© September 2022| IJIRT | Volume 9 Issue 4 | ISSN: 2349-6002

Detection of Diabetic Retinopathy Using Convolutional Neural Network

P.Revathi [1], Dr. S. Mohideen Abdul Kadhar [2]
[1] *Student, Sri Vidya College of Engineering and Technology*
[2] *Professor, Sri Vidya College of Engineering and Technology*

***Abstract* - The objective of this paper is to develop a model for diabetic retinopathy, a prime cause for blindness that appears due to diabetes. A deep learning model based on fully convolutional neural network is developed to classify the disease from images of the patient. The combination of multi-structure morphological process and Segmentation technique is used effectively for retinal vessel detection to identify diabetic retinopathy using a neural network. The method is accomplished through various steps: Data Collection, Pre-processing, Augmentation and modelling. Our proposed model achieved 90% of accuracy. The Regression model was also employed, manifested up an accuracy of 78%. The main aim of this work is to develop a robust system for detecting DR automatically.**

***Index Terms* - Diabetic Retinopathy, Convolutional Neural Network.**

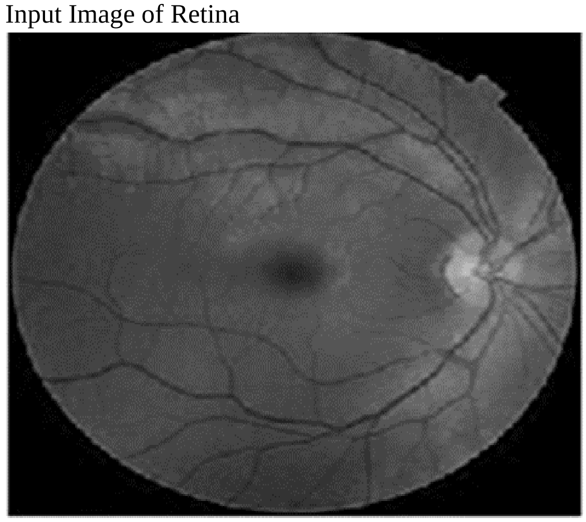
I.INTRODUCTION

Diabetic retinopathy is best diagnosed with a comprehensive dilated eye exam. For this exam, drops placed in eyes widen (dilate) the pupils to allow the doctor a better view inside the eyes. The drops can cause close vision to blur until they wear off, several hours later. After the eyes are dilated, a dye is injected into a vein in your arm. Then pictures are taken as the dye circulates through eyes' blood vessels. The images can pinpoint blood vessels that are closed, broken or leaking. Problem Identification: There will be no symptoms in the early stage of diabetic retinopathy. As the condition progresses, you might develop: Spots or dark strings floating in your vision (floaters), Blurred vision, Fluctuating vision, Dark or empty areas in your vision, Vision loss. If you have diabetes, reduce your risk of getting diabetic retinopathy by doing the following: Manage your diabetes, monitor your blood sugar level, Ask your doctor about a glycosylated hemoglobin test, Keep your blood pressure and cholesterol under control, If you smoke or use other types of tobacco, ask your doctor to help you quit, Pay attention to vision changes.

II.RESEARCHMEDHODOLOGY

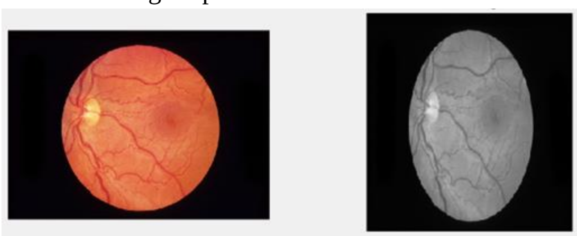
The INPUT images are processed for noise removal and converted into gray images using the preprocessing steps to ensure easier post processing. The optic disc and retinal nerves are then segmented. The features that are extracted are used for classification using Convolutional Neural Network and Fuzzy Classifier to identify whether the eye image is Normal or of NPDR or PDR stage. A convolution neural network (CNN) is a type of artificial neural network used in image recognition and processing that is specifically designed to process pixel data. Input Image :Retinal dataset images including affected and normal, they were taken as input to pre-processing. The combination of multi-structure morphological process and Segmentation technique is used effectively for retinal vessel detection to identify diabetic retinopathy using a neural network.

Input Image of Retina

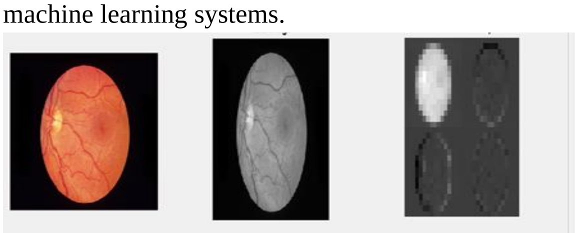


Pre-Processing: Image restoration is the operation of taking a corrupted/noisy image and estimating the clean original image. Corruption may come in many forms such as motion blur, noise and mis focus. Image restoration is different from image enhancement in that the latter is designed to emphasize features of the image that make the image more pleasing to the observer, but not necessarily to produce realistic data from a scientific point of view.

Pre-Processing Step:



Segmentation: Segmentation is the process of determining the boundaries and areas of objects in images. We humans perform segmentation without conscious effort, but it remains a key challenge for machine learning systems.



Feature Extraction: GLCM:

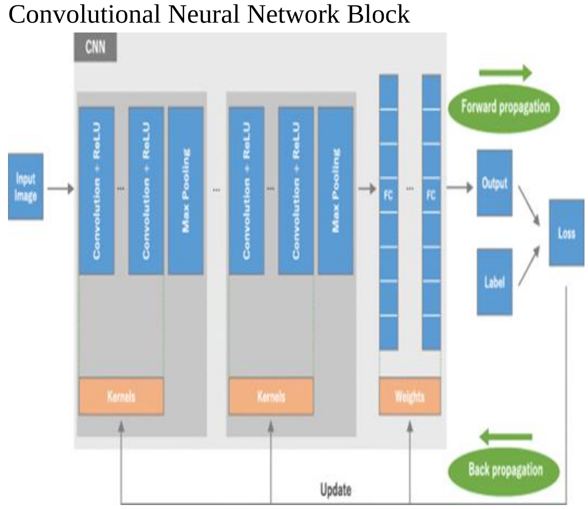
The GLCM functions characterize the texture of an image by calculating how often pair of pixels with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. The grey level or grey value indicates the brightness of a pixel. The minimum grey level is 0. The maximum grey level depends on the digitization depth of the image. For an 8-bit-deep image it is 255. In a binary image a pixel can only take on either the value 0 or the value 255.

III. CLASSIFICATION

A Convolutional Neural Network (CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a Convolutional Neural Network is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, Convolutional Neural Network have the ability to learn these filters/characteristics.

PYTHON: Python is an interpreted high-level programming language for programming. Python offers multiple options for developing GUI (Graphical User Interface). Out of all the GUI methods, tkinter is most commonly used method. It is a standard Python interface to the TK GUI toolkit shipped with Python. Python with tkinter outputs the fastest and easiest way to create the GUI applications. Creating a GUI using tkinter is an easy task. Convolutional Neural Network: To reiterate from the Neural Networks Learn Hub article, neural networks are a subset of machine learning, and they are at the heart of deep learning algorithms. They are comprised of node layers, containing an input layer, one or more hidden layers, and an output layer. Each node connects to another and has an associated weight and threshold. If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network. Otherwise, no data is passed along to the next layer of the network.

Convolutional Neural Network Block



Working of Convolutional Neural Networks

Convolutional neural networks are distinguished from other neural networks by their superior performance with image, speech, or audio signal inputs. They have three main types of layers, which are: Convolutional layer, Pooling layer, Fully connected (FC) layer.

Convolutional Layer: The convolutional layer is the core building block of a CNN, and it is where the majority of computation occurs. It requires a few components, which are input data, a filter, and a feature map. Let's assume that the input will be a color image, which is made up of a matrix of pixels in 3D. This means that the input will have three dimensions—a height, width, and depth—which correspond to RGB in an image. We also have a feature detector, also known as a kernel or a filter, which will move across the receptive fields of the image, checking if the feature is present. This process is known as a convolution.

1. The number of filters affects the depth of the output. For example, three distinct filters would yield three different feature maps, creating a depth of three. 2. Stride is the distance, or number of pixels, that the kernel moves over the input matrix. While stride values of two or greater is rare, a larger stride yields a smaller output. Zero-padding is usually used when the filters do not fit the input image. This sets all elements that fall outside of the input matrix to zero, producing a larger or equally sized output. There are three types of padding: Valid padding: This is also known as no padding. In this case, the last convolution is dropped if dimensions do not align. Same padding: This padding ensures that the output layer has the same size as the input layer Full padding: This type of padding increases the size of the output by adding zeros to the border of the input. After each convolution operation, a CNN applies a Rectified Linear Unit (ReLU) transformation to the feature map, introducing nonlinearity to the model.

Pooling Layer: Pooling layers, also known as down sampling, conducts dimensionality reduction, reducing the number of parameters in the input. Similar to the convolutional layer, the pooling operation sweeps a filter across the entire input, but the difference is that this filter does not have any weights. Instead, the kernel applies an aggregation function to the values within the receptive field, populating the output array. There are two main types of pooling Max pooling: As the filter moves across the input, it selects the pixel with the maximum value to send to the output array. As an aside, this approach tends to be used more often compared to average pooling. Average pooling: As the filter moves across the input, it calculates the average value within the receptive field to send to the output array. While a lot of information is lost in the pooling layer, it also has a number of benefits to the CNN. They help to reduce complexity, improve efficiency, and limit risk of over fitting. Fully Connected Layer: The name of the full-connected layer aptly describes itself. As mentioned earlier, the pixel values of the input image are not directly connected to the output layer in partially connected layers. However, in the fully connected layer, each node in the output layer connects directly to a node in the previous layer. This layer performs the task of classification based on the features extracted through the previous layers and their different filters. While convolutional and pooling layers tend to use Relu functions, FC layers usually leverage a softmax activation function to classify inputs appropriately, producing a probability from 0 to 1.

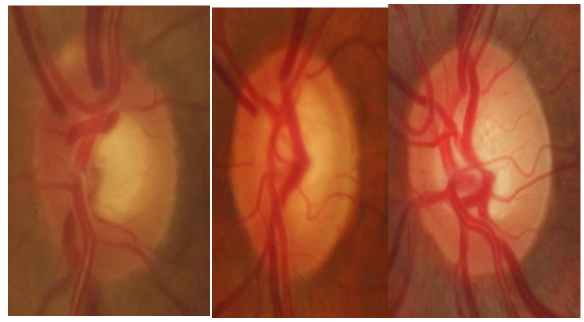
Machine Learning Works: UC Berkeley (link resides outside IBM) breaks out the learning system of a machine learning algorithm into three main parts.A Decision Process: In general, machine learning algorithms are used to make a prediction or classification. Based on some Input data, which can be labelled or unlabeled, your algorithm will produce an estimate about a pattern in the data. An Error Function: An error function serves to evaluate the prediction of the model. If there are known examples, an error function can make a comparison to assess the accuracy of the model. A Model Optimization Process: If the model can fit better to the data points in the training set, then weights are adjusted to reduce the discrepancy between the known example and the model estimate. The algorithm will repeat this evaluate and optimize process, updating weights autonomously until a threshold of accuracy has been met.

Real-World Machine Learning Use Case: Here are just a few examples of machine learning you might encounter every day: Speech Recognition: It is also known as automatic speech recognition (ASR), computer speech recognition, or speech-to-text, and it is a capability which uses natural language processing (NLP) to process human speech into a written format.

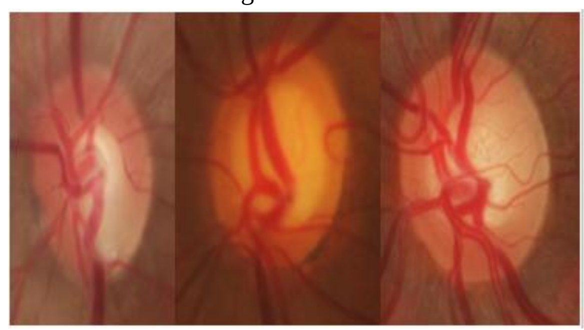
Many mobile devices incorporate speech recognition into their systems to conduct voice search Eg: Siri — or provide more accessibility around texting. Customer Service: Online chatbots are replacing human agents along the customer journey. They answer frequently asked questions (FAQs) around topics, like shipping, or provide personalized advice, cross-selling products or suggesting sizes for users, changing the way we think about customer engagement across websites and social media platforms. Examples include messaging bots on e-commerce sites with virtual agents, messaging apps, such as Slack and Facebook Messenger, and tasks usually done by virtual assistants and voice assistants. Computer Vision: This AI technology enables computers and systems to derive meaningful information from digital images, videos and other visual inputs, and based on those inputs, it can take action. This ability to provide recommendations distinguishes it from image recognition tasks.

Powered by convolutional neural networks, computer vision has applications within photo tagging in social media, radiology imaging in healthcare, and self-driving cars within the automotive industry. Recommendation Engines: Using past consumption behavior data, AI algorithms can help to discover data trends that can be used to develop more effective cross-selling strategies. This is used to make relevant add-on recommendations to customers during the checkout process for online retailers. Machine

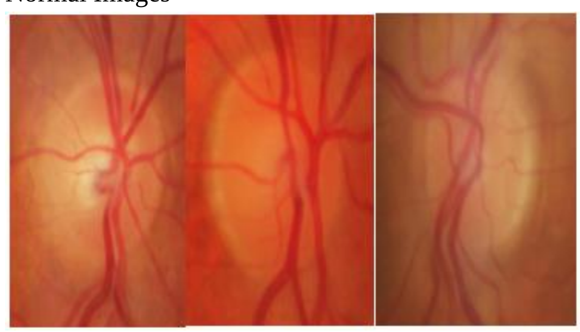
Learning and IBM Cloud: IBM Watson Machine Learning supports the machine learning lifecycle end to end. It is available in a range of offerings that let you build machine learning models wherever your data lives and deploy them anywhere in your hybrid multi cloud environment. IBM Watson Machine Learning on IBM Cloud Pak for Data helps enterprise data science and AI teams speed AI development and deployment anywhere, on a cloud native data and AI platform. IBM Watson Machine Learning Cloud, a managed service in the IBM Cloud environment, is the fastest way to move models from experimentation on the desktop to deployment for production workloads. For smaller teams looking to scale machine learning deployments, IBM Watson Machine Learning Server offers simple installation on any private or public cloud. INPUT IMAGES:



Abnormal Retina Images



Normal Images



Unaffected Retina Images

IV.CONCLUSION

The potential benefit of using our trained CNN is that it can classify thousands of images every minute allowing it to be used in real-time whenever a new image is acquired. In practice images are sent to clinicians for grading and not accurately graded when the patient is in for screening. The trained CNN makes a quick diagnosis and instant response to a patient possible. The network also achieved these results with only one image per eye. The network has no issue learning to detect an image of a healthy eye. This is likely due to the large number of healthy eyes within the dataset. In training the learning required to classify the images at the extreme ends of the scale was significantly less. The issues came in making the network to distinguish between the mild, moderate and severe cases of DR. The low sensitivity, mainly from the mild and moderate classes suggests the network struggled to learn deep enough features to detect some of the more intricate aspects of DR. An associated issue identified, which was certified by a clinician, was that by national UK standards around over 10% of the images in our dataset are deemed upgradable. These images were defined a class on the basis of having at least a certain level of DR. This could have severely hindered our results as the images are misclassified for both training and validation.

REFERENCE

[1] Afrin, R., & Shill, (2021)“Automatic Lesions Detection and Classification of Diabetic Retinopathy Using Fuzzy Logic,” P. C. International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST). DOI:10.1109/icrest.2019.8644123.

[2] K. V. Maya and K. S. Adarsh,(2020)"Detection of Retinal Lesions Based on Deep Learning for Diabetic Retinopathy,”2019 Fifth International Conference on Electrical Energy Systems (ICEES), Chennai, India, 2019, pp. 1-5, DOI: 10.1109/ICEES.2019.8719242.

[3] R. D. Badgujar and P. J. Deore, (2019)“Region Growing Based Segmentation Using Forstner Corner Detection Theory for Accurate Microaneurysms Detection in Retinal Fundus Images,”2019 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), Pune, India, 2019, pp. 1-5, DOI: 10.1109/ICCUBEA.2018.8697671.

[4] M. P. Paing, S. Choomchuay and M. D. RapeepornYodprom,(2017) “Detection of lesions and classification of diabetic retinopathy using fundus images,” 9th Biomedical Engineering International Conference (BMEiCON), Laung Prabang, DOI: 0.1109/BMEiCON.2016.7859642.

[5] P.Mohanaiah, P. Sathyanarayana, L. GuruKumar,(2013)“Image Texture Feature Extraction Using GLCM Approach”, International Journal of Scientific and Research Publications, Volume 3, Issue 5, May 2013 1 ISSN 2250-3153.

[6] Michael D. Abramoff et al,(2010)“Retinal Imaging and Image Analysis,” IEEE Reviews in Biomedical Engineering DOI: 10.1109/RBME.2010.2084567.