Direct Cup-to-Disc Ratio Estimation for Glaucoma Screening via Semi-supervised Learning

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ABSTRACT

A series of connected eye conditions known as glaucoma harm the optic nerve, which transmits information from the eye to the brain, and can eventually result in blindness. For proper treatment, it is crucial that glaucoma is identified as soon as possible. A Convolutional Neural Network (CNN) approach for the early identification of Glaucoma is suggested in this research. To start, augmented ocular pictures are used to produce data for deep learning. The ocular pictures are then pre-processed using the Gaussian Blur technique to reduce noise and prepare the image for additional processing. When new input images are provided to the system, it classifies them as either normal eyes or glaucoma eyes based on the features collected during training. The system is trained using the pre-processed images.

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1. Introduction

A series of connected eye conditions known as glaucoma harm the optic nerve, which transmits information from the eye to the brain, and can eventually result in blindness. For proper treatment, it is crucial that glaucoma is identified as soon as possible. A Convolutional Neural Network (CNN) approach for the early identification of Glaucoma is suggested in this research. To start, augmented ocular pictures are used to produce data for deep learning. The ocular pictures are then pre-processed using the Gaussian Blur technique to reduce noise and prepare the image for additional processing**.** [1]When new input photos are sent to the system, it classifies them as normal eye or glaucoma eye based on the features collected during training. The system is trained using the pre-processed images**.**e[1][12].One of the most clinically significant glaucoma screening methods is optic nerve head assessment. Glaucoma is a chronic eye condition that causes irreversible vision loss and gradually weakens the optic nerve. By manually measuring the ONH geometric structures, one can separate glaucomatous patients from healthy ones based on the ONH assessment. In this process, certain measurements—like vertical distance—are suggested as clinical criteria for glaucoma screening.In order to acquire a reliable CDR value, segmented optic disc and cup measurements must be taken. These measurements are often taken after manually contouring the edges of the segmented optic disc and cup or after manually correcting contours created by segmentation algorithms. The margins of the optic disc/cup must be manually contoured, which takes time and is subject to individual preferences. The CDR value of the same individual frequently differs between various doctors as a result of the lack of crisp border information of the optic disc/cup. Recently, a lot of work has gone towards automating the process.

2. Literature Review

Low-Rank Super pixel Representation for Optic Cup Segmentation for Glaucoma Detection.Without utilising any extra training images, we offer an unsupervised method for segmenting optic cups in fundus images for glaucoma identification. The super pixel classification job is formulated as a low-rank representation (LRR) issue with an effective closed-form solution in our method, which is based on the super pixel framework and domain prior recently proposed in [1]. Additionally, we create an adaptive technique for automatically selecting the sole LRR parameter and determining the ultimate outcome for each image. The results ofour approach's evaluation on the well-known ORIGA dataset demonstrate that it outperforms other methods.Optic disc and optic cup segmentation for glaucoma screening using super pixel classification

A persistent eye condition called glaucoma causes vision loss. Early disease detection is crucial because there is no treatment for it. For population-based glaucoma screening, the intraocular pressure (IOP) assays now in use are not sensitive enough. Assessment of the optic nerve head in retinal fundus pictures is superior and more promising. This study suggests utilising super pixel classification to segment the optic disc and optic cup for glaucoma screening. Histograms and centre surround statistics are employed in optic disc segmentation to categorise each super pixel as a disc or a non-disc. In order to analyse the effectiveness of the automated optic disc segmentation, a self-assessment reliability score is calculated.The location data is added to the feature space for the optic cup segmentation in addition to the histograms and centre surround statistics to improve performance. The suggested segmentation techniques have been tested on a library of 650 photographs with the boundaries of the optic disc and the optic cup manually marked by skilled experts. According to experimental findings, segmenting optic discs and cups has an average overlapping error of 9.5% and 24.1%, respectively. Survey on methods for classifying and segmenting the optic disc and cup for glaucoma diagnosis

The second most common cause of eyesight loss worldwide is glaucoma. When determining the presence of glaucoma and for patient monitoring following a diagnosis, the head of the optic nerve must be examined (cup-to-disc ratio). Fundus photography and optical coherence tomography are used to capture images of the optic disc and the optic cup. The pertinent portions of the retinal image are separated out using the optic disc and optic cup segmentation techniques, which are also utilised to determine the cup-to-disc ratio.The primary goal of this paper is to review disc and cup boundary segmentation methodologies and techniques that are used to calculate disc and cup geometrical parameters automatically and precisely. This will assist glaucoma professionals in having a broad perspective and more information about the structure of the optic nerve head using retinal fundus images. Each technique is briefly described, emphasising its classification and performance measures. The summary and discussion of the existing and next research directions. Segmenting the optic disc and optic cup for glaucoma testing using digitised fundus images Glaucoma is an eye condition that causes permanent vision loss. It is a common practise to manually examine the optic disc (OD) to identify glaucoma. The segmentations of the OD and optic cup obtained from colour fundus pictures serve as the foundation for the glaucoma expert system presented in this paper. In order to have robustness against the fluctuations present in and around the OD region, a unique implicit region based active contour model is suggested for OD segmentation that combines the image information at the site of interest from several image channels. Additionally, a brand-new technique for segmenting cups using their structural and Grayassessment. On 59 retinal images, including 17 normal and 42 glaucoma-related images, the proposed system is assessed against the ground truths provided by an expert ophthalmologist. The average F-score for the suggested OD segmentation approach was 0.975, the average boundary distance was 10.112 pixels, and the average correlation coefficient was 0.916. The average F-score, average boundary distance, and average correlation coefficient for the cup segmentation approach were 0.89, 18.927 pixels, and 0.835, respectively. In glaucomatous images compared to normal images, the mean error and standard deviation of the error are significantly lower. This suggests that the suggested strategy is highly sensitive for glaucoma assessment.-level characteristics is suggested. Depending on the specific information regarding the OD and cup shapes, many glaucoma parameters are determined.

3. Proposed System

An input layer, convolutional layers, and a fully linked layer make up the CNN model. The input layer is the 256x256 pixel input image. 16 filters with 3x3 size kernels each are applied to the input picture in the first convolution layer by gliding one at a time through the position, producing a total of 16 feature maps. We refer to this technique as feature extraction. The ReLU activation function, which executes a threshold operation for each input variable with values below zero, is then given these features. The feature maps are downscaled to 128x128 pixels as a result of applying a max pooling layer with a 2x2 window size to the output of the ReLU layer. The final convolution layer's output the input for the following convolution layer. Each of the function mappings acquired from the previous layer is applied to one of 32 3x3 scale kernel filters in the following convolution layer. To create 64x64 pixel down-sampled data, specific processes like ReLU and max pooling are carried out. On the third layer, which is the final layer and uses 64 filters with 3x3 size kernels to produce 32x32 pixel data, the same actions are carried out. 64 32x32 pixel feature maps are the result of the third convolution layer. Then, these features are levelled to create a single 32x32x64 = 65536 long vector that serves as the input for a fully connected layer. These characteristics are then utilised to determine whether the image type represents a healthy eye or an eye with glaucoma. There are numerous computer-based methods for diagnosing glaucoma disease,

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but each of these methods has benefits and drawbacks. Using a cleverer algorithm, we have created a system with more benefits and fewer downsides. Our project's goal is to use a different algorithm to increase the system's efficiency and accuracy.

4. Implementation

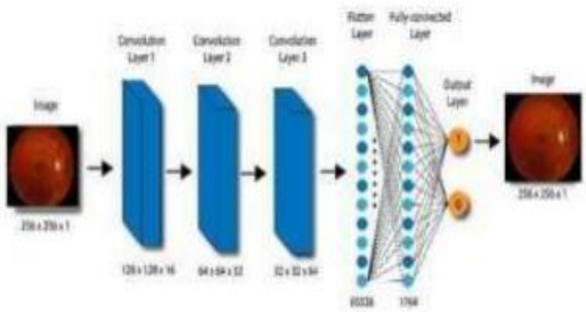


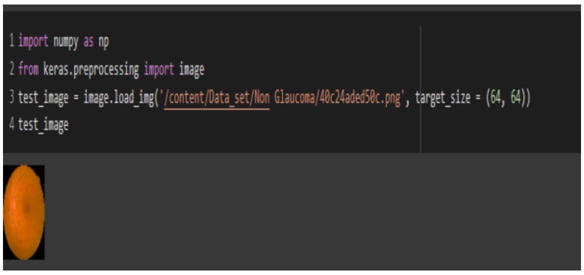
Figure 2: CNN Architecture

```
import MySQLdb

print "Content-Type: text/html"
print
print "<html><head><title>Books</title></head>"
print "<body>"
print "<h1>Books</h1>"
print "<ul>"

connection = MySQLdb.connect(user='me', passwd='letmein', db='my_db')
cursor = connection.cursor()
cursor.execute("SELECT name FROM books ORDER BY pub_date DESC LIMIT 10")
for row in cursor.fetchall():
    print "<li>%s</li>" % row[0]

print "</ul>"
print "</body></html>"

connection.close()
```

This code is straightforward. First, it prints a “Content-Type” line, followed by a blank line, as required by CGI. It prints some introductory HTML, connects to a database and executes a query that retrieves the latest ten books. Looping over those books, it generates an HTML unordered list. Finally, it prints the closing HTML and closes the database connection. With a one-off dynamic page such as this one, the write-it-from-scratch approach isn’t necessarily bad. For one thing, this code is simple to comprehend — even a novice developer can read these 16 lines of Python and understand all it does, from start to finish. There’s nothing else to learn; no other code to read. It's also easy to use; just store the code in a file called latestbooks.cgi, post it to a web server, and open it in a web browser to access the page. But as a Web application becomes more complex, this strategy fails, and you run into a number of issues: Should a developer be concerned about remembering to end the database connection and output the "Content-Type" line? Boilerplate like this decreases programmers' productivity and increases the possibility of errors. It would be preferable if some shared infrastructure could manage these setup and teardown-related duties. What happens if this code is utilised in many settings, each of which has a different database and password? At this point, certain setting particular to the environment is required. What happens if a Web designer wants to rebuild the page but has never coded Python? A designer may alter the

HTML display of the website without impacting the logic of the page, which is the retrieval of books from the database, in an ideal world. These issues are exactly what a web framework is meant to address. Instead of having to create everything from scratch, a Web framework gives your apps an infrastructure for programming, allowing you to concentrate on writing clear, maintainable code. That's basically what Django does. Django is a well-known representative of a new wave of web frameworks

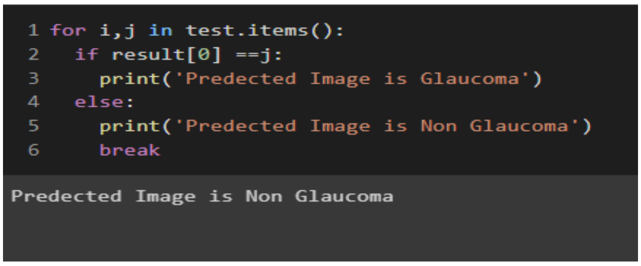
5. Result Analysis



```
import numpy as np
from keras.preprocessing import image
test_image = image.load_img('/content/Data_set/Non Glaucoma/40c24aded50c.png', target_size = (64, 64))
test_image
```

Fig.1: Input image by setting path

We take input as the image path once the model has been trained.Take the picture path as the absolute path. Once you've chosen it by navigating to the Data Set, choosing the search path, and getting the absolute path, execute the programme to have the image divided into segments and each segment examined. In the table construction module, the user can create many tables at once, and the tables are formed with user-specified fields. They can include calculations, conditions, and constraints when making tables. The generic code upholds the user needs throughout the project.



```
for i,j in test.items():
  if result[0] ==j:
    print('Predected Image is Glaucoma')
  else:
    print('Predected Image is Non Glaucoma')
    break
Predected Image is Non Glaucoma
```

Fig 2: output result

Predicted image is glaucoma will be printed if the if block is true, and Predicted image is Non Glaucoma will be printed if the condition is false

6. Conclusion and Future Enhancement

A useful technique for estimating CDR value directly from fundus images was proposed, without the intermediate step of segmentation employed in previous methods. Random regression forest creates connections between image features and matching CDRs, while semi-supervised learning improves the expressiveness of picture structures. The suggested direct method was evaluated on a difficult glaucoma dataset, and it predicted the CDR value more accurately than results from conventional segmentation-based methods. It also achieved accurate estimation with strong correlations with manually produced ones. The classification of papillary pictures using deep learning algorithms has been found to increase diagnostic precision and aid in the detection of glaucomatous papillae. With the technological advancement of the Internet, smartphones, and programmes that can assist professionals in tracking glaucoma, particularly in more remote locations, we anticipate obtaining photographs of higher quality in the future. We might simplify, lower the cost, and increase the precision of papilla glaucoma diagnosis, particularly in its early stages. We could make papilla glaucoma diagnosis easier, less expensive, and more accurate, especially in the early stages.

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