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Diabetic Retinopathy and Glaucoma Diagnosis using Deep Learning Algorithms

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Abstract— The most common consequence of diabetes mellitus is diabetic retinopathy, which continues to be the primary cause of vision loss in the world. It is observed in middle-aged and older adults, brought on by the aberrant formation of new retinal blood vessels, and diabetic macular edema, which causes exudation and edema in the central region of the retina, are examples of severe phases of DR. Initial diabetic retinopathy has been identified and graded using artificial intelligence-based technology. A timely and precise diagnosis is essential for effective intervention in the treatment. Glaucoma, a common and permanent eye illness that causes visual loss. This study offers a complete methodology that has 2 parts one with only glaucoma and other tried with glaucoma combined with diabetic retinopathy. For glaucoma U-Net architecture is used for segmentation. After segmenting the optic disc and optic cup areas, the original pictures are retrieved and used as inputs for the glaucoma classification stage. For the other part glaucoma combined with diabetic is used and algorithms are applied to classify the images. To evaluate the model's diagnostic ability, key performance indicators like accuracy, precision, recall, and F1-score are calculated.
Keywords*-CNN,DT, Diabetic Retinopathy, Glaucoma*

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I. INTRODUCTION

Individuals with diabetes mellitus have damaged blood vessels in their eye tissue.Blood sugar management issues are a risk factor. A few of the initial symptoms are floating, fuzzy vision, dark patches in the field of vision, and trouble seeing colors. It is possible to become blind. Diabetes can be carefully managed in mild forms. Diabetes is a disease that affects many people globally and can lead to serious micro vascular problems.Diabetic retinopathy is a degenerative eye disease that can cause irreversible blindness. Because retinal pictures have a high sensitivity for retinopathy identification, they are the most commonly utilized screening tool. With its gradual progression and perhaps permanent effects on eyesight, glaucoma is a major global public health concern. Being a chronic eye condition, glaucoma sometimes progresses without obvious symptoms until significant damage has been done, thus getting a diagnosis as soon as possible is essential to halting vision loss. Using cutting-edge deep learning algorithms, this initiative offers a complete method to improve glaucoma diagnosis. The integration of optic disc and optic cup analysis is motivated by the pathophysiology of glaucoma, which involves elevated intraocular pressure and consequent damage to the optic nerve. These markers are essential for the diagnosis of glaucoma.

Then, from the original retinal pictures, the segmented optic disc and optic cup areas are retrieved. The inputs for the glaucoma classification stage are these distinct areas. Optimizing the model—a deep convolutional neural network well-known for its ability to classify images—is done using a dataset that consists of segmented areas that have been identified and associated with glaucoma diagnoses.By providing a precise and effective method for the detection of glaucoma and diabetes, the ultimate goal is to advance the field of medical image analysis. Through the integration of segmentation and classification methodologies, our objective is to provide a resilient diagnostic framework that can promptly detect diabetes and glaucoma, hence enabling timely intervention and better patient outcomes. Total datasets is 4182 in case of diabetic combined with glaucoma.For only glaucoma the dataset is 520.

II. RELATED WORKS

[1] Diabetes patients may have a condition called diabetic retinopathy that affects their eyes. It can cause vision loss over time by causing damage to the retina. It focuses on analyzing different phases of disaster recovery using deep learning. A network called DenseNet was trained on a sizable dataset made up of over 3662 train photos in order to automatically identify the DR stage and categorize them into high resolution fundus images.The

datasets are gathered from Kaggle between the VGG16 and DenseNet121 CNN architectures, and the outcomes of these two architectures are contrasted.A trained model generates the output after features are extracted from fundus images of the eye. Making comparisons between DenseNet121 and VGG16, the two CNN architectures with their accuracy of 96% and 73%.

[2] The goal of the suggested DR detection strategy is to use deep learning to automatically identify the issue. With 35126 retinal photos made available to the public via eyePACS on the Kaggle website, the model was trained on a GPU and attained an accuracy of roughly 81%.This work makes use of the CNN algorithm. Accompanying the classification of various phases of diabetes is a confusion matrix, recall, and accuracy matrix.

[3] Diagnosing diabetic retinopathy (DR) using color fundus pictures is a challenging and time-consuming task that requires skilled doctors to recognize the existence and significance of several tiny characteristics, in addition to a complicated grading system. In order to effectively diagnose and characterize the severity of DR using digital fundus images, the CNN technique is applied in this work. They have created a network using CNN architecture and data augmentation that can recognize the complex elements required for the classification task and, as a result, automatically and without user input, deliver a diagnosis, the dataset is from Kaggle. CNN attains a 75% accuracy rate on 5,000 validation images out of the 80,000 photos in the dataset.

[4] Early identification of diabetic retinopathy by the use of an AI-developed model. With a primary focus on binary classification, this model employs machine learning to detect diabetic retinopathy in retina fundus images and categorize them into three disease progression stages: normal, moderate, and proliferative. This will assist medical professionals in treating patients. Convolutional Neural Nets were used to classify the photos into the various phases of eye illness.Normal cases were categorized with 85% accuracy while instances with diabetic retinopathy were classified with 84.12% accuracy, according to an accuracy assessment of the findings obtained using the Binary Classification model.

[5] One of the main causes of eyesight loss in the modern world is glaucoma. If glaucoma is not treated in a timely manner, the patient may lose their vision. Glaucoma is a condition of the eye where fluid pressure in the eye increases. Examining the optic disc and cup boundaries obtained from fundus pictures can help identify glaucoma. By analyzing fundus images, the suggested method suggests automatically detecting the boundaries of the optic disc and cup. The innovative fast fuzzy C-mean technique for segmenting the optic disc and optic cup in fundus images is examined in this research. In tests conducted on publicly accessible fundus image databases using DRIONS, DRIVE, and STARE, the suggested approach yielded results of 91.91%, 90.49%, and 90.17%.

[6] Blindness is a result of the chronic eye illness glaucoma. It is among the leading causes of blindness worldwide. As a result, vision is lost and cannot be recovered. While there is no known cure for glaucoma, early discovery can halt the disease's progression. The key components of a retinal picture that can be utilized to diagnose specific retinal illnesses are the optic disk (OD), optic cup (OC), and neuroretinal rim (NRR). The suggested approach is easy to use, computationally efficient, and useful for computer-assisted glaucoma diagnosis. Four databases that are open to the public have been used to test the method. The suggested approach classifies glaucoma pictures with a sensitivity of 92.59%.

[7] The goal of this research work is to develop an accurate deep learning model to aid in the diagnosis of glaucoma. The method used to identify glaucoma in retinal eye scans is described in the document. Because we examined several approaches to solving this problem utilizing several open source and publicly available models that were compared, the research's findings pave the way for the model's widespread application in the medical community. Users who are connected to this article can clearly experience all of these templates. However, other elements that affect the effectiveness of these applications include the caliber of retinal scans and the caliber of images that are trained using deep learning models.

III. PROPOSED SYSTEM

A series of retinal images were obtained, including cases of glaucoma-positive and glaucoma-negative individuals, as well as patients at various stages of diabetes, such as severe, mild, and moderate. Each image was tagged with ground truth segmentation masks for the optic disc and cup regions. To guarantee uniformity, the photos were scaled to a constant input size of 256x256 pixels, with pixel intensities adjusted to the range [0, 1]. Data augmentation techniques such as random rotations, flips, and shifts were used during training to improve data diversity and model generalization. The Unet architecture was chosen because it performs well in semantic segmentation tasks. It contains an encoder-decoder structure Deep learning framework is used to create the Unet model and divided the dataset into sets: training, validation, and testing. During training, appropriate loss functions is utilized for picture segmentation tasks.

For glaucoma and it's classification, CNN and Inception v3 is used and updated the original classification head with a new fully linked layer, appropriate for binary classification.
To guarantee consistency, the classification task was trained, validated, and tested using the same dataset split as for segmentation.

Glaucoma combined with Diabetic: Confusion matrix is obtained by applying CNN, Densenet, and Decision Tree algorithm in conjunction with the summary report.

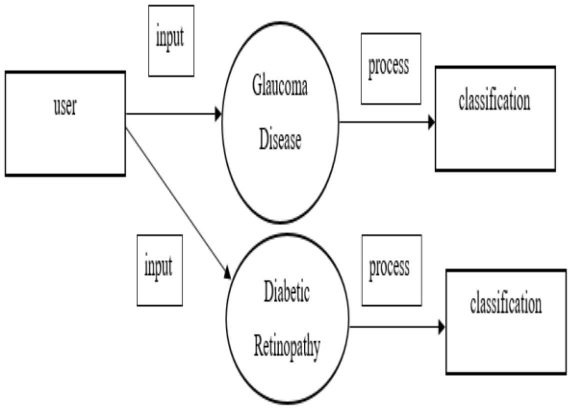

Figure1 Context diagram

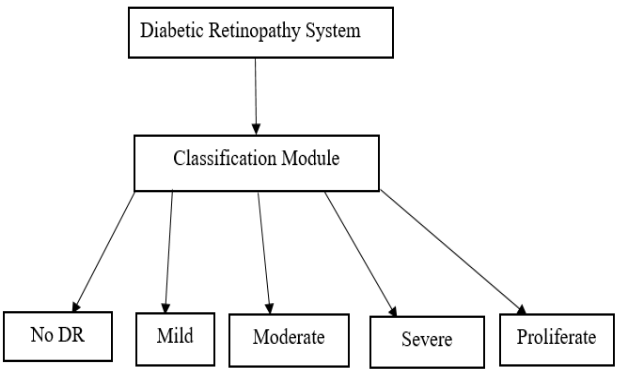

Figure 2 Classification for Diabetic Retinopathy

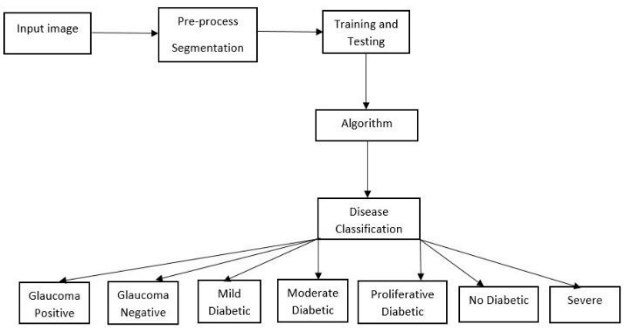

Figure 3 Methodology Process

For Glaucoma:80% designated for training and 20 % designated for testing ,suitable algorithm is applied and the retinal image is classified into glaucoma positive and glaucoma negative.

For Glaucoma combined with diabetic retinopathy:

The datasets for diabetic retinopathy and glaucoma will be obtained as retinal pictures, with 20% designated for testing and 80% for training. It is categorized into various diabetic stages, such as mild, moderate, proliferative, severe, and no diabetic, glaucoma stages such as glaucoma positive glaucoma negative after the classification algorithms are applied.

IV. RESULTS

Algorithms	Accuracy
CNN(Glaucoma) INCEPTION V3(Glaucoma) CNN(Glaucoma+Diabetic)	94% 76% 73%
DT (Glaucoma+Diabetic)	62%
Densenet(Glaucoma+Diabetic)	78%

	Precision	Recall	F1 Score	Support
Glaucoma positive	0.87	0.93	0.90	386
Glaucoma negative	0.75	0.59	0.66	134
mild	0.68	0.82	0.74	370
moderate	0.84	0.84	0.84	999
No DR	0.95	0.98	0.97	1805
Proliferate	0.92	0.55	0.69	295
Severe	0.77	0.73	0.74	193

	Precision	Recall	F1 Score	Support
Glaucoma positive	0.97	0.85	0.91	386
Glaucoma Negative	0.68	0.93	0.78	134

The accuracy of these algorithms are obtained and compared.

V. CONCLUSION

Deep learning algorithms are used in Glaucoma and diabetic retinopathy diagnosis. It also focused on the evaluation criteria like accuracy, precision, recall, F1score and support

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