IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Diabetic Retinopathy Detection Using Convolutional Neural Network With Rectified Linear Unit and Softmax As An Activation Function

Tejas Phirke[1], Omkar Parte[2], Aniket Garje[3], Prof. Sanjay .S. Kadam[4]

[1,2,3] Student, Dept of Information Technology Engineering, BVCOE Navi Mumbai, Mumbai, India
[4,5] Assistant Professor, Dept of Information Technology Engineering, BVCOE Navi Mumbai, Mumbai, India

Abstract - Diabetic retinopathy (DR) is a type of disease which is spreading in significant numbers, it not only spreads in India but also in all over the world. The increase in the spread of disease can lead to many deaths since there is no proper medication that can heal the patient. Diabetic Retinopathy is a disease that occurs due to irregular blood flow in retina vessels and weakens the retina. Due to the irregularities in the blood vessels patients face difficulty in the vision loss and can also make the patient blind. In this paper, we used deep learning which includes Convolutional Neural Network (CNN) provides better accuracy by using Rectified Linear Unit (ReLU). As there are various image classification techniques but CNN provides much better accuracy from other techniques. For detecting a particular part of the eye, it needs advanced mechanisms and tools. The main objective is to provide lucid image classification among other images with better accuracy.

Index Terms- Diabetic Retinopathy, Convolutional Neural Network, Rectified Linear Unit

I. Introduction

Diabetic retinopathy is a common disease nowadays because of lots of diabetic patients not aware about this disease. It causes vision loss as well as blindness. It is caused by damaging the retina by choking blood vessels as increasing the level of blood in the retina. Almost 171 million individuals worldwide were diagnosed with diabetes in 2000, and it is expected that this number will rise to 366 million by 2030. If diabetic is well treated and patients are aware of this disease then sometimes it is easily treated. In a diabetic the sugar level of the patient increases or decreases. At that time blood into the retina also increases therefore blood vessels are choked severe a blood vessels are damaged and it causes vision loss. To avoid this disease required well treatment. Diabetic retinopathy, a major cause of permanent blindness needs an early treatment though proper diagnosis. Many technical approaches have been made for the automatic detection of diabetic retinopathy through fundus images and other technologies. Today CNN, a part of deep learning is a very important technique in the field of image processing. In CNN technology images are classified into some part. Dermatoglyphics as a diagnostic aid used from ancient eras and now it is well established in a number of diseases which have strong hereditary basis and is employed as a method for screening for abnormal anomalies [13].

These convolutional neural network models are surrounded across image data space. There are various datasets that you can leverage for applying convolutional neural networks. Here are three popular datasets: MNIST, CIFAR-10, and ImageNet.

II. Research & Collecting idea

In this modern era, many people deal with a variety of health problems due to air pollution, so while searching for the idea, we found that many people are facing medical problems across the country. Today, Artificial Intelligence is mainly beneficial in the health care system which will predict and detect the type of disease in just a matter of time. In South India there are many people having DR. This problem is not only present in South India but also all over the world. As it is seen that due to changes in blood glucose, inadvertently causes retinal damage. It is quite difficult to see the patient blindness due to DR. Since, increasing this type of disease can not only lead to blindness but also causes death within twenty-four hours which is quite dangerous. Considering this problem, it can be treated with a lot of efficiency, since there is no medication available. Searching for problems, found the Kaggle site, it seems that it's beneficial to solve worldwide problems. Lots of people have already solved this problem by using different technologies of image processing. Sometimes it's very time-consuming for image processing. In Diabetic retinopathy detection Using Digital Image Processing by Kranthi Kumar Palavalasa and Bhavani Sambaturu they used public database to implement this project which contains the

ground truth for all images.The exudates are detected using the combination of background subtraction of fundus image, exudate candidate extraction to generate actual result [1]. Neural Network Technique for Diabetic Retinopathy Detection by Prabhajot Kaur and Son Sirsa they use the Neural Network approach to classify the images into different color modules. This was implemented in MatLab to predict the actual result [2]. Diabetic Retinopathy Detection by Extracted Area by Shailesh Kumar and Basant Kumar they used pre-processing techniques like green channel extraction by using the histogram they predicted the actual result [3]. A Modern Screening Approach for Detection of Diabetic Retinopathy by S.D. Shirbahadurkar and V. M. Mane and D. V. Jadhav used image processing. The retinal color fundus images are converted to gray scale. That gray scale image is binarized. That image is classified and using that classification result will predict [4]. Automatic Diabetic retinopathy Detection and Classification System by Z.A. Omarv and M. Hanafi and S.Mashohor also used classification technique.They are convert fundus image in different image patterns on the basis pattern predict results [5]. Wide-field imaging in diabetic retinopathy by T. Y. Alvin Liu and J. Fernando Arevalo use current data suggesting that Unified Write Filter imaging, as compared to conventional Early Treatment Diabetic Retinopathy Study fields, detects additional and more extensive pathologies [6].

III. Methodology

1. Detecting Diabetic Retinopathy:

Diabetic retinopathy can be detected by using the Retina of the eyes. The eyes having the retina, inside the retina lots of blood vessels are present. The retina of diabetic patients is different from the normal patient. The blood vessels are chocked inside the retina that indicate the patient has a diabetic. By using cnn we have detected the leaking blood vessels. The image of both the sides (left and right) are required to be clearer and more visible. That image has lots of pixels inside it. By using those pixels images are classified into the part of color sheds. If the blood vessels anywhere choked or leaked then that classified image easily detected the changes into the image. Then the algorithm detects if the patient has Diabetic Retinopathy or not.

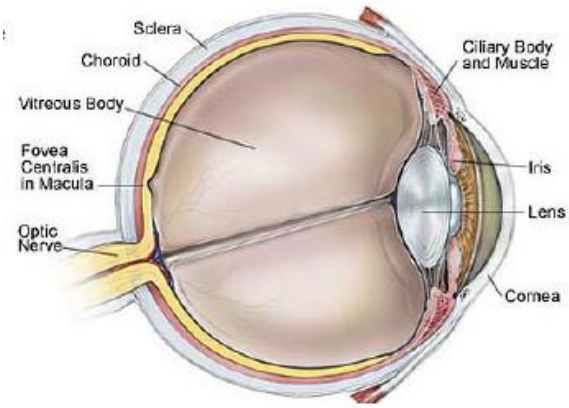
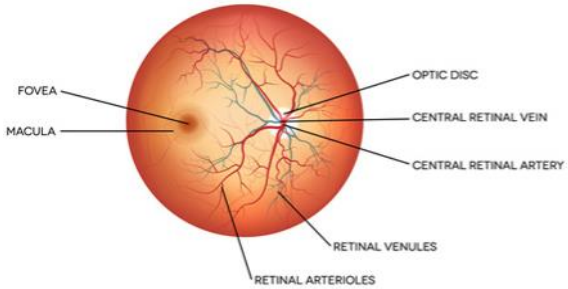
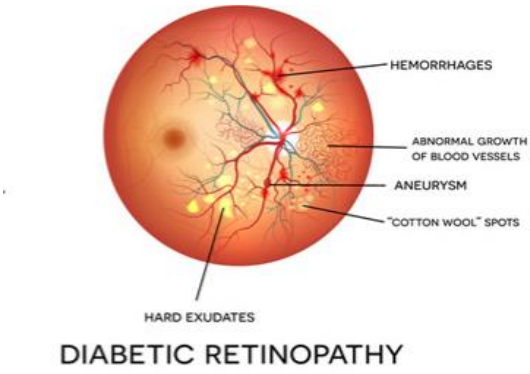


Fig 1. Retinal Image [7]



2(a)



2(b)

Fig 2. Normal vs Diabetic Retina. Figure 2(a) represents Normal retina while figure 2(b) represents Diabetic Retina [8]

A) Image Classification:

The python program has been written that data of images are labeled as the left and right that images store into the excel file in the format of 0 and 1. The train images store as 1 and the untrain images are stored as 0 format.

B) Image Resize:

All the fundus images taken for training have 4928x3264 resolution but will be resized down to 1024x720 resolution. Python opencv2 library has been used for resizing the images.

C) Fundus Images:

Fundus photography involves capturing photographs of the back of the eyes basically fungus images are captured by the micro photography camera. The eyes image capture machine captures the fundus images inside the eyes retina. That fundus images are clearer and the more visible to classification of the image. Also for detection of the blood vessels to predict the actual result.

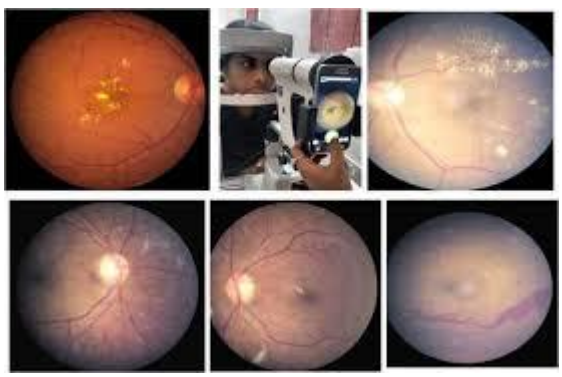


Fig 3. Various Fundus Images [9]

Above are the fundus images of the eyes to check whether that patient has the DR or not.

D) Layers:

Figure 4 represents that there are different layers present to work on images and predicate the actual result.

1. Convolution Layer: In the Convolution Layer the heavy computation is done to make future jobs easier.
2. Max-Pooling layer: In max pooling layer the highest weighted feature is extracted.
3. Flatten Layer: The Flatter Layer converts the matrix images into the one single array format.
4. Dropout Layer: That trains the images in the neural network and increases the probability and reduces the dropout rate.
5. Output Layer: The output layer predicts the actual result by using a matrix of images and classification of the image.

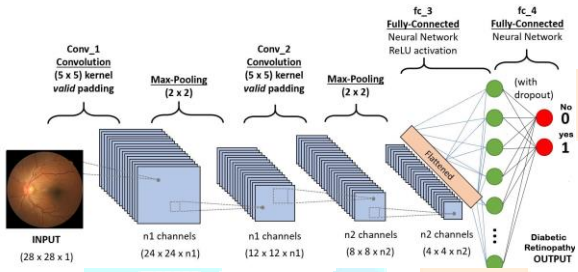


Fig 4. CNN Layers

2. Implementation:

The Figure 5 represents the architecture that follows the building of a model with supervised algorithms which includes convolutional neural networks. Tensor flow plays the major role for performing graphical processing units which basically helps to have high quality images that can be processed through various techniques including classification algorithms to train the model in various ways and explore it in different ways. Selecting the proper algorithm can make implementation easy and by using the histogram they can predict the actual result. Image Classification is done by using Convolutional Neural Network (CNN) there are various image classification techniques but CNN is most widely used. At first data is collected along with image labels. Image data is collected and preprocessing is done. Further to build the model we use a numpy array and using cv2 library from OpenCV to analyze the images. Image data is further splitted into training and testing data or validation data. CNN algorithm is applied on training dataset. Sample image is taken for training the model, scaling of raw pixels that ranges from 0 to 1. Using numpy libraries we further convert integers into vector forms. We train models using optimizer from Keras library, constructed image generator for data augmentation. In this model we use various convolutional layers to filter the images and using ReLU to maximize the pooling layers. By filtering from 32 size to 512 size. To avoid the overfitting, dropout layer. To normalize exponential function using Softmax activation function enables target range from 0 to 1. So the sequence for the image classifier goes from Conv2D of 32 size to another layer of Conv2D of max size 512. Before using the activation function there needs to convert into dimension layer which is a flatten layer, then use max pooling and finally dropout to avoid overfitting of data.

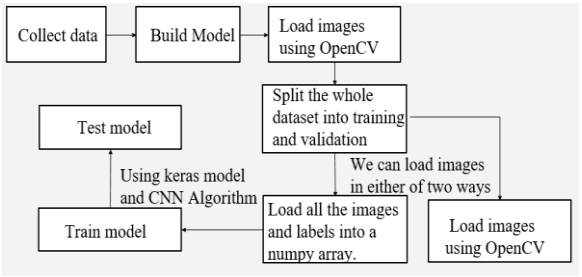


Fig 5. Flow Diagram

Html, CSS and JavaScript: Hyper Text Markup Language is the standard language for implementation of web applications. Also the Cascading Style Sheet is the makeup language for improving the web page design. Also the javaScript is basically used for more functionality in web applications. Using that technology implementation and interaction of applications are increasing and also this application is a more user friendly application. Any user can easily access this application through the mobile phone and also the desktop.

SQL Database: Structured Query Language is the domain based programming language to store the
Data on the local host or the server host. It is basically used for maintaining the structure of the data. The patient data report required to store for some days that easy to understand the report of the patient data. Also the patient is not required to upload the same images more than one time. Just log in and go to the report section to view his details of the data.

Tensor flow: Tensor Flow is a free and open source software library for machine learning to train the data. It can be used across a range of tasks but has a particular focus on training the data also in the neural networks. Tensor flow is a symbolic math library based on dataflow. By using the tensor flow we train the module to produce the appropriate result. First the data into the image format comes then that untrained data trains into the tensor flow module and train data are stored. That data is used for the future coming untrained data to predict the actual result. [11]

Flask Library: Flask is a micro web framework written python. It is classified as a micro framework because it does not require particular tools or libraries. It has no database abstraction layer, from validation or any other components where preexisting third party libraries provide common functions. [12]

However, Flask supports extensions that can add application features as if they were implemented in Flask.
Keras: Keras is an open-source software library that provides a Python interface for artificial neural networks. Keras acts as an interface for the Tensor Flow library. [10]

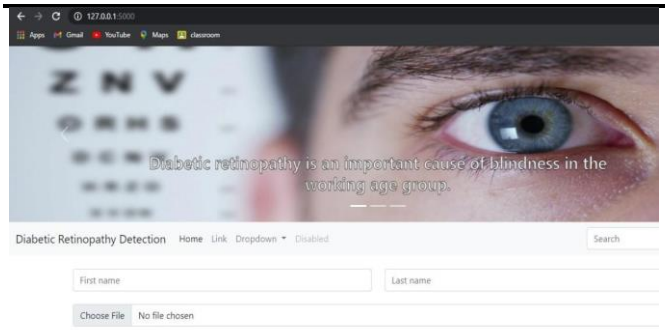


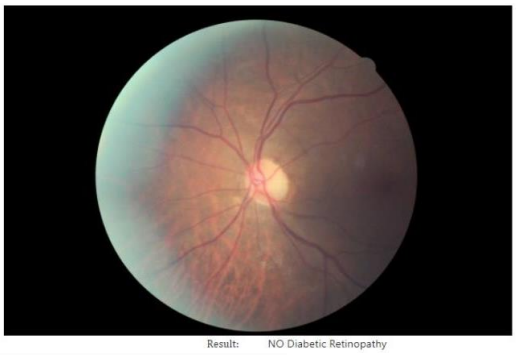
Fig 6. Web Application

Figure 6 shows that the Deployment is done using the Flask application. Flask is efficient to use and easy to present. So there are some deployment images that finalizes whether the patient is having diabetic retinopathy or not.

This web application basically shows that by browsing the images from the computer disk and further by having particular image from a computer to retinal images that will indicate that the person is facing the diabetic retinopathy based on some of the feature like image of retina. So, in figure 6 shows that patient should register himself at first then browse for retinal image. On further selecting the image the model thus runs in background so that image can be said whether the patient is having DR or not. Just as figure 7 representing the images of DR and no DR.

As going through various research papers we come up with binary classification of diabetic retinopathy which will state DR based on an algorithm used which is mainly convolutional neural network. Figures 7 web application mainly uses flask and some of the basic html and css for styling the web page in certain form and to make it more in attractive design and also user friendly. So, the web page will follow certain steps before checking for DR. Therefore, patients will not face any difficulty on the web page. As some features are not included like sharing the web page to another person through social media. As this is a model representing the sample, the output and this model can be advanced.

7(a)



7(b).

Fig 7. Representing in Application. Figure 7(a) represents the patient is having DR and Figure 7(b) represents that patient do not have DR

IV. Result

From figure 8. By analyzing images and running multiple epochs the training accuracy we get is around 76.92 % while validation accuracy is around 76.86 % The difference is pretty much low. At beginning the validation data loss is high then training loss thus overfitting happens due to larger validation loss. In the figure below the validation loss is greater.

Figure 9 Due to increase in training loss and decrease in validation loss, accuracy slightly decreases from 76.92 to 76.61 %.. Finally by avoiding overfitting and underfitting we get accuracy of 76.74 %

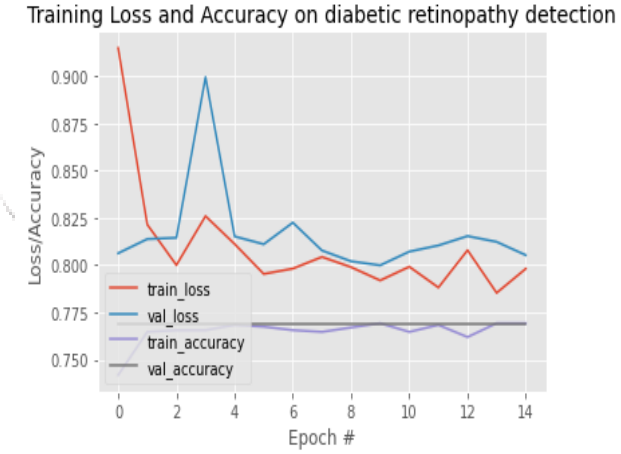


Fig 8. Overfitting

Now, from the Figure 9 graph the training loss is slightly higher than validation loss, hence there happens some sort of underfitting of data.

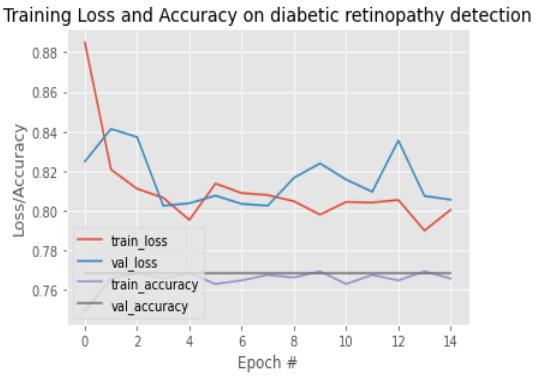


Fig 9. Underfitting

.

V. Conclusion and future scope

From analysis and implementation of Convolutional Neural Network it is clear that by having a proper dense layer and flatten later, we can have better accuracy so that we can avoid overfitting and under fitting of data. So, we can get better accuracy based on increasing and decreasing the size of the layer. There is a high possibility that DR will be detected effectively and minimally. Through web application, the proposed model provides very accurate results almost 75-80 percent .To predict the result model use relu and CNN based Algorithm. In future, the model framework can be modified and a GUI can be added to detect DR within a couple of minutes.

Reference:

[1]Kranthi Kumar Palavalasa, Bhavani Sambaturu "Diabetic retinopathy detection Using Digital Image Processing" 2018 International Conference on Communication and Signal Processing (ICCSP).

[2]Prabhajot Kaur and Son Sirsa "Neural Network Technique for Diabetic Retinopathy Detection" in 2018.

[3]Shailesh Kumar and Basant Kumar "Diabetic Retinopathy Detection By Extracted Area" in the 2018 5th International Conference on Signal Processing and Integrated Networks (SPIN).

[4]S.D. Shirbahadurkar and V. M. Mane and D. V. Jadhav "A Modern Screening Approach for Detection of Diabetic Retinopathy" in 2017 2nd International Conference on Man and Machine Interfacing (MAMI).

[5] Z.A. Omarv and M. Hanafi and S.Mashohor "Automatic Diabetic retinopathy Detection And Classification System" in 2018

[6] T. Y. Alvin Liu and J. Fernando Arevalo "Wide-field imaging in diabetic retinopathy" in 2019.

[7] Nirmala, S. & Nath, Malaya & Dandapat, Samarendra. (2011). Retinal Image Analysis: A Review. Int J Comput Commun Technol (Spec Issue). 2. 10.47893/IJCCT.2012.1154.

[8] Figure 2. Houston Eye Associates.1971.Available on:.https://www.houstoneye.com/retinal-disorders-houston/diabetic-retinopathy/

[9] Rajalakshmi, R., Subashini, R., Anjana, R.M. *et al.* Automated diabetic retinopathy detection in smartphone-based fundus photography using artificial intelligence. *Eye* 32, 1138–1144 (2018). https://doi.org/10.1038/s41433-018-0064-9

[10] Chollet, F. & others, 2015. Keras. Available at: https://github.com/fchollet/keras.

[11] M. Abadi, A. Agarwal, P. Barham, E. Brevdo, Z. Chen, C. Citro, G. S. Corrado, A. Davis, J. Dean, M. Devin, S. Ghemawat, I. Goodfellow, A. Harp, G. Irving, M. Isard, Y. Jia, R. Jozefowicz, L. Kaiser, M. Kudlur, J. Levenberg, D. Mané, R. Monga, S. Moore, D. Murray, C. Olah, M. Schuster, J. Shlens, B. Steiner, I. Sutskever, K. Talwar, P. Tucker, V. Vanhoucke, V. Vasudevan, F. Viégas, O. Vinyals, P. Warden, M. Wattenberg, M. Wicke, Y. Yu, and X. Zheng, "TensorFlow: Large-scale machine learning on heterogeneous systems," 2015, software available from tensorflow.org. [Online]. Available: http://tensorflow.org/

[12]Grinberg, M. (2018). Flask web development: developing web applications with python; Reilly Media, Inc.

[13] Patil, V., Ingle, D.R. An association between fingerprint patterns with blood group and lifestyle based diseases: a review. Artif Intell Rev 54, 1803–1839 (2021). https://doi.org/10.1007/s10462-020-09891-w