



Article Title: Detection of Diabetic Retinopathy by Using Convolutional Neural Network

Detection of Diabetic Retinopathy by Using Convolutional Neural Network

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ABSTRACT

This project proposes machine learning methods for detecting diabetic retinopathy by using CNN. The classification of retinal lesions from non-lesions using CNN classifiers is examined. Retinal retina images can be evaluated using machine learning-based medical image analysis. The image is pre-processed using the Contrast limited adaptive histogram equalization (CLAHE) filter. CLAHE is used to improve the visibility level of blurry images. The image is segmented using the FCM method to generate an appropriate threshold value for data segmentation. The method of feature extraction is implemented by RLC. The Gray Level Co - occurrence Matrix (GLCM) method is used for extracting statistical skin parameters in a given direction and distance. The use of convolutional neural network (CNN) algorithms has facilitated the early identification of diabetic retinopathy. This project provides excellent specificity and sensitivity for classifying images as with or without diabetic retinopathy. This project is implemented using MATLAB software.

1 Introduction

Diabetic retinopathy (DR) is a leading cause of preventable blindness among individuals of working age in developed nations. The disease's global prevalence is expected to increase exponentially, reaching 439 million by 2030. Blood vessels, optic discs, and the macula make up a healthy retina; any changes to these elements are signs of an actual eye condition. To achieve this, people who suffer from diabetes should have regular eye examinations, which are very resource-consuming. Lesions caused by diabetic retinopathy are typically thought to be reversible, and the disease can only grow slowly in its early stages. The incidence of legal blindness in the working-age population has been said to have decreased as a result of early detection and treatment of DR, as well as coordinated care.

There Tina is at hint issue of them which lines the surface of the back of the eye excluding the area of the optic nerve. The retina contains light-sensitive cells which receive and transfer the light through neural signals and coordinate with the brain to process visual information. Like other organs in the human body, the retina receives its nourishment through blood vessels. If the blood sugar (glucose) level is high, it will cause DR, which will block the tiny blood vessels that nourish the retina, cut off its blood supply, and eyes will try to grow new blood vessels, but they won't develop well and will start to weaken. In other words, DR



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causes the blood vessels of their Tina to swell, leak fluid, or bleed, which often leads to vision impair mentor blindness

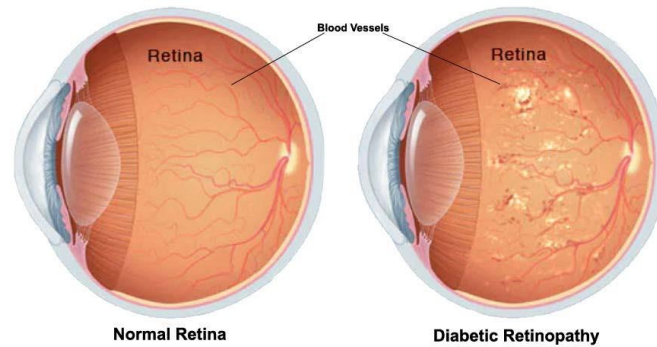


Figure 1: *Effects of diabetic Retinopathy on their Tina vessels*

The four stages of diabetic retinopathy show the evolution cycle and the intensity of DR. These stages are:

1.1 Mild non proliferative diabetic retinopathy

It is their lest stage of DR. Tiny areas of swelling in the blood vessels of the retina, micro aneurysms, is the character-istic of this stage. In this stage, it is possible that a small portion of fluid leaks into the retina and triggers swelling of them macula.

1.2 Moderate non proliferative diabetic retinopathy

In this stage, nourishment cannot reach the retina due to the swelled blood vessels and blockage of the ways for blood to reach the retina. This process accumulates blood and the fluids in the macula.

1.3 Severe non proliferative diabetic retinopathy

At this stage, the number of blocked blood vessels increases and causes a considerable reduction in blood flow. At this point, new blood vessels start to grow in there Tina.

1.4 Proliferative diabetic retinopathy

This stage is considered the most dangerous because a large number of fragile blood vessels have formed in the retina. At this stage, there is a possibility of fluid leakage and visual disturbances such as blurriness, reduced field of vision, and even blindness satiny time.



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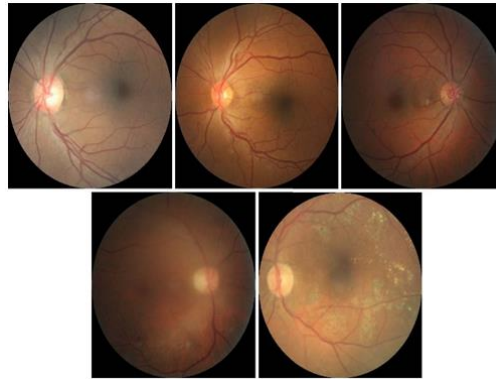


Figure 2: Sample of diabetic retinopathy images with stage zero (healthy)
To four (proliferative diabetic retinopathy)

2 Related work

Diabetic retinopathy classification plays an important role in the diagnosis of DR disease and prevents blindness by early detection of the disease. Similar to other research lines in the computer vision field, diabetic retinopathy classification approaches can be categorized into hand crafted (engineering features based) and DL-based approaches.

2.1 Hand crafted approaches

Akram mixed the structure of the support vector machines and Gaussian Mixture Model (GMM) to identify and classify micro aneurysms there Tina for early detection of diabetic retinopathy. Furthermore, they improved their method via enriching the feature set with shape, intensity, and statistics of the affected region. Roy Chowdhury et al proposed a two-step hierarchical classification approach that uses a computer-aided screening system (DREAM) for classifying the severity grade of DR. They investigated varying illumination and fields of view for generating these verity grade.

2.2 Deep Learning Approaches

DL methods, especially CNN, have made great strides in recent years and have been able to successfully perform several complex tasks. The hierarchical learning capability and extraction of high-level features of CNNs has made them much more powerful than methods that solely work with typical raw image features. Various architectures of CNN have been introduced in recent years, some state-of-the-art architectures include but not limit to: Fully Convolutional Neural Network (FCN), U-Net, Sag Net, hour-glass, and Deep Lab. In the following, we review some recent methods in the field of diabetic retinopathy classification using CNNs.

One of the central limitations of the previous work on recognizing the diabetic retinopathy grade is the lack to model the hidden structure that exists in the texture of their Tina images. To adaptively highlight these types of hidden information inside the representational space,



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we propose to incorporate the textual and spatial attentions mechanism on top of the network bottleneck. In the next section, we will present our method in more detail.

3 Proposed Method

This proposed system uses machine learning-based CNN for the detection of diabetic retinopathy. The image is pre-processed using the CLAHE filter. The Contrast limited adaptive histogram equalization (CLAHE) filter is applied to measure the amount of visibility in noisy images and videos. Following pre-processing, this dataset is passed into the segmentation block. Image segmentation is considered an important step in image processing. This segmentation approach uses fuzzy C-means (FCM). Fuzzy c-means clustering is one of the common methods of image segmentation. An adequate threshold value for data segmentation is created using the FCM segmentation method. Finally, achieved the desired output of the segmentation.

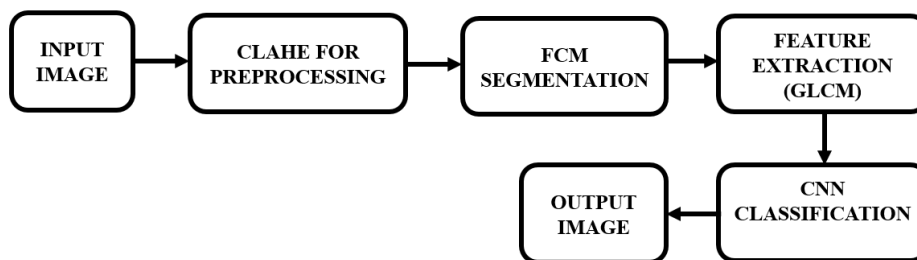


Figure 3: Structure of the proposed method for diabetic retinopathy classification

3.1 Preprocessing

Nowadays with the rapid progress in the development of the imaging system, several clinical imaging devices are produced by different companies. Although these retinopathy imaging equipment's follow the same pipe line to produce there Tina images, due to the intrinsic characteristics of these devices the produced images may vary in terms of intensity, color, and shape. If such variation share not addressed, it can affect the network training process, and consequently, the trained model will be biased towards a specific imaging standard. Furthermore, the input data need to be pre proceeding a way that would be suitable for a deep model. In this regard, we have added a series of preprocessing step stop repair the data set for neural network training. First, based on the input images as peroration were sized them to the size of 512*512 pixel suing the bi cubic interpolation technique. Next, the retina circle location in the resized input images is centred by cropping each image from the centre to a size of 320*320 pixels. Moreover, we utilized Graham approach to enhance the clarity of blood vessel sandles ion areas. Forth is purpose, all the black pixels have been removed from the input image sand a min-pooling filtering technique used to normalize the images?



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4 Experimental Results

Our proposed method has been evaluated on the data set for diabetic retinopathy classification. Besides the dataset description, this section provides detailed information regarding the training process, evaluation metrics, comparison results for both multiclass diabetic retinopathy classification and healthy or non-healthy retinopathy classification, and finally the ablation study to emphasize the contribution of each proposed module on the model generalization performance.

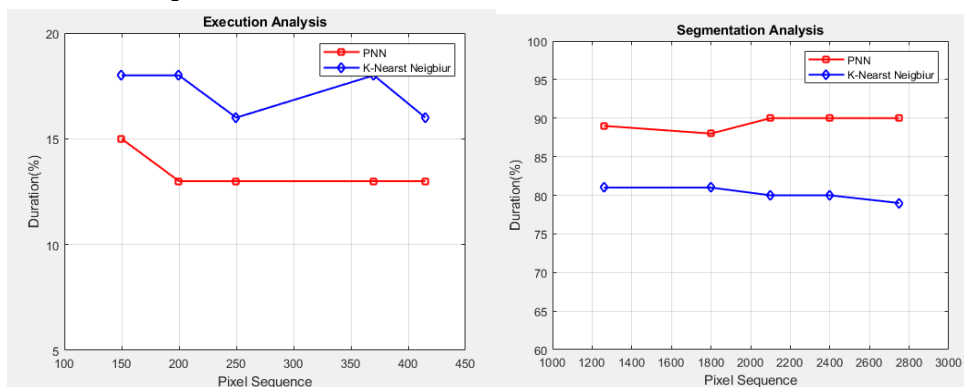


Figure 1: Execution Analysis & Segmentation Analysis

5 Conclusion

Diabetic retinopathy is caused by high blood sugar levels damaging the back of the eye (retina). This project provides a comprehensive overview of machine learning methods for detecting diabetic retinopathy by using CNN. To achieve this goal, a detailed and systematic review of relevant publications was conducted. Following the inclusion criteria and quality evaluation, the studies in this project have been examined from the angles of 1) the input image applied, 2) the image preprocessing methods used, and 3) the segmentation method used. Using this methodology, we discovered that 15.0023% of the retina is affected. Our project will be expanded in future work to include a feature extraction method and CNN classification that will be used to detect diabetic retinopathy accurately.

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