International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2020 www.irjet.net p-ISSN: 2395-0072

Early Detection and Grading of Diabetic Retinopathy using Deep Learning

Neeta Mesta[1], Kamakshi Bichu[2], Alisha Barretto[3], Shayesha Mhamal[4], Mrunal Sawant[5]

[1,2,3,4,5] *Department of Electronics and Communications Engineering, Agnel institute of Technology and Design, Assagao, Goa.*

Abstract – *Diabetic Retinopathy(DR) is an eye disease related to long status diabetes. As of now, the detection of DR is a time-consuming and guide technique that calls for a trained clinician for examination and assessment of the digital shade fundus photos of the retina. Since that is a guided procedure, this will take a number of days or even weeks relying on numerous factors, the delayed results cause lost observe ups, miscommunication and not on time treatment. There is a wonderful need for the DR screening process to be automated and former efforts have made good progress using picture classification, pattern recognition and deep learning. Here we present a deep learning system that takes in a colour fundus photograph as input as detects the presence and additionally classifies the photograph according to the severity of the disease.*

1. INTRODUCTION

The area of focus of this project work is the development of an algorithm to rate the presence of diabetic retinopathy in each image on a scale of 0 to 4 where,
0 - No Diabetic retinopathy
1 – Mild
2 - Moderate
3 - Severe
4 – Proliferative DR

The reason behind choosing this topic is that the regular process of detecting the disease is very arduous and time consuming and therefore automated detection and grading of diabetic retinopathy is very important in order to tackle the above problem. Early stage detection is also very important for diagnosis which can prevent blindness. Moreover, this model can also be used as a second opinion.

1.1 Artificial Intelligence

Artificial intelligence refers to the simulation of human intelligence in machines that are programmed to assume like human beings and mimic their movements. The ideal feature of artificial intelligence is its capacity to rationalize and take moves that have the satisfactory risk of achieving a specific goal.

The packages of artificial intelligence are endless. It can be applied in many different industries and sectors. AI is being tested and used in the healthcare industry, self - driving cars, computers playing chess, banks, etc.

1.2 Deep learning

Deep learning is an artificial intelligence function that mimics the working of the human brain in processing the data and creating patterns for use in decision making. Deep learning is a subset of Machine learning in artificial intelligence that has networks capable of learning unsupervised form of data that is unstructured or unlabelled.

1.3 Convolutional neural networks (CNN's)

A convolutional neural network is a Deep learning algorithm that takes in a photograph as an input, assigns importance to numerous aspects in the photo(weights) and be able to then distinguish different photos one from another. While in primitive methods, filters are hand engineered, with enough training, convnets have the ability to study those filters. The architecture of convnets is similar to that of the connectivity patterns of neurons in the human brain and was stimulated by the company of visual cortex. Individual neurons reply to the stimuli best in a restricted place of the visual field called receptive field. A series of such fields overlap to cowl the entire visual area.

2. DEEP LEARNING MODELS

We started by training the model on a simple CNN. The results that we obtained from that model was bad. The precision and recall scores were averaged out to 50%. The reason for such bad performance was that or dataset was imbalanced. We then moved on to implement the model using transfer learning and fastai library. We used the inceptionv3, VGG16, Densenet, VGG19, resnet34 and resnet50. The results obtained were good enough as can be seen from the figures below.

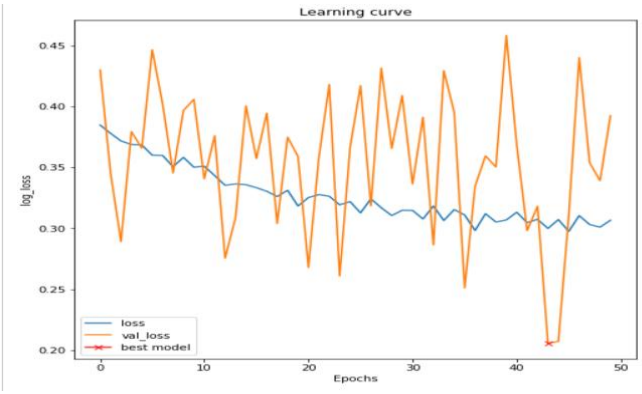

Fig 1: learning curve

Loss: 0.24203035235404968
Accuracy: 0.879999995231628

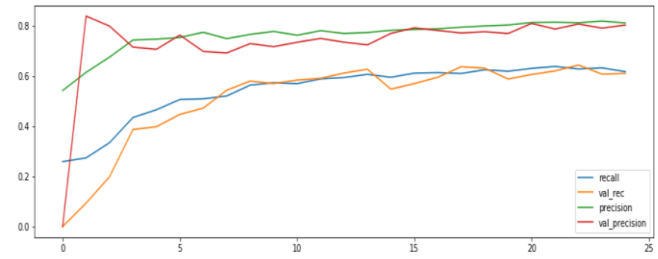

Fig 2: Precision and recall

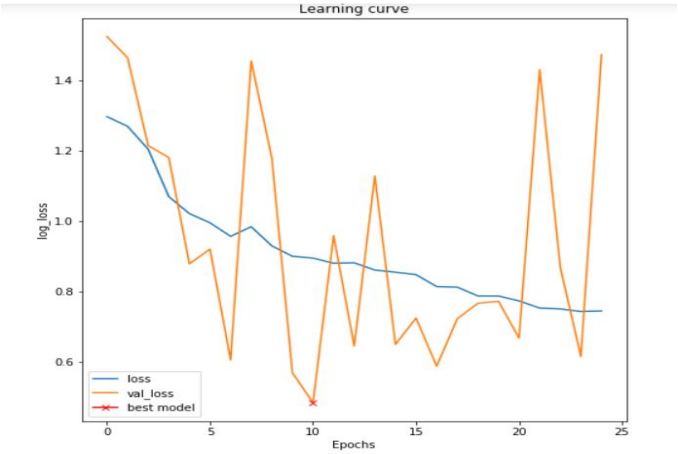

Fig 3: Learning curve

Precision: 0.8565593361854553
Recall: 0.7142857313156128
Loss: 0.6666666865348816
AUC: 0.9088888168334961

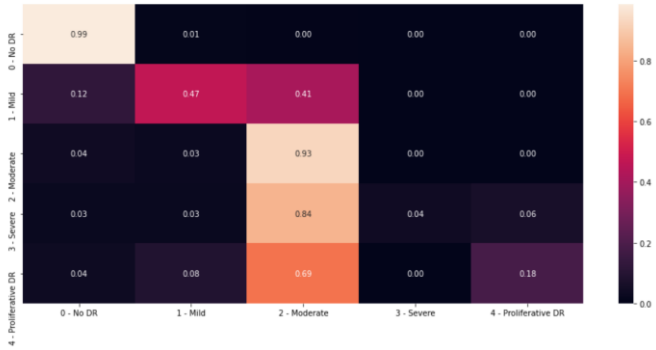

Fig 4: Confusion matrix

```
Train Cohen Kappa score: 0.815
```

Fig 5: Kappa score for the above model

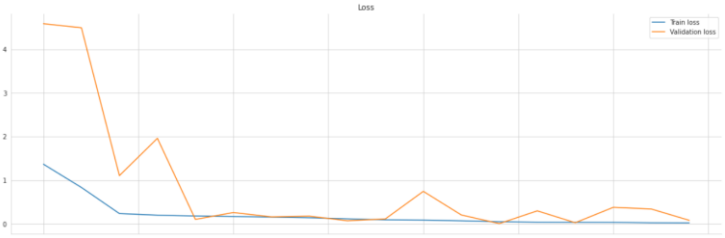

Fig 6: Loss graph

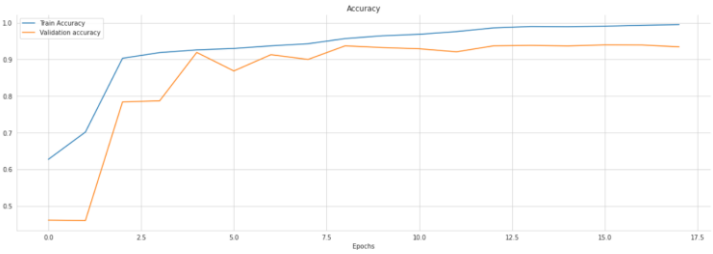

Fig 7: Accuracy graph

```
The accuracy is 0.8214285969734192
```

Fig 8: Accuracy on fastai model

```
ROC area is 0.9025908633159389
```

Fig 9: ROC area

3. GUI for the model

We most of the times used Jupyter notebook or some similar environment and all our analysis, finings and explorations are within jupyter notebook or other similar Python environment. So it's a good option to expose this

model into a web application so that the end users are in a position to interact with the model. During the development of the model, it's rest API is exposed to the front end application. It can either be a web app or a mobile app. So in order to develop an API for the model, either flask or Django frameworks can be used. They are the most popular frameworks of python. Apart from web API, flask and Django can be used to create web based framework. Django is a full stack web framework while flask is a micro and light weight web framework. We went ahead with Django in this project.

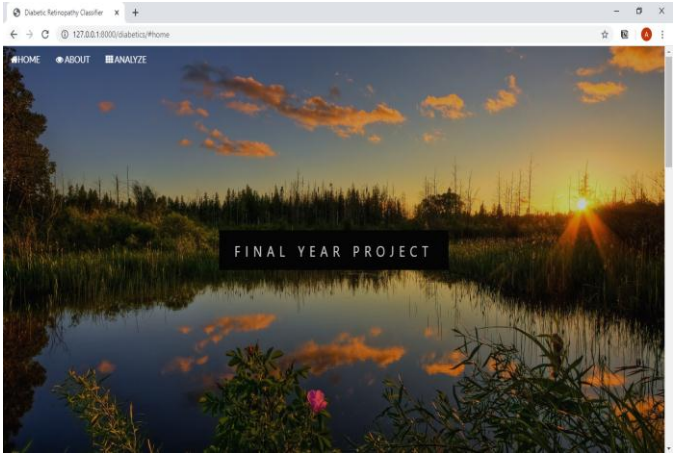

Fig 10: GUI for the model-1

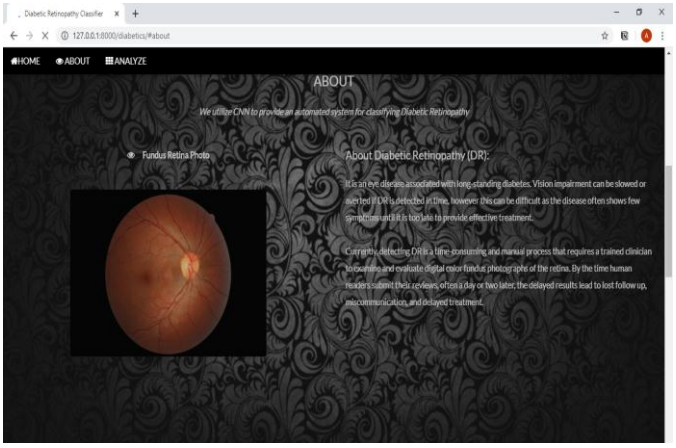

Fig 11: GUI for the model-2

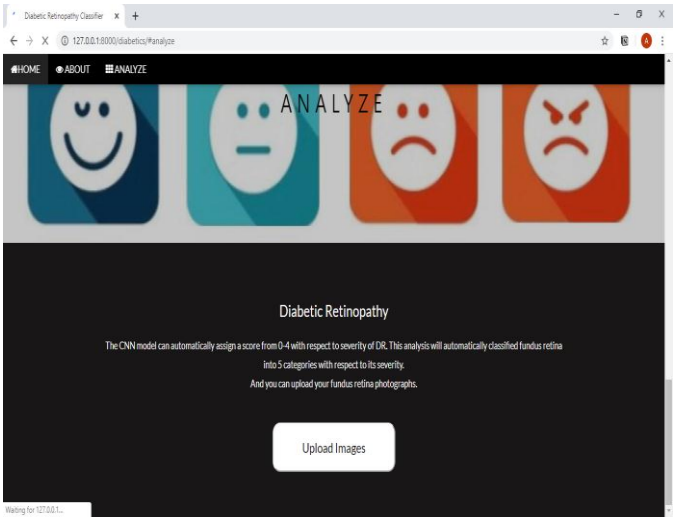

Fig 12: GUI for the model-3

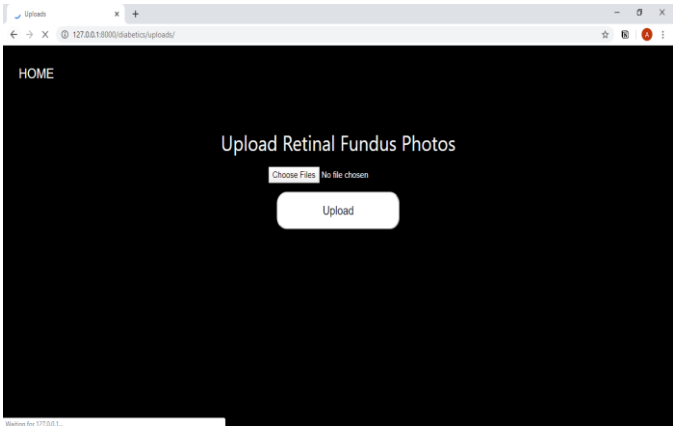

Fig 13: GUI for the model-4

4. CONCLUSION

The motivation behind this project was to automate the disease detection, to speed up disease detection and use this model as a second opinion. The model could diagnose the No diabetic retinopathy case and the moderate diabetic retinopathy case very well, the mild diabetic retinopathy case moderately well but the classification ability of the model was poor for the severe and proliferative diabetic retinopathy case. This is because of the imbalanced dataset available with us. The dataset contained many images of the No DR, mild and moderate cases but the number of images for the severe and proliferative DR were few. In future we aim to build a more robust system by acquiring more images belonging to the severe and proliferative case so that the classification ability of the model improves.

ACKNOWLEDGEMENT

We express our profound gratitude towards our principal Dr. V. Mariappan for his constant support and motivation. We heartily thank our internal project guides Prof. Mrunal Sawant and Prof. Vijaya Hadfadkar for their approval, advice, constant support and motivation throughout the course of our project.

We would also like to extend our gratitude towards Dr. Girish Velis , an Eye surgeon at the vision hospital Goa.

REFERENCES

[1] Diabetic Retinopathy Detection using Image Processing (GUI) - R.Subhashini, T.N.R.Nithin, U.M.S.Koushik
[2] Diagnosis of Diabetic Retinopathy Using Machine Learning Classification Algorithm- Karan Bhatia, Shikhar Arora and Ravi Tomar
[3] Diagnosis of Diabetic Retinopathy Using Deep Neural Networks - ZHENTAO GAO1, JIE LI2, JIXIANG GUO1,YUANYUAN CHEN 1, ZHANG YI 1 AND JIE ZHONG 2
[4] Deep Learning Models for Retinal Blood Vessels Segmentation: A Review - TOUFIQUE AHMED SOOMRO 1,5, (Member, IEEE), AHMED J. AFIFI 2, LIHONG ZHENG 1, SHAFIULLAH SOOMRO3, JUNBIN GAO 4, OLAF HELLWICH2 AND MANORANJAN PAUL 1