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Implementation and Segmentation of Glaucoma using Mathematical Morphology of Retinal Fundus Images

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Abstract: ***To diagnose diseases, various healthcare systems use content-predicted picture analysis and computer vision techniques. Fundus images acquired with a fundus camera are used to detect anomalies in a human ocular perceiver. Glaucoma is the second most common ocular perceiver disease that can lead to neurodegeneration. The main cause of this condition is said to be an insufficient intraocular pressure within the human ocular perceiver. Glaucoma has no symptoms in its early stages and can lead to ocular incapacitation if it is not treated. Glaucoma can be detected early enough to prevent representative vision loss. Manual evaluation of the human ocular perceiver is a valid technique, but it is prone to human error. To identify glaucoma, we will need image processing, artificial intelligence, and computer vision techniques.***
Keywords: Medical image processing, glaucoma detection, optic disc abnormalities, fundus images, glaucoma detection review, glaucoma detection computer vision techniques

I. INTRODUCTION

This study shows how to detect and segment the optic disc fast and efficiently using advanced approaches such as specialized filtering, contrast limiting, advanced histogram equalization, and morphology-based procedures. Glaucoma is an eye illness in which the optic disc (OD) and optic cup (OC) are destroyed, eventually leading to vision loss. Glaucoma affects an estimated 80 million individuals worldwide. Glaucoma is caused by an imbalance in intraocular pressure (IOP) within the ocular perceiver, which destroys the optic nerve. Handcrafted features were employed to distinguish between affected and ordinary portions of the photos for automated detection of ocular perceiver illnesses. However, due to color, size, larger intra-class fluctuations, and effulgent regions other than OD, these parameters are ineffective in representing glaucoma zones, resulting in disappointing results.

The proposed mechanism provides for a reduction in the amount of computing cost necessary while simultaneously reducing the process area required for segmentation algorithms for each retinal fundus image, giving it a competitive advantage in terms of performance. It focuses on the impact of glaucoma on the human eye's retinal optic disc. Optic Disc is the brightest point in an eye image, where blood vessels converge and the fovea may be determined at a precise distance. The identification of optic discs can be utilized to locate blood vessels, the fovea, and diagnose Glaucoma.

II. LITERATURE SURVEY

1) The many varieties of glaucoma, their causes, potential treatments, picture benchmarks, performance evaluations, and a variety of graphical image processing, computer vision, and deep learning techniques are all public information. are all comprehensively examined in this work. This work includes a wide spectrum of knowledge form various other works, from low-level feature extraction to modern deep learning advances, targeted at identifying glaucoma. The advantages and disadvantages of each approach are thoroughly addressed, and the outcomes in each area are summarized using tabular representations. We share our findings as well as possible study avenues in the future.

2) To categorize photos obtained from the Eye Diseases Department of Akdeniz University Hospital, this work uses the Xception model and the transfer learning method. By scanning the model's optimal hyper-parameter space, 50 distinct parameters were used to train the Xception model, during the investigation. Many models were compared. Among which one model obtained the best precision rate of 91.39 percent for the training set, while the validation set had the highest precision rate of 82.5 percent.

3) The present methods for identifying glaucoma from 2D and 3D images are examined in this study, which highlights both limitations and potential future prospects. The datasets that were used in the retinal analysis, as well as the existing evaluation techniques, are also described in this paper. The following are some of the major themes explored by this study: 1. methods for

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segmenting diverse things from 2Dimension and 3Dimension images; 2. methodologies that could result in promising detection of the disease discoveries; 3. research challenges; and 4. datasets and methods for evaluating retinal images already available

4) We provide a computational technique for automatic glaucoma detection in this study. We provide disc segmentation revisions in comparison to previous literature, a unique thresholding method for cup segmentation, and an incipient measure between cup and disc sizes. The findings were based on fundus photographs collected in association with the Glaucoma Aversion and Attention Center in Bucaramanga, Colombia where the achievement for glaucoma detection was 88.5 percent

5) In order to calculate the parameters needed in glaucoma prediction analysis, we offer an automatic technique for segmenting in RGB channels, the cup region is distinguished from the OD region. The cup-to-disc area ratio can be computed from a retinal fundus picture(ACDR), the cup area and the optical disc were segmented. With a precision of 83.168 percent, this prediction study is statistically tested using a freely available database.

6) This study presents a method for recognizing the OD in fundus pictures. The potential optic disc region is segmented using mathematical morphology, Then, using a circular model, determine its center and approximate the circular optic disc boundary. The method that has been proposed is is tested on two separate data sets, one local database and the other, MESSIDOR, a public database. The suggested The optic disc segmentation algorithm achieved a 99.45 overlapping score on average. percent and The difference between real OD and segmented OD is 99.47 percent for the local and public databases, respectively. Furthermore, success rates of 92.06 percent and 92 percent, respectively, were observed in both the local and public databases.

7) The study includes, an updated categorization based on a hierarchical approach was created for the identification and segmentation of the OD. Assessing the region of interest and employing a novel morphological modification known as adaptive thresholding can be used to establish the exact boundaries of the optic disc. The presented technique allows for a reduction in the required process area for segmentation algorithms, resulting in significant performance advantages and a reduction in the amount of computing each retinal fundus image costs a certain amount of money. In terms of precision and processing time, the proposed technique outperformed existing techniques. utilizing publicly available retinal imaging data sets such as HRF, DIARETDB1, STARE, DRIONS-DB, IDRiD, and DRIVE,

8) This research proposes a new technique for detecting OD in retinal fundus pictures based on area expansion. While analyzing the picture a seed point is obtained and observed in the region of growing segmentation approach based on the entropy of the input image histogram and binary morphological procedures. Using an average filter, the suggested method evens out input images before applying area expanding to the leveled image to generate a circular OD border.

9) Inadequate amplitude in the training data or an imbalanced class consistency among datasets is the most commonly reported challenge in machine learning. Soi-disant data augmentation is one solution to this challenge. We compare and analyze a variety of data augmentation methods for image relegation in this paper, starting with Traditional picture transformations such as rotating, cropping, zooming, and histogram-based approaches, as well as typical examples of Style Transfer and Generative Adversarial Networks. Then, based on image style transfer, we presented our own data augmentation technique. By merging, the technology allows for the modification of the content of a basic image, development of high-quality new images. The neural network will be pre-trained using current photos, which will increase the training process efficiency.

10) In order to build Researchers used the Fast Region-based Convolutional Neural Network (FRCNN) method and fuzzy k-means (FKM) clustering to develop an automated illness localization and segmentation approach. The FRCNN is a bounding-box annotation-based object detection algorithm. Unfortunately, datasets lack these annotations, so we created them using ground-veracities. The FRCNN is subsequently trained for localization over the interpreted images, which are then segmented out using FKM clustering. Intersection-over-coalescence processes are used to compare the segmented regions to the ground-veracities. The DR-HAGIS, Diaretdb1, ORIGA, MESSIDOR, and HRF datasets were used to assess performance. A thorough comparison to current methods demonstrates the approach's efficacy in terms of illness identification and segmentation.

11) This work proposes an Artistic Style Neural Algorithm that can breakdown and reconstruct natural visual material and style. The algorithm encourages us to build high-quality incipient images by combining the content of a random snapshot with the appearance of several well-known works of art. The findings provide fundamental insights to Convolutional Neural Networks' deep picture representations are investigated, and their potential for high-quality image creation and modification is demonstrated.

12) This paper discusses the current techniques for obtaining the CDR and ISNT from the OD and optic cup identification. The major goal of this paper is to provide some of the most recent detection and segmentation approaches, as well as to provide an overview of current research. There is also a discussion of current trends and issues in optic disc and optic cup identification, as well as future directions.

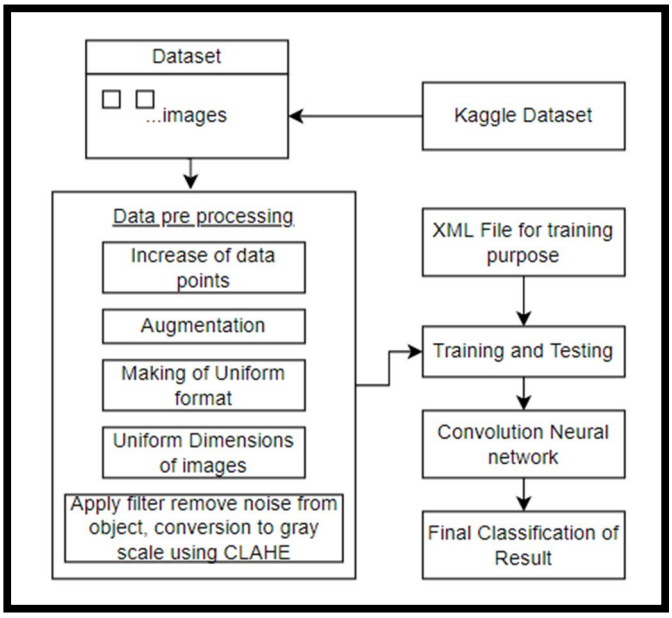
13) Strategies for segmenting retinal vessels are covered in detail in this publication. To begin, a brief overview of The author discusses photography of the retinal fundus and imaging techniques for retinal pictures. The most up-to-date retinal vascular identification methods and preprocessing procedures are next discussed. Future improvements and trends in retinal vascular detection techniques are explored, as well as an objective assessment.

III. COMPARISION TABLE

AUTHOR	YEAR	APROACH	DESCRIPTION
Amsa Shabbir1 and Tehmina Shehryar1	2021	Peripapillary trophy, retinal nerve fibre, and vessel displacement are all used to detect glaucoma.	This study employs Deep Learning (DL)methodologies, which rely on big volumes of annotated data to produce findings. Because DL relies on vast amounts of annotated data, rare or atypical diseases may have a higher risk of delivering unsatisfactory results.
Batuhan Bulut and Rim Khazhin.	2020	For image processing, deep learning is used.	It's computationally expensive, needing a lot of memory and computer power, and it's difficult to apply to other issues.
A.Sarhan, J. Rokne, R. Alhajj,	2019	Machine learning (ML) and deep learning-based approaches (DL)	Because the fundus images were taken using diverse equipment and institutions, the suggested approach's trained model parameters were unable to produce consistent detection findings.
J.Carrillo, L. Bautista and D. Rueda,	2019	Artificial Vision and Signal Processing (STSIVA)	ADC and DAC are required by DSP (Digital Signal Processor), hence ADC and DAC modules are required.
Kaushik Dutta and Anindya Sen	2018	CDR (Cup To Disk Ratio) Calculation and Decision Making, Optical Disc Segmentation, Blood Vessel Suppression, Optic Cup Segmentation, CDR (Cup To Disk Ratio) Calculation and Decision Making	The cup-to-disc area ratio is computed from a retinal fundus picture(ACDR)
Ganapatsingh G Rajput	2015	The OD is detected using mathematical morphology (optic disc).	This study presents a method for recognizing the OD in fundus pictures. The potential optic disc region is segmented using mathematical morphology, Then, using a circular model.
Niladri Halder Bandyopadhyay.	2020	The optic disc is detected and segmented using mathematicamorphology.	This study proposes a novel supervised approach for The optic disc must be identified and segmented. that is resistant to changes in lighted pictures and retinal defects.
Sara Omid, and S. Shervin Ostadzadeh	2015	region-based segmentation is a method of segmentation that is based on directly locating regions.	Based on area expansion, this work proposes a new technique for OD identification in retinal fundus pictures. While analyzing the picture a seed point is obtained and observed in the region of growing segmentation approach based on the entropy of the input image histogram and binary morphological procedures.
Agnieszka Mikołajczyk, Michał Grochowski	2018	Deep learning, style transfer, data augmentation, and medical imaging.	This paper consists of many different data generation methods in the task of classifying the image, beginning with traditional image transformations such as histogram-based methods and ending with Style Transfer and Generative Adversarial Networks, as well as representative examples.

Tahira Nazir and Rizwan Ali Naqvi.	2020	Deep Learning	The bounding box (boxes) of disease locations are detected using a deep learning (DL) approach in this paper.
Leon A. Gatys and Matthias Bethge.	2016	Convolutional Neural Network, Photorealistic style transfer.	illustrates how to use feature representations from high-performing CNN to transfer image style between arbitrary images.
A. Almazroa and V. Lakshminarayanan	2015	Fundus Photography, Optic Disc and Optic Cup Segmentation	Discusses the current methods for obtaining the CDR and ISNT from the OD and optic cup segmentation. The main purpose was to provide the reader some current detection and segmentation techniques as well as an overview of existing research.
J. Almotiri and A. Elleithy	2018	Mathematical Morphology, Monochromatic (Filtered) Imaging, Fluorescence Angiogram	This book goes over the methods for segmenting retinal vessels in great depth. Preprocessing processes and The most up-to-date approaches for identifying retinal vessels include discussed briefly, as well as retinal fundus photography and imaging modalities of retinal images. Future advancements and trends in retinal vascular detection techniques are discussed, as well as an objective appraisal.

IV. METHODOLOGY



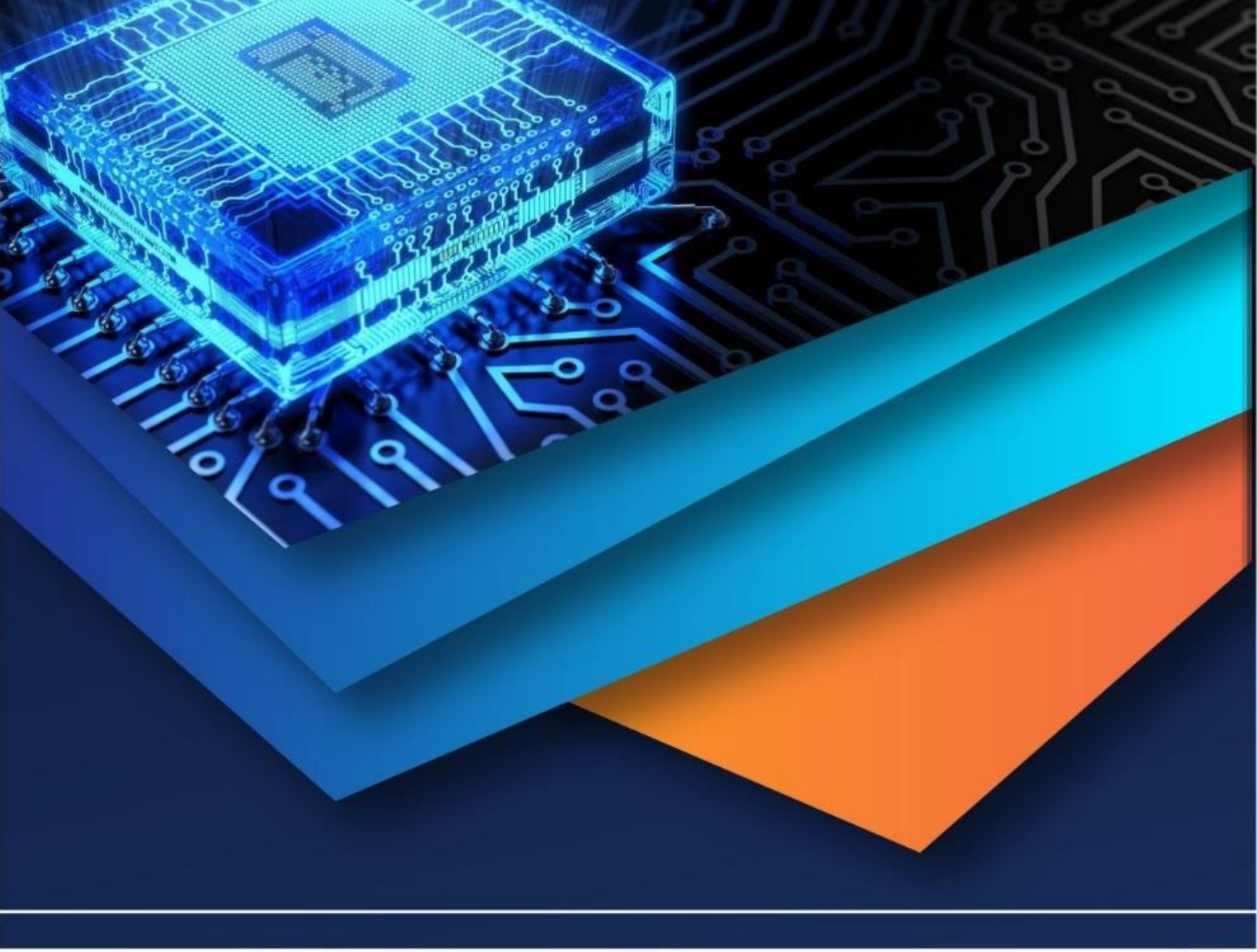
Glaucoma is an eye disease that mainly affects the optic disc and the optic cup which in later stages can lead to vision loss. This project focuses on designing computational tools which will assist quantification and visualization of eye structure. It identifies the optic disk in retinal fundus images, analyses the evolution of its shape and size and the abnormalities related to the retina of human eye. Finally determines if a particular image is affected with glaucoma.

V. CONCULSION

Medical imaging systems are used to provide a visual depiction of the human body in order to monitor various disorders, and public health-care systems rely on them. To detect diseases, some health-care systems employ Computer vision and digital image processing techniques. Glaucoma is a chronic ocular perceiver condition that affects the optic nerve over time, resulting in aeonian vision impairment. The main cause of this condition is claimed to be insufficient intraocular pressure within the human ocular perceiver, with glaucoma being the second biggest cause of visual perception loss. Clinicians can benefit from the use of image analysis using CAD tools.

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