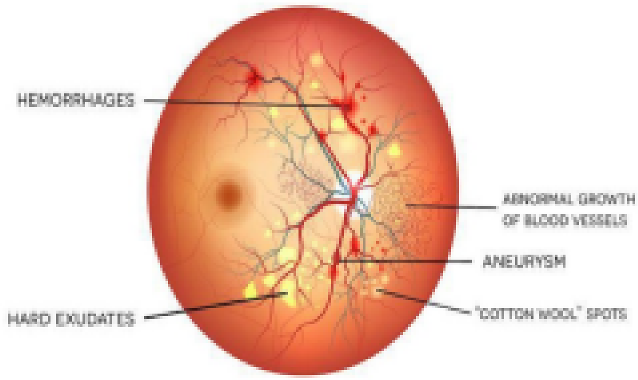
EYE DISEASE CLASSIFICATION

Abstract: One of the main causes of blindness worldwide is diabetic retinopathy (DR), a serious eye condition that is a result of diabetes. Early detection of DR may allow for prompt treatment and shield against permanent visual loss. No DR, mild, moderate, severe, and proliferative are the five stages of DR severity. Images of the retinal fundus are frequently utilised to diagnose DR. We suggest using the DenseNet-121 model, a pre-trained convolutional neural network, for the purpose of an automated early diagnosis of DR from colour fundus images (CNN). We used the openly accessible Kaggle APTOS 2019 Blindness Detection dataset for this analysis. Hype-parameter tuning and data augmentation approaches are employed to attain a satisfactory classification performance.The validation accuracy attained by training the model results out around 72 %.

Introduction

Diabetes retinopathy (DR) is a diabetes condition that is a diabetic complication and one of the major causes of blindness.According to the World Health Organization (WHO), the number of diabetic people hiked to 422 million in 2014, with an expectation to reach 700 million by 2045.One of the long-term diabetic microvascular effects is diabetic retinopathy. Damage to the blood vessels of the light-sensitive tissue at the rear of the eye causes it (retina).In most situations, the early stages of DR are symptomless, and in certain circumstances, it may just produce blurry vision difficulties.Fortunately, early identification can help avoid visual loss.However, if not screened on a regular basis, it may cause lasting damage.As a result, numerous studies have been conducted in the development of automated methods to detection DR at an early stage.Visible retinal lesions include microaneurysms (MAs), haemorrhages, hard exudates, cotton-wool spots, intraretinal microvascular abnormalities



(IRMA) and venous beading.

Convolutional neural networks have proved to be highly promising and effective in the development of computer aided methods, particularly in the domain of medical image processing and analysis.The selected model of our method is a pre-trained CNN model called DenseNet-121 for the grading of DR based on their severity level. .The aim of our method is to contribute to the creation of an end-to-end automated system capable of generating trustworthy DR diagnosis.In order to achieve an adequate

Methodology

A. Dataset Description

The dataset used for this research is the APTOS 2019 on diabetic retinopathy classification contest organised by the Asia Pacific

Tele-Ophthalmology Society.The dataset contains 3662 retinal fundus images of variable sizes.Fundus images provided in this dataset are categorised into five classes: No DR (Class 0), Mild DR (Class 1), Moderate DR (Class 2), Severe DR (Class 3), Proliferative DR (Class 4).

The dataset has a severe imbalance in the amount of photos divided into the five classes. Bias in favour of the dominant

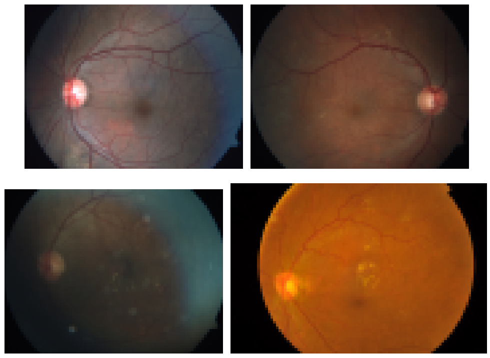
B. CNN Model

A proposed CNN design is called DenseNet121, or densely connected convolutional networks. Each layer in this network is directly connected to all the layers below it. Because it is a smaller model, DenseNet121 is less likely to overfit. It is made up of four substantial

classification performance, data preprocessing and data augmentation techniques are used.

class may result from imbalance in a dataset.

We have used oversampling on the minority classes inside the training set to prevent issues with class imbalance. To prevent complete duplication of the images due to oversampling, each image in the training set is then randomly rotated, sheared, zoomed, and flipped.



blocks. Every layer in DenseNet121 is openly exposed to the loss function gradients, which has other advantageous effects such as lowering the problem of the disappearing gradient, enhancing function propagation, encouraging reuse, and drastically lowering the number of parameters.

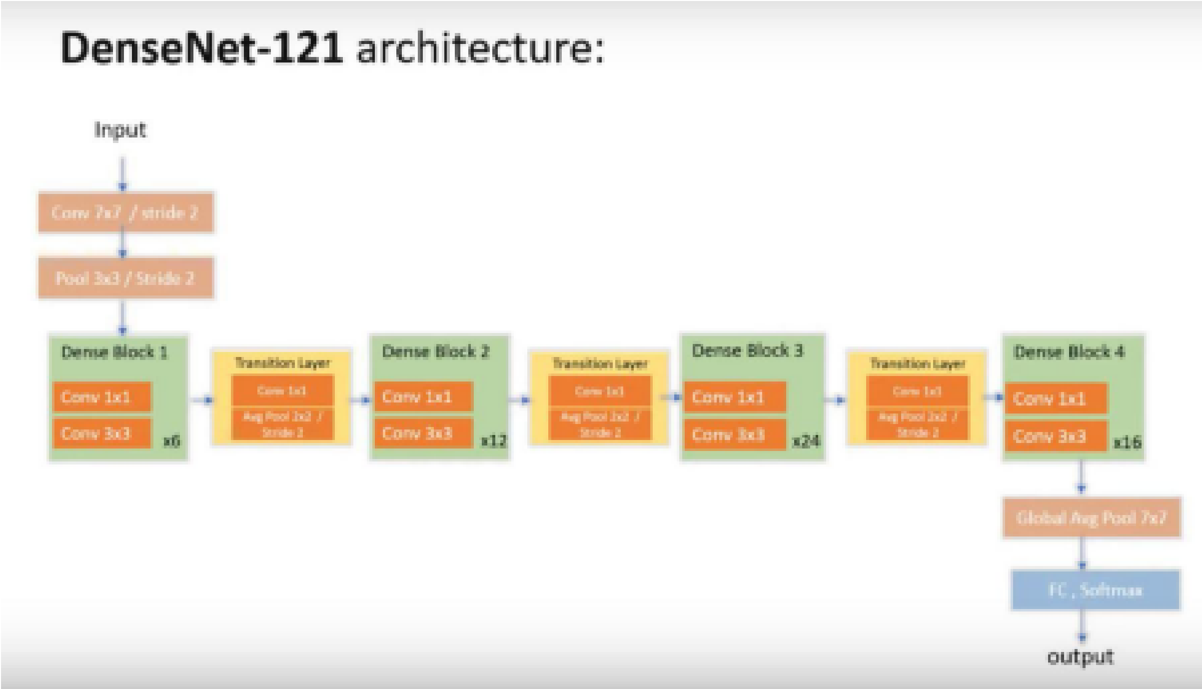
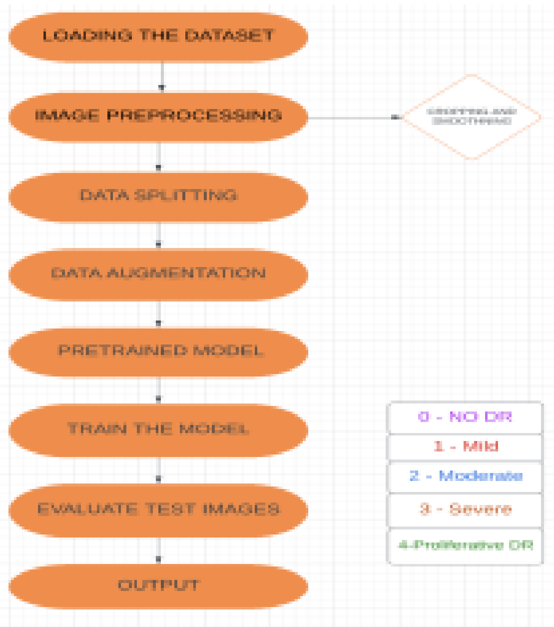


Figure -1

C. Approach

Below is the flowchart of the process of functionality of the Densenet121 pretrained model in this implementation.



Result

Here , the results of the experiment are enumerated below.

Introducing the Evaluation criteria first :

– Evaluation Metrics

The performance of all the used models in our study are evaluated using four metrics-accuracy, precision, recall (sensitivity) and F1 score. Observing the number of true positives (TP), false positives (FP), true negatives (TN) and false negatives (FN) from the confusion matrices obtained from each CNN model, the metrics are calculated using the equations given below:

$$(10.1)\quad Accuracy = \frac{T_p + T_n}{T_p + T_n + F_p + F_n}$$

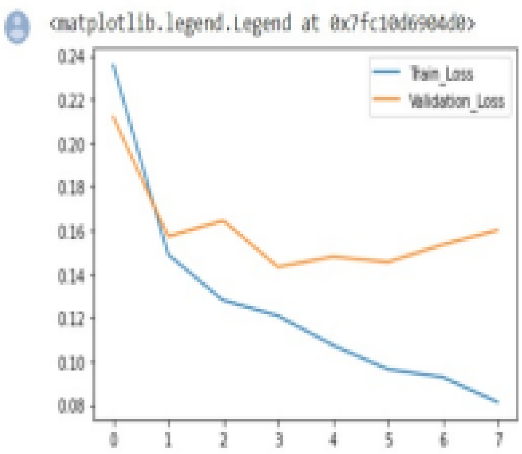
$$(10.2)\quad Precision = \frac{T_p}{T_p + F_p}$$

$$(10.3)\quad Recall = \frac{T_p}{T_p + T_n}$$

$$(10.4)\quad F_1 = 2 \cdot \frac{precision \cdot recall}{precision + recall}$$

Figure -2

Accuracy and f1_score attained after training the model :



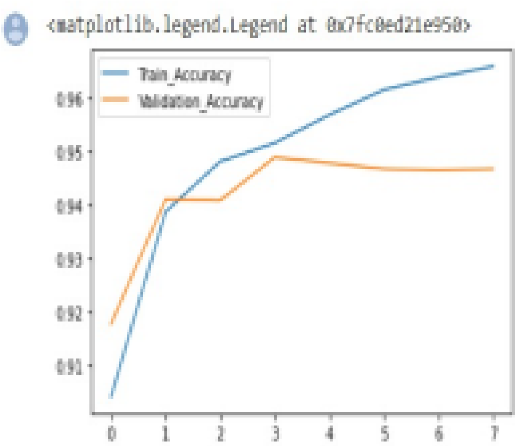
Train_Loss vs Validation_Loss

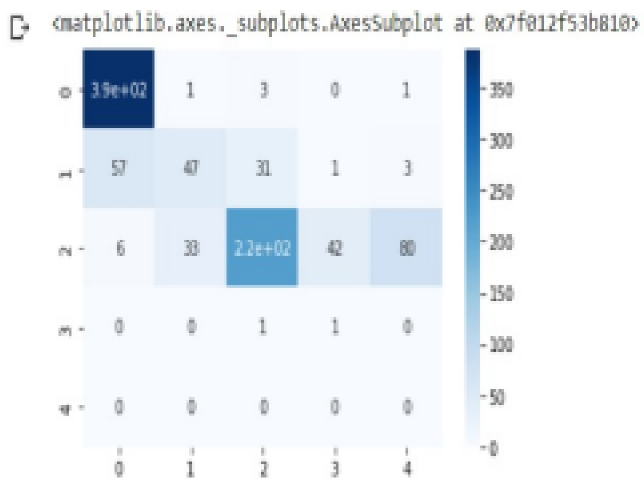
Model	Ac
Densenet-121	72

F-1 Score 30%

Implementation visuals along with confusion matrix :

Train_Accuracy vs Validation_Accuracy





Confusion matrix

Conclusion

In this study the proposed system uses a pre-trained DenseNet-121 CNN model for the DR classifications task. The dataset used was highly imbalanced which is handled by data augmentation and random geometric transformation of each image of minority classes.This has improved the overall classification performance of the model. The major objective of this study is to contribute to the automated classification of diabetic retinopathy.The validation accuracy attained by training the model results out around 72 % and f1_score around 30% .

References

1. S. H. Kassani, P. H. Kassani, R. Khazaei Nezhad, M. J. Wesolowski, K. A. Schneider and R. Deters, "Diabetic Retinopathy Classification Using a Modified Xception Architecture", *2019 IEEE International Symposium on Signal Processing and Information Technology (ISSPIT)*, pp. 1-6, 2019.
2. R. Ghosh, K. Ghosh and S. Maitra, "Automatic detection and classification of diabetic retinopathy stages using CNN", *2017 4th International Conference on Signal Processing and Integrated Networks (SPIN)*, pp. 550-554, 2017.
3. Z. Gao, J. Li, J. Guo, Y. Chen, Z. Yi, and J. Zhong, ‘‘Diagnosis of diabetic retinopathy using deep neural networks,’’ IEEE Access, vol. 7,pp. 3360–3370, 2019 4. Amalia, R.; Bustamam, A.; Sarwinda, D. Detection and description generation of diabetic retinopathy using convolutional neural network and long short-term memory. J. Phys. Conf. Ser. 2021, 1722, 12010.
5. Gayathri, S.; Gopi, V.P.; Palanisamy, P. Diabetic retinopathy classification based on multipath CNN and machine learning classifiers. Phys. Eng. Sci. Med. 2021, 44, 639–653.