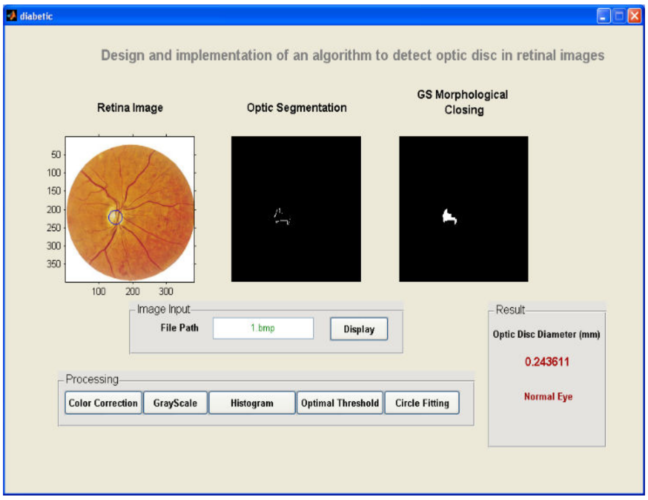
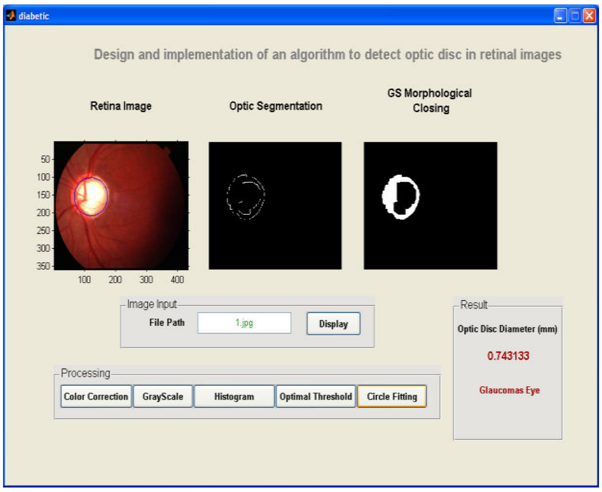
4.7 MORPHOLOGICAL OPERATION:





Using morphological operations, the blood vessels are being suppressed. The radius and the diameter of the circle are measured and the optic disc's diameter is calculated and is displayed in the resultant panel which classifies the images into normal and the glaucomatous eyes.

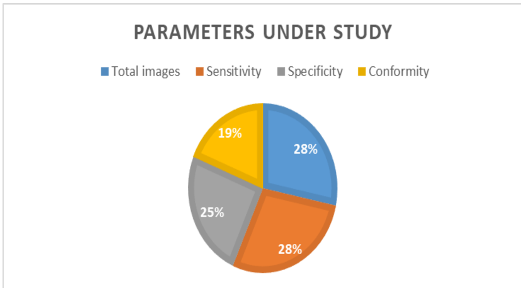
4.8 PARAMETERS UNDERSTUDY

Fundus photos from a variety of datasets were gathered and compared to the proposed methodology. A total of 15 photos were chosen and examined from this group. Under three dimensions, sensitivity, specificity, and conformance, these 15 photos worked exactly against the stated methodology.

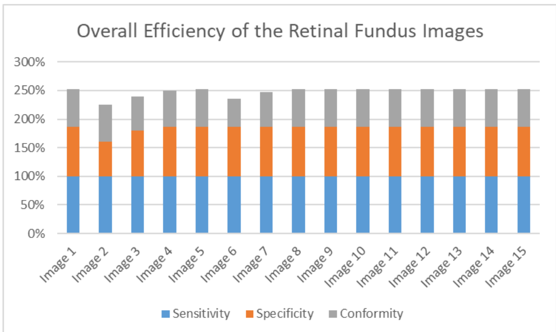
a) Sensitivity: All 15 images were successfully felt, and the images were classified into normal and glaucoma-affected images.

b) Specificity: Thirteen of the fifteen photos accurately defined the region of interest, the optic disc. The optic disc was appropriately recognized in both normal and glaucoma-affected pictures in these 13 photographs.

c) Consistency: Of the 15 photos, 10 reveal the detected optic disc to be exactly the region of interest or other landmarks.



As a result, these three characteristics were investigated in greater depth in order to determine the number of optic discs that were evaluated correctly and how many were examined under the abnormality condition. The results will aid in determining if the input retinal fundus images are affected by glaucoma or are in a normal state. Clinical reports will also be included in this interface tool, and clinicians will make the final choice. This screening system will serve as a computer helper and an interface tool in medical science.



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V. CONCLUSION

The current study's major purpose is to develop methods for distinguishing between normal and aberrant photographs (cases of glaucoma). In a screening clinic, these would be used to identify persons who are at risk. Images were gathered from a variety of sources, and data was gathered in a variety of locations. With reasonable success, methods for distinguishing between normal and abnormal photos were developed. The limited success could be owing to the insensitivity of the analyses, but it could also be due to the nature of the diagnosis: We categorize sights as aberrant or not abnormal, oblivious to the fact that there is a range of looks. The optic disc has a more uniform appearance than normal, which gets less uniform as the disease develops, according to the tests. The screening system can be utilized as an interface tool for glaucoma disease early detection and as one of the modules in a medical diagnosis system.

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