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Deep Learning Convolutional Neural Network Based Diabetics Identification through Data Mining Approach

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Abstract: This project proposes Data mining based Diabetics Identification and Classification using Signal Processing Approach. Adaptive Median filter is used for preprocessing approach, this filter removes the blur noises. Fuzzy C-means algorithm is used for segmentation process. Genetic algorithm based Feature extraction technique is used for extracting the features from the input data. To increase the result classification accuracy Deep learning based Convolutional Neural network is used. This project is implemented using python.

I. INTRODUCTION

Diabetes is a chronic disease and the numbers of diabetes patients are increasing at a very rapid pace, which may eventually lead to vital organ failure. In most cases, it may affect heart, kidney and there can be complications in the eye. As it a metabolic disease, therefore the body is unable to produce insulin which eventually increases the glucose level in the blood. When the glucose level of the blood vessel in retina is increased the vision becomes blurred and without proper treatment it can lead to complete blindness, this process of damage within the retina is called diabetic retinopathy. Excess amount of glucose in the blood vessel may lead to anomalies like micro aneurysms, hemorrhages, hard exudates and cotton wool spots develop during the different phases of diabetic retinopathy. According to a study which was conducted by World Health Organization, it shows that the number of diabetes patients will increase from 130 million to 350 million over the next 20 years.In developed countries, one of the alarming cause of blindness is diabetic retinopathy and for the developing countries this problem is even more dangerous as they do not have the proper screening technologies to overcome the prevention from this disease, however 75% of the people with diabetic retinopathy lives in the developing countries. The symptoms for diabetic retinopathy do not show up in the early stages, which makes it even harder for the ophthalmologist to prevent the patient from being blind. The number of patient with diabetic retinopathy is increasing, which will increase the workload for the ophthalmologist because most of their time will be spent to detect diabetic retinopathy. As a result, they will not be able to take care of the patient with their full potential. Nowadays, diabetes is being diagnosed in the age group of 30 or even before. This is mainly due to indulgent lifestyle, obesity, increasing age and bad diet. As life expectancy is increasing, the number of people with diabetes is rising exponentially. Global prevalence of diabetes above 18 years has raised from 108 million (4.7%) in 1980 to 422 million (8.5%) in 2014, according to the World Health Organization [39]. In US alone 30.3 million people are suffering from diabetes out of which 7.2 million (23.8%) peoples remain undiagnosed. Due to diabetes, many other serious problems occur like diabetic eye diseases, kidney failure etc. Diabetic eye disease refers to a condition in which a person suffers from eye problems occurred due to diabetic complications. It includes diabetic retinopathy, cataract and glaucoma. All these diseases are capable of causing a severe vision loss or even blindness. Diabetic Retinopathy (DR) is the most common diabetic eye disease and the main cause of blindness in the modern world. Around 40-45% of people suffering from diabetes will have DR at some stage of life. Diabetic retinopathy is a disease caused due to high level of glucose in the blood. It damages tiny blood vessels in the retina. Early stages of DR shows very small and intricate features like micro-aneurysms, hard exudates etc. Whereas in later stage (severe and proliferative), features like haemorrhages, neovascular iza- tion and macular

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oedema are clearly visible. Detecting such small and complex features through fundus images is very time consuming and it requires an experi- enced ophthalmologist. This demands an automated diagnosis system which can vastly reduce the burden on the clinicians.

II. EXISTING SYSTEM

Diabetic retinopathy (DR) is a major microvascular complication resulting from diabetes and continues to have a serious impact on global health systems. Globally about 95 million people suffer from DR. This paper focuses on detection aspects of a mobile application developed to perform DR screening in real time. The application is powered by a tensor flow deep neural network architecture that is trained and tested on 16,798 fundus images. These images are preprocessed to remove noise and prepare them to be fed into neural network. Preprocessing steps involve averaging all the images using a 5x5 filter to improve the quality of images and then these images are resized to 256x256 pixels. After preprocessing the input dataset is fed into the neural network. The convolutional neural network model used in this project is MobileNets, which is used for mobile devices. The neural network has 28 convolutional layers and after each layer there is batchnorm and ReLU nonlinear function except at the final layer. The output from last layer is a class label either DR or no DR. The final accuracy of the model is 73.3%. This model is optimized to work on mobile devices and does not require Internet connection to run. Conclusion All preprocessing and post-processing task on images are done in Python 2.7.12 with necessary dependencies installed. After preprocessing the data, it is then ready to be fed into a neural network. The neural network model used in this project is the MobileNets, which has 28 convolution layers. The details of architecture are discussed in section. Once the data is inputted to network it will try to update its parameters such as weights and biases. The technique used in this project for making the neural network learn the input data is referred to as transfer learning. In this technique, a pre-trained network is utilized which was trained with millions of images from ImageNet dataset. This model is stored in the form of a graph file and one can make use of this graph file to generate a new graph file with updated weights and biases. This process is much faster and more efficient than creating a neural network from scratch and try to fit such a large dataset to it can take several days of training and requires high GPU power. Implementing convolutional neural network has become a popular method in the biomedical field. Furthermore, the neural network can be used in detecting brain tumours and analyzing x-ray images. A convolution neural network if it is trained on a large dataset can be proved to work better than humans as described in Harvard Medical School and MIT joint study on classifying metastatic breast cancer. The developed Android application was tested in real time on test dataset images. Since the test dataset contains images of both categories of DR and no DR, so it is used as source for real time image analysis as one would be capturing image of an actual subject. Therefore, it's a process of acquiring image from the test database to show that this method will work for any subject. After training the neural network model one gets two files as output: graph file and class labels. Graph file contains all the nodes and operations that are performed during the training of the network. Since the final built application is to be run on a mobile device that has limited capability to perform operation one needs to optimize the graph file before building the application. The whole neural network is built using tensor flow library that has a built-in tool for removing all the nodes that are not needed for a given set of inputs and outputs. With the help of an optimized model, the number of calculations is reduced by merging the explicit batch normalization. Images are in the form of a matrix with some numbers in it. If one wants to compress an image, the number of colors in the image needs to be reduced. The described neural network model based Android application works well for classification of Diabetic Retinopathy. The application makes use of the robust deep neural network architecture MobileNets that is trained on millions of Image Nets images. With the help of transfer learning, one can retrain such a model with its own image dataset. The application was currently developed to work for Android devices but one can use this model in a windows or Linux operating system with the help Python programming language. This developed application can serve as a useful screening tool for Diabetic Retinopathy.

III. PROPOSED SYSTEM

Healthcare is an important field where image classification has an excellent value. An alarming healthcare problem recognized by the WHO that the world suffers is diabetic retinopathy (DR). DR is a global epidemic which leads to the vision loss. Diagnosing the disease using fundus images is a time-consuming task and needs experience clinicians to detect the small changes.

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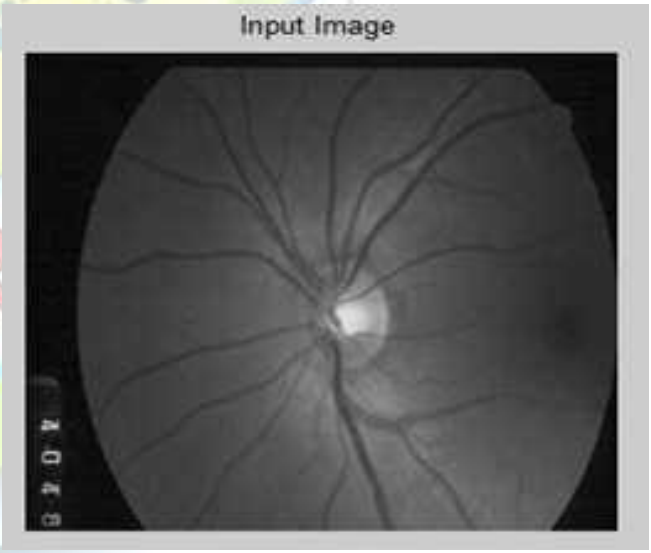
Here, we are proposing an approach to diagnose the DR and its severity levels from fundus images using convolutional neural network algorithm (BFRBFNN). Using BFRBFNN, we are developing a training model which identifies the features through iterations. Later, this training model will classify the retina images of patients according to the severity levels. In healthcare field, efficiency and accuracy is important, so using deep learning algorithms for image classification can address these problems efficiently. Artificial neural network (ANN) is inspired from the brain. The brain is considered as the information processing device of a human. The brain has many abilities and can excel many engineering products in fields such as vision, speech recognition, and learning. The ANN model mimics the properties of the brain which are neurons and its property of working parallelly. The neurons in the brain are connected to each other as synapses which help in parallel computation. Convolutional neural networks (BFRBFNNs) are an important class of neural networks that have been used to solve numerous computer vision problems. Deep BFRBFNNs, in particular, are composed of several layers of processing called convolutional layers and pooling layers that allow the neural network to snare prolific images properties. In the present work, we would like to propose a methodology using BFRBFNNs for classifying the images that indicate diabetic retinopathy (DR). The retina images are from fundus photography. This photography uses fundus camera to get the color images of interior surface of the eye so that we can monitor the eye and find the disorders. Fundus camera contains intricate microscope which attached to a flash-enabled camera. This camera helps to photograph the interior surface of the eye including retina, macula, and posterior pole. Currently, the DR detection is a manual and time-consuming process. The patient will go to clinic to take fundus photograph of the retina and the image will take. He/she will get the result in 2 or 3 days, and then patient should take the result to an ophthalmologist for the review. As this traditional way of DR detection takes more time and the chance of miscommunication and the delayed treatment lead is more, there we can use automatic DR Detection algorithm which can be implemented in fundus camera itself. Here, after taking the retina image, the image will be given to already trained model which classifies the images based on whether the patient has DR or not, if he/she has the DR, and then the severity level of the disease. This helps both the ophthalmologist and patient so that the delayed treatment would not be happen.

INPUT IMAGE (Test image):

GRAY SCALE IMAGE:



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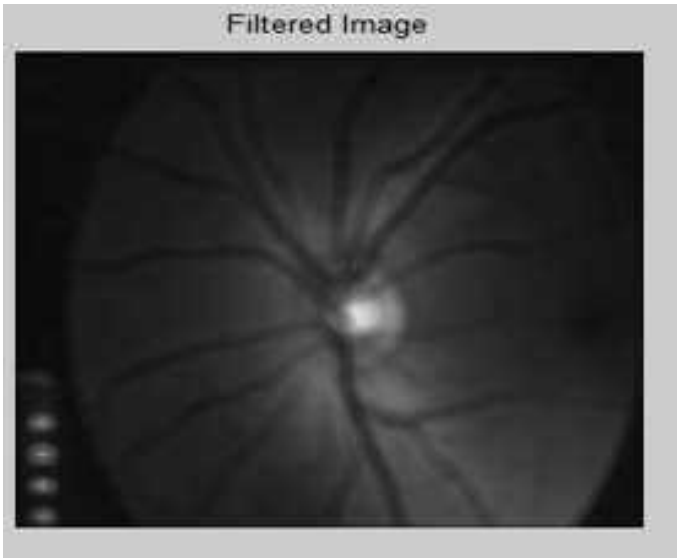
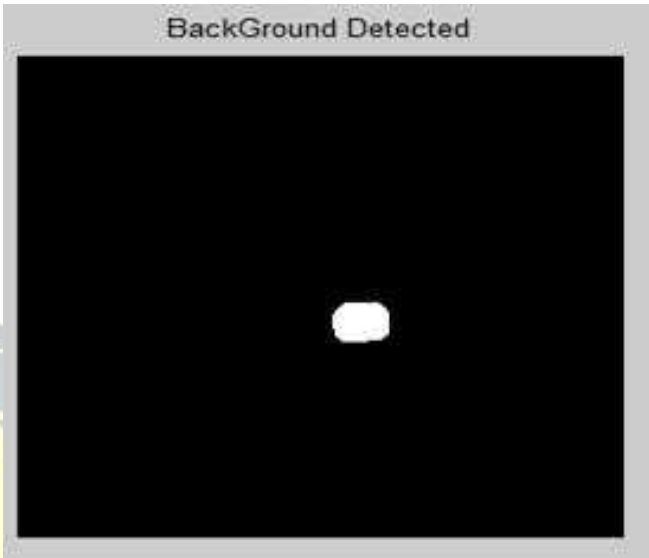
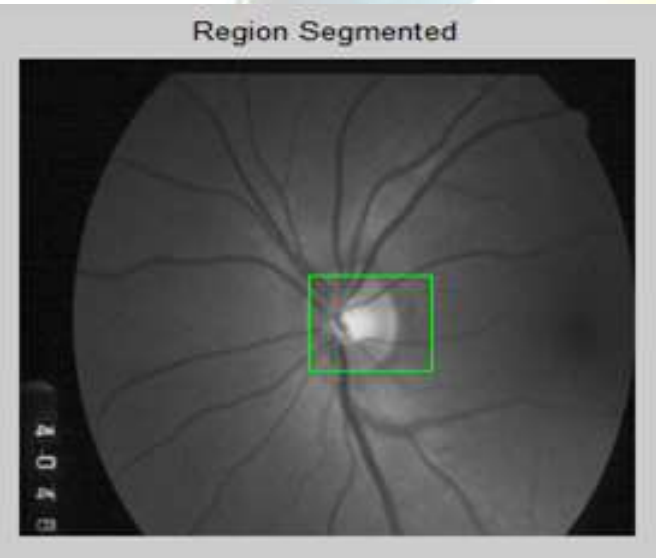
FILTERED IMAGE:



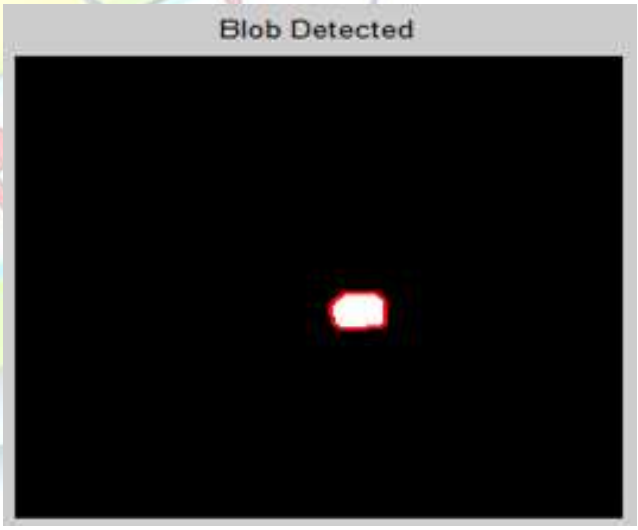
BLOB BACK GROUND DETECTION:



SEGMENTATION RESULT:



BLOB DETECTION:



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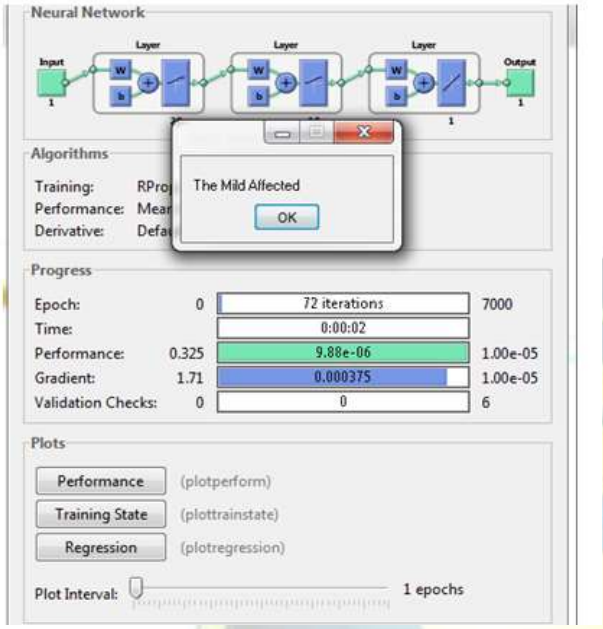
DR problems identification:



IV. CONCLUSION

Our proposed algorithm for automated feature extraction and detection of DR provides the robust solution. Results obtained indicate that deep learning can provide a low-cost solution for diagnosing DR with consistency. Our experiment on large dataset indicates the potential of deep learning based model in diagnosing DR accurately from fundus images. Such automated system reduces dependencies on clinicians. The challenges which we faced in our proposed algorithm was that the fundus images of stage 4 are very rare which make our proposed algorithm little biased since enough features to diagnose stage-4 were not learned by the network. In future, a work can be done on segregating larger dataset having enough images of each stage and from different demographic regions also. This reduces doctor's belief in using the automated system. Hence this algorithm is not a replacement for the eye examination, which has many other critical aspects.

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