Survey on Detecting Diabetic Retinopathy using Deep Learning

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Abstract **- Diabetic Retinopathy (DR) is a vision problem caused by high blood sugar levels damaging the blood vessels in the retina. In order to have effective treatment, it must be detected early. As a result, the purpose of this research is to combine image processing and deep learning approaches to help detect Diabetic Retinopathy early and reduce retinal damage. The methods suggested in this paper include using Convolutional Neural Network (CNN) variants on fundus photography which helps us in detecting Diabetic Retinopathy.**

Keywords - convolutional neural networks; deep learning; diabetic retinopathy; image processing.

I. INTRODUCTION

DIABETIC RETINOPATHY (DR) is a common blood related disease found in diabetic patients that is a major cause of blindness among the world's working population. [1]. To prevent it from going undetected, approximately 30,000 per million population need to be examined, which is beyond the capacity of the current ophthalmology departments. [2]. Thus, a computerized system can assist the ophthalmologists to assess the patients more efficiently [3].

Retinal abnormalities caused by DR include light lesions (hard exudates and cotton wool patches) and red lesions (internal bleeding and micro aneurysms).

Micro aneurysms (MA) are the first scientifically observable DR lesion and are meandering signs of ischemia, since each MA represents the sealing of at least one capillary. [4].

Conversely, an array of attributes such as hard exudate formation, macular edema and others can be used for accurate detection of DR [5]. Detecting DR in the early stages can help reduce 80 percent of all blindness cases amongst the patients. Hence, an automated and efficient system that can detect the signs of DR missed by the human eye can be very helpful in this field.

II. LITERATURE REVIEW

For many years, a large amount of work has gone in using Machine Learning techniques to detect DR and many researchers have proposed a variety of methods.

Timothy Spencer [6] proposed an early approach, which consists the usage of mathematical morphology on fluorescence angiography images. Here directional structural factors are applied to extract the capabilities and top hat remodeling is used. Another approach proposed was turned into to apply diverse filters to fit the templates of MA [4].

Additional strategies contain the usage of K-NN algorithm to discover and grade DR [7, 8]. These strategies are normally supported with the aid of using a feature extraction approach, which include Hessian Matrix property. Akara Sopharac [3] proposed the usage of Naïve Bayes approach to categorize the photos the usage of a hybrid approach. Balambigai Subramanian [9] proposed a singular approach to extract capabilities the usage of Adaptive Super Pixel Algorithm and feeding it to a Support Vector Machine (SVM) to discover DR within the initial levels.

Earlier, there have been research the use of CNN [10, 11] for DR retina photos and feature carried out specification of around 90 percentages for binary classification. We will recognition on similarly improving those outcomes via way of means of including characteristic extractions to fully or recurrent convolutional networks (FCN or RCN).

III. IMPLEMENTATION

Using deep learning techniques, we aim to detect Diabetic Retinopathy in the early stages. The proposed technique is to use Fully Convolutional Neural Network along with a Random Field to accurately determine the affected regions and perform binary classifications. We can also use this to determine the severity of the condition.

The doctor will first open the website and upload the retina scan of the patient at the prompt received. Then, the image gets stored in the database from where, it is accessed by the Orchestrator. This image will then pass on to the Featurizer where the image will be processed and the features extracted.

The processed image will then be fed to the Model Server which stores the trained model. From there, the image will be labelled and the results along with the processed images are sent back to the user.

The model will be trained on the California Healthcare Foundations (CHF) dataset and the Indian Diabetic Retinopathy Image Dataset (IDRiD) dataset. These datasets are already labelled and are very apt for classification models.

The table below contains a breakdown of the major methods used in this project, their merits as well as their demerits.

Method	Description	Merits	Demerits
Support Vector Machines	SVMs represent features as points in space, allowing data to be mapped into different categories. They're separated by a basic Boundary gap..	Where there is a strong margin of distinction between groups, SVM functions well. In multi-dimensional applications, it is much more efficient.	As the support vector classifier places data points above and below the classifying hyperplane, there is no probabilistic reason for the classification.
Image Preprocessing	The aim of pre-processing is to optimize the image by suppressing unwanted distortions or enhancing those image features that are necessary for subsequent processing.	Image preprocessing can remove noise and correct image contrast and density.	Requires considerable processing power especially if the number of images is large
Traditional Convolutional Neural Network	Requires considerable processing power especially if the number of images is large	It automatically detects important features without any human supervision. It also has high accuracy in image recognition problems.	It has high computational cost and can be quite slow to train with complex data. It requires more training data than some other methods.
Fully Convolutional Neural Network	In this CNN, each unit in one layer is coupled to every unit in the other layer.	They have no limitations with respect to input size. Less spatial information loss	It takes longer than a traditional CNN to train.

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