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Diabetic Retinopathy Using Deep Learning

Chetan Bhamare[1], Vivek Niwane [2], Avni Bhatia [3], Shubham Gite[4]

Department of E&TC Engineering, SKNCOE, SPPU, Pune, India

[1]chetan99bhamare@gmail.com

[2]vivek.niwane_skncoe@sinhgad.edu

[3]avnibhatia707@gmail.com

[4]shubhamgite0007@gmail.com

Abstract

Diabetic retinopathy is one of the most threatening complications of diabetes that leads to permanent blindness if left untreated. One of the essential challenges is early detection, which is very important for treatment success. Unfortunately, the exact identification of the diabetic retinopathy stage is notoriously tricky and requires expert human interpretation of fundus images. Simplification of the detection step is crucial and can help millions of people. In this project we propose an automatic deep-learning-based method for stage detection of diabetic retinopathy by single photography of the human fundus. Convolutional neural networks (CNN) have been successfully applied in many adjacent subjects, and for diagnosis of diabetic retinopathy itself. However, the high cost of big labeled datasets, as well as inconsistency between different doctors, impede the performance of these methods. In this project we propose an automatic deep-learning-based method for stage detection of diabetic retinopathy by single photography of the human fundus. In this system, we analyzed diabetes detectability from retinal images in the Diabetic Retinopathy Database - Calibration Level Raw pixel intensities of extracted patches served directly as inputs into the following classifiers: CNN.

Keywords— *CNNs, retinopathy, fundus, deep learning.*

I. INTRODUCTION

Diabetic Retinopathy that is caused by the untreated diabetes have the symptoms which starts from microaneurysms which exists due to weakened capillary walls and viewed as red colour small dots. Once these walls ruptured, hemorrhages appeared which are flame shaped and are of red colour. When the severity of the DR increases, hard exudates appear in the retina which exists due to leakage of proteins and lipids from the blood. They are yellow in colour. After more advancement in severity of DR, there is obstruction in blood vessels that leads to formation of soft exudates in the form of cotton wool spots of white colour. both healthy and pathological retina there are various stages of DR which includes Non-Proliferative DR (NPDR) and Proliferative DR (PDR). NPDR is further divided into Mild, Moderate and Severe. If the disease is detected at the stage of NPDR by the accurate segmentation process, then it can be cured. Early diagnosis of DR can be done if the screening programs for segmentation are performed very effectively. But there is number of difficulties in the early diagnosis as the patients have progressive DR without symptoms of reduced vision. The severity of DR increases as there is decrease in the distance of abnormalities from the macula decreases

The manual segmentation of blood vessels is very difficult and tedious task as it requires expertise since the images are very complex. Also it is very time consuming when the database is very large. There is great difficulty in measurement of various features of blood vessels which includes length, width manually. So there is a need of computer aided automatic segmentation of blood vessels with higher accuracies so that the early diagnosis of DR as well as various diseases can be performed.

II. LITERATURE REVIEW

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The [1] explains about proposed algorithm can be used for early detection of Diabetic Retinopathy. This can be performed as accurate segmentation can be done by this method. This method is in the category of supervised approach as it uses neural network for training purposes. The performance parameters given by Sensitivity, Specificity and Accuracy shows the better performance as it is compared by human observer values of these parameters. The results clearly show the proposed algorithm is effective for the segmentation of retinal blood vessels. DR that is caused by the untreated diabetes have the symptoms which starts from microaneurysms which exists due to weakened capillary walls and viewed as red colour small dots. Once these walls ruptured, hemorrhages appeared which are flame shaped and are of red colour. When the severity of the DR increases, hard exudates appear in the retina which exists due to leakage of proteins and lipids from the blood. They are yellow in colour. After more advancement in severity of DR, there is obstruction in blood vessels that leads to formation of soft exudates in the form of cotton wool spots of white colour. both healthy and pathological retina. There are various stages of DR which includes Non-Proliferative DR (NPDR) and Proliferative DR (PDR). NPDR is further divided into Mild, Moderate and Severe. If the disease is detected at the stage of NPDR by the accurate segmentation process, then it can be cured. Early diagnosis of DR can be done if the screening programs for segmentation are performed very effectively. But there is number of difficulties in the early diagnosis as the patients have progressive DR without symptoms of reduced vision. The severity of DR increases as there is decrease in the distance of abnormalities from the macula decreases.

The [2] explains about segmentation. Automatic blood vessel segmentation in the images can help speed diagnosis and improve the diagnostic performance of less specialized physicians. An essential step in feature extraction is blood vessel segmentation of the original image. Many algorithms have been developed to accurately segment blood vessels from images with a variety of underlying pathologies and across a variety of ophthalmic imaging systems. This work focuses on developing existing retinal blood vessel segmentation algorithms, comparing their performances, and combining them to achieve superior performance.

The multistage transfer learning approach and an automatic method for detection of the stage of diabetic retinopathy by single photography of the human fundus [3] are proposed. We have used an ensemble of CNN architecture and made transfer learning for our final solution. The experimental results show that the proposed method achieves high and stable results even with unstable metric. The main advantage of this method is that it increases generalization and reduces variance by using an ensemble of the networks, pretrained on a large dataset, and fine-tuned on the target dataset. Also, we will be using kaggle dataset because it is the largest dataset which is available publically out of which the images will be classified into malignous or non-malignous images.

[4] presents a framework to explore multi-field data of aneurysms occurring at intracranial and cardiac arteries by using statistical graphics. The rupture of an aneurysm is often a fatal scenario, whereas during treatment serious complications for the patient can occur. Therefore, medical researchers are very interested in better understanding these relationships. However, the required analysis is a time-consuming process, where suspicious wall regions are difficult to detect due to the time-dependent behaviour of the data. Our proposed visualization framework enables medical researchersto efficiently assess aneurysm risk and treatment options.

The [5] gives idea about different stages of diabetic retinopathy. The four stages of DR was classified as: 1. Mild Non-proliferative Retinopathy: The earliest stage where microaneurysms occur. 2. Moderate Non-proliferative Retinopathy: As the disease advances, few blood vessels that supply the retina are blocked. 3. Severe Non-proliferative Retinopathy: More blood vessels are blocked, which reduces blood flow to the areas of the retina. These areas send signals to the body for growth of new blood vessels for nourishment. 4. Proliferative Retinopathy: This is the advanced stage, the

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signals sent by the retina for nourishment trigger the growth of new blood vessels. This condition is called proliferative retinopathy. These new blood vessels are abnormal and fragile. These blood vessels by themselves do not cause symptoms or vision loss. Since they have thin and weak walls., they can leak blood, causing severe vision loss and even blindness can result.

A different technique to detect diabetic retinopathy [6] and studied the efficiency of them. Employing computational approaches for this purpose would help in efficient retinal analysis. The methodology proposed in this work involves sequential application of image pre-processing, supervised and unsupervised learning and image post-processing techniques.

III. METHODOLOGY

Following diagram gives complete flow of project. For the purpose of detecting retinopathy in the eye images spider software is used. The figure shown below is the block diagram of the proposed system.

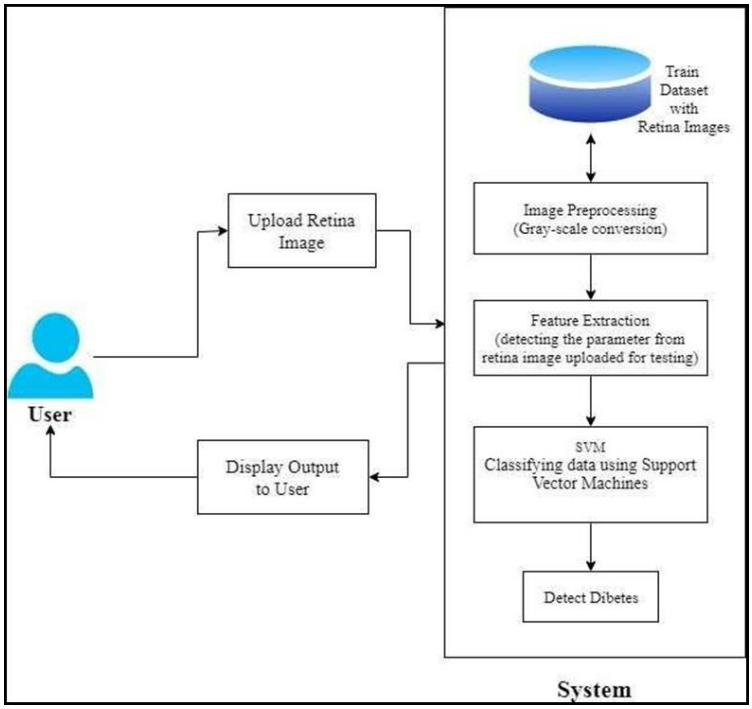

Figure 1: Block Diagram of proposed system

The detail description of system proposed is as follows. Pre-processing: It generally entails removal of background noise having frequency low, 1normalizing 1the 1intensity 1of the 1individual 1particles' images, masking 1of some portions of the images and removing reflections. Image pre-processing is that the method to enhance data images before computational processing.

Image conversion: In greyscale image or RGB image is that image the value of each pixel is only a single sample which carries information related to the intensity of light or in other words which represents only the amount of light. This sort of images is composed of various shades of gray colour. The range of the contrast from black colour at the weakest intensity to the white colour at the strongest. Keeping this in mind, the conversion of the image in black and white is done. As we understand Tumor is actually big enough to not deemed as tiny bound, therefore we are going to detach little pixel bound.

Feature Extraction: For binary classification, here we are using 2 features, ie, number of exudates as first parameter and number of hemorrhages and micro aneurysms as second parameter. That is, we are counting number of white pixels from the segmented images and divide it by total number of pixels in the image.

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Segmentation: It is the process of selecting the region of interest.

Classification: Support vector machine i.e., is SVM are used for the purpose of classifying the eye image 1into normal or malegnous.

Following are the steps for the proposed system:

1) Input Image
2) Input Image Pre-processing
3) Pre-processing
4) Image Segmentation
5) Image Segmentation
6) Feature Extraction
7) Apply SVM
8) Canny edge detection
9) Prediction of status of blood vessels.

IV. RESULT

This is the result of input MRI image. In this we detected that the given patient has Benign type of tumour. We successfully implemented the SVM algorithm for classification of tumour. From this image we also extracted 13 features from the segmented image(Tumour).We also run Accuracy test of different kernels using system on the segmented image. The kernels are RBF i.e. Radial basic Function , Linear kernel , Polygonal Kernel and Quadratic Kernel.

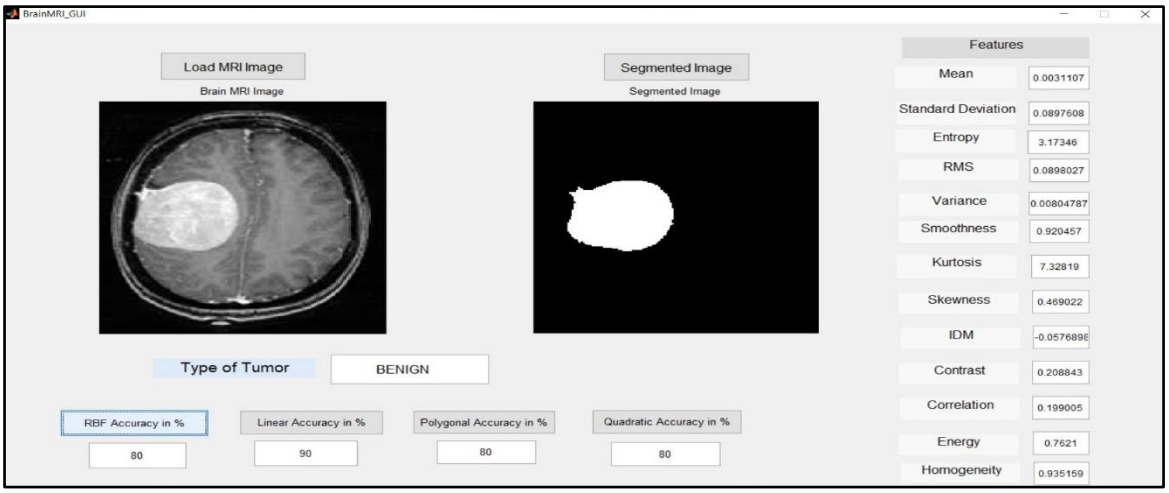

Figure 2 input and output of MRI image with features

V. CONCLUSION

In the proposed work, a non-invasive procedure has been presented to evaluate the presence of diabetic diseases in the eye. The classification of diabetic diseased and normal eye IR images is done through Support Vector Machine classifier using various combination of texture and statistical features The simulation results indicate that the classifier in the detection of diabetic diseased eye performed in the accepted level and provide accuracy, sensitivity, specificity using SVM classifier.

A number of studies use 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.

Currently in the scope of this paper, the processing time of diabetic retinopathy detection is kept in mind, so as to deliver a graphical user interface to the user / patient, so that they can use their fundus

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images as input to the graphical user interface and thereby get to know whether they are suffering from diabetic retinopathy or not from a reliable source with faster processing time also. Further upgrades later on might incorporate the use of a superior calculation something like a convolutional neural system which can help in arranging the pictures well than the present utilized classifier individually. Aside from that, highlights like helpline or client manual ought to be given in the graphical UI, to be useful for the clients who probably won't be acquainted with innovative progressions and utilization of the application. this project will surely help a step ahead in diabetic retinopathy detection.

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