RETINOPATHY PROJECT REPORT

INTRODUCTION

Diabetic Retinopathy is the most prevalent cause of avoidable vision impairment, mainly affecting the working-age population in the world. The importance of diabetic retinopathy screening programs and difficulty in achieving reliable early diagnosis of diabetic retinopathy at a reasonable cost needs attention to develop a computer-aided diagnosis tool. Due to the complexity of the task, it can be quite difficult to extract useful options from huge datasets.

AIM

The aim of this challenge is to make Machine Learning algorithms for automated detection and grading of diabetic retinopathy and diabetic macular edema using retinal fundus images. Our proposed model is based on Convolution Neural Networks. As CNN's can predict straight from images at the pixel level, limited preprocessing is needed. Using deep learning will make predictions reliable and superfast.

DATASET

We have used the dataset of Fundus Images of retinal eye part and appropriate class of DR of image . The dataset is taken from the website and the training data of approx 8,000 images is uploaded onto kaggle along with a csv file containing labels details. There are 5 classes (0-4) and these classes represent the severity of the disease.We augmented the images according to requirement and the final dataset contains 12,000 images and their corresponding labels.

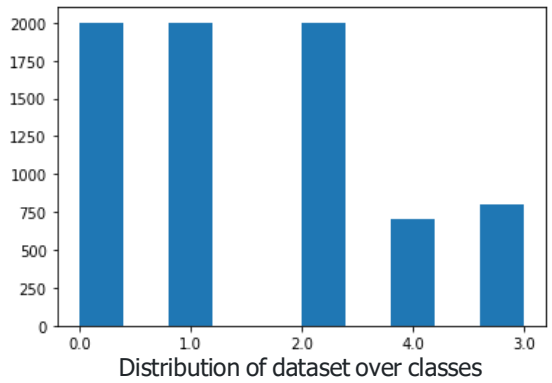
PREPROCESSING

In our model, we enhanced our images using RGB channels extraction, contrast limited adaptive histogram equalization (CLAHE), and illumination correction.We balanced the number of images with respect to their labels so that the model will not be underfitting.

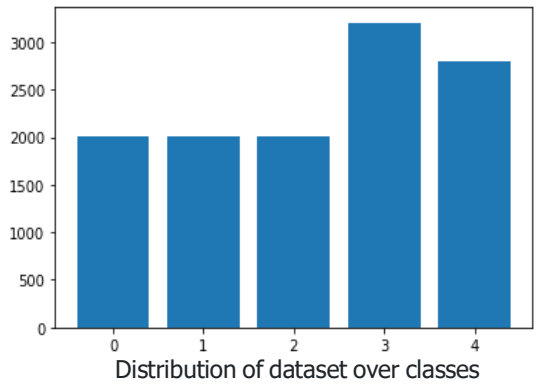
- We enhanced the RGB channels of the original image so that we can distinguish various parts of the retina easily.The details that vanished because of high red color channel values were now visible.
- We used 'contrast limited adaptive histogram equalization' (CLAHE), to equalize the brightness of an image and to balance the RGB channels.

- Image Augmentation is the method which is used to make a dataset larger and robust. Additional images are added in the dataset using previously existing images. Image Data Generator is used to create augmented images with illumination and flip changes for the labels which are low in count to balance the total number of images.

Initial Dataset



Dataset after augmentation of images:



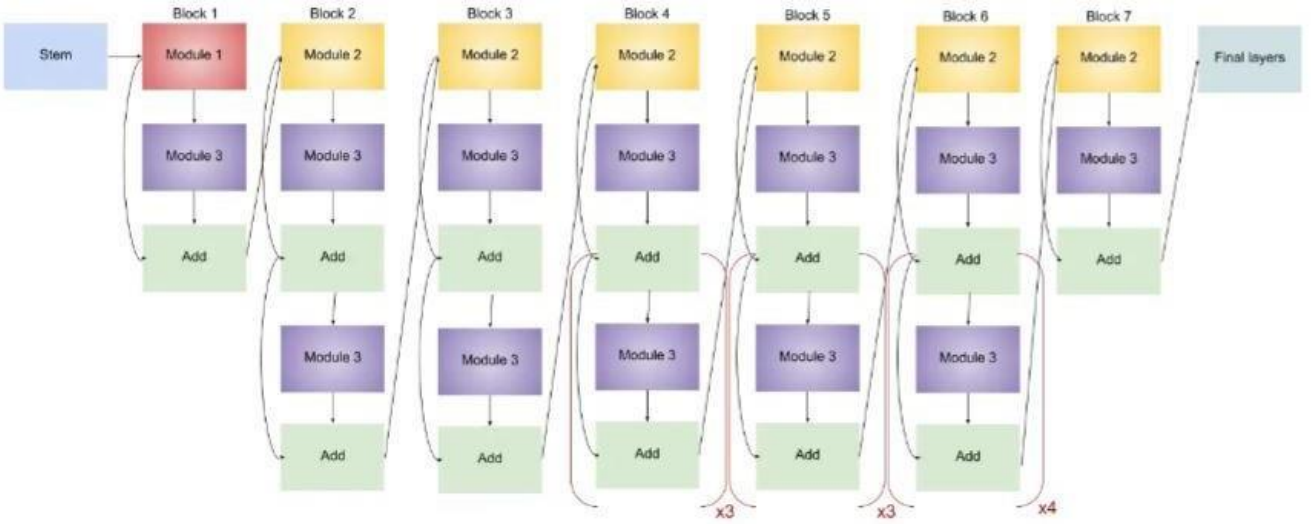
MACHINE LEARNING MODELS

We make models to detect the Diabetic Retinopathy level grading which take in the preprocessed training images as input and train on them.Various models are used to experiment with the images which include pretrained models,native models and custom networks to increase the accuracy of prediction .The best working model out of all of them was EfficientNetB3.

EfficientNetB3 model:

EfficientNet is a convolutional neural network architecture and scaling method that uniformly scales all dimensions of depth/width/resolution using a compound coefficient.

- In our model, we have used EfficientNet-B3 . The pretrained weights of EfficientNet-B3 on **ImageNet** have been initialized.
- The include_top layer is set to false which will not load the Fully Connected layer for giving output.
- **Max Pooling** is done as it helps in extracting sharp and smooth features and reduces overfitting.
- **Batch normalization** which is used to standardize the data and dropout has been added.
- Classification section has **3 dense layers** with 1024, 128, 5 layers respectively. In the first two layers, we have implemented **l1** as well as **l2 regularization**.
- **Relu** is used as the activation function as it converges quickly and thus takes much less time when compared to models and it doesn't suffer from vanishing gradients
- The final layer has 5 neurons with activation function of **SoftMax**. We have 5 neurons because we have to predict severity and severity scale has 0,1,2,3,4 as classes to predict.
- While training the model, the loss function used was **categorical cross entropy** as this is a multi class classification and the labels are one hot encoded.
- **Callbacks** : **Early stopping**, and **Reduce learning rate** because too many epochs can lead to overfitting of the training dataset, whereas too few may result in an underfit model.
- **Optimizer used** : **Adamax** optimizer with lr = 0.01 is used.
- Finally, we train the model for **20 epochs** and **batch size 16**.



Architecture for EfficientNet-B3

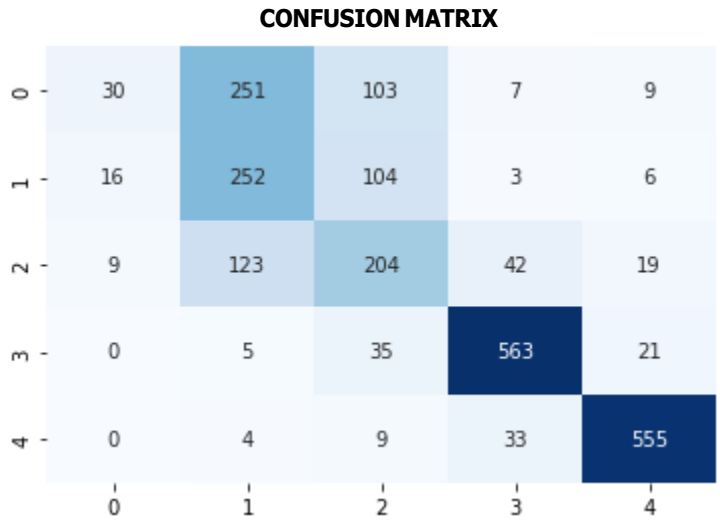
OBSERVATIONS

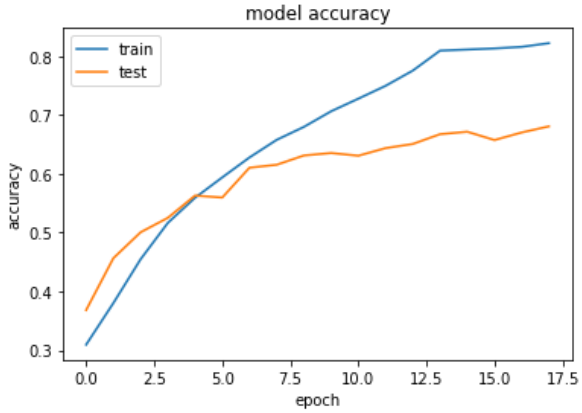
The observations of various models are compiled in the following table:

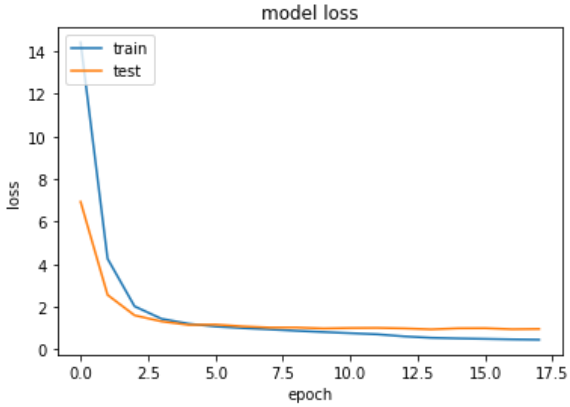
MODEL NAME	VALIDATION ACCURACY
DenseNET model	val_accuracy: 0.5035
VGG16 model	val_accuracy: 0.5814
Inception Model	val_accuracy: 0.4603
Inception and Resnet model with Attention	val_accuracy: 0.3770
EfficientNetB3	val_accuracy: 0.6808
Resnet50 Model	val_accuracy: 0.3616
Custom Baseline Model	val_accuracy: 0.5714

RESULTS AND CONCLUSION

From the above results we can conclude that the EfficientNetB3 model with a validation accuracy of 68.08% works best for the current challenge.







Levels	precision	recall	fscore
Level 0	0.545455	0.075	0.131868
Level 1	0.39685	0.661417	0.496063
Level 2	0.448352	0.513854	0.478873
Level 3	0.868827	0.902244	0.88522
Level 4	0.909836	0.923461	0.916598

Precision,Recall and F1 Scores

We also observed that data preprocessing significantly influenced the outcomes, and that if data imbalance is not taken into consideration, model performance may suffer.

REFERENCES

1. https://medium.com/analytics-vidhya/predict-retinal-disease-with-cnn-retinal-oct-images-dataset-6df09cb50206
2. https://www.kaggle.com/code/manifoldix/inceptionv3-for-retinopathy-gpu-hr
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