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Detection of Diabetic Retinopathy Using Convolutional Neural Networks

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ABSTRACT: Diabetic Retinopathy is the leading cause of blindness in the working-age population of the developed world and is estimated to affect over 347 million people worldwide. The main goal of this project is to detect the type of Diabetic Retinopathy using fundus images. Retinopathy is a damage to the retina of the eye, which may cause vision impairment. Diabetic Retinopathy is a disease that results from complications of Type1 and Type2 diabetes. Type1 diabetes is a chronic condition in which the pancreas produces little or no insulin. Type2 diabetes is a chronic condition when the body either doesn't produce enough insulin, or it resists insulin. The disease is attacked when the blood sugar levels are left uncontrolled for a prolonged period of time. This project is based on Convolutional Neural Networks (CNNs) and Residual Blocks. Hence this system proposes an approach to detect the type of diabetes that occurs in diabetic patients.

KEYWORDS: Machine Learning,Convolutional Neural Network(CNN),Residual Blocks, Diabetic Retinopathy(DR).

I.INTRODUCTION

Machine learning is an area of artificial intelligence (AI) with a concept that a computer program can learn and adapt to new data without human intervention.Machine learning is an area of artificial intelligence (AI) with a concept that a computer program can learn and adapt to new data without human intervention.
A complex algorithm or source code is built into a computer that allows for the machine to identify data and build predictions around the data that it identifies.

Machine learning is useful in parsing the immense amount of information that is consistently and readily available in the world to assist in decision making.

Machine learning can be applied in a variety of areas, such as in investing, advertising, lending, organizing news, fraud detection, and more.

Machine learning – and its components of deep learning and neural networks – all fit as concentric subsets of AI. AI processes data to make decisions and predictions. Machine learning algorithms allow AI to not only process that data, but to use it to learn and get smarter, without needing any additional programming. Artificial Intelligence is the parent of all the machine learning subsets beneath it. Within the first subset is machine learning; within that is deep learning, and then neural networks within that.

An artificial neural network (ANN) is modeled on the neurons in a biological brain. Artificial neurons are called nodes and are clustered together in multiple layers, operating in parallel. When an artificial neuron receives a numerical signal, it processes it and signals the other neurons connected to it. As in a human brain, neural reinforcement results in improved pattern recognition, expertise, and overall learning.

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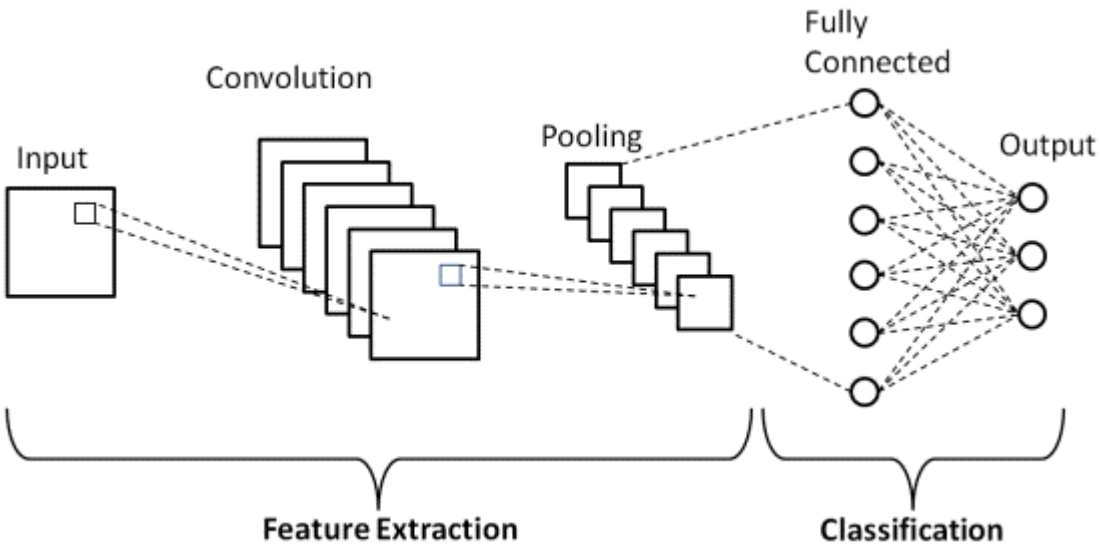

Figure 1 : CNN Architecture

II.RELATED WORK

Bob Zhang etaldescribed a method for Detecting Diabetes Mellitus and Non proliferative Diabetic Retinopathy. In their method, the Geometry Features, Color and Texture utilized for detection. The image is captured and preprocessed. Then color features are extracted from pre-processed image.In order to represent the texture feature the imafe is separated into eight blocks.

By using 70 images as training dataset he got the results on classification. The test process took around 5-6 hours to run over the images with the processor Intel(R) Core (TM) i5-6200U CPU @ 2.30GHz 2.40 GHz ,installed memory (RAM) 4.00 GB (3.90 usable) and system type 64-bit Operating System, x64-based processor . The whole data set is also run for validation. He used a confusion matrix which determines the accuracy of the classification and list the correct of them as 'true positives' or 'true negatives' and incorrect of them as 'false positives' or 'false negatives'. They have taken plot confusion (targets, outputs) that returns a confusion matrix plot for the target and output. In Confusion matrix, the first two diagonal cells show the number and percentage of correct classifications by the trained network. 44 biopsies are correctly classified as benign. This corresponds to 62.9% of all biopsies. Similarly, 14 cases are correctly classified as malignant. This corresponds to 20.0% of all biopsies.9 of the malignant biopsies are incorrectly classified as benign and this corresponds to 12.9% of all biopsies in the data. Similarly, 3 of the benign biopsies are incorrectly classified as malignant and this corresponds to 4.3% of all data. Overall, 82.9% of the predictions are correct and 17.1% are wrong classifications.

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III.PROPOSED SYSTEM

The main goal of our project is to detect the type of Diabetic Retinopathy. Diabetic Retinopathy (DR) is a common complication of diabetes mellitus, which causes lesions on the retina that effect vision. If it is not detected early, it can lead to blindness. Early detection of this condition is critical for good prognosis. It is the leading cause of blindness among working-age adults. The US Center for Disease Control and Prevention estimates that 29.1 million people in the US have diabetes and the World Health Organization estimates that 347 million people have the disease worldwide.The manual diagnosis process of DR retina fundus images by ophthalmologists is time-, effort-, and cost-consuming. It can be made easily with the help of computer-aided system and intervariability for the observer. Recently, deep learning has become one of the most common techniques that has achieved better performance in many areas, especially in medical image analysis and classification. Here, we demonstrate the use of convolutional neural networks (CNNs) on colour fundus images for the recognition task of diabetic retinopathy staging. With color fundus photography as input, the goal of this competition is to push an automated detection system. Convolutional neural networks are more widely used as a deep learning method in medical image analysis and they are highly effective. In this project, we will train deep neural network model based on Convolutional Neural Networks (CNNs) and Residual Blocks to detect the type of Diabetic Retinopathy from images. The main advantage of CNN is that it automatically detects the important features without any human supervision. A sum of 3000 pictures were utilized, out of which 80%Pictures were utilized for training and 20% pictures were utilized for testing. With the power of Artificial Intelligence and Deep Learning, doctors will be able to detect blindness before it occurs.

Sample Input Images:

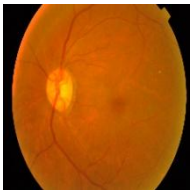
Fig2:Mild

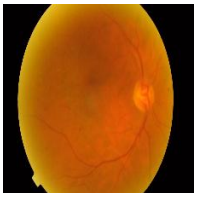
Fig3:Moderate

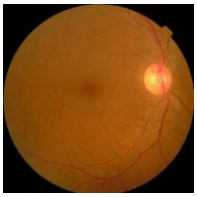
Fig4:Normal

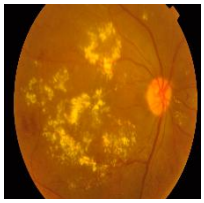
Fig5: Severe


Fig6:Proliferative

IV.DESIGN ARCHITECTURE

In our project we are using residual blocks to achieve the task. We have collected a dataset of 3500 images from Kaggle and stored in Google Drive and then we are using colab notebook. Our design architecture involves various steps among them the first and foremost step is to import all the necessary libraries and dataset, and then we perform data visualization to visualize the data has been correctly invoked or not followed by we augment the data. This step is followed to resize all the images into similar shape and then we send all this images to residual blocks for feature extraction. By using CNN we classify the type of Diabetic Retinopathy

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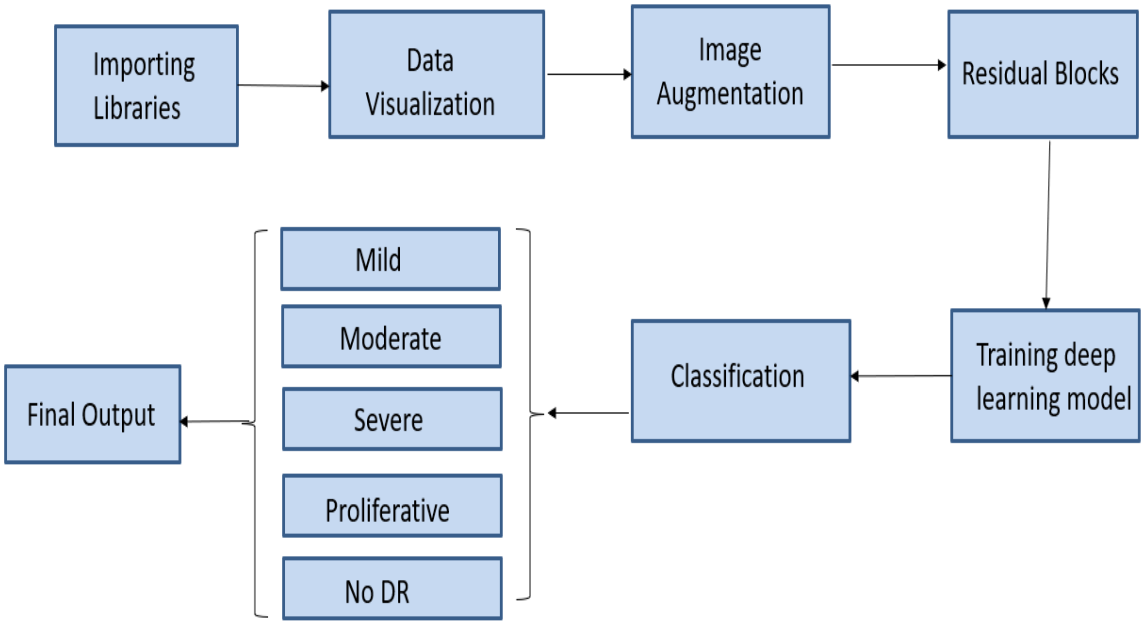

Figure 7: Architecture Diagram

PSEUDO CODE

Step 1: Importing the dataset and Libraries.
Step 1.1: Collected data set is uploaded in google drive.
Step 1.2: Importing the data set
Step 1.3: Importing necessary libraries such as pandas, tensorflow, os, PIL, matplotlib..

Step 2: Data Visualization.
Step 2.1: Using for loop, os.listdir() fetching the images in the dataset.
Step 2.2: By using Nested for-loop, going to fetch 5 images from each class.
Step 2.3: Displaying each image of every class .

Step 3: Data augmentation and Creating data Generators
Step 3.1: Shuffling the data in dataset using shuffle() method.
Step 3.2:Splitting the shuffled data into two parts i.e training and testing
Step 3.3: Allocating 80% of images for training and 20% of images for testing
Step 3.4: Using imagedataGenerator() method for rescaling the image.
Step 3.5: Splitting images from 5 classes to train generator, validation generator and test generator.

Step 4: Building residual blocks
Step 4.1: Considering the input fundus image.
Step 4.2: Converting image to zero padding.
Step 4.3: And then we Conv2D it
Step 4.4: we max pool this 2D
Step 4.5: We create 4 stages of Residual Blocks
Step 4.6: then perform Average pooling and finally flatten it.

Step 5: Training the model
Step 5.1: In stage 1, we perform normalization, activation and max pooling.
Step 5.2: In stage 2,by calling res_block() method and adding it's filter as 64

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Step 5.3: In stage 3,by calling res_block() method and adding it's filter as 128
Step 5.4: In stage 4,by calling res_block() method and adding it's filter as 256

Step 6: Testing the model
Step 6.1: We compile it using model.compile() method
Step 6.2: Using early stopping to exit training if validation loss is not decreasing
Step 6.3: Using check pointer we save the best model with lower validation loss
Step 6.4: We fit the model by using model.fit() method.

Step 7: Accessing the performance
Step 7.1: Here we perform accuracy of a test using model.evaluate() method
Step 7.2: And then print the final output i.e prediction and original

Step 8: End

V.RESULTS

1)Model Loss And Accuracy

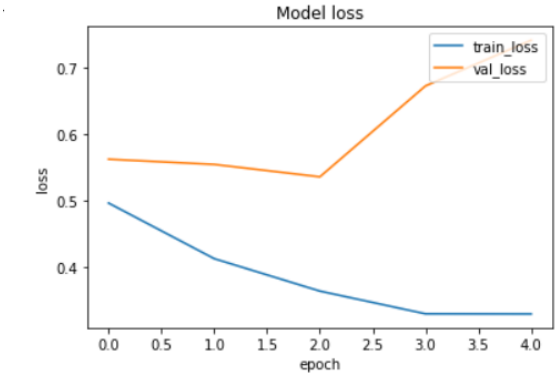

Figure 8: Model loss graph

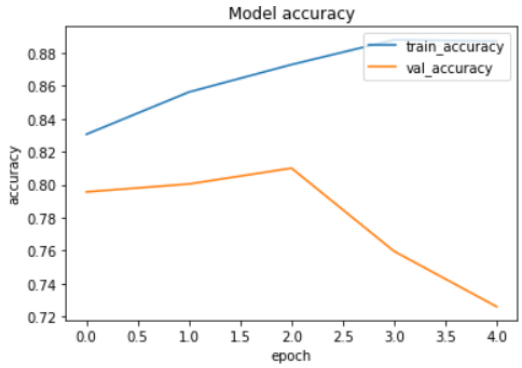

Figure 9: Model accuracy graph

2)Predicted and Original results3)Confusion Matrix

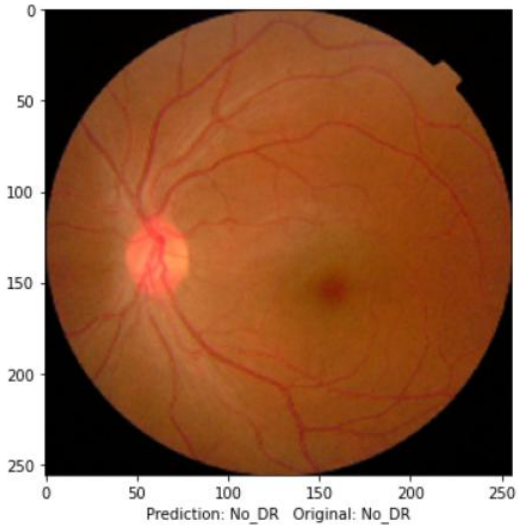

Figure 10: Test Case

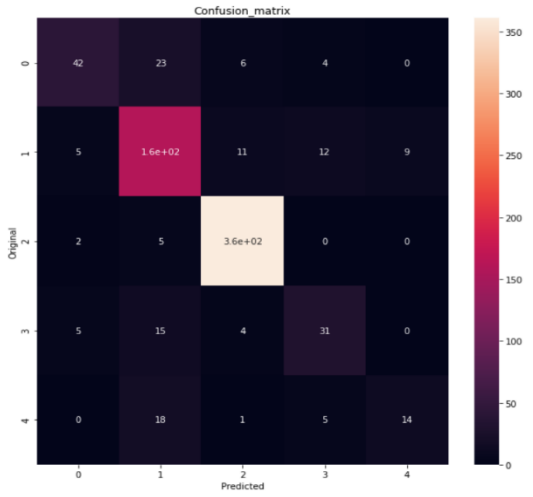

Figure 11:Confusion Matrix

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VI.CONCLUSION

Detection of DR helps in prevention of blindness. Opthamologists judge the stage of DR by visualizing various features like vessels, microaneurysm etc. with the assistance of an opthalmoscope. Now a day's digital imaging helps tons in automating the method of DR.Regular screening of patients are very necessary for detection of DR stage in order that they will be cured on time. This is often highly required as treatment in some cases is even impossible at the later stages of DR However grading of the retinal images by ophthalmologists cost high so automated systems for an equivalent are highly required.In this study, we have proposed a deep learning based model to detect and classify Diabetic Retinopathy from fundus images. For implementation, we have managed to meet our aims and goals despite how it does not output the most accurate results.The pre-processing techniques such as flattening and resizing of images were performed using matplot library. Our developed system is able to perform binary task with an accuracy of 82.94%. This system can be used in remote places in countries to overcome the shortage of radiologists.

VII.FUTURE ENHANCEMENTS

The basic input of the proposed system will be a fundus image where fundus is a inner part of retinathat is produced after screening tests respectively. This is given by the user using a Graphical User Interface (GUI). The user should open the interface and then click on the upload image button respectively to upload the image. The user can easily access the results.

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