Diabetic Retinopathy Detection

Adarsh Sharma, Harshit Joshi, Dilan Setiya, Antara Ganapathy

Univ.AI

Abstract

Millions of people suffer from diabetic retinopathy, the leading cause of blindness among working-age adults. The manual diagnosis process by ophthalmologists is time, effort, and cost-consuming. For people in rural areas, this diagnosis only gets harder. The goal is to scale efforts through technology; to gain the ability to automatically screen images for disease and provide quicker and more affordable healthcare. We will be training two CNNs, with and without transfer learning, on the Indian Diabetic Retinopathy Image Dataset (IDRID).

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Introduction

Diabetic Retinopathy is a complication that affects the eye due to the result of high blood glucose called diabetes. Diabetic retinopathy can cause the blood vessels within the retina to leak fluid or hemorrhage (bleed), which can lead to a blurred or impaired vision. It's a severe and widely spread disease. The danger of the disease increases with age and thus, middle aged and older aged people with diabetes are vulnerable to Diabetic Retinopathy. Of an estimated 285 million people with diabetes mellitus worldwide, approximately one third have signs of diabetic retinopathy. Early symptoms of diabetic retinopathy include blurred vision, darker areas of vision, eye floaters and difficulty in perceiving colours. Diabetic Macular Edema is the most common cause of vision loss in people with diabetic retinopathy. Available physical tests to detect diabetic retinopathy include pupil dilation, visual acuity test, optical coherence tomography, etc. But detecting DR is time consuming and patients need to suffer a lot. Hence, this paper includes four models, two with transfer learning and two without transfer learning that focuses on automated computer aided detection of diabetic retinopathy and the risk of macular edema using convolution neural networks (CNNs).

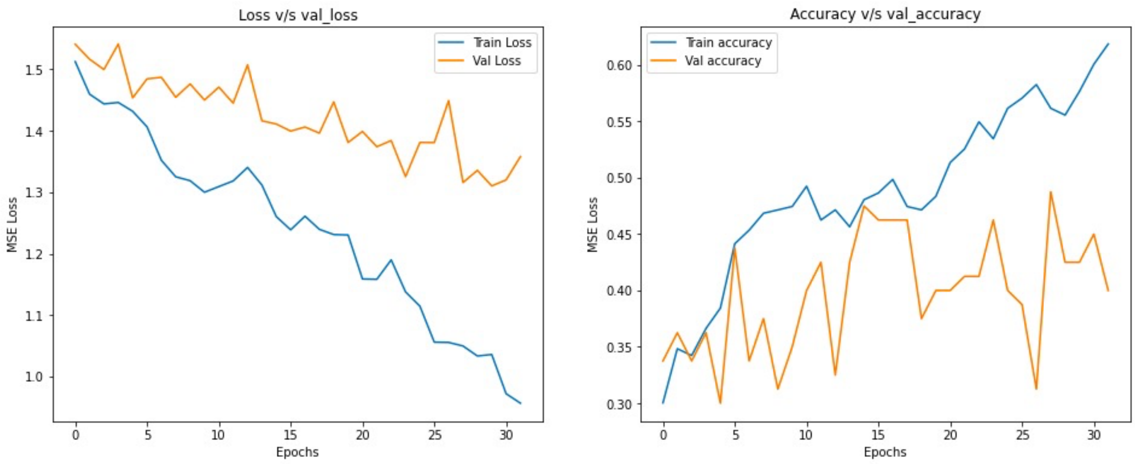
Approach

We trained one model each to predict the retinopathy grade and the risk of macular edema. We approached this by creating two sets of models, one trained without transfer learning, and the other trained with transfer learning. We used gaussian blur(also known as Gaussian smoothing) as a pre-processing stage.
Gaussian blur is used to reduce the image noise and in our case we used it to highlight Abnormal Growth of Blood Vessels and Aneurysm. The effects of gaussian blur helped the model to focus on the parts of eyes that are causing Diabetes Retinopathy and Macular Edema.

2.1. Without transfer learning

2.1.1. Model to predict retinopathy grade

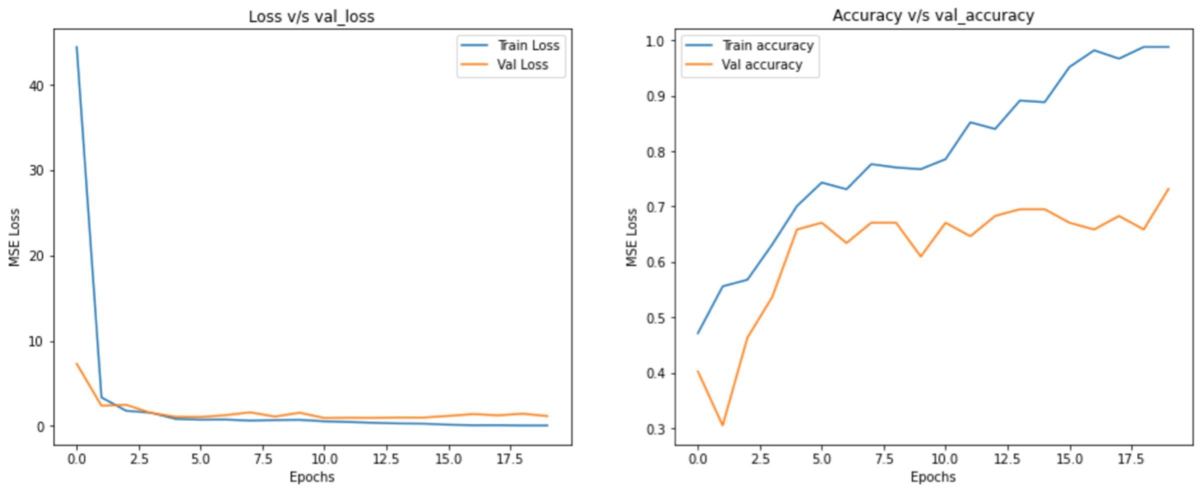
We applied gaussian blur and rescaled our datasets to pre-process our images. We used 20% of our training data for validation. After training, our model has a val-accuracy of 56%. We tried to experiment with hyperparameters such as the sigma value in gaussian blur, the learning rate, the no. of epochs, batch size, no. of layers, adding dropouts and data augmentation. However, we weren’t able to achieve a val-accuracy above 70%, which we intend to improve.



Graph of model loss and accuracy

2.1.2. Model to predict risk of diabetic macular edema

We applied gaussian blur and rescaled our datasets to pre-process our images. We used 20% of our training data for validation. After training, our model has a val-accuracy of 74%. We experimented with hyperparameters such as the sigma value in gaussian blur, the learning rate, the no. of epochs, batch size, no. of layers, adding dropouts and data augmentation.

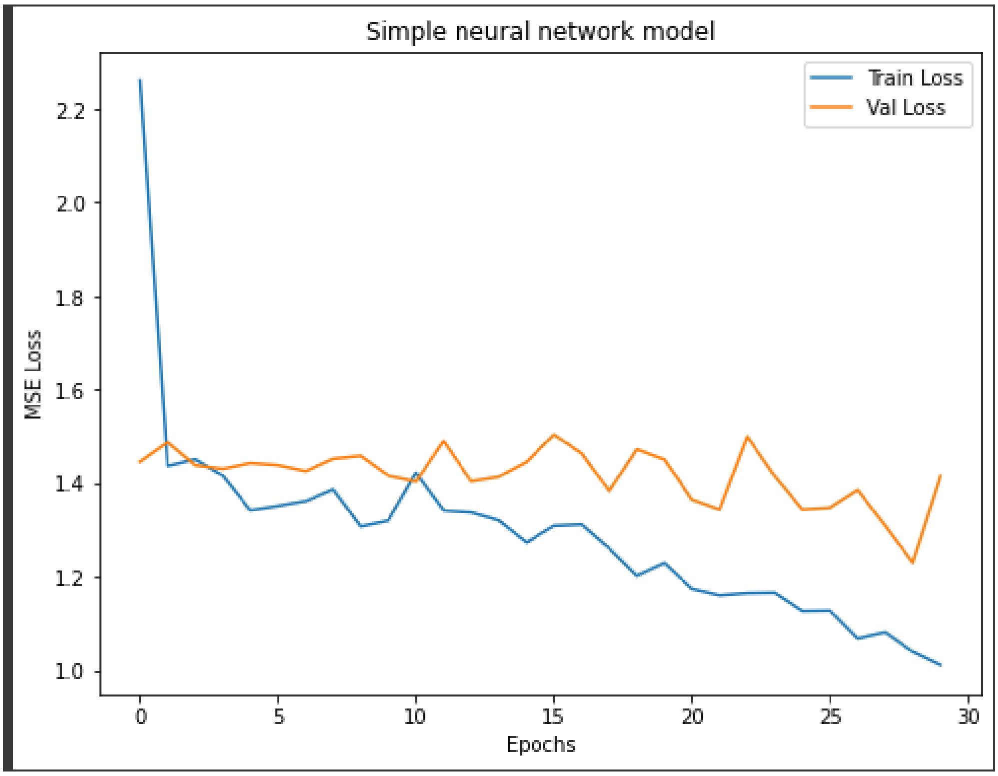


Graph of model loss and accuracy

2.2. With transfer learning

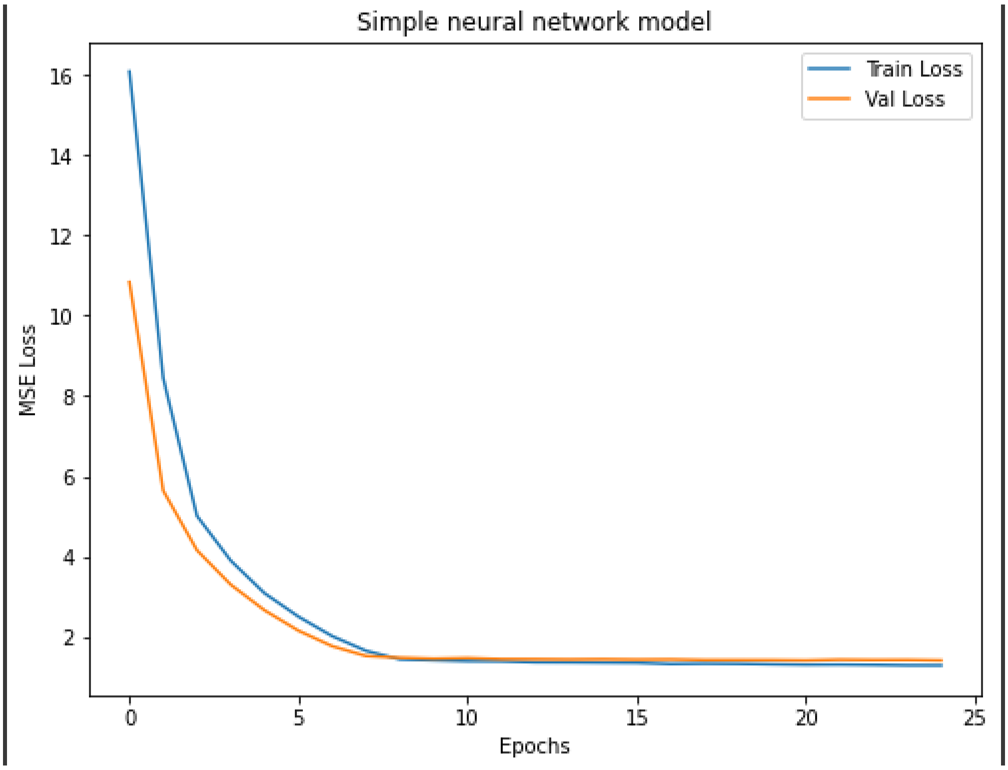
2.2.1. Model to predict retinopathy grade

We applied gaussian blur and rescaled our datasets to pre-process our images and added data augmentation. We used 20% of our training data for validation. After training, our model has a val-accuracy of 45.63%. We experimented with hyperparameters such as the sigma value in gaussian blur, the learning rate, the no. of epochs, batch size, no. of layers, adding dropouts and data augmentation.



2.2.2. Model to predict risk of diabetic macular edema

We applied gaussian blur and rescaled our datasets to pre-process our images and added data augmentation. We used 20% of our training data for validation. After training, our model has a val-accuracy of 38.83%. We experimented with hyperparameters such as the sigma value in gaussian blur, the learning rate, the no. of epochs, batch size, no. of layers, adding dropouts and data augmentation.



Conclusion

This report summarizes our study on the detection of Diabetic Retinopathy and risk of Diabetic Macular Edema. Our study uses neural networks and image processing for detection using different architectures. It is certain that using machine learning techniques will give us good results along with good accuracy for prediction. In this report, we explored the potential usage of the CNN in retinal image classification. Due to the tedious manual methods by medical personnel, an automated system can reduce the labor involved in diagnosing large quantities of retinal images significantly as early detection and diagnosis of diabetic retinopathy help the patients from blindness and also the severe effects of disease can be decreased.

Future enhancements

We will enhance the amount of our data set to improve the accuracy of our model even further. To achieve high accuracy, we will also experiment with the following hyper parameters: batch size, learning rate, epochs, number of layers, data augmentation, and the sigma value in gaussian blur. Nonetheless, for more efficient outcomes, we shall better pre-process the image.

References

- https://www.tutorialspoint.com/opencv/opencv_gaussian_blur.htm
- https://www.geeksforgeeks.org/python-shutil-copy-method/
- https://docs.python.org/3/library/functions.html