Glaucoma Detection Using DenseNet

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In

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Certificate

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This is to certify that the work present in this Project entitled "**Glaucoma Detection Using DensNet**" has been carried out by **P.DHEERAJ , P.SAI AKASH , T.LOKESH , N.SUBHASH** under our Professor supervision. The work is genuine, original, and suitable for submission to the SRM University – AP for the award of Bachelor of Technology/Master of Technology in **School of Engineering and Sciences**.

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Abstract

Glaucoma, a progressive eye disease, can lead to irreversible vision loss if left undetected. They don't have any early warning indications of this glaucoma. We might not notice a change in your vision because the effect is so subtle. Traditional diagnostic methods rely on manual assessment of optic disc images, which can be time-consuming and prone to errors. This study proposes a deep learning-based approach using Convolutional Neural Networks (CNNs) to detect glaucoma from retinal images. Our model utilizes a hierarchical structure to differentiate between glaucoma and non-glaucoma patterns, achieving a high accuracy of 98%. Furthermore, we have developed a user-friendly interface that integrates our model, allowing clinicians and patients to easily upload and analyze retinal images, making the diagnosis process more efficient and accessible. The integration of an image data generator for data augmentation enhances the diagnosis, allowing for more accurate detection of glaucoma. Our results demonstrate the potential of deep learning in improving glaucoma detection and paving the way for early intervention and treatment.

1.Introduction

1.1 Problem Statement

The eyes are important sensory organs that provides sight. Glaucoma is a neuro degenerative eye disease developed due to an increase in the Intraocular Pressure inside the retina and is the common cause of blindness in elderly people. When the cup-to-disc ratio is greater than the normal range, the patient's eye is suspected as glaucomatous eye. It must be detected early. To cure this disease, it is most important to find and start its treatment as early as possible. With respect to this underlying issue, there is an immense need of developing a system that can effectively work in the absence of excessive equipment, skilled medical practitioners and also is less time consuming

1.2 Objectives of The Study

The primary aim of this study is to enhance the prediction of glaucoma disease using data augmentation techniques. A robust system has been designed by training the model on diverse datasets that include a wide range of fundus image characteristics, while also expanding the number of training and testing images. The proposed methodology utilizes a large dataset and employs an image data generator for augmentation. To improve classification accuracy and minimize memory usage, the images are converted into binary format. Additionally, CNN is utilized for feature extraction and classification, resulting in highly accurate outcomes.

1.3 Scope

Convolutional Neural Networks (CNN) are highly effective in delivering accurate results due to their ability to efficiently learn complex features through multiple layers and handle intensive computational tasks simultaneously. By combining individual datasets into a larger dataset, CNN eliminates the need for manual intervention or human supervision. The stage of glaucoma in an individual can be determined using factors such as ocular pressure, optic disc, and optic cup. Data augmentation is particularly beneficial for smaller datasets as it increases the dataset size, enabling more productive and reliable detection.

1.4 Motivation

It is the second leading cause of blindness globally, and if a person does not receive an early diagnosis, it may result in total blindness. In light of this fundamental problem, there is a pressing need to create a system that is less time-consuming and capable of operating without the need for specialized medical personnel or expensive equipment. Therefore, this application can also be effectively used for diagnosis by professionals in rural locations. As glaucoma diagnosis is a time-consuming technique and needs competent professionals, no special abilities are required to work with developed applications.

2.Methodology

2.1 Dataset Details

a. ACRIMA

ACRIMA database is composed by 705 fundus images (396 glaucomatous and 309 normal images). They were collected at the FISABIO Oftalmología Médica in Valencia, Spain, from glaucomatous and normal patients with their previous consent and in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All images from ACRIMA database were annotated by glaucoma experts with several years of experience. They were cropped around the optic disc and renamed

b. RIM-ONE

The RIM-ONE database contains 169 optic nerve head images. Each image has 5 manual segmentations from ophthalmic experts. A gold standard for each image was created from its corresponding segmentations.

2.1.1 Preprocessing Steps

The dataset was curated to include retinal images categorized into Glaucomaand Non-Glaucoma. Preprocessing involved resizing all images to 256x256 pixels for uniformity. Data augmentation techniques such as rescaling, shearing, zooming, and horizontal flipping were applied to enhance dataset diversity and reduce overfitting. The dataset was split into training, validation, and testing subsets in an 80:10:10 ratio, ensuring balanced class representation.

2.2 DenseNet Model Implementation

The DenseNet201 architecture, pre-trained on ImageNet, was used as the base model, and its layers were frozen to retain learned features. Additional layers, including global average pooling, batch normalization, dense, and dropout layers, were added to tailor the model for glaucoma detection. The final output layer used a softmax activation function to classify images into glaucoma or non-glaucoma categories.

The model was compiled with the Adam optimizer and categorical cross-entropy loss. A learning rate reduction strategy was employed to adjust the learning rate dynamically based on validation loss. The model was trained over multiple epochs with performance metrics like accuracy and loss monitored for both training and validation datasets. Finally, the model was evaluated on the test dataset to verify its predictive accuracy and robustness.

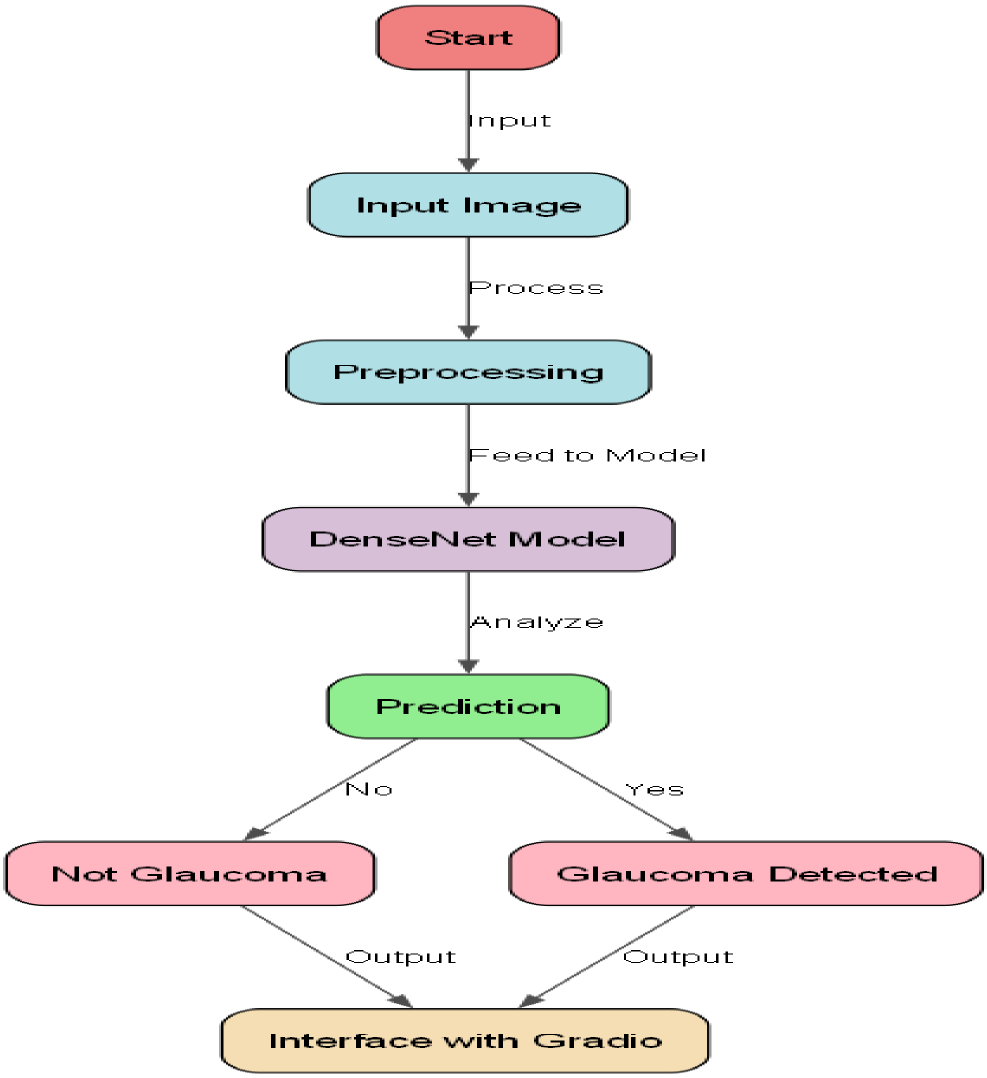
2.3 User Interface Development

To make the system accessible and user-friendly, a Graphical User Interface was developed using Gradio, a Python library for building interactive web-based interfaces. The Gradio interface allows users to upload retinal images and receive real-time predictions. The interface displays the model's classification output (Glaucoma or Non-Glaucoma) along with the confidence score, providing an intuitive and seamless experience for medical professionals and researchers.

2.4 Model Development and Testing

The trained model was integrated into the Gradio-based interface, allowing real-world testing with unseen data. Comprehensive testing ensured the robustness of both the prediction model and the user interface, verifying its ease of use and reliability for practical applications.

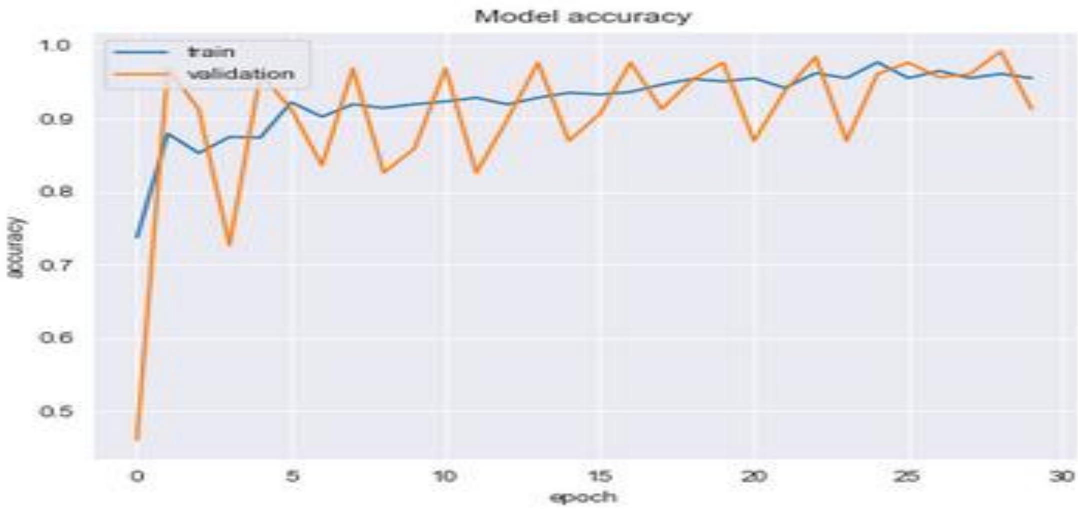
3 FLOW CHART

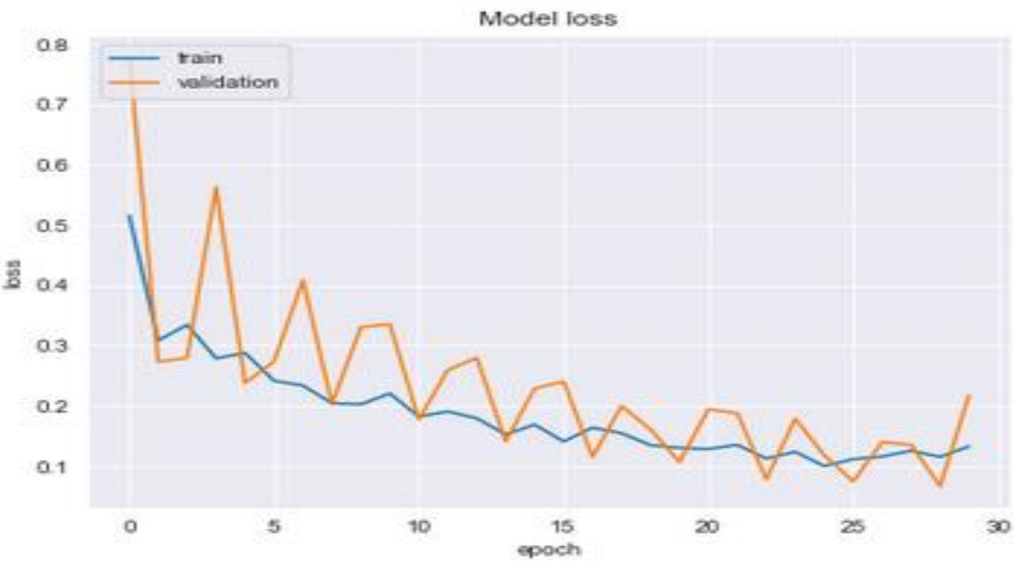


Start
Input
Input Image
Process
Preprocessing
Feed to Model
DenseNet Model
Analyze
Prediction
No
Yes
Not Glaucoma
Glaucoma Detected
Output
Output
Interface with Gradio

4. Results and Discussion

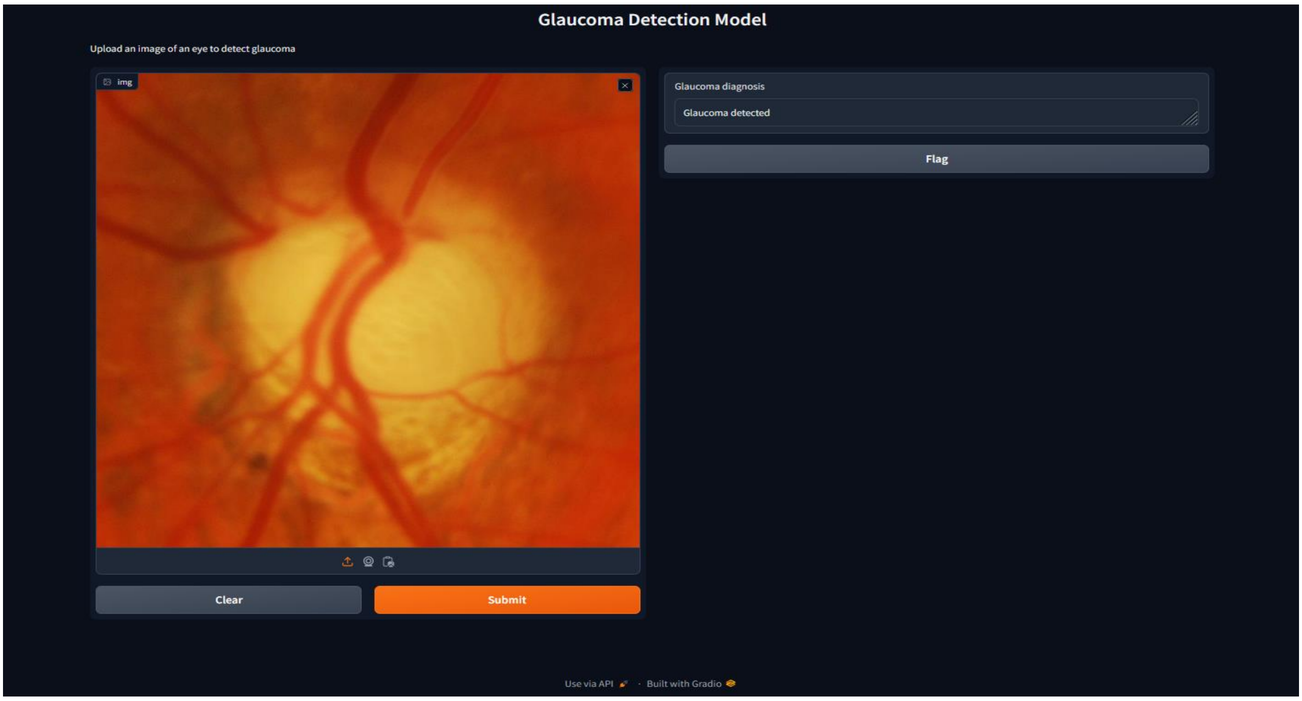
4.1 Model Performance

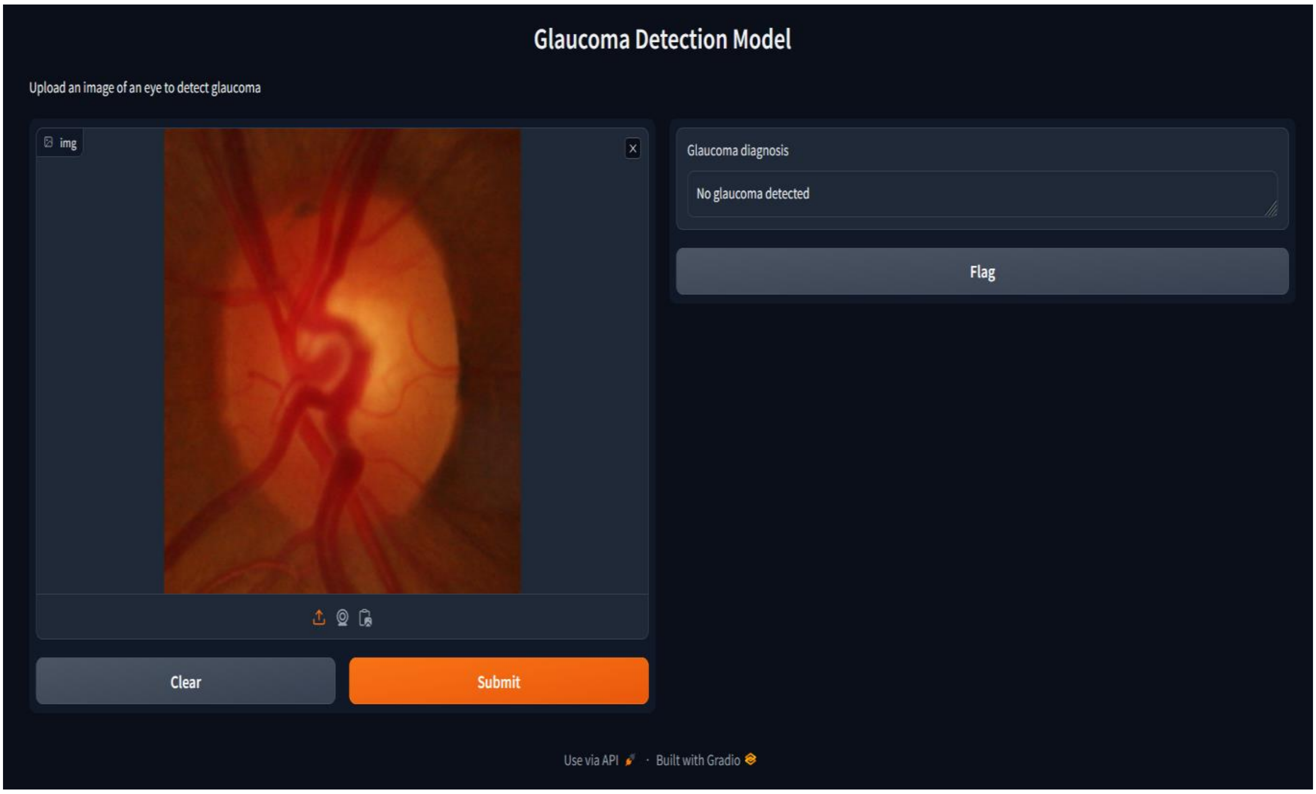





```
9/9 ━━━━━━━━━━━━━━━━━━━━ 37s 3s/step - accuracy: 0.9695 - loss: 0.1001
Loss: 0.11006055772304535 Accuracy: 0.9685314893722534
```

4.2 Outputs


Glaucoma Detection Model
Upload an image of an eye to detect glaucoma
img
Glaucoma diagnosis
Glaucoma detected
Flag
Clear
Submit
Use via API
Built with Gradio


Glaucoma Detection Model
Upload an image of an eye to detect glaucoma
img
Glaucoma diagnosis
No glaucoma detected
Flag
Clear
Submit
Use via API
Built with Gradio

5. Conclusion

The proposed glaucoma detection system leverages advanced medical image processing technology to identify glaucoma effectively, addressing one of the leading causes of blindness worldwide. By utilizing DenseNet for feature extraction and binary classification, the system simplifies the detection process, providing two possible outcomes: glaucoma or normal. The incorporation of an image data generator for augmentation expands the dataset, improving the model's robustness by introducing diverse variations of the original images. This approach ensures accurate feature learning, enabling the system to achieve a remarkable accuracy of **96.47%**, setting a high benchmark in the field. Furthermore, the computer-generated outcomes support clinical decision-making, offering a reliable and efficient tool to assist healthcare professionals in early glaucoma identification, ultimately improving patient outcomes. The system's scalability and efficiency also make it a promising solution for widespread use, particularly in resource-limited settings. By combining technology and innovation, this method has the potential to revolutionize glaucoma detection and management.

6.Future Work

In our future research endeavors, we plan to expand the application of Convolutional Neural Networks (CNNs) to identify a range of eye diseases beyond glaucoma, including cataracts, retinal detachment, and diabetic retinopathy. Specifically, we aim to develop a multi-disease detection system that can accurately diagnose and classify these conditions from retinal images, leveraging the capabilities of deep learning to improve the speed and accuracy of diagnosis. This system will have the potential to revolutionize the field of ophthalmology, enabling clinicians to detect and treat eye diseases at an early stage, and ultimately improving patient outcomes and quality of life. Our future work will involve collecting and annotating large datasets of retinal images, developing and training new CNN models, and evaluating the performance of our system in real-world clinical settings.

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keywords: {Deeplearning;Computers;Head;Computational modeling;Neural networks;Blindness;Computer architecture;glaucoma;DenseNet;convolutional neural networks;deep learning;early detection of glaucoma},

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