



Detection of Glaucoma Using Convolutional Neural Network

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ABSTRACT

Glaucoma is a degenerative illness that influences vision, causing harm to the optic nerve that closes in vision misfortune. The classic methods to distinguish it have experienced an extraordinary alter since the interruption of machine learning strategies into the handling of eye fundus pictures. A few works center on preparing a convolutional neural organize (CNN) by brute constrain, whereas others utilize division and include extraction procedures to distinguish glaucoma. In this work, a demonstrative help apparatus to distinguish glaucoma utilizing eye fundus pictures is created, prepared and tried. It comprises of two subsystems that are autonomously prepared and tried, combining their comes about to progress glaucoma discovery. The to begin with subsystem applies machine learning division procedures to distinguish optic circle and container freely, combine them and extricate their physical and positional highlights. moment one applies exchange learning strategies to a pre-trained CNN to distinguish glaucoma through the investigation of the total eye fundus pictures. The comes about of both frameworks are combined to separate positive cases of glaucoma and move forward last discovery. The comes about appear that this framework accomplishes a higher classification rate than past works.

1. Introduction

Glaucoma includes a bunch of dynamic neurological clutters that antagonistically influence vision, regularly driving to reciprocal impedance and, eventually, visual deficiency. Characterized by the misfortune of retinal ganglion cells and optic nerve head harm, it stands as a noteworthy cause of irreversible vision misfortune and visual impairment around the world, positioning moment in Europe. The two essential shapes of glaucoma are Open-angle glaucoma (OAG) and Angle-closure glaucoma (ACG). OAG, constituting roughly 90% of cases, emerges from the continuous hindrance of waste canals, coming about in hoisted intraocular weight. On the other hand, ACG, moreover known as intense glaucoma, happens due to the sudden blockage of seepage canals, driving to a fast increment in intraocular weight.

While OAG and ACG are well-understood, other shapes such as normal-tension glaucoma and intrinsic glaucoma show extra complexities, with causes not completely illustrated. These varieties, along with distinctive appearances inside OAG and ACG, require partitioned assessments. Universally, the predominance of OAG and ACG midpoints 1.96% and 0.69%, separately, with an yearly movement rate to one-sided visual impairment surpassing 1%. With the worldwide populace maturing, the anticipated number of glaucoma cases is assessed to reach 111.8 million by 2040, underlining its noteworthy affect on open well being and quality of life.

The determination of glaucoma remains multifaceted due to varieties in person eye characteristics, requiring cautious translation by restorative experts. Be that as it may, progressions in restorative imaging, especially through the integration of Machine Learning (ML) frameworks, offer promising roads for robotized determination. ML-based frameworks use datasets comprising labeled pictures of glaucomatous and sound eyes to extricate related highlights consequently. In spite of the complexity including preprocessing, arrange design determination, and preparing, ML-based approaches have illustrated prevalent execution compared to conventional symptomatic strategies. In this way, leveraging these headways, this consider points to create an ML-based help framework for glaucoma conclusion, centering on analyzing fundus images. By saddling ML strategies connected to fundus pictures, this ponder endeavors to contribute to the computerization of glaucoma determination, improving proficiency and accuracy.

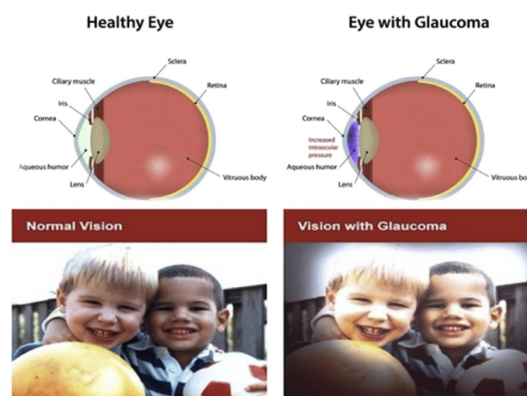


Figure 1 Normal Eye and Glaucoma Eye

2. Literature Review

Anindita Septiarini [1] proposed a computerized method for identifying retinal nerve fiber layer (RNFL) based on surface highlights. By utilizing a co-occurrence framework, surface highlights such as relationship and auto correlation were extricated and chosen utilizing a relationship include choice strategy. These highlights were at that point nourished into a backpropagation neural organize for RNFL discovery in retinal fundus images.

A. Sevastopolsky [2] presented a widespread strategy for portioning the optic plate and container utilizing profound learning, particularly by altering the U-Net convolutional neural organize. The division of the optic nerve head, vital for measuring the cup-to-disc proportion, was accomplished through cutting edge computer vision calculations. Their approach, assessed on databases like DRIONS-DB, RIM-ONE v.3, and DRISHTI-GS, outflanked existing strategies in terms of division quality and expectation time.

Andres Diaz-Pintos [3] fine-tuned five pre-trained CNN structures (VGG16, VGG19, InceptionV3, ResNet50, and Xception) for glaucoma appraisal. Through tests shifting fine-tuning layers, ages, and utilizing procedures like k-fold cross-validation and information expansion, the think about optimized show execution. Eminently, the assessment was conducted on concealed datasets, recognizing it from past literature.

J. Nayak [4] presented a neuro-fuzzy strategy utilizing fluffy sets for glaucoma conclusion, accomplishing higher affect-ability and specificity. By utilizing topographic pictures of patients' optic nerve heads, a feed forward fake neural arrange (ANN) accomplished critical precision in recognizing glaucomatous from typical pictures. Different machine learning calculations were assessed, emphasizing highlights like cup-to-disc proportion and optic nerve head position shift.

Dwarikanath Mahapatra [5] proposed a novel retinal picture division strategy combining gathering learning and CNNs. Through entropy inspecting, the strategy diminished computational complexity whereas keeping up prevalent execution in optic container and plate division. A softmax calculated classifier prepared on learned filters' yields, along with unsupervised chart cut and curved body change, contributed to accomplishing fabulous division results.

These ponders collectively contribute to the progression of glaucoma discovery strategies, utilizing assorted approaches such as texture-based examination, profound learning, fine-tuning of CNNs, neuro-fuzzy strategies, and outfit learning techniques.

3. System Specifications

Convolutional Neural Systems (CNNs) are a sort of neural arrange design characterized by parameter sharing among layers. These systems comprise of a few sorts of layers:

1. Input Layer
2. Convolution Layer
3. Actuation Work Layer

The Input Layer serves as the section point for crude input information, ordinarily pictures with measurements of 32 pixels in width, 32 pixels in stature, and a certain depth.

The Convolution Layer is mindful for computing the yield volume by performing a speck item operation between all channels and the picture fix. For occasion, if 12 channels are utilized in this layer, the coming about yield volume will have measurements of $32 \times 32 \times 12$.

The Actuation Work Layer applies an element-wise enactment work to the yield of the convolutional layer. Common enactment capacities incorporate Corrected Direct Unit (ReLU), Sigmoid, Tanh, Cracked ReLU, among others. These actuation capacities present non-linearity to the arrange, empowering it to learn complex designs and connections inside the data.

4. System Methodology

4.1 System Analysis

The Waterfall approach stands as one of the most punctual Computer program Improvement Life Cycle (SDLC) models broadly utilized in the field of Computer program Designing to guarantee extend victory. In the Waterfall demonstrate, the program advancement prepare is isolated into unmistakable stages, where the yield of one stage serves as the input for the ensuing stage in a consecutive manner.

Outlined underneath are the different stages of the Waterfall Model:

1.Requirement Gathering and Investigation: This starting stage includes the comprehensive collection of all potential framework necessities, which are at that point recorded in a prerequisite determination document.

2.System Plan: Taking after the prerequisite investigation stage, the assembled determinations are inspected in detail amid framework plan. This stage centers on laying out the framework design, indicating equipment and frame work necessities, and making an by and large framework design.

3.Implementation: With the framework plan in put, the real advancement prepare starts. The framework is built in little components called units, leveraging the experiences picked up from the plan phase.

4.Integration and Testing: Once the person units are created, they are coordinates into a cohesive

framework. Each unit experiences thorough testing to recognize and amend any issues or disappointments. In this way, the whole framework is tried to guarantee its usefulness and reliability.

5.Deployment of Framework: Upon effective completion of testing, the item is prepared for arrangement in the client environment or showcase discharge. This stage marks the move of the item from advancement to down to earth usage.

6.Support: Post-deployment, the framework may experience issues or require improvements based on client input or changing necessities. To address these issues, patches are discharged, and made strides forms of the item are created and conveyed. Upkeep exercises point to convey these overhauls to upgrade the product's execution and ease of use in the client environment.

5. Requirements

5.1 Functional Requirements

- Admin Login
- Prediction
- Training
- Testing Image
- Result message

5.2 Non-Functional Requirements

-Upgraded Framework Organization Security: It is basic to reinforce the security measures of the application chairman to avoid any abuse of the application by unauthorized clients. This involves actualizing strong security conventions to guarantee the system's keenness and availability.

-User-Friendly Interface: The application's interface ought to be natural and simple to explore, encouraging consistent interaction for clients. Guaranteeing effortlessness in plan empowers clients to comprehend and react to the application's functionalities effortlessly.

-Unwavering quality: The application's foundation ought to display a tall degree of unwavering quality, guaranteeing reliable execution and the capacity to fulfill users' necessities dependably. This unwavering quality is significant for keeping up client believe and satisfaction.

-Quick Reaction Time: The application ought to illustrate quick reaction times when executing errands relegated by clients. Minimizing idleness guarantees provoke completion of client demands, improving generally client encounter and efficiency.

-Versatility: Our application ought to have the adaptability to suit changes and upgrades in line with advancing client needs and mechanical progressions. This versatility permits for consistent integration of modern highlights and functionalities to make strides the application's execution over time.

-Strength: The extend ought to show strength in dealing with inputs from clients, defending against incorrect or unauthorized inputs. Consolidating error-checking components is basic to moderate the

hazard of framework disappointments and guarantee continuous operation.

6. Data Set

The database utilized in this think about combines two freely available datasets: RIM-One V3 and DRISHTI. This database progression is fundamental for comparative examination with past investigate [3]. Both datasets include names showing whether the pictures compare to glaucoma patients or sound people. The labeling handle includes administered appraisal by a qualified proficient, guaranteeing the precision of each sample's classification. Moreover, works centering on container and plate division require manual division by ophthalmologists, giving labeled pictures with ground truth information for these areas.

However, the DRIONS dataset utilized in earlier considers needs glass division information, rendering it unacceptable for our purposes. Subsequently, it is prohibited from this ponder. Instep, the DRISTI-GS dataset from Aravind Eye Clinic, Madurai (India), comprising 101 color fundus pictures labeled for both circle and container, and the RIM-ONE dataset from the College of La Laguna, comprising of 151 pictures so also labeled for plate and container, are utilized. In spite of the fact that both datasets offer high-quality division information, the characteristics of the pictures shift significantly.

For preparing and approval, 75% of the pictures from each dataset are utilized, with the remaining 25% saved for approval. Be that as it may, to expand the dataset, both inactive (offline) and energetic (online) information enlargement stages are coordinates into the system's design. This considerably increments the add up to number of pictures utilized for preparing and testing past the unique dataset sizes. This increase prepare is reflected in the given table, displaying the introductory number of pictures in the open datasets, the increased picture number, and the dispersion of pictures for preparing and testing purposes.

7. Overview of Technology

For, Detection of Glaucoma using Machine learning, the technology used is:

7.1 Python

Python is a flexible programming dialect famous for its deciphered nature, object-oriented worldview, and energetic semantics. Its offer lies in its high-level built-in information structures, energetic writing, and energetic official, making it perfect for Fast Application Improvement (RAD) and as a scripting dialect to coordinated existing components consistently. Python's clear and brief sentence structure prioritizes lucidness, in this manner minimizing the costs related with program support. Furthermore, its bolster for modules and bundles advances code seclusion and re-usability, cultivating a collaborative improvement environment.

One of Python's striking qualities is its capacity to improve efficiency among software engineers. With

no compilation step, the edit-test-debug cycle is eminently quick, empowering fast improvement emphases. Investigating Python programs is direct, as blunders provoke special cases or maybe than causing division flaws. The mediator gives nitty gritty stack follows upon experiencing exemptions, encouraging successful investigating. Moreover, Python offers a comprehensive source-level debugger, permitting for variable review, expression assessment, breakpoint setting, and step-by-step code traversal. Eminently, the debugger itself is executed in Python, underscoring Python's contemplative capabilities. Then again, including print explanations to the source code is frequently a speedy and viable investigating method due to Python's proficient edit-test-debug cycle.

Python's biological system gloats a plenty of libraries custom fitted to different spaces, encouraging advancement over distinctive perspectives. Striking libraries incorporate MDP, which offers a run of administered and unsupervised learning calculations, nearby suggest, scikit-learn, TensorFlow, and Keras.

In outline, Python's advancement into a unmistakable dialect inside the programming scene is inferable to its expressive language structure, vigorous highlights, and broad library environment. These qualities contribute to its broad selection and proceeded significance in assorted program advancement endeavors.

Implementation

Our project's essential objective is to streamline the prepare of recognizing glaucoma. We utilize color fundus pictures for this reason. In an mechanized approach, the fundus or retinal camera captures pictures of the insides surface of the eye, including the retina, optic circle, macula, and back post. In this way, the captured picture experiences a few preprocessing steps such as gray level change, middle sifting, and numerical morphology. To accomplish exact glaucoma location, we use the picture preparing capabilities of Matlab extensively.

Python plays a significant part in our venture, with three key bundles being utilized:

1.NumPy: As a Python bundle, NumPy, brief for 'Numerical Python,' offers a library comprising multidimensional cluster objects and a set of schedules for cluster processing.

2.Pandas: Pandas gives a quick and effective DataFrame question with default and customizable ordering. It incorporates apparatuses for stacking information into in-memory objects from different record groups, information arrangement, dealing with lost information, and reshaping and rotating datasets.

3.Matplotlib: This bundle serves as a apparatus for performing numerical operations in Python, improving the computational capabilities of our project.


```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

Figure 2
Packages

In outline, our extend combines the picture handling capabilities of Matlab with the numerical and information control functionalities given by Python's NumPy, Pandas, and Matplotlib bundles to proficiently distinguish glaucoma from color fundus images.

In this venture, we utilize five particular machine learning algorithms:

- 1.Logistic Relapse:** As a directed learning calculation, calculated relapse is utilized for labeled information classification tasks.
- 2.K-Nearest Neighbors (KNN) Calculation:** KNN is utilized to categorize information focuses based on their nearness to other information focuses in the dataset.
- 3.Random Timberland Calculation:** This administered machine learning approach, known as the Irregular Timberland Calculation, is profoundly favored for tackling classification and relapse problems.
- 4.Support Vector Machine (SVM) Calculation:** SVM, moreover known as Back Vector Machine, is a directed learning strategy utilized for classification and relapse errands. Whereas it's commonly related with relapse, its essential application lies in classification. The objective of SVM is to discover a hyperplane in an N-dimensional space that successfully isolates the information points.
- 5.Ensemble Calculation:** The outfit calculation is a combination of all the previously mentioned calculations utilized in the extend. It leverages the qualities of each person calculation to upgrade generally performance.

9. Result

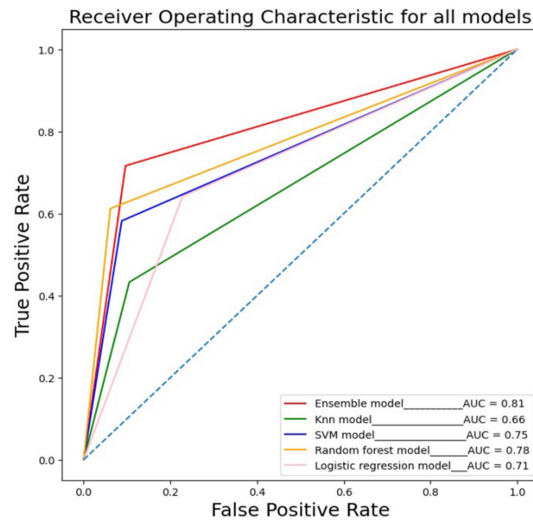


Figure 3
Receiver operating characteristic for all models

Classification Report				
	precision	recall	f1-score	support
Glaucomatous	0.71	0.94	0.81	16
Normal	0.95	0.75	0.84	24
accuracy			0.82	40
macro avg	0.83	0.84	0.82	40
weighted avg	0.85	0.82	0.83	40

Figure 4
Receiver operating characteristic for all models

```

Run time = 1.5097341537475586
[[16  0]
 [ 6 18]]

Sensitivity = 0.75

Specificity = 1.0

Accuracy = 0.85

Model = ensemble
    
```

Figure 5
Result of Accuracy

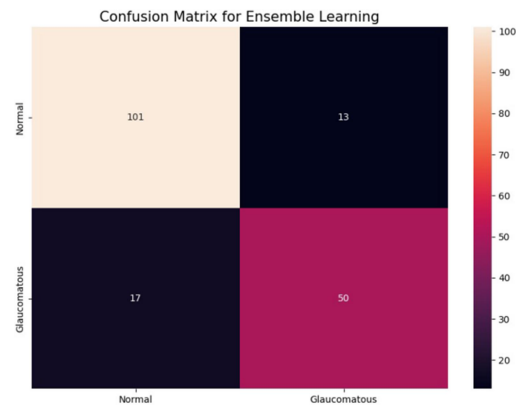


Figure 6
Confusion Matrix for Ensemble Learning

10. Conclusion

The announcing apparatus serves as a significant component inside our framework, amalgamating the yields of both systems to outfit specialists with comprehensive data essential for understanding and leveraging the symptomatic exhortation advertised by the framework. There exists impressive potential for the improvement and application of this work in different ways to abdicate a important and therapeutically worthy demonstrative instrument. Fundamentally, the preparing of gatherings utilizing extra information sourced from both open and private databases would be basic. Moreover, the consolidation of a auxiliary compact classification subsystem might assist improve the steadfastness and affect-ability of the results.

10.1 Future

Enhancements

Ongoing glaucoma inquire about is upgrading our comprehension of the disease's beginnings and encouraging the improvement of more specialized and individualized medications. Separated from the essential sorts of glaucoma identified prior, there exist subtypes that stand to advantage from different treatment modalities. In the future, hereditary testing holds the guarantee of anticipating an individual's lifetime chance of creating glaucoma. Neuroprotection treatments, pointed at avoiding the end of nerve cells in the retina and optic nerve, too appear noteworthy guarantee. Analysts are investigating novel medicines, medicate conveyance strategies, and mechanical progressions to improve the security and viability of surgical strategies, in this manner contributing to progressions in glaucoma management.

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