G. Narayanamma Institute of Technology and Science
(For Women)
Computer Science and Engineering Department

A Novel Deep Learning Approach for Classification of Eye Diseases using Fundus Images

Guide:
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INTRODUCTION

EYE DISEASE	NUMBER OF PEOPLE AFFECTED (WORLDWIDE) APPROXIMATELY (IN MILLION)
Cataract	94
Glaucoma	7.7
Diabetic Retinopathy	3.9

- Globally, at least 2.2 billion people have a near or distance vision impairment.
- Vision problems can arise due to various factors
- Such as age, genetics, and environmental influences
- Necessity of in time treatment to preserve eye health and ensure clear sight.

LITERATURE SURVEY

Sl.no	Title	Author	Algorithm	Findings
1	Enhancing Ocular Healthcare: Deep Learning-Based Multi-Class Diabetic Eye Disease Segmentation and Classification	MANEESHA VADDURI AND P.KUPPUSAMY (Member, IEEE)	Deep Convolutional Neural Networks (DCNN),Transfer Learning, image enhancement, segmentation, classification	Accuracies for the Cataract(CA): 96.43%, Diabetic Retinopathy (DR): 98.33%, Glaucoma (GL): 97%, and NORMAL: 96%
2	Deep Transfer Learning Strategy to Diagnose Eye-Related Conditions and Diseases: An Approach Based on Low-Quality Fundus Images	Gabriel D. A. Aranha	Deep Transfer Learning, Convolutional Neural Networks (CNNs), VGG16 Architecture, Low-Quality Fundus Images, Fine-Tuning Pre-Trained Models.	Accuracies of 87.4%, 90.8%, 87.5%, 79.1% to classify cataract, diabetic retinopathy, excavation and blood vessels, respectively

LITERATURE SURVEY

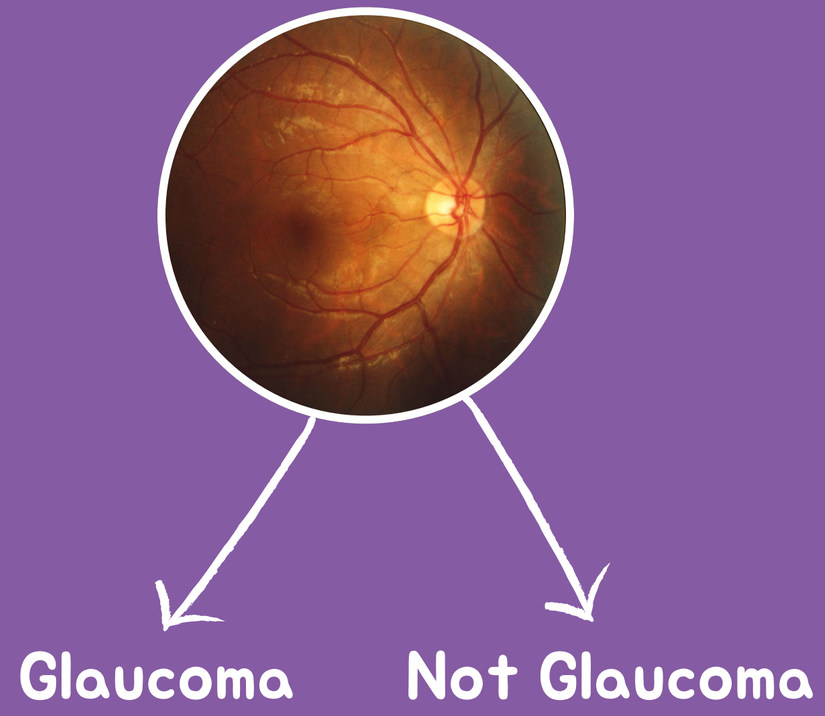
Sl.no	Title	Author	Algorithm	Findings
3	Artificial Intelligence-Driven Eye Disease Classification Model	EM. Onyema	AI-driven classification, multi-class image classification, uncertainty analysis, performance metrics	Precision: 85%, Specificity: 90%, Sensitivity: 88% for diabetic retinopathy
4	The Proposed Convolutional Neural Network Architecture for the Detection and Classification of Eye Diseases	Rahul Singh, Neha Sharma, Rupesh Gupta from Chitkara University Institute of Engineering and Technology	Convolutional Neural Network (CNN), Adam optimizer, multi-class classification, confusion matrix analysis.	The model achieves a 94% overall accuracy in classifying eye conditions, with 87.4% for Cataract, 90.8% for Diabetic Retinopathy, 87.5% for Glaucoma, and 79.1% for blood vessels. This underscores its effectiveness in diagnosing various eye diseases.

LITERATURE SURVEY

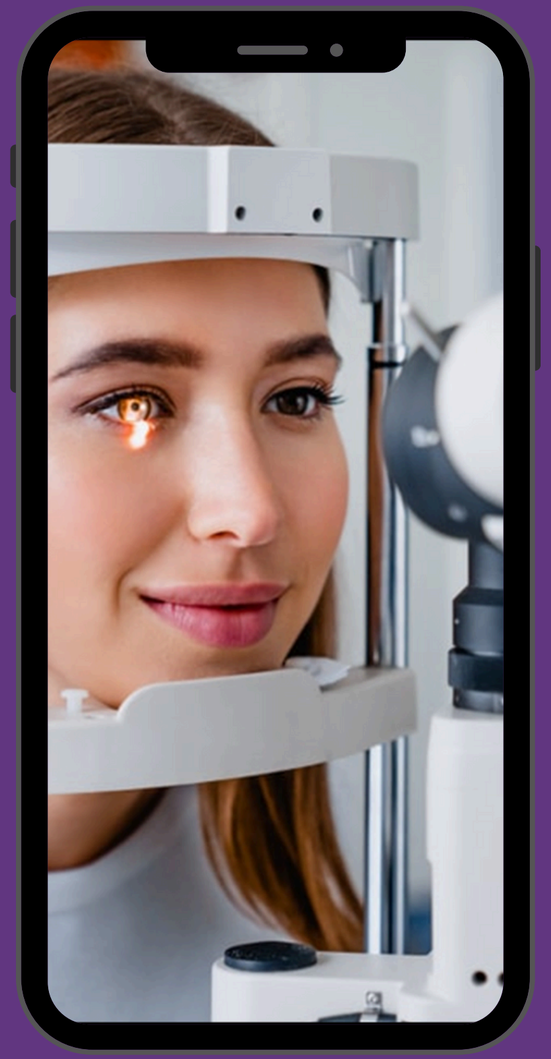
Sl.no	Title	Author	Algorithm	Findings
5	Glaucoma Retinal Image Synthesis Using the GAN	N. Kalyani AND G. Sahasra, K. Sathwika, K. Arthi, L. Sharvani (G. Narayanamma Institute of Technology and Science)	Generative Adversarial Network (GAN), Deep Convolutional GAN (DCGAN), Classification(CNN)	Accuracies for DenseNet: 95.83%, MobileNet V2: 92.10%, Inception V3: 90.20%, and Xception: 93.50% in binary classification for Glaucoma screening.
6	A deep transfer learning approach for identi-fication of diabetic retinopathy using data augmentation	Yerrarapu Sravani Devi AND Singam Phani Kumar (GITAM Deemed to be University)	Deep Learning(ResNet152), Data Augmentation(Gaussian Blur, Circle Crop)	Accuracies of 91% using synthetic data and 86% without synthetic data for diabetic retinopathy identification through a deep transfer learning approach with ResNet 50.

EXISTING SYSTEM

- Pre-trained Convolutional Neural Networks (CNNs)Transfer Convolutional Neural Networks (TCNNs)
- Hybrid Neural Networks
- Binary classification
- Severity Check Models



SMART EYE CARE SYSTEM



Accurate identification of Eye Disease Classification (EDC) retinal fundus images is vital for patients' vision. We need an effective diagnostic model that enhances images and accurately identifies EDC, enabling early diagnosis and personalized treatment using Neural Network.

OBJECTIVES

1.To collect data for EDC

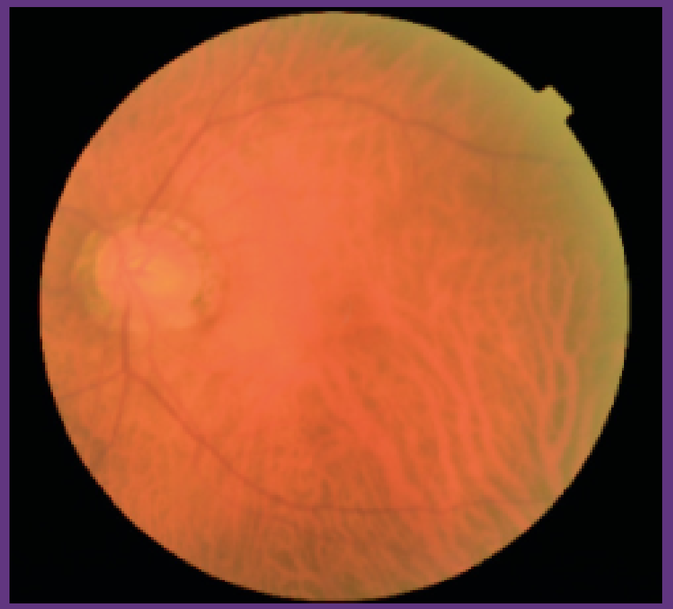
2.To adjust scalar pixel and train the Models

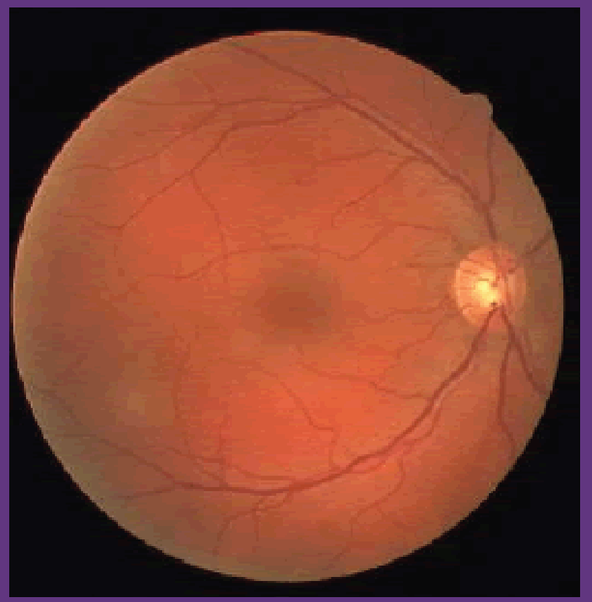
3.To compare different architecture models for EDC using Evaluation Metrics

DATASETS

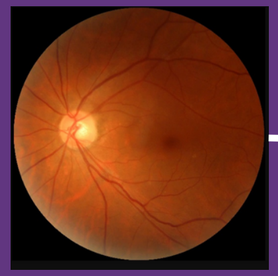
Fundus Images

- Publicly available Kaggle datasets used for training (4000 images =>each 1000 including normal)
- Local dataset from LV Prasad Hospital for testing the model





ARCHITECTURE



Real Fundus Images

Scalar Pixel Adjustement

Convolution layer (7x7, 2)

max pooling (3x3, 2)

Batch Normalization (7x7, 2)

Dense Block 1 (3x3 conv x 6)

Deep Learning Layer

Transition Layer 1 (1x1 conv) + average pool (2x2 , 2)

Dense Block 2 (3x3 conv x 12)

Transition Layer 2 (1x1 conv) + average pool (2x2 , 2)

Dense Block 3 (3x3 conv x 24)

Transition Layer 3 (1x1 conv) + average pool (2x2 , 2)

Dense Block 4 (3x3 conv x 16)

Dropout

Global Average Pooling(GAP)

Fully Connected Layer

Softmax

Glaucoma

ARMD

Diabetic Retinopathy

Normal

METHODOLOGY

Fundus RGB Images are taking as input and converted into feature maps for image processing

Sl.no.	Layer	Description
1	Convolution Layer	Uses feature Maps to extract patterns or features from input
2	ReLu	A non-linear activation function that increases non-linearity in images
3	Max Polling	Decreases the size of Feature maps taking the largest element from map
4	Fully Connected Layer	Connects the neurons among different layers
5	Softmax	An activation function used in multi-class classification in neural networks

MODULES

1) Training using different architecture models on Kaggle dataset
2) Changing the parameters for all models on Kaggle dataset
3) Classifying into different eye diseases or normal eye on real dataset from locality on best model
4) Creating a GUI(Website) out of best model to doing predictions

LIBRARIES USED

- TensorFlow and Keras
  - tensorflow &keras
  - layers
  - optimizers
  - metrics
  - regularizers
  - ImageDataGenerator
  - Model, load_model, Sequential
- NumPy
- Pandas
- shutil, time, os
- cv2
- tqdm

- scikit-learn
  - train_test_split
  - confusion_matrix
  - classification_report
- matplotlib and seaborn
- PIL
- IPython
- logging
- Flask
- render_template
- request

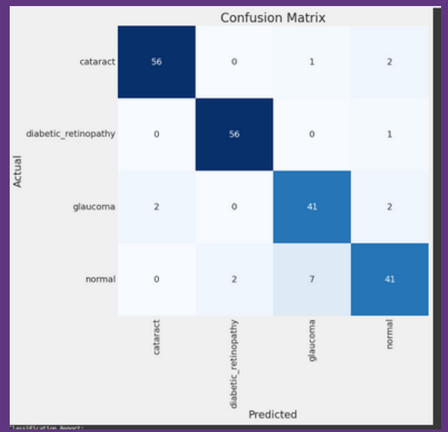
RESULTS

- VGG16

(LR=0.001, BS=60,HF=T)

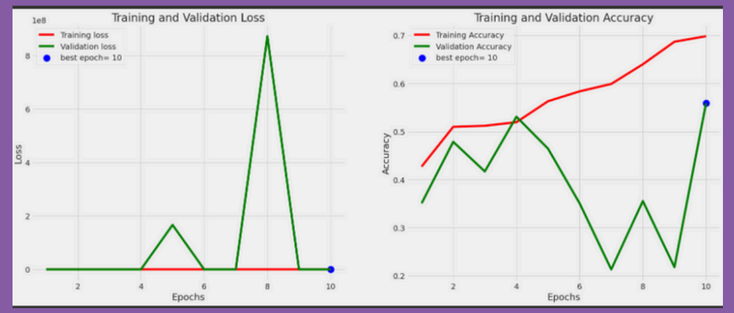
```
211/211 [==============================] - 3s 13ms/step - loss: 0.
accuracy on the test set is 91.94 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.
  saving_api.save_model(
model was saved as ./VGG16-eye_disease-91.94.h5

class csv file was saved as ./class_dict.csv
```

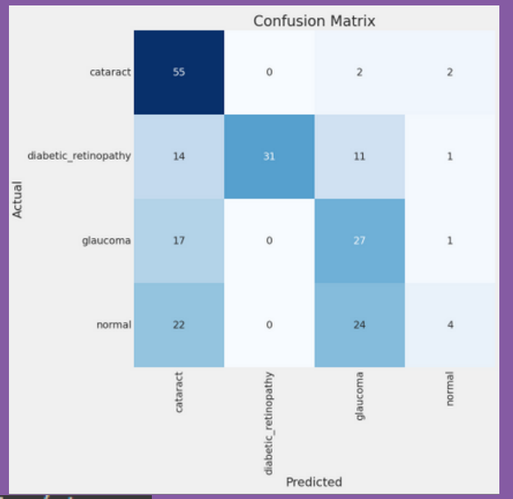
```
Classification Report:
----------------------
                    precision    recall  f1-score   support

          cataract       0.97      0.95      0.96        59
diabetic_retinopathy       0.97      0.98      0.97        57
          glaucoma       0.84      0.91      0.87        45
            normal       0.89      0.82      0.85        50

          accuracy                           0.92       211
         macro avg       0.91      0.92      0.91       211
      weighted avg       0.92      0.92      0.92       211
```



- VGG16

(LR=0.01, BS=100,HF=T)





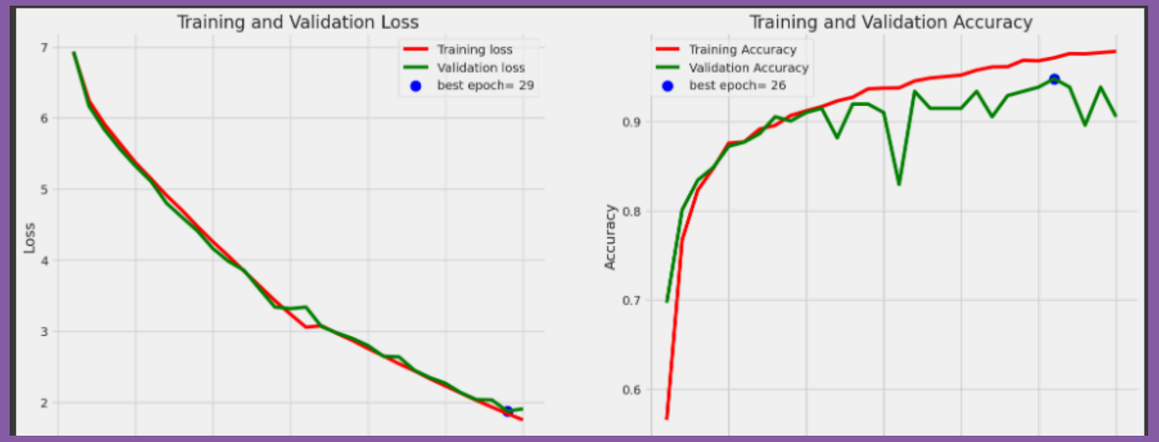

```
211/211 [==============================] - 4s 11ms/step -
accuracy on the test set is 55.45 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/t
  saving_api.save_model(
model was saved as ./VGG16-eye_disease-55.45.h5

class csv file was saved as ./class_dict.csv
```

```
Classification Report:
----------------------
                    precision    recall  f1-score   support

          cataract       0.51      0.93      0.66        59
diabetic_retinopathy       1.00      0.54      0.70        57
          glaucoma       0.42      0.60      0.50        45
            normal       0.50      0.08      0.14        50

          accuracy                           0.55       211
         macro avg       0.61      0.54      0.50       211
      weighted avg       0.62      0.55      0.51       211
```

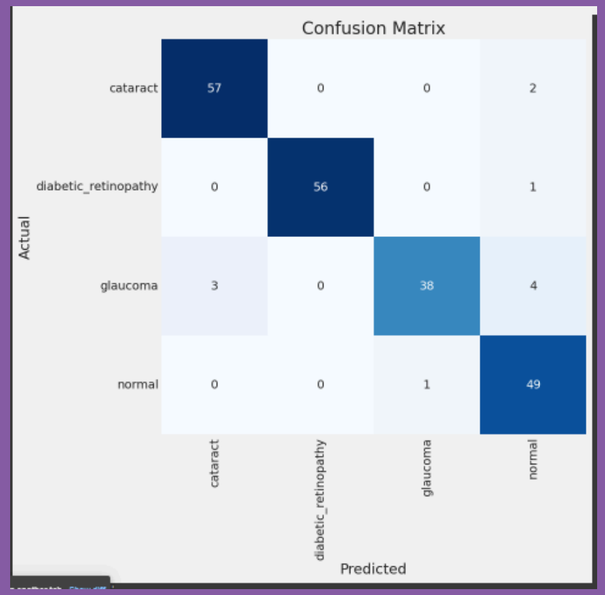
- **VGG16**

(LR=0.01, BS=100,HF=T)

```
211/211 [==============================] - 3s 12ms/step - loss: 1.8563 -
accuracy on the test set is 94.79 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.py:3103
  saving_api.save_model(
model was saved as ./VGG16-eye_disease-94.78.h5

class csv file was saved as ./class_dict.csv
```

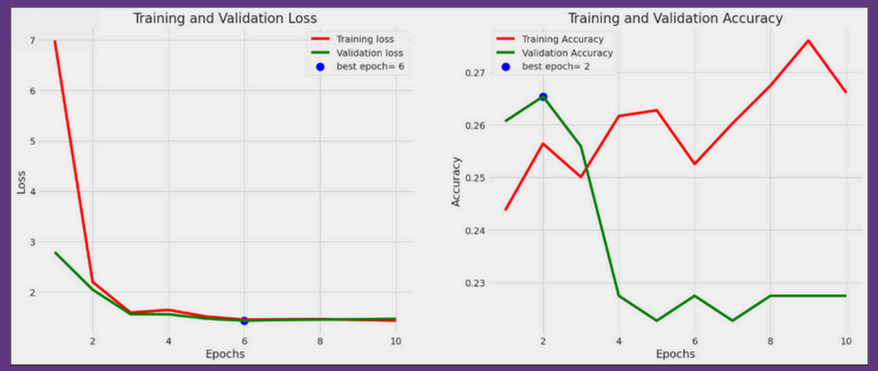



```
Classification Report:
----------------------
                     precision    recall  f1-score   support

           cataract       0.95      0.97      0.96        59
diabetic_retinopathy       1.00      0.98      0.99        57
           glaucoma       0.97      0.84      0.90        45
             normal       0.88      0.98      0.92        50

           accuracy                           0.95       211
          macro avg       0.95      0.94      0.94       211
       weighted avg       0.95      0.95      0.95       211
```

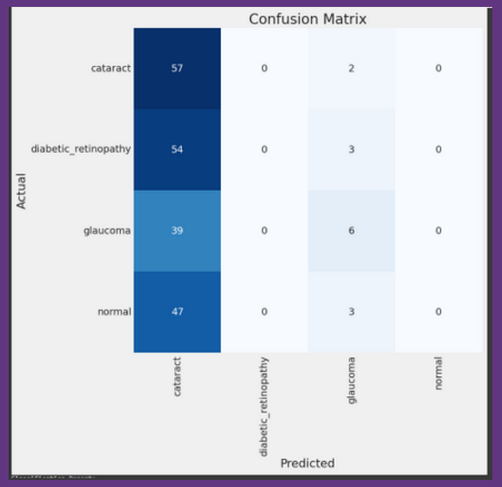


- **ResNet**

(LR=0.0001, BS=60,HF=T)




```
accuracy on the test set is 29.86 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/trai
  saving_api.save_model(
model was saved as ./ResNet152-eye_disease-29.85.h5

class csv file was saved as ./class_dict.csv
```

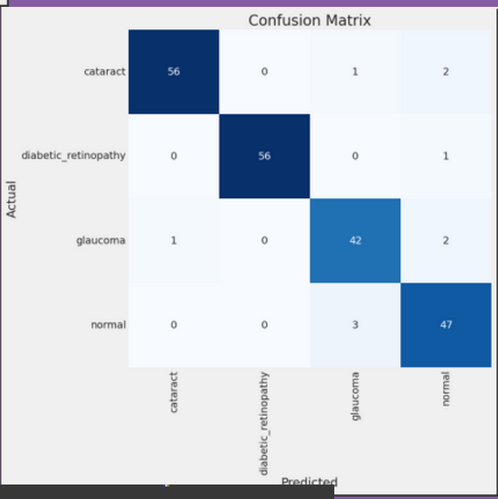



```
Classification Report:
----------------------
                    precision    recall  f1-score   support

          cataract       0.29      0.97      0.45        59
diabetic_retinopathy       0.00      0.00      0.00        57
          glaucoma       0.43      0.13      0.20        45
            normal       0.00      0.00      0.00        50

          accuracy                           0.30       211
         macro avg       0.18      0.27      0.16       211
      weighted avg       0.17      0.30      0.17       211
```

- **ResNet**

(LR=0.001, BS=100,HF=T)


```
Classification Report:
----------------------
                    precision    recall  f1-score   support

          cataract       0.98      0.95      0.97        59
diabetic_retinopathy       1.00      0.98      0.99        57
          glaucoma       0.91      0.93      0.92        45
            normal       0.90      0.94      0.92        50

          accuracy                           0.95       211
         macro avg       0.95      0.95      0.95       211
      weighted avg       0.95      0.95      0.95       211
```



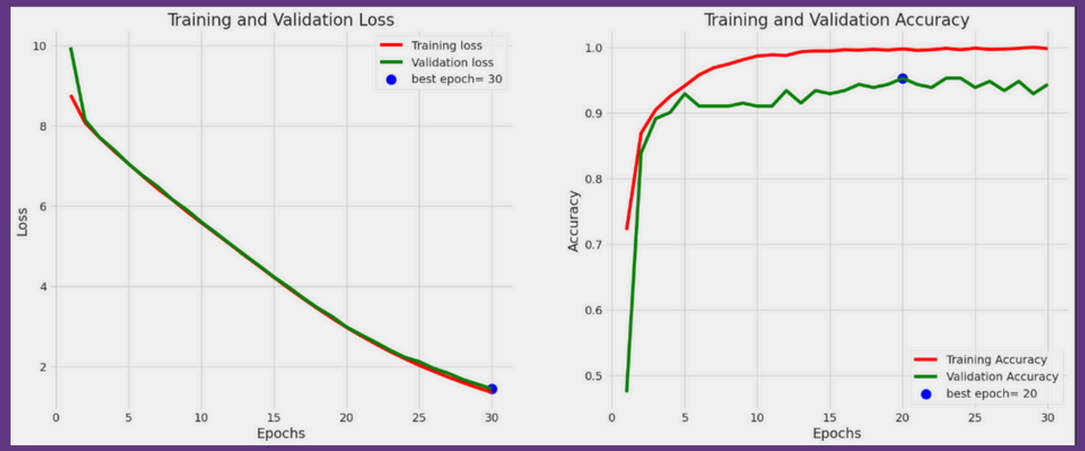

```
accuracy on the test set is 95.26 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/trainin
  saving_api.save_model(
model was saved as ./ResNet152-eye_disease-95.26.h5

class csv file was saved as ./class_dict.csv
```

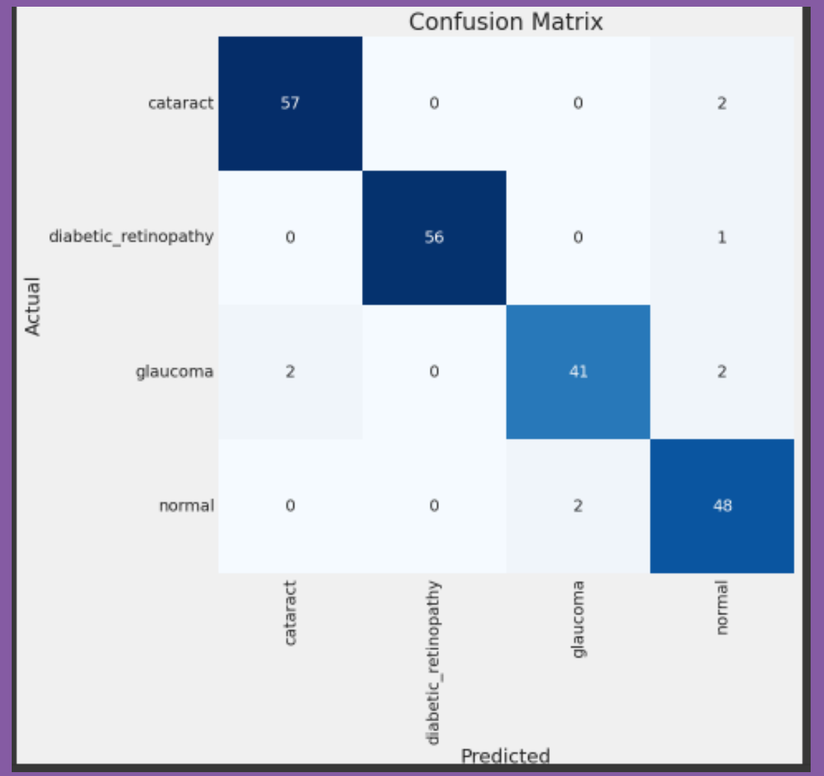
- **ResNet**

(LR=0.0001, BS=100,HF=F)

```
accuracy on the test set is 95.73 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.
  saving_api.save_model(
model was saved as ./ResNet152-eye_disease-95.73.h5

class csv file was saved as ./class_dict.csv
```

```
Classification Report:
----------------------
                     precision    recall  f1-score   support

           cataract       0.97      0.97      0.97        59
diabetic_retinopathy       1.00      0.98      0.99        57
           glaucoma       0.95      0.91      0.93        45
             normal       0.91      0.96      0.93        50

           accuracy                           0.96       211
          macro avg       0.96      0.95      0.96       211
       weighted avg       0.96      0.96      0.96       211
```



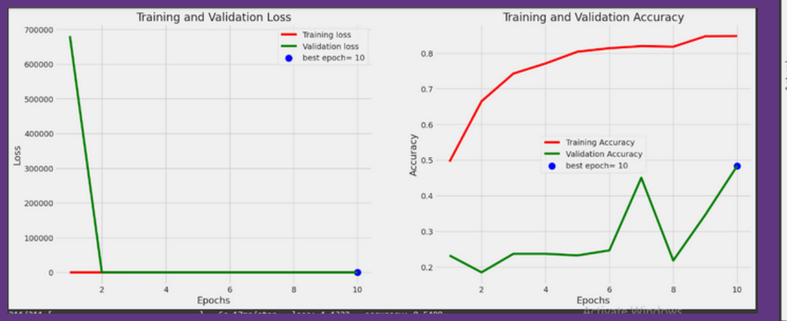


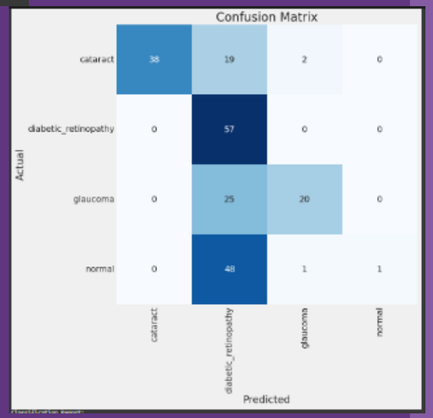
- **DenseNet**

(LR=0.01, BS=60,HF=T)

```
211/211 [==============================] - 6s 17ms/step - loss: 1.1
accuracy on the test set is 54.98 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.py
  saving_api.save_model(
model was saved as ./DenseNet121-eye_disease-54.97.h5

class csv file was saved as ./class_dict.csv
```

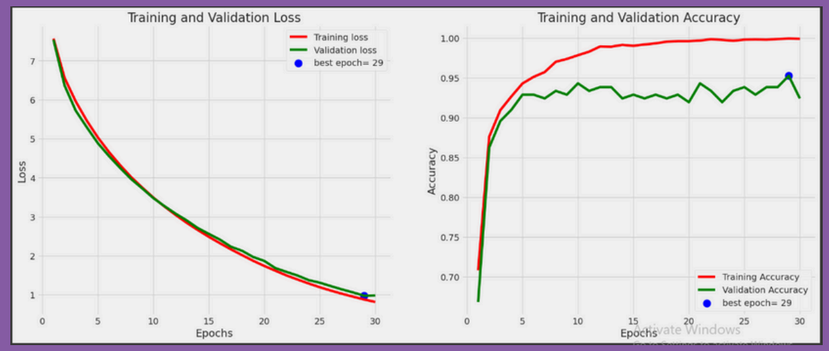
```
Classification Report:
----------------------
                    precision    recall  f1-score   support

          cataract       1.00      0.64      0.78        59
diabetic_retinopathy       0.38      1.00      0.55        57
          glaucoma       0.87      0.44      0.59        45
            normal       1.00      0.02      0.04        50

          accuracy                           0.55       211
         macro avg       0.81      0.53      0.49       211
      weighted avg       0.81      0.55      0.50       211
```

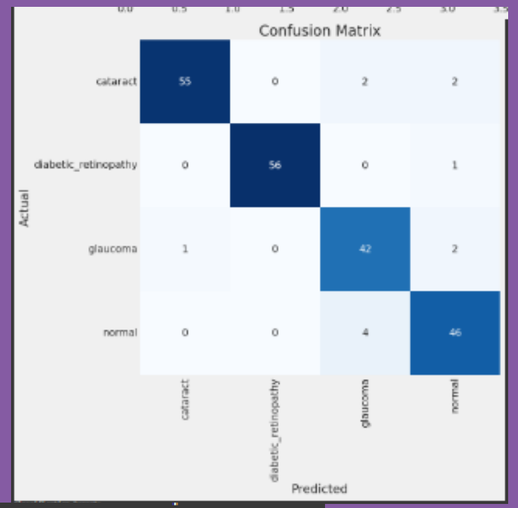




- **DenseNet**

(LR=0.0001, BS=60,HF=F)






```
Classification Report:
----------------------
                    precision    recall  f1-score   support

          cataract       0.98      0.93      0.96        59
diabetic_retinopathy       1.00      0.98      0.99        57
          glaucoma       0.88      0.93      0.90        45
            normal       0.90      0.92      0.91        50

          accuracy                           0.94       211
         macro avg       0.94      0.94      0.94       211
      weighted avg       0.95      0.94      0.94       211
```

```
accuracy on the test set is 94.31 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/trainir
  saving_api.save_model(
model was saved as ./DenseNet121-eye_disease-94.31.h5

class csv file was saved as ./class_dict.csv
```

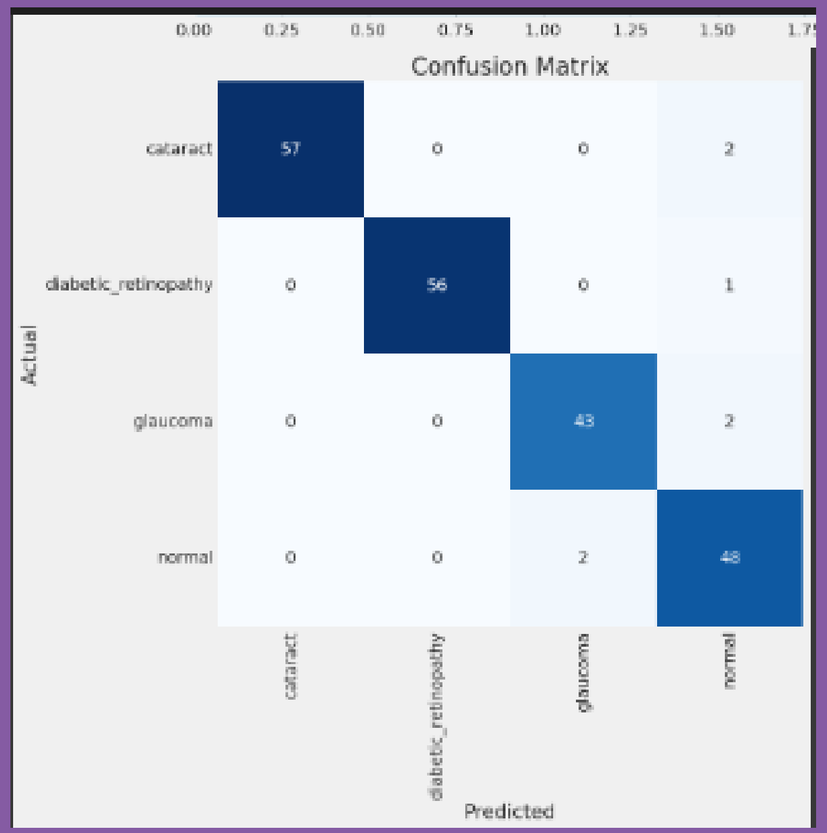
- **DenseNet**

(LR=0.001, BS=100,HF=T)

```
211/211 [==============================] - 4s 17ms/step - loss: (
accuracy on the test set is 96.68 %

/usr/local/lib/python3.10/dist-packages/keras/src/engine/trainin
  saving_api.save_model(
model was saved as ./DenseNet121-eye_disease-96.68.h5

class csv file was saved as ./class_dict.csv
```

Classification Report:

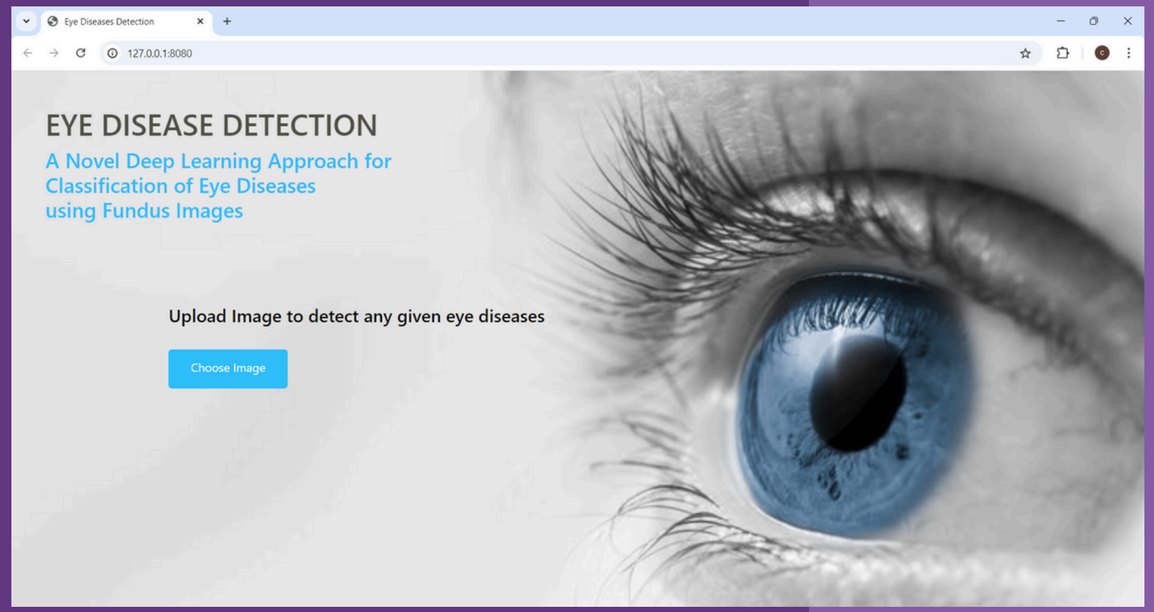
	precision	recall	f1-score	support
cataract	1.00	0.97	0.98	59
diabetic_retinopathy	1.00	0.98	0.99	57
glaucoma	0.96	0.96	0.96	45
normal	0.91	0.96	0.93	50
accuracy			0.97	211
macro avg	0.97	0.97	0.97	211
weighted avg	0.97	0.97	0.97	211

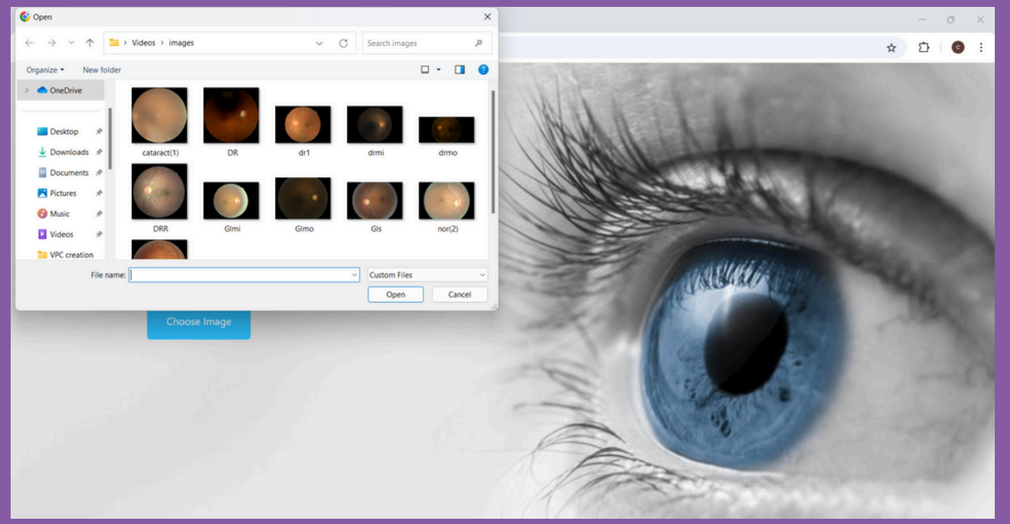


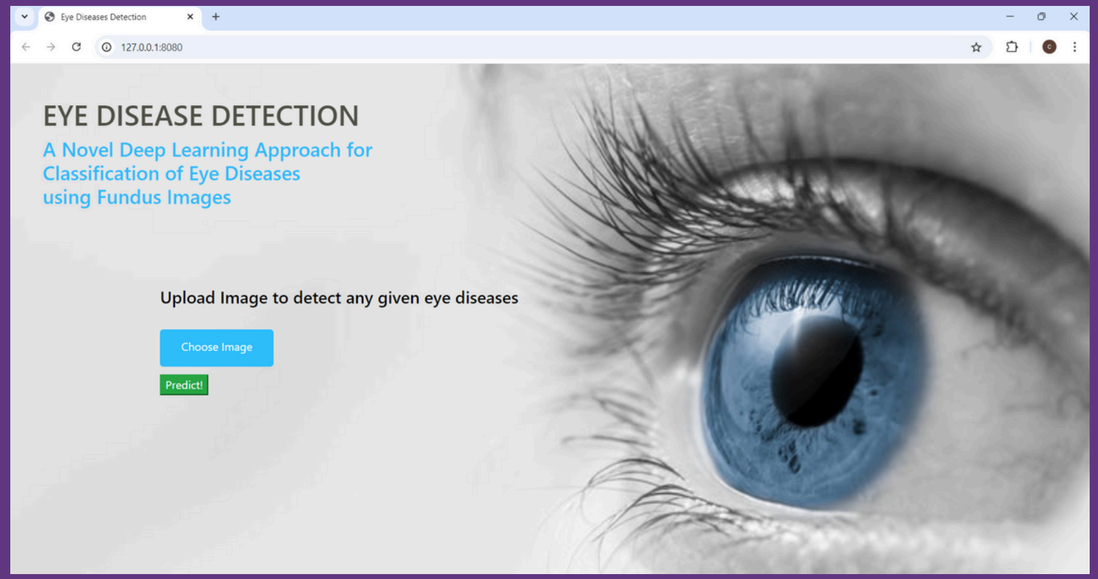
EVALUATION

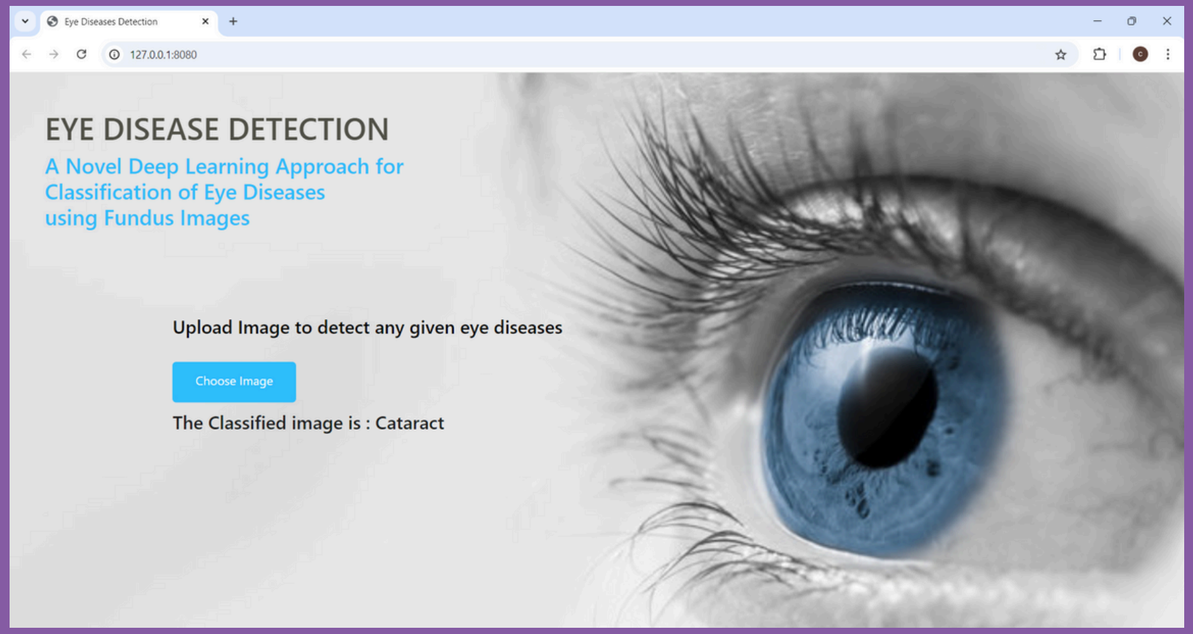
Model	Learning Rate	Epochs	Accuracy	Precision	Recall
VGG16	0.01	10	55.45	62.07	51.87
ResNet	0.01	10	29.86	17.86	27.32
DenseNet	0.01	10	54.98	81.98	52.98
VGG16	0.001	20	91.94	91.87	92.98
ResNet	0.001	20	95.26	95.26	95.35
DenseNet	0.001	20	96.68	97.08	96.33
VGG16	0.0001	30	94.79	95.08	94.09
ResNet	0.0001	30	95.73	95.21	95.73
DenseNet	0.0001	30	94.31	94.53	93.98

GUI

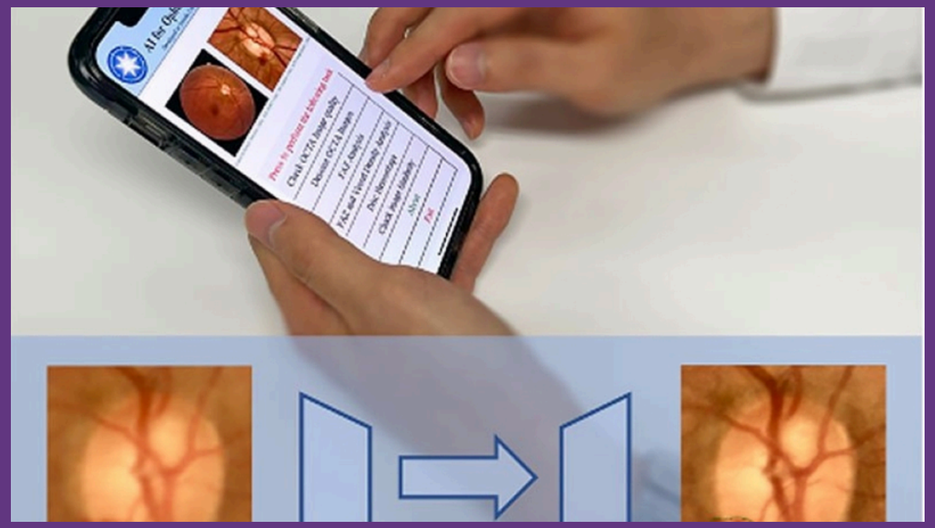

Eye Diseases Detection
127.0.0.1:8080
EYE DISEASE DETECTION
A Novel Deep Learning Approach for
Classification of Eye Diseases
using Fundus Images
Upload Image to detect any given eye diseases
Choose Image


Open
Videos › images
Search images
Organize
New folder
OneDrive
Desktop
Downloads
Documents
Pictures
Music
Videos
VPC creation
cataract(1)
DR
dr1
drmi
drmo
DRR
Glmi
Glmo
Gls
nor(2)
File name:
Custom Files
Open
Cancel
Choose Image


Eye Diseases Detection
127.0.0.1:8080
EYE DISEASE DETECTION
A Novel Deep Learning Approach for
Classification of Eye Diseases
using Fundus Images
Upload Image to detect any given eye diseases
Choose Image
Predict!


Eye Diseases Detection
127.0.0.1:8080
EYE DISEASE DETECTION
A Novel Deep Learning Approach for
Classification of Eye Diseases
using Fundus Images
Upload Image to detect any given eye diseases
Choose Image
The Classified image is : Cataract

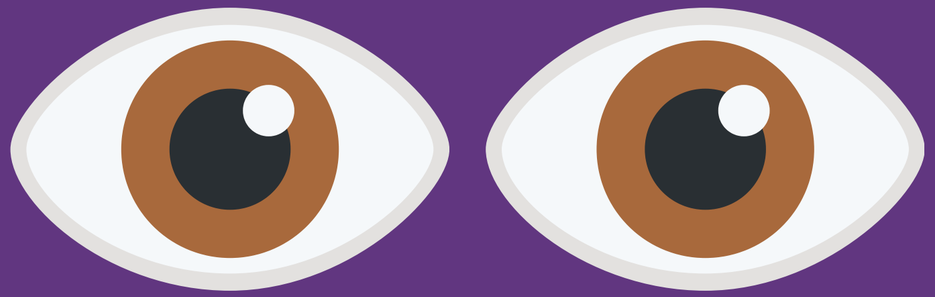
CONCLUSION



This project introduces a method for identifying EDC using deep learning. It achieves high accuracies for detecting EDC using DenseNet Architecture (96.68% accuracy) with a user friendly GUI.

FUTURE SCOPE

- Develop a model that identifies diseases and also assesses their severity.
- Improve detection and analysis of other diseases through further research.
- Provide valuable insights for healthcare professionals and improve patient outcomes.



THANK YOU!