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EYE DISEASE CATARACT CLASSIFICATION USING DEEP LEARNING

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Abstract: One of the many conditions that can affect the eyes is called a cataract. Cataracts are an extremely common condition, but unfortunately, they frequently result in the irreversible loss of an eye. A cataract may develop for a number of different reasons. The early identification of cataracts is beneficial to the therapy process. Surgery may also be necessary in cases where the cataract is caused by a serious infection. Therefore, the patient will benefit from an early diagnosis of the condition. The identification of cataracts will begin with the capture of fundus pictures of both the right eye and the left eye. We dealt with around 1094 datasets, 594 of which contained photos with cataracts, while the other datasets had normal photographs. We used four algorithm models: vgg19, vgg16, Inceptionv3, and Restnet50. Vgg19 achieved an accuracy of 95%, vgg16 achieved an accuracy of 94%, Inceptionv3 achieved an accuracy of 85%, and Restnet50 achieved an accuracy of 87%. The validation accuracy assessed how effectively the models generalized to new data, which was used to avoid overfitting.

Keywords: *Eye disease, Cataract, Classification, Machine Learning, Deep learning, Algorithms.*

1. INTRODUCTION

A cataract causes the eye's normally clear lens to become obscured. The human eye is capable of distinguishing between around 10 million different colors and has a chance of being able to detect a single photon[1]. The primary emphasis of this study is on eye disease cataract classification using Deep Learning. When one's vision is blurred by cataracts, it might be more difficult to read, drive a car (especially at night), or detect the expression on a friend's face. There is no scientific evidence to support any methods for cataract prevention or cataract progression. However, doctors believe that a number of methods, such as: regularly check your eyes. Cataract formation may be influenced by the sun's ultraviolet rays. When you're outside, put on sunglasses that block ultraviolet B (UVB) rays. Drink less alcohol. The risk of cataracts might rise with excessive alcohol use. On a global scale, eye illnesses are recognized as one of the primary factors contributing to conditions that do not result in death. 1.5% of the population in Bangladesh is blind, whereas 21.6% of individuals have impaired eyesight[2]. The inability of patients to accurately identify their own illnesses at the appropriate time is the primary contributor to this problem. If we are not aware of some common eye disorders, we put ourselves at risk of experiencing serious complications.

2. LITERATURE REVIEW

In paper[3], This basic DenseNet201 model was compared with the proposed DenseNet201-based deep learning model to classify cataract and normal fundus images of eye. it has been shown that the proposed deep learning model achieves 10% more success than the basic DenseNet201 deep learning model. In order to conduct out automatic cataract categorization, the suggested approach makes use of a convolutional neural network (CNN) with an accuracy of 92.91% . The study [4] introduces a new approach for automating the detection and grading of cataracts using fundus images. Instead of using the original images, the study employs 2D-DFT spectrograms which contain details of blood vessels that serve as distinguishing features for cataract detection. Experimental results demonstrate superior performance with an accuracy of 93.10%. VGG19 model was chosen in this study. Test accuracy was 88%, recall was 83%, precision was 93%[5]. The input picture size with the minimum resolution of 31X35 pixels has the maximum test accuracy of 80.93% according to the network configuration employed[6]. Weighted KNN, Cubic SVM, and Simple Tree are the machine learning methods employed for result analysis, and they each offer an accuracy of 85.8%, 87.2%, and 88.6%, respectively. The total accuracy for the combination of exudates and blood vessel features using the Weighted KNN method is 85.8%[7]. It[8] introduces a deep-learning algorithm based on retinal photographs for automated detection of visually significant cataracts. By using 25,000 image from population based study, the algorithm showed comparable or slightly superior performance, with a sensitivity of 93.3% compared to 51.7–96.6% by ophthalmologists and a specificity of 99.0% compared to 90.7–97.9% by ophthalmologists. The study[8] focuses on utilizing a deep learning approach to detect and diagnose these eye diseases accurately. A total of 5 different Convolutional Neural Networks (CNN) architectures e.g DenseNet, EfficientNet, Xception, VGG, Resnet, used to detect and diagnose these eye diseases accurately. Among all of these EfficientNet comes up with highest accuracy of 95.02%.

3. METHODOLOGY

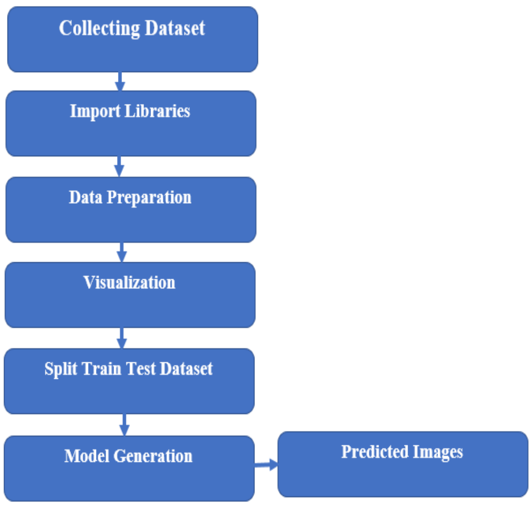

Figure 1: pipeline of the system

A. Data Collection

We collected the dataset from Kaggle[9], an online platform. There are different eye diseases in this dataset but we only use normal data and cataract diseases. This data has 6392 rows and 19 columns. They are male count 3424 and female count 2968.This dataset has two eyes different diseases. To ensure that the data is given to the training and testing sets at random, shuffle the dataset. Decide on the preferred split ratio, such as 80% of the data for training and 20% for testing.

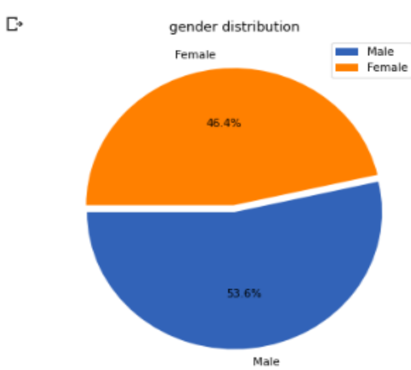

Figure 2: Gender Pie Chart in dataset

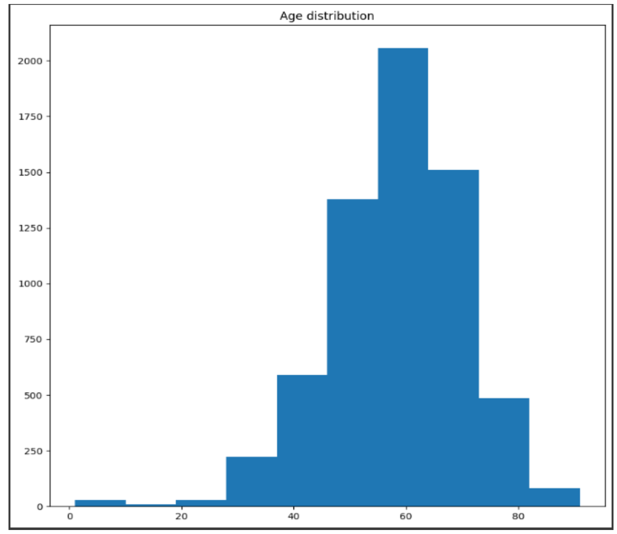

Figure 3: Age bar Chart in dataset

B. Data Preprocessing

We followed some steps to prepare the dataset. There are some pictures of two eyes. Left diagnostic and right diagnostic. There are some columns also, but we only find cataract diseases, that's why we use some specific columns. After getting cataract data, we take a normal image. Get 250 left normal images and 250 right normal images. Total normal images both eyes 500 images. It's our final normal images data. Using a total of 1094 data in this project.

C. Model Generation

For computer vision applications like image classification, the VGG19 model [10] is a deep learning model. The steps below may be used to produce it:

- import appropriate libraries (e.g. TensorFlow, Keras)
- Using the VGG19 architecture and the Keras Sequential model, define the model architecture.
- Set up the model's optimizer, loss function, and metrics appropriately.
- On a labeled dataset of picture data, train the model.
- Analyze the model's output.

D. Predicted Images

Using a trained model to create new pictures based on input data is known as "predicting images" in deep learning. This may be accomplished using a variety of techniques, such as image classification, image generation, creating fresh pictures using an input noise

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vector or an existing image. predicting a mask that divides backgrounds from objects in a picture. The strategy used will depend on the job at hand and the training data that is available. After preprocessing the dataset, splitting train test data set, model fit we get our expected output, and its image will be detected.

- **Vgg19**

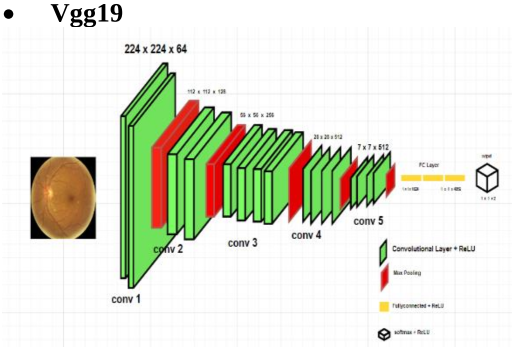

Figure 4: Vgg19 model

The VGG model, commonly known as VGGNet, is referred to as VGG16. Convolutional neural network (CNN) model of 16 layers. It employs a convolution process to transform an input feature map or input image with a given height, width, and number of channels into a new feature map. The adjusted feature map contains different heights, widths, and channels depending on the filter size, padding, and stride.

Max pooling:

MaxPooling2D Therefore, the feature map produced by the max-pooling layer would contain the standout features from the previous feature map. After each convolutional layer, CNNs are frequently introduced to the max pooling operation type.

Cov2d:

A necessary Conv2D [11] parameter is the quantity of filters from which the convolutional layers will learn. It also determines how many output filters will be used in the convolution, and it is an integer.

Dense:

Information travels from every cell in the layer below to every neuron in the simple layer of neurons known as the dense layer. The photos are categorized using a dense layer based on the output of the convolutional layers.

Flatten:

By flattening all of the resulting 2-Dimensional arrays from the pooled feature maps, a single, large continuous linear vector is produced. The categorization of the picture is done by the fully connected layer using the flattened matrix as input.

- **Vgg16:**

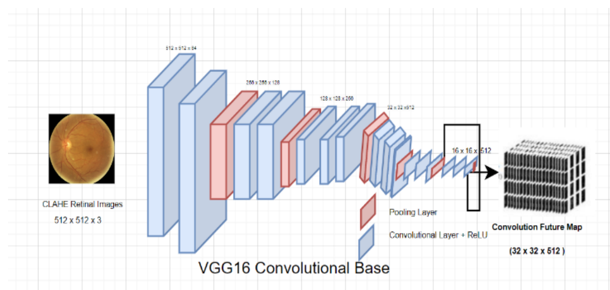

Figure 5: Vgg16 model

VGG16 architecture has 16 layers, comprising 3 fully linked levels and 13 convolutional layers. Max-pooling layers come after each group of two or three convolutional layers in the arrangement. While the final three fully connected layers each comprise 4096, 4096, and 1000 neurons, the first 13 convolutional layers employ 3x3 filters.

- **Inceptionv3**

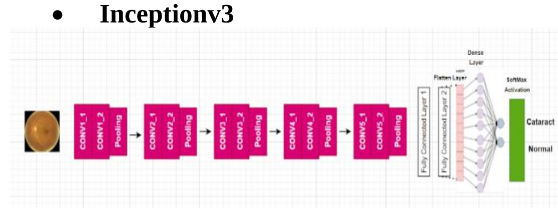

Figure 6: Inceptionv3 model

Inception also employs "1x1 convolutions," which decrease the depth of the feature maps while maintaining their spatial resolution, to further lower the computational cost of the architecture. This enables the network to carry out more calculations on smaller feature maps, which may result in training that is quicker and more effective.

- **Restnet50:**

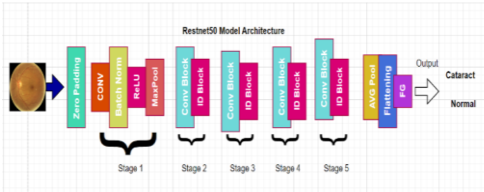

Figure 7: Restnet50 model

A big dataset, like Image Net, which has millions of photos and thousands of classifications, is often used for the training. ResNet50 has been widely applied and modified for a variety of computer vision problems, such as segmentation, object identification, and picture classification. It has showed cutting-edge performance on various benchmark datasets and helped deep learning grow.

4. RESULT AND DISCUSSION

The loss and validation accuracy are important measures in deep learning that are used to assess a model's performance.

```
loss: 0.4422389268875122
Accuracy: 0.9447236061096191
```

Figure 8: loss and accuracy score

After using the deep learning vgg19 model we get 94% accuracy. The following variables may influence the VGG19 model's accuracy:

The level of detail and volume of the training data: The quantity and variety of the training data, as well as the caliber of the labels, will influence the model's accuracy. The selection of hyperparameters, such as the learning rate, batch size, and number of epochs, may have an impact on the model's accuracy. Whether the VGG19 model is being utilized for picture classification, segmentation, or creation, or something else entirely, will determine how accurate it is. In general, it has been shown that the VGG19 model performs well on a range of computer vision applications, including picture classification.

```
              precision    recall  f1-score   support

           0       0.89      0.99      0.94        84
           1       0.99      0.91      0.95       115

    accuracy                           0.94       199
   macro avg       0.94      0.95      0.94       199
weighted avg       0.95      0.94      0.95       199


Accuracy:  0.9447
Confusion Matrix:
 [[ 83   1]
 [ 10 105]]
```

Figure 9: Vgg19 model accuracy

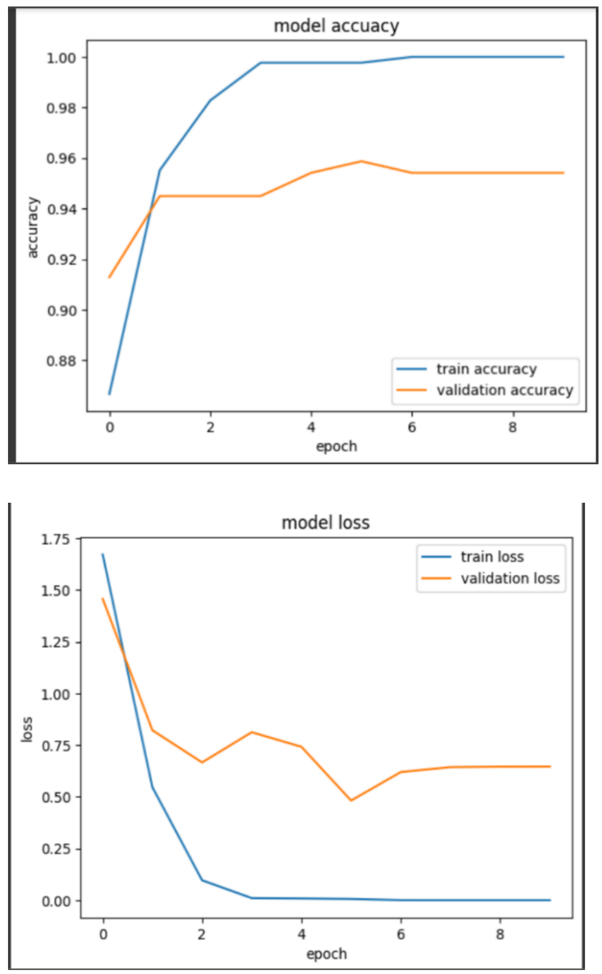

Figure 10: Accuracy and loss performance for vgg19

The final cataract image output predicts perfectly. Our actual image is cataract and our detect image is also our cataract image.

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In figure 4.5 some random images are detected. We can see all types of images are detected perfectly.

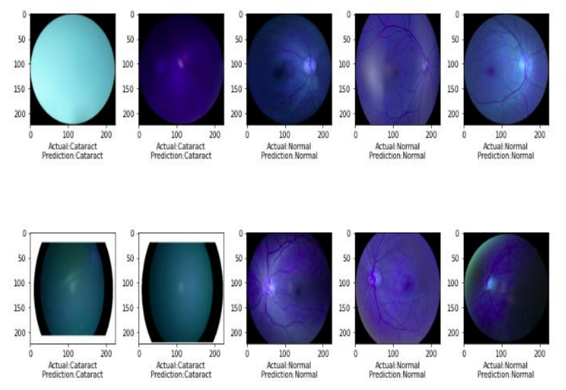

Figure 11: Random image detections

Algorithm	Categories	Precision	Recall	F1-score	Accuracy
VGG19	0	0.92	0.92	0.92	0.94
	1	0.93	0.93	0.93	
VGG16	0	0.93	0.89	0.91	0.92
	1	0.91	0.94	0.93	
RestNet50	0	0.86	0.96	0.90	0.91
	1	0.96	0.87	0.91	
InceptionV3	0	0.77	0.94	0.85	0.84
	1	0.94	0.76	0.84	

Table 1: Different Algorithm Accuracy

Preprocessing the data is necessary to ensure that our model accurately fits the data set. For computer vision applications like image classification, the VGG19 model [20] is a deep learning model. The steps below may be used to produce it:

- import appropriate libraries (e.g. TensorFlow, Keras)
- Using the VGG19 architecture and the Keras Sequential model, define the model architecture.
- Set up the model's optimizer, loss function, and metrics appropriately.
- On a labeled dataset of picture data, train the model.
- Analyze the model's output.

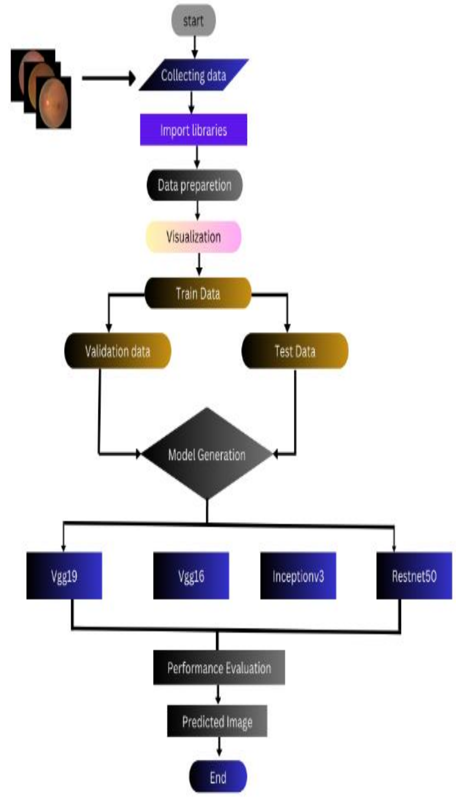

Figure 12: Methodology of eye Disease

This data has 6392 rows and 19 columns. They are male count 3424 and female count 2968.This dataset has two eyes different diseases. We detect cataract disease from this research. After taking only cataract disease and normal eyes.

a. 304 left cataract image count
b. 290 right cataract image count
c. 250 left normal image count
d. 250 right normal image count

5. ACKNOWLEDGMENT *(HEADING 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g.” Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page. Collate acknowledgements, including information on grants received,in a separate section at the end of the article and do not, therefore, include them on the title page, as a footnote to the title or otherwise.

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